SHIFTING TECHNOLOGIES OF CERAMIC MANUFACTURE

A HISTORICAL APPROACH TO SHIFTING TECHNOLOGIES OF CERAMIC MANUFACTURE AT GASPEREAU LAKE, KINGS COUNTY, NOVA SCOTIA

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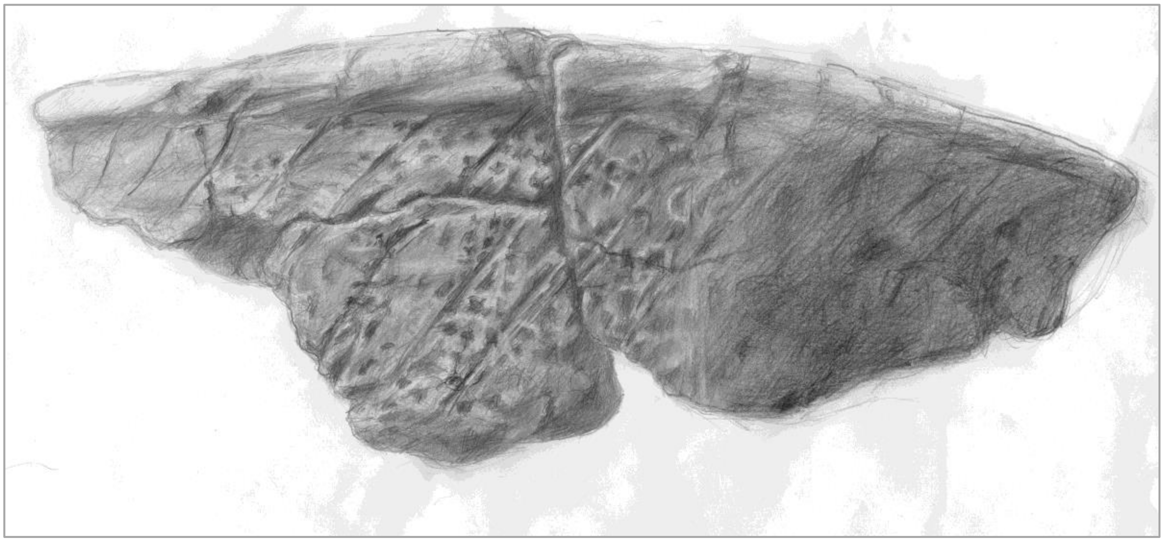
ABSTRACT

A lengthy history (1550–950 Cal BP) of ceramic manufacture took place at the Gaspereau Lake Reservoir (GLR) Site Complex in Kings County, Nova Scotia, during which potters shifted their practice from fineware, emphasizing self-expression and signalling affiliation, to "production" pottery, focusing on quick turnaround times and larger scale of production. Researchers in the Maine–Maritimes Region have repeatedly noted the change from hard-bodied, thin-walled, elaborately and carefully decorated pots during the Middle Woodland to coarser-tempered, expediently decorated pottery with many coil breaks evident during the Late Woodland. This has sometimes been interpreted as a decreasing skill level through time, but I argue that these changes instead suggest a manufacturing context in which demand for pottery increased. This created incentives for "cutting corners" and employing strategies that increased the survival rate of pots during firing. Increased production is partly evident in increasing standardization of temper minerals and clay later in time, suggesting that potters increasingly accessed a single reliable source of raw materials rather than many different sources. I further argue that manufacturing occurred at or near the End of Dyke Site.

I present a method of analyzing ceramics that is designed to take full account of the unusually large and nuanced GFC assemblage. This method goes beyond chronological and typological classifications that have sometimes been employed in the Northeast: it seeks to establish a historical understanding of the assemblage through tracing learning lineages. This classification, which I have called a "tradition-based classification," introduces knowledge transfer as the dominant mechanism behind style at the level of assemblage. The ceramics have been grouped using attribute analysis, after which inferences about the variability have been assessed, and finally, several trends—chronologically situated using AMS dates—are proposed to build a history of ceramic manufacture at Gaspereau Lake.

This dissertation is dedicated to Toni, Nana, Dorothy, and to all the grandmothers.



How objects are handed on is all about story-telling. I am giving you this because I love you. Or because it was given to me. Because I bought it somewhere special. Because you will care for it. Because it will complicate your life. Because it will make someone else envious. There is no easy story in legacy. What is remembered and what is forgotten? There can be a chain of forgetting, the rubbing away of previous ownership as much as the slow accretion of stories.

——Edmund de Waal

Never trust the storyteller. Only trust the story.

——Neil Gaiman

Drawing of a pottery sherd from the Gaspereau Lake Reservoir Site Complex by Peggy Woolsey

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There seems no way to pay due attention to all those who have contributed to the present work, or supported me during my PhD in innumerable ways. Although a dissertation is conventionally considered a single-author work, I recognize a myriad of voices running through this writing, all of which deserve recognition. I wish to begin by thanking my many communities for welcoming and inspiring me, and to all the community members I have been touched by.

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Undying thanks are also due to my mom and dad, my first and greatest teachers, who have seen me through every adventure. Becoming a mother has given me insights about what you have gone through as parents, especially the way your kid asks everything from you and barely remembers to thank you for your trouble. I have taken a lot of time during this research to reflect on the rich gifts you gave me growing up, gifts that have nourished me throughout my life and have provided my character with resilience and fortitude. You taught me to teach myself, to learn every day, to create, to build, to invent, to self-critique, and, above all, to think. There is nothing greater you can give a child and though I cannot seem to tell you these things in the run of our conversations, it is only right that I am telling you here. As an addendum to this, the countless days of childcare are very much appreciated as well, and were integral to the completion of this research.

I have been fortunate to have high-quality in-laws. One of the role models in my life is my mother-in-law, Valerie; of all the intelligent people I know (including her son, my husband), Valerie may well be the most intelligent. It has been an honour and a privilege to have been accepted into her family. Valerie and John have been important sources of support, solace, professional advice, excellent reading material, childcare on date nights, clothes we could never afford ourselves, and Christmas dinners, and I imagine the socializing effect on me has been beneficial. I am also grateful to Richard, the potter in my life, who never fails to have a meal for us when we come out to visit, always has my back in a jam, and always lets me question him about pottery.

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LIST OF ACRONYMS AND ABBREVIATIONS

BP – Before Present

CAL – Calibrated

CWS – Cord-Wrapped Stick

dbs – Depth Below Surface

GFC – George Frederick Clarke

GLR – Gaspereau Lake Reservoir

LBR – L'sitkuk Bear River

LA-ICP-MS – Laser Ablation Inductively Coupled Plasma Mass Spectroscopy

NSM – Nova Scotia Museum

PSS – Pseudo-Scallop Shell

SEM – Scanning Electron Microscopy

Ttl - Total

UNB – University of New Brunswick

XRF – X-Ray Fluorescence

CHAPTER 1: INTRODUCTION

In this research I address the roles ceramics played in the lives of people in the area of Gaspereau Lake, in Kings County, Nova Scotia, and in the Maine–Maritimes Region more generally during the Woodland Period (3050–500 BP).[1] The technological and social roles of ceramics are not well investigated here, and with this research I seek to bridge the gap between the chronological focus on ceramics and the underexplored social and technological importance of ceramics to people's lives. I have three broad aims: 1) to flesh out a conceptual outline of how ceramics were made at Gaspereau Lake; 2) to state how these manufacturing practices changed through time in order to define a ceramic classification that takes into account the historical contingency of the observed variation; and 3) to infer activities, learning lineages, and social dynamics from the evidence of manufacturing practices and uses.

The assemblage I analyzed comes from the End of Dyke Site, a large Precontact multicomponent site within the Gaspereau Lake Reservoir Site Complex from south-central Nova Scotia (Sanders 2014; Sanders, Finnie, et al. 2014; Sanders, Green, et al. 2014; Sanders and Finnie 2014). The assemblage represents a rare opportunity to study nuanced changes in technology, decorations, and use—rare, because such a large and spectacular assemblage is not at all typical of this region. The present research both takes full advantage of the

[1] The Woodland Period in the Maine–Maritimes Region is also referred to variously as the Maritime Woodland Period (e.g., Allen 2005; Blair 2004b; Bourque 1995:169–70; Keenlyside 1984), the Ceramic Period (e.g., Bishop and Black 1988; Sanger 1986:139; Turnbull and Allen 1988:251), or the Late Period (Allen 1981). These names are used in place of the more common and broadly applicable name "Woodland Period" on the basis of arguments that Maine and the Maritime Provinces are culturally distinct from the rest of the Northeast and therefore cannot be placed under the cultural denomination of "Woodland" (Mason 1970). The main contention is that the Eastern Agricultural Complex, which paved the way for widespread maize horticultural adoption, did not appear to a large extent in the far Northeast (Sanger 1986), and instead, a "maritime character of local adaptations" (Blair 2004:136) is in evidence in this region. "Ceramic Period" is adopted by those who see the main or major difference between the Archaic Period and the following period consisting of the invention or adoption of pottery (e.g., Bourgeois 2004:117; Sanger 1986, 1988a), taking the emphasis away from whether or not horticulture was practiced (Leonard 1995:27). I have chosen to retain the more broadly used "Woodland Period" for the following reasons. First, the contention that the advent of ceramics defines the shift from Archaic to Woodland is problematic both as a chronological marker and as a definition of a lifeway (Sassaman 1992, 2010). Second, I agree with McEachen (1996:39–40) that the interconnectedness of cultures across the Northeast is potentially downplayed by the term "Maritime Woodland." Although there is a distinct adaptation evident in the Maritime Provinces and Maine, the interaction with areas to the south, west, and north show up in numerous horizon styles such as the Pseudo Scallop Horizon Style (Gates St. Pierre and Chapdelaine 2013; Pauketat 2012; Petersen 1988, 1997) as well as in circulated goods such as shark's teeth (Betts et al. 2012) and lithic materials (Bourque 1994; J. Wright 1994). Finally, the contention that the Maine–Maritimes Region shows evidence of maritime adaptation is an overly simplistic statement, as much of the population lived in the interior of the region and therefore did not meet Sanger's (1988:83) definition of a marine-focussed/maritime-adapted culture as "one in which there is clear evidence for a certain amount of dependence upon marine-based resources, and where the annual settlement cycle is strongly influenced by the availability of food in the marine environment."

nuanced archaeological record at the site and evaluates the implications of such an atypically large assemblage in understanding the Maine–Maritime Region more broadly.

The Gaspereau Lake Reservoir ceramic assemblage required an approach that could accommodate its size and complexity. Although the assemblage is typical of the Maine–Maritimes Region in the distribution of vessels with decoration types and broad fabric types, it also includes some unusual configurations of typical decorations (Sanders, Finnie, et al. 2014:200) as well as some wholly unique vessels (Sanders, Finnie, et al. 2014:109–10). Not so typical is the large number of vessels and other artifacts, which indicated early on that a more detailed understanding of ceramic manufacture through time was possible than usually is the case for sites from this region (although Maine has a similarly large ceramic assemblage—see Table 1). I therefore chose a "close reading" approach to the ceramics, recording a large amount of data about a relatively small sample (ca. 3500 sherds) to achieve a high resolution dataset. I used the resulting nuanced data to construct learning lineages, which I define as *a specific manufacturing tradition that shows continuity through time as a result of a structured group of learners and teachers passing on their style from one generation to the next* (see Chapter 2 for a discussion).

Table 1: Some sites in New Brunswick, Nova Scotia, and Maine in comparison with the Gaspereau Lake Reservoir Site Complex. The sites listed below yielded some of the largest assemblages in the region but the list is not meant to be exhaustive. * indicates sites that were manually added up from tables in the report. † indicates sites that were reported in Deal and Kristmanson (1991:2).

Site Name	Region	Ceramics (Sherds)
GLR Site Complex	Nova Scotia	18,609
Goddard Site	Maine	13,000–18,000[2]
Oxbow Site	New Brunswick	3980*
Fulton Island Site	New Brunswick	1508
Skull Island	New Brunswick	1260
Melanson Site	Nova Scotia	1018
Merigomish Harbour Sites	Nova Scotia	2670†
Eel Weir Site	Nova Scotia	2500†
L'sitkuk Bear River Site	Nova Scotia	2800†
Port Joli Site	Nova Scotia	1500†
Brown Site	Nova Scotia	1033

The present study differs somewhat from typical ceramic analyses conducted in the Maine–Maritimes Region. The aim is to develop an idea of manufacturing practices through time and ceramic technology change. Although I looked at decorative practices as a means of understanding boundaries between communities of practice (Druc 2013; Kohring 2012; Lave and Wenger 1991; Sassaman and Rudolphi 2001) or "technological populations" (Petersen 1996:114) and of generalizing about broad time periods, the focus was on understanding

[2] This number comes from Steven Cox (pers. comm. August 3rd, 2017), who conservatively estimates the number of all sherds collected by private collectors, excavated by field schools, and analyzed by James B. Petersen from the original excavation to be somewhere between 8,000 and 10,000 sherds in total, but acknowledges that the number could be as high as 18,000. Uncertainty exists because the assemblage is unevenly catalogued.

less-explored dimensions of variability rather than on existing models of classification or chronology.

THE GASPEREAU LAKE RESERVOIR SITE COMPLEX

The Gaspereau Lake Reservoir Site Complex is a group of 21 sites clustered around the northeastern edge of Gaspereau Lake where it feeds into the Gaspereau River. This brings the total of sites up to 33 "within a kilometre of Lane's Mills and Muskrat Cove Dam, 31 of which are Precontact" (Sanders, Finnie, et al. 2014:3). The largest of these sites, the End of Dyke Site, is directly on the shoreline and just north of the Gaspereau River outlet as well as the reservoir created by the dam (Figures 4 and 6). The area is known to be unusually rich in food resources, including seasonal runs of gaspereaux (*Alosa pseudoharengus*), Atlantic salmon (*Salmo salar*), and smelt (*Osmerus mordax*) (Sanders, Finnie, et al. 2014:350). The Gaspereau River can be navigated beginning ca. 1 km downstream from Gaspereau Lake, providing a route to the coast, where it empties out into the Minas Basin on the Bay of Fundy. Another significant cluster of sites is located along the Gaspereau River (Nash and Stewart 1990; Nash et al. 1991; Sanders, Finnie, et al. 2014:350), and an important quarry for toolstone is located on the coast near the mouth of the Gaspereau River (Deal 1988, 1991). This toolstone, variously referred to as Minas Basin chert (Gilbert et al. 2006), Scots Bay agates (Sanger 1991a:55) and Scots Bay chalcedony (Deal 2005), is common in sites on the eastern shore of Nova Scotia, and occurs in sites all over the Maine–Maritimes Region (e.g., Black 2004b; S. MacDonald 1994; Sanger 1991a, 1991b). The GLR site complex represents several millennia of occupation (Erskine 1972; Laybolt 1999; Nash and Stewart 1990; Sanders et al. 2014) during which these various rich resources and important localities were taken advantage of, and may have been important in the building of trade networks (Sanders, Finnie, et al. 2014:348–49) and the hosting of regular aggregation events (see discussion in Chapter 4).

At this juncture in the history of archaeology in the Maine–Maritimes Region, the GLR Site Complex is as important as the Debert Site was 50 years ago and as the Augustine Mound was 40 years ago. In the case of each of these sites, archaeologists dramatically revised their histories of the region: the Debert Site conclusively showed that Palaeo peoples lived here during the last Ice Age (Bernard et al. 2011; Davis 1998; G. MacDonald 1966), while the Oxbow and Augustine Mound sites definitively showed a relationship between this area and regions that were over a thousand kilometers distant (Jarratt 2013; Keenlyside 1999; Turnbull 1976). The GLR Site Complex shows that the manufacture of products, of which ceramics constituted one sector, was not limited to domestic manufacture and use but instead reflected a more complex economic situation than previously supposed. This situation is reflected in the large number of ceramics, certainly, but also in the signs of craft work and the working of raw materials (Sanders, Finnie, et al. 2014:86). Large-scale production of lithic tools is evident in the unusually dense concentrations of high-quality materials, mostly pink and grey mottled chert (Minas Basin/Bay of Fundy shore) and brown quartzite (White Rock, Gaspereau River).[3] Four great white shark's teeth likely come from

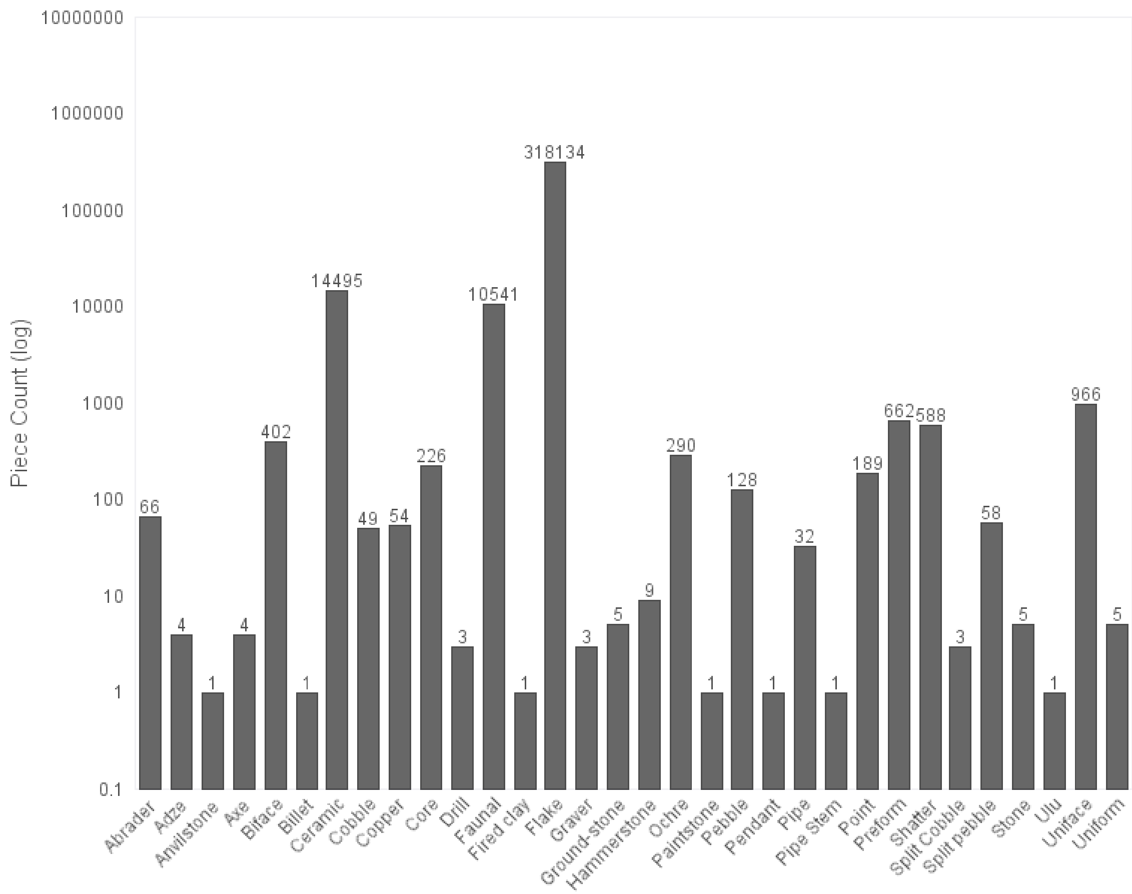

Figure 1: Distribution of artifact classes across the GLR Site Complex (n=346,928).

more southerly regions over 1000 km distant (Betts et al. 2012; Sanders, Finnie, et al. 2014:30). Red ochre occurred in unusually large amounts, a valuable material that was likely procured for a number of activities, including pottery manufacture, but also painting and ceremonial purposes. Copper was also unusually common, possibly indicating wealth accumulation (Leonard 1996) as well as manufacture of ceremonial ornamentation (Jarratt 2013). Lithic artifacts appear in all stages of the manufacturing sequence, and some show links to other regions and interaction spheres (Sanders, Finnie, et al. 2014:185). It is clear

[3] The materials represented by the lithic assemblage are not discussed in detail by Sanders et al. (2014), so the support for this statement comes from my own observations of the flakes while looking through the assemblage as well as while excavating in 2013. Sanders, Finnie, et al. (2014:185 and 318, respectively) note the presence of a pink and grey mottled chert that they claim comes from a source on North Mountain Ridge but that might also be Scots Bay chalcedony, which is also called Minas Basin chert. During excavations, I noted that a majority of the flakes I excavated were made of either Minas Basin chert or the similar chert from either North Mountain Ridge (Sanders, Finnie, et al. 2014:21) or White Rock downriver from Gaspereau Lake. I also observed that the next most common material I excavated was brown quartzite, which has been linked to a source downriver at White Rock (Michael Deal pers. comm. July 6th, 2017; Sheldon 1988:79).

from the assemblage that Gaspereau Lake was economically important in this region, potentially for several millennia.

Despite the rich and diverse artifact assemblage, it is perhaps the vast amount of quotidian activities evident at the site that is truly significant. No evidence of house floors, architecture, burials, or clearly domestic middens exist on the site.[4] Activities at Gaspereau Lake were certainly connected with ceremonial activities such as burials and other rituals, and probably with events such as feasts and gatherings. The high artifact density may indicate large numbers of residents who may have, in all ways, been a settled village or town such as Ouigoudi or Meductic. However, the importance of the End of Dyke Site is that it was separate from ritual, residential, and aggregating activities.

Previous work in the Area

Erskine (1972) was the first to publish on the archaeological record of Gaspereau Lake. He recorded lithic tools that may have been as old as the Palaeoamerican era. He also uncovered a sizable Archaic and Woodland assemblage, although he found no pottery, and concluded from this that there must have been a much smaller Woodland occupation (Erskine 1972:4). Deal (1991) and Laybolt (1999) also tested the vicinity around Gaspereau Lake, including some of the islands, and found more sites, although these were not much greater in scope than those uncovered by Erskine.

Extensive testing near the site of the Gaspereau Lake Reservoir Dam by CRM Group Ltd. revealed a long-term and intensive occupation spanning the Archaic and Woodland Periods with evidence of Palaeoamerican activities as well (Sanders, Finnie, et al. 2014). Walk-over surveys and testing were conducted in 2010 and excavations occurred during the field seasons of 2012−2013. These excavations yielded over 300,000 artifacts and over 18,000 ceramic pieces.

Culture History and the Building of Periods

In the Maine–Maritimes Region, the evidence base is still forming. Site excavations and testing have focussed on certain areas, such as along the Kennebec River in Maine, the South Shore of Nova Scotia, and the Saint John River in New Brunswick, leaving many

[4] The absence of these features could indicate that housing was ephemeral, as is the case of Historic-Period Mi'kmaw architecture (LeClerq 1910:100–01), which did not sink poles below the surface. A further indication that the site may not have been used for habitation is that domestic space is not clearly demarcated in a way that is evident on other Woodland Period sites in the Maine–Maritimes Region (e.g., Erskine 1986:90). Hrynick and Betts (2017:7–9) posit that, though wigwams did not necessarily penetrate the soil, trampling caused a greasy black-soil basin to form in a roughly circular depression; additionally, stones were used to demarcate space within the wigwam, and ceramic and lithic artifacts would be found to be clustered in statistically significant patterns within the space. Although these features could have been obliterated by later activities, the fact that no features matching this description were in evidence—despite the large size of the site as well as the existence of other kinds of features, such as hearths—supports the possibility that no features matching this description were in evidence—despite the large size of the site as well as the existence of other kinds of features, such as hearths—supports the possibility that no habitation occurred on the End of Dyke Site. Nevertheless, the tentative nature of this inference is acknowledged here and below.

patches of the archaeological record without any real visibility or extant data. Even these areas of focus have received far too little attention relative to their archaeological resources because of a perennial dearth of funding and a lack of post-graduate degree programs in the region. The collections that do exist hold huge potential beyond what they have already provided for insight into the region, but much of the material culture was analyzed only minimally as part of cultural resource management (CRM) projects, and has never been looked at again. Studies that compare site assemblages tend to select (small) judgemental samples from each assemblage, usually chosen for completeness (e.g., Stapelfeldt 2009) or because artifacts conform to one particular attribute state (e.g., Petersen and Sanger 1991), meaning the majority of artifacts are not considered to be of interest. In short, there is significantly more to learn about the past of this region.

The state of base-level archaeological knowledge here has meant that research is at least partly culture-historical in nature. Almost each new site discovered adds insight into past cultures' activities, and the artifact assemblages are nowhere near sufficiently understood. Subjects such as trade and exchange, settlement patterns, transitions from the Archaic to the Woodland, and subsistence rounds are still unclear (Bourque 1994; Feidel 1994; Petersen 1990; Wright 1994). Ceremonial and mortuary customs are mysterious, particularly given the respectful practice of leaving burials intact and unexcavated in the Maritime Provinces (Blair 2004:xiv, 58, 156). Synthesizing studies are rare and usually broad in scope, encompassing large distributional areas or general artifact attributes such as decorative motifs on pottery (e.g., Petersen and Sanger 1991; Kristmanson 1992; Stapelfeldt 2009).

Archaeologists in this region are still working to understand how to delimit culture periods, and they use two main tools to accomplish this goal: artifact seriations based on existing culture-historical models, and absolute dating techniques. In lieu of radiocarbon dating, archaeologists often fall back on pottery, an artifact class that has been studied somewhat intensively (here, as in other regions) for temporally sensitive attributes (e.g., Bourgeois 1999, 2004). In particular, the Petersen and Sanger (1991) ceramic sequence has been used as a model for dating ceramics, and hence whole assemblages (e.g., Sanders 2014). This is a particularly quintessential culture-historical technique (Lyman et al. 1997), so that ceramic studies remain at least partly culture-historical in their inferential strategies even when they go beyond establishing or refining sequences into realms of changing technological function (e.g., Kenyon 1986; MacIntyre 1988), materiality (Woolsey and Stapelfeldt 2014), or lived experience (e.g., Will 2014).

The present research is no exception in this last regard. In this dissertation, I seek to go beyond chronological models of ceramics into technological, economic, and social function and how these changed through time. In order to accomplish this, I have placed an emphasis on the mechanisms that cause ceramic change rather than on the descriptions and codification of ceramic change. To this end, I examine existing ceramic chronologies for what they can and cannot reveal about the behaviour of people and cultures. In particular, the Petersen and Sanger model requires careful consideration if it is to continue to be used in ceramic analysis. How is this model used presently? What does it mean theoretically and methodologically? Are the answers to these questions justifiable in archaeological practice? The present research seeks to fulfill the original mandate of Petersen and Sanger (1991:116–

17) to use the model as a scaffolding in order to better understand local and subregional sequences and therefore continuously broaden the knowledge base.

Periods, Traditions, and Manufacturing Groups

The ceramics are divisible into groups along several overlapping axes. These include paste preparation, temper and clay materials, decorative tools and strategies, forming practices, and firing practices. The fact that these groups are apprehensible, but at the same time overlap and co-occur in variable patterns, suggests that no one manufacturing tradition can be identified at the End of Dyke Site. Rather, the evidence shows that manufacturing practices varied through time in complicated historical trajectories that involved the blending and diverging of learning lineages, differential responses to group needs, and the importing of new teachers and learners throughout the ceramic manufacturing history. Such a varied history should not be surprising given the large number of manufacturing activities that took place at Gaspereau Lake and, probably, the large number of people involved in the occupation: a great deal of activity through time is detectable, requiring multiple and shifting responses from potters and implying significant demand for resources and tools. The Woodland Period was characterized by movements of people, goods, and ideas (Allen 1981, 2005; Betts et al. 2012; Bourque 1995, 2001; Brose 1990; Clark et al. 1992; Deal 1986; Fiedel 1994, 1999; Heckenberger et al. 1990; Leonard 1996; McEachen 1996, 2004; Morin 2001; Taché 2011; J. Wright 1967, 1994), such that the Gaspereau Lake occupation was probably affected by significant influxes (both in and out) of people through various mechanisms, including trade (Betts et al. 2012), alliance-building, marriage and adoption (J. Wright 1972:93–94), and possibly war and raiding (J. Wright 1994:49). New ideas about ceramic manufacture are bound to have been imported and incorporated to some extent, and new and old ideas are bound to have mixed to form new traditions.

The bulk of this dissertation describes the results of analysis on the ceramic sample. Before this discussion can occur, the theoretical framework that guided the research is presented in Chapter 2. The next section, Chapter 3, concerns the high degree of variability as well as the attributes that exhibit low variability. The chapter reports and describes the ceramic groups that were drawn along lines of decoration, clay, and temper. The next section, Chapter 4, describes broad shifts in manufacturing through time, looking at forming, firing, and morphology. Finally, in Chapter 5, the AMS dates that directly date specific ceramics are used to place in context the previous data to form five distinct periods from ca. 1500 Cal BP to ca. 700 Cal BP and to define eight manufacturing traditions. The manufacturing trajectory shows that, through an approximate range of 1500–1000 BP, ceramic manufacture shifted from an emphasis on elaboration, fineness, and expressiveness toward an emphasis on expediency and standardization. Ceramic production scale also increased through time. These two observations likely indicate a response to increased production and processing of other resources, such as fish and other foodstuffs, and—along with the many traded goods at the End of Dyke Site and the likelihood that some of the hearth features represent earth ovens—suggest an evolving context of feasting and regular aggregation.

Gender and Ceramics

A difficulty of interpretation arises from the lack of evidence about whether pottery manufacture was a gendered labour. The assumption about pottery manufacture in this region, as in others of North America, has been that women made pottery. This is not a bad assumption, since it is based on ethnographic evidence of women as potters (e.g., the Iroquois) and analogic reasoning by comparing artifact assemblages to what is known about other hunting and gathering groups (Rice 1999:7, 9; Sassaman 1992:73). Several authors have made a case for why the first potters were women (Claassen 1991; Hoopes and Barnett 1995:6; Levi-Strauss 1988; Longacre 1995:278; Sassaman 1992; 1995; Sassaman and Rudolphi 2001; Skibo and Schiffer 1995; Vitelli 1995:61, 1999; but see Crown and Wills 1995:248; R. Wright 1991:6). Additionally, ethnographic studies show a trend towards small-scale societies with little or no market economy tending to designate female potters, while male potters are often in evidence where pottery production occurs as a full-time activity (Arnold 1985; Crown 2014:74; Rice 2005:184; van der Leeuw 1977). However, the fact remains that no direct, and very little indirect, evidence exists for whether potters in this region were male, female, both, or whether the appropriate gender for pottery making changed through time.

The closest reference to Aboriginal pottery manufacture comes from Lescarbot writing about Aboriginal groups to the south of the Maine–Maritimes Region:

> Au païs de labeur, comme des Armouchiquois, et plus outre infiniment, les hommes font de la poterie de terre en façon de bonnet de nuit, dans quoy ils font cuire leurs viandes chair, poisson, féves, blé, courges, etc. Nos Souriquois en faisoient aussie anciennement et labouroient la terre, mais depuis que les François leur portent des chaudrons, des féves, pois, biscuit, et autres mangeailles, ils sont devenus paresseux, et n'ont plus tenu conte de ses exercises. (Lescarbot 1606:750–51)

> In the realm of labour, like the Armouchiquois,[5] and even further beyond, men made earthenware pottery in the shape of a night cap, in which they cooked their meat, fish, beans, wheat, squash, etc. Our Souriquois [Mi'kmaq] had done the same in the past and worked the earth, but once the French brought them cauldrons, beans, peas, biscuits, and other edibles, they have become lazy, and no longer carry on these activities.

This leaves somewhat of a problem for interpreting the gender of potters because, although Lescarbot is clear that it was men making pottery, he does not say whether he

[5] Armouchiquois is a term used by several early explores to refer to a group that apparently is no longer in existence. This group seems to have been part of the New England Algonkian groups with whom the Mi'kmaq, Wolastoqiyik, and Passamaquoddy were at war at various times. They may have been the Massachusetts who were later devastated by disease and a massive offensive from the Mi'kmaq sometime before 1650.

observed this first hand, was told that this was the case, or assumed it was the case. Additionally, he does not specify whether this gender situation also applied to the "Souriquois," or Mi'kmaq. Most troubling is that the majority of ethnographic records establish firmly that women were in charge of the various cooking activities (e.g., Champlain and Biggar 1971; Denys et al. 1908; LeClerq 1910), and so Lescarbot's apparent assignment of the use of the cooking pots to men also casts his interpretation into doubt.

Iroquoian potters are generally understood to have been women. This is based on both ethnographic records and oral history of the Iroquoian peoples (Michelaki 2007). Because archaeological evidence shows that Iroquoian groups influenced the pottery of the surrounding Algonkian groups and vice versa (Mason 1969, 1970; Petersen and Sanger 1991:143), there is reason to believe that the gender of the potters was also cross-influenced, since intermarriage is known to have occurred. However, this line of evidence for female potters is extremely tenuous.

It has been noted by Longacre (1995; also Claassen 1991, 2002; Nelson 2004:83; Rice 1999) that ceramics most obviously benefit women and children of small-scale societies by increasing their potential for caloric intake (through cooking) and by making domestic activities (such as storing foodstuffs) easier. Although this assumes a rather rigid gender division if taken at face value (Bolger 2013; e.g., J. K. Brown 1970), the fact remains that women are more vulnerable to subsistence pressures at times when they are pregnant, new mothers, or mothers strongly committed to many children (Bolger 2013:164). Pottery may be one way of offsetting the risks associated with these vulnerable times, first, by providing women with a method of cooking readily available foods that, in their raw state, are non-nourishing or poisonous (such as acorns) (Longacre 1995:279; Taché 2008:65–67), and second, by constituting an economic system in which women organize—to varying degree—the labour and value associated with the commodities being circulated (Hayden 1995; Sassaman 1992; Williams and Bendremer 1997). The importance of pottery in the economy of marriage has been noted in a number of cultures (e.g., Sassaman 1995; Skibo and Schiffer 1999; Waggoner 2009), arguably the most ubiquitous type of alliance in human societies. Pottery, therefore, represents a measure of independence for women (as pottery consumers) and a measure of security for their children, regardless of whether men, women, or only a few specialists of either gender are the primary pottery producers. This, in turn, would likely also have allowed women more decision-making power within the community (Sassaman 1992:73, 2010). In combination with the "female advantage" in pottery-making alluded to by Arnold (1985:105), which stipulates that women are more able to engage in pottery manufacture because of their greater time spent at a home base, the case for pottery being a de facto female labour (which none-the-less is subject to numerous exceptions) is strongly made by the evidence.

J. Wright (1972) asserts that women potters married into Algonkian groups in Ontario, sometimes moving a significant distance to join their husbands' groups. Because he assumed that women were the primary pottery makers, pottery styles showed great variability through time as multiple traditions—some from distant locales—interacted. This may have been the case in Nova Scotia as well, for, as Fiedel (1994) shows, the Mi'kmaq were likely patrilocal. The mixing of different styles in pottery may be the strongest evidence for female potters; interestingly, the heterogeneity decreases through time at Gaspereau Lake, which may indicate a change in the gender of the potter (Senior 2000), or the introduction of a learning framework more like apprenticeship (Lancy 2010), or both.

For the purposes of this research, I follow most other researchers in this region in assuming that potters were, for the most part, women and girls. However, I recognize the problems of such an assumption and also that the labour involved in pottery manufacture may have been divided up among people of different ages and genders (R. Wright 1991). Ultimately, where so little direct evidence exists, and where models based on ethnographic evidence predict that potters in mobile, hunter-gatherer societies (Arnold 1985; Bolger 2013; Nelson 2004:82–84; Rice 1991; Sassaman 1992; R. Wright 1991) would be female, the question has to be asked whether there is any reason to assume women were *not* the primary pottery manufacturers. At the time of this writing, my answer is 'no.'

Theoretical and Methodological Issues

Characterizing ceramic change in this region remains an explanatory problem. This problem originates from the fact that, at a broad scale, ceramics exhibit recognizable trends throughout approximately 2500 years, but when ceramics are examined for inter-site relationships, they tend to exhibit a confusing array of variability along both technological and aesthetic dimensions, indicating that more than personal taste is involved in producing ceramic heterogeneity. Because variability of technological attribute states in pottery are more likely the results of differing learning lineages than freedom of expression (Hegmon et al. 2000:219), ceramic heterogeneity seems to arise in part from the movement of potters and possibly pots around the landscape in ways not yet well understood. Exogamy has been cited as one possible mechanism for the movement of potters in northern Ontario (J. Wright 1972:92–94), but in the Maine-Maritimes region, no such explanation has been put forward. Attempts to refine the existing regional chronologies (e.g., Bourgeois 1999; Godfrey-Smith et al. 1997; Kristmanson 1992) have encountered significantly more "noise" than emergent types or trends, such that ceramic analysis seems to have given up on explaining the variability and instead resigned itself to being a cheaper but less accurate substitute for radiocarbon dating. Reporting of discernible patterning below the resolution of regional horizons has been rare, with Bourgeois (1999) being a notable exception in his refinement of the lower Saint John River area. At the site level, ceramics are generally fit into the existing regional chronology and no explanation given either for similarities with nor differences from other assemblages, nor of characteristics specific to that assemblage. Ceramics are often thought to be part of one generalizable tradition across the region that remained more-or-less unchanged (e.g., Davis 1991; Rutherford 1991), though how a tradition could span such a large area, carried on by people who may have had only sporadic contact with each other and no institutionalized learning frameworks such as guilds or schools, has never been offered (cf. Martelle 2002:17–18).

This difficulty with explanations of ceramic variability arises from two obstacles that have been overcome in the present research on the GLR ceramics. First, researchers have tended to examine fairly superficial ceramic attributes such as decoration, morphology, and temper types. These attributes represent manufacturing choices not particularly integral to the functioning and success of the pottery.[6] Therefore, ancient potters could choose a wide range of decorations, lip forms, and so on, with few restrictions and no requirements for additional skill building, giving them wide freedom to experiment and borrow from others. On the other hand, attributes such as forming techniques and firing attributes required significant skill building and knowledge acquisition on the part of the potter in order to turn out successful pots; therefore, those attributes would have tended to remain stable (Gosselain 1992, 2016:47–48; Hegmon et al. 2000), unless spurred to change by another social realm within the group, such as changing subsistence strategies (Chilton 1998), marriage partner acquisition (J. Wright 1967), economic constraints (Arnold 2008; Chilton 1998), and so on. When these more integral, or primary, attributes (Jeffra 2011:103–04) form the basis of categories, the more superficial attributes should, and do, resolve into patterning.

The second difficulty is that assemblages in this region tend to be small (>2000 sherds) and the processes by which they were formed unknown. Specifically, it is usually unknown or not investigated whether assemblages reflect a) both local manufacture and use, b) local manufacture but transport away from the site, or c) non-local manufacture and transport to the site. Gaspereau Lake contains evidence of being a manufacturing locale, which allows certain assumptions to be made about the large assemblage, but which cannot be made about other assemblages. Significant variability in surface colour across multiple vessels from a site, for instance, could mean differences in clay, or differences in firing techniques, or differences in post-depositional processes, if local manufacture cannot be assumed. In the case of Gaspereau Lake, however, it can be assumed that the pots being manufactured were made by people who were connected through kin and/or learning lineages, so differences in ceramic colour were found to indicate chronological and technological rather than spatial or ethnic differences. Patterning therefore illustrates a local tradition rather than a subregional or regional one, and extra increments or "missing links" are more likely to emerge in a larger assemblage, making patterning easier to recognize.

The present research is concerned with drawing out the patterns that exist at this third, high-resolution scale of analysis—the local—made possible by the prioritizing of primary attributes and the large size of the GLR ceramic assemblage. The aim in doing so is to explain ceramic variability at all three scales of resolution: the regional chronology, the inter-site movement of pots and potters, and the local tradition. This goal requires a different approach to classification that views ceramics primarily as the outcomes of learning lineages and as a response to needs and constraints originating in the larger group, some part of

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[6] Much has been written about the technological considerations in regard to temper and, to a lesser extent, morphology of pots in the Northeast (e.g., Arnold 1985:24–26; D. Braun 1986; Bronitsky and Hamer 1986; Feathers 2003, 2006; Herbert 2008; Hoard et al. 1995; Skibo et al. 1989; Tite et al. 2001). Some temper types, such as shell, may have conferred beneficial properties such as improved strength and thermal shock resistance on low-fired pottery (Herbert 2008:274; Tite et al. 2001), but the fact that shell temper was differentially adopted across the Northeast, and only became the majority temper in some places after the Middle Woodland, indicates that its beneficial qualities were not sufficient to make it the preferred temper in all times and places (Feathers 2006). This indicates that tempering materials are generally important technologically but the choice of one temper over another may not be particularly crucial to the technological functioning of pottery. Similarly, while the conoidal base and wide mouth of cooking jars that characterize the Northeast are technologically important for dispersing heat effectively, the many variations on this theme are likely not integral to the technological function of cooking (but see Chilton 1998, 2000).

which results from ties to wider groups, places, and agendas (cf. Crown 2014; Gosselain 2016, 2017; Hosler 1996). Accordingly, classification cannot take place at the regional scale, since region-wide processes are likely to have had only superficial effects on individual pots, nor at the inter-site scale, since the processes responsible for inter-site variability cannot be discerned without first identifying the site-specific traditions. In other words, explanation for variation is built from the most specific (the site) to the general (the region). Classification should begin with a close reading of single, large assemblages to document gradational change through time, whereupon inter-site relationships can be drawn out by examining variability, and finally, the areal extent of horizons and regional chronologies can be investigated.

RESEARCH STRATEGY

A significant portion of the GLR ceramic assemblage comes from other sites in the GLR cluster (ca. 4000 sherds), but because of the size and fragmentary nature of the entire assemblage, I chose to focus on the End of Dyke Site assemblage, consisting of 14,688 sherds. I further narrowed my focus to the main activity areas. The research focussed on ca. 3500 ceramics from Locus 3, the high-activity area in the north of the End of Dyke Site, set off from the larger portion by a small hill overlooking Gaspereau Lake (Figure 20). Another portion of the assemblage from Locus 1 in the main portion of the End of Dyke Site was examined more superficially in order to determine whether the patterns at Locus 3 occur elsewhere on the site.

Classification

The basic strategy for researching the comparatively large GLR assemblage rested on creating a large sample size of vessel lots. Vessel lots are groups of sherds that come from the same vessel; (Ashley 2001; Chilton 1998:146; Finlayson 1977:57–60; Mason 1966; Petersen 1985:10); they are theoretical constructs because they are often constructed inductively through similarities of paste, breakage patterns, and so on. (Mason 1966:111). Although the idea is to delimit sherds from only one original vessel, absolute certainty is not always possible in this regard (e.g., Bollong 1994). Theoretically, one vessel lot may actually represent multiple similar original vessels, and more than one vessel lot may in fact all have come from the same highly variable vessel (see Appendix 2). However, the method is preferable to sherd count analysis (Finlayson 1977:57; Schiffer 1989; Skibo et al. 1989) and the rimsherd method, which counts each rimsherd as an individual vessel (MacNeish 1952:4), although expediency may cause a researcher to opt for the rimsherd method over the more time consuming vessel count method (Kennlyside 1978:327). Consistent with the methods used in vessel counts, vessel lots were the analytical unit used in this research while sherds were the measurement unit, with all data gathered on sherds compiled in their respective vessel lots. Vessel lots were later grouped into traditions, which I define as group of vessel lots bearing evidence of having originated out of a single, cohesive knowledge base, or learning lineage, about how pottery is made.[7]

[7] A full discussion of methods can be found in the appendices.

As a classification system, the delineation of traditions resembles other classifications such as types and sequences. The primary difference is that traditions are meant to be linked to each other while remaining (somewhat) distinct based on inter- and intra-group similarities and differences. This means that blending of groups, soft edges of groups, units that do not fit any one group (or "noise"), and other problems normally experienced by archaeologists are, instead, welcomed as additional information. While the tradition-based classification assumes temporality and continuity, as do other classification systems, it does not assume that continuity will be steady, punctuated, or even predictable, nor does it assume sameness or stability. Instead, where a typological system assumes intra-group stability and a chronological sequence assumes turnover from one period to another, use of the tradition-based classification system treats these as questions to be answered, for which it requires careful examination of units for evidence of links to other units and temporal significance. I explicitly incorporate subjective evaluation (what I choose to call "literacy") and an assumption of linked traditions in place of types or chronological periods, meaning I do not accept *a priori* the categories others have constructed, preferring instead (ideally) to delineate categories for comparison with others *a posteriori*.

The classification of traditions is intended, ultimately, to allow for some understanding of the communities of practice and how these changed through time (Minar and Crown 2001). Although in archaeological data such communities of practice are rarely visible, the importance of some attribute states over others indicates members' priorities and origins (G. Braun 2010; Sillar and Tite 2000:9–10; White 2017). These in turn can be used to construct a model of changing "technological identity" (Gosselain 2000:189; also, Michelaki 2008) through time. In the patterning of the variability certain standards and practices become evident, and the degree of deviation from evident standards indicates something about how the members saw themselves and their work in relation to the larger group (e.g., Graves 1985; Pauketat and Emerson 2008:173; White 2017:71; see also Naji 2009). The range of variation indicates what was possible, including current trends or "fashions" (e.g., Gosselain 2017:59–60), competing or foreign styles (e.g., Hosler 1996), past styles that still exist in memory and possibly in physical form as well (e.g., de Waal 2010; Sōetsu 1989), and innovations (both accidental and on purpose) (Smith 2005). Another way that the variability gives clues about how members saw themselves in relation to others is by indicating the degree of deviation from a norm acceptable within the community of practice (Crown 2007) and the likelihood of ties to other groups or localities (Brumbach 1986). Understanding something of the community of practice also helps in understanding the larger group within which potters existed and to which potters contributed (e.g., Gosselain 2000; Hosler 1996).

I hasten to add that my interest in building a classification system not dependent on other systems, such as the Petersen and Sanger sequence, does not mean that I ignored the work done by others. Rather, I matched my terminology and thinking up with other work to the extent I was able in order to make my research as meaningful to other researchers in this region as possible. My aims are not to refute this other work but rather to build on it, and to that end, I have used terminology and classification schemes from Petersen and Sanger (1991), Bourgeois (1999), Keenlyside (1999), Allen (1981, 2005), Foulkes (1981), Sheldon (1988), and Kristmanson (1992). This has meant that my thinking follows a shift from inductive to deductive methods in trying to compare with other work while still trying to define categories after the fact of evidence, rather than before. In order to avoid circular reasoning (1.e., identifying categories in the literature→defining categories based on these→justifying the categories with evidence from the literature), I have conceptually separated attributes from their categories, such that I understand their co-occurrence with other attributes, but do not import assumptions from these co-occurrences. In other words, I look for attribute states I know to be chronologically significant, but I allow evidence to accrue for a temporal placement rather than using previous work to indicate temporal placement. This is not always possible, and I have tried to be honest where I encountered problems of circularity in my own reasoning.

The Database

Filemaker Pro was used to develop a relational database. The database consisted of three main tables: 1) individual sherds or specimens table; 2) a vessel lot table; and 3) a unit and level table. This allowed each specimen to be placed in a vessel lot and to be spatially located. Because rough time periods were attached to most sherds on account of their decorations, units and levels could be roughly contextualized by chronology and manufacturing tradition. Full details about the database can be found in Appendix 4.

Instruments and Measurements

The sherds were examined under a stereoscope with a magnification up to x63. Pictures captured both microscope and regular images. Cameras used were a Nikon D70 and a Nikon D80. Measurements were taken using a pair of biological calipers, a set of home-made diameter templates, and a ruler. Compositional analysis of sherds was conducted using a variety of techniques, including Scanning Electron Microscopy, X-Ray Fluorescence, and Laser Ablation. Compositional analysis was always performed on detritus of sherds rather than on the sherds themselves to preclude artifact destruction.

Sources of Evidence

Inferences were an important part of constructing arguments and identifying salient variables. Inferences came from four main sources. The first was the GLR ceramics themselves, particularly the ways in which certain attributes repeated or were different. Attributes that were co-distributed or co-occurring (e.g., lower temper percentages and redder bodies vs. higher tempers and greyer bodies) formed the clusters upon which groups were constructed. These clustering attributes were considered from technological, aesthetic, economic, and efficiency perspectives (among others) to form hypotheses about the reasons for repeating attribute states.[8] The second source was the ethnographic, archaeological,

[8] In this research, I follow Pfitzner (2009:361) in defining clusters as "simply a process in which the members of a data set are divided into groups such that the members of each cluster (group) are sufficiently similar to infer they are of the same type and the members of the separate clusters are sufficiently different to infer they are of different types." As opposed to most kinds of "hard" cluster analysis (defining groups whose difference

ethnoarchaeological, experimental, and materials science literature on ceramics. Principles were extracted from this literature and applied to the GLR ceramics. This was particularly important in identifying use wear traces, forming attributes such as coil breaks and anvil marks, and identifying temper minerals such as iron oxide. The third source was my experiences studying pottery at the New Brunswick College of Craft and Design (NBCCD), where I became familiar not only with the principles and logistics of pottery manufacture, but also with the ways people organize themselves around pottery manufacture. The NBCCD students and their teachers (and, sometimes, I) formed a cohesive and distinctive community of practice (cf. Lave and Wenger 1991) that often served as a good comparison to Woodland potters in terms of how their different motivations and skill levels manifested in their pottery products. The fourth source of evidence was other Woodland Period ceramic assemblages that I have studied in the past. The most important in this regard is the George Frederick Clarke Artifact Collection, on which I conducted research for my MA thesis (Woolsey 2010). This ceramic assemblage represents the most complete dataset on ceramics I have next to the GLR ceramics. Another dataset is composed of the collections held by the Archaeological Services Branch in Fredericton, New Brunswick and the Metepenagiag Heritage Park in Red Bank, also in New Brunswick, which I had previously studied in various capacities (Woolsey n.d.). Locations of all sites used in this manner are shown in Figure 7. I have also encountered ceramic assemblages in other forms, such as during an excavation I participated in at Port Joli. These four sources of data are cited as necessary to support or dispute hypotheses throughout this dissertation, and are mentioned where they seem relevant.

ORGANIZATION OF THE THESIS

Because ceramics have usually been used in chronology building in this region, my first task is to justify going beyond this important endeavour. Ceramics, by their nature, involve both technological and aesthetic interfaces (Allen 2008), such that a significant amount of multivariate information is passed on from each pottery-making generation to the next. By the same token, significant information is filtered out, making the resulting ceramic assemblage a map of the family tree of intentions and ideas through time. Chapter 2 is a discussion of the methodological problems involved in applying the Petersen and Sanger

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is non-overlapping), I used a fuzzy or "human-generated" (Pfitzner 2009:361) clustering method in which categories where intuitively or simply generated and then tested against existing models or templates as well as internally (that is, against themselves) and refined (Baxter 2009:1037; Pfitzner 2009:361). The reasons for doing this are severalfold. First, there is insufficient evidence that computer-generated or mathematical cluster analysis such as principle component analysis generates better understandings of groups than more simple methods such as similarity measures on archaeological assemblages (Baxter 2009:1037; but see Cowgill 2015). Second, where the assumption in this research is that the significance of attribute states is not fully understood, sophisticated statistical analysis is not guaranteed to reveal anything "real" about the assemblage (Baxter 2009:1037; Pfitzner 2009:361). Third, some attributes that would have been particularly useful in producing more sophisticated cluster analysis, such as elemental composition of clays and tempering materials, could only be investigated superficially in this research. Therefore, the dataset is not ideally suited to hard clustering, but *is* ideally suited to fuzzy clustering as well as descriptive statistical techniques to answer low-level questions (Drennan 2010).

(1991) ceramic sequence to the study of ceramic change in this region, and sets out the concept of a tradition-based classification system, which is built on conceptual learning lineages and models of craft production. The method for building a tradition-based classification system consists of the acquisition of a high-resolution dataset that can be used in a variety of ways, including statistical analysis. Such a dataset is best for taking account of a high degree of variability within a large assemblage, and this approach was demanded by the GLR ceramics, which showed patterning at a fine resolution early on in the analysis and therefore could not be treated using the usual models.

Van der Leeuw (1991) noted that variation among artifacts is not the same as variability, the one being real-world dimensionality, the other being ideological dimensionality. Variation, he argued, is empirical and observable, but not necessarily significant. In contrast, variability is the difference among ceramics that results from particular mechanisms, and is therefore archaeologically significant. One of the reasons classification is so difficult, particularly among ceramics in the Northeast, is that large amounts of variation are observable in single assemblages, but the significance of the variation is often unclear. This fact is often accepted by researchers as a necessary imperfection in the method, called "noise," and dealt with as well as possible within the structure of the classification method (Lyman et al. 1997). Van der Leeuw perceptively noted the circularity of this argument and the inherent flaw in the activity of classification that the circularity revealed.[9]

Van der Leeuw's point was that these categories obscure variation's importance, the variability, by conflating inductive and deductive reasoning and taking real-world phenomena to be the ideological phenomena with which archaeologists explain culture history. This occurs because researchers construct categories before knowing the importance of the variation and reify these categories into static entities before their validity can be tested. In contrast, the craftspeople who made the artifacts worked with open categories that shifted based on complicated criteria, always searching for what was possible within time, environmental, physical, and mechanical constraints, and always operating within a history of personal and public practice (cf. Keller and Keller 1996). Van der Leeuw calls this thinking "poly-interpretable," meaning craftspeople maintained many realities at once to keep up productivity, even in the face of difficulties. If researchers do not recognize these "open" categories, they are probably missing important information about the motivations of the makers, and hence, the cultures to which they belonged.

Since there is no way to take account of all variation among artifacts, the question is this: do we, as researchers, know ahead of time what to look for, and if so, how do we know

[9] If groups are defined based on real-world specimens, then the significance is only proposed after the fact, as a justification for the groups (inductive reasoning). If groups are rather defined ahead of time so that specimens are grouped based on whether or not they meet the criteria, more specimens are likely to remain uncategorized than categorized (deductive reasoning), because any such classification will have been developed for one assemblage and will not fit another assemblage quite so well. Besides which, the groups had to have been defined based on real-world observations at some point, mixing inductive and deductive methods. A further point is that neither method is particularly useful nor pragmatic if used without the other, so archaeological practice usually involves a fair amount of moving between the two to formulate categories that make sense (Lyman et al. 1997; Wylie 2002).

this? And if we do not know ahead of time, on what criteria do we select what we look for, and what we disregard as unimportant? There is no easy answer, but an important step in mitigating the circularity of the method is to acknowledge up front that categories are constantly shifting based on new information and that variation is sometimes too large to take into full account. Furthermore, the intuitive aspect of the process cannot be escaped, and should actually be welcomed, but at some point, definitions and evidence for groups need to be set out to the best ability of the researcher. In Chapter 3, I present the groups I constructed and my rationale for choosing the variability that I did in constructing those groups. I did this by sorting attributes into the manufacturing stage for which each gave evidence and using the evidence to form low-level inferences about the mechanisms that likely resulted in those attributes. From these inferences, I formed groups of attributes that were later used to construct traditions. Importantly, it is the attribute states, not the ceramics, that were grouped, so a given specimen belongs to multiple groups based on each of the following: paste (clay and temper), forming and morphological, and surface modification (decorative and finishing mark) attributes.

The groups thus formed allowed me to identify trends through time, leading to some higher-level inferences about the evolution of ceramic manufacture at Gaspereau Lake. Spanning ca. 600 years from ca. 1550 BP to ca. 950 BP, the manufacturing tradition at Gaspereau Lake underwent a transformation from fineware, carefully decorated and extensively shaped and paddled, to coarser and/or thicker wares that evidently were expediently manufactured in larger numbers. Good evidence exists to suggest that the majority of ceramics in all periods were manufactured at Gaspereau Lake, based on the distinctive clay and temper seen in many vessels. This has meant that the assemblage could be treated as an *in situ* manufacturing tradition, even though the exact location of the manufacture has not been identified and theoretically could be located some distance from the site. Among the most evident changes is the increase in production through time, peaking at ca. 1000 BP. Expedient manufacture is also in evidence, as the time-consuming activity of paddling apparently decreased through time and firing temperatures may have increased to compensate for the weakened ceramic walls that resulted. The larger number of ceramics later in time also corresponds with increasing standardization of certain attributes. All of this adds up to a picture of increasing scale of production through time. Chapter 4 looks at the evidence for this trajectory.

In Chapter 5, I propose a model for ceramic change through time at Gaspereau Lake, including how this *in situ* manufacturing tradition articulated with the wider region, both in ceramic manufacture and in other social realms. I draw on the evidence from the GLR ceramics, literature reviews of ceramic studies in this region, and experimental work to reconstruct the importance of ceramics to peoples' lives through time and the likely reasons for ceramic change. The AMS chronology acquired on the GLR ceramics points to at least three distinct periods from ca. 1550 Cal BP to 1050 Cal BP and two more probable periods ending as late as 600 Cal BP. These periods are framed in the context of the shift from the Middle to the Late Woodland Period. In this chapter, I present the traditions I have constructed using AMS data, groups based on attributes specific to stages of the manufacturing sequence, and trends recognizable through time.

I conclude in Chapter 6 that the Gaspereau Lake manufacturing tradition, though still greatly in need of more in-depth study, reveals an important trajectory of economic and subsistence strategies moving from the Middle to the Late Woodland in Nova Scotia. The largest site in the Maritime Provinces, the GLR Site Complex indicates that the ancestors of the Mi'kmaq were engaged in larger scale activities than has previously been claimed. Although some sites (such as the Oxbow Site in New Brunswick and the Goddard Site in Maine, as well as the likely Wolastoqiyik town of Ouigoudi where Saint John, New Brunswick, now exists) point to larger scale settlements and greater complexity, these have usually been thought of as remarkable rather than as the *status quo* during the Woodland Period. Increasingly, this view must be replaced with an understanding of the Maine–Maritime Region as culturally complex and historically dynamic as a result of its rich landscape, its connections with other regions, and its own remarkable character.

CHAPTER 2: THEORY AND METHODS FOR CLASSIFYING AND INTERPRETING THE GASPEREAU LAKE RESERVOIR CERAMIC ASSEMBLAGE

In the summer of 1965, a naturalist and avocational archaeologist named John Erskine undertook a survey of Gaspereau Lake in King's County, Nova Scotia. Collectors and avocational archaeologists had noted the many surface finds there for several preceding decades, and Erskine was optimistic about the possibility of answering some longstanding questions concerning Nova Scotia's prehistory. He found a number of surface finds and a site dating back as far as the Paleoindian period as indicated by artifacts, but was disappointed to find little from the Woodland Period and no ceramics (Erskine 1972:4).[10] This excavation was ca. 250 m down the northwest shore from the End of Dyke Site, in a place known as Welton's Landing. It is now underwater and inaccessible for most of the year (Laybolt 1999:132). Erskine concluded that Gaspereau Lake had been the site of intermittent occupation since the Paleoindian period, one of many longstanding and sporadically used resting places in the rounds of highly mobile people who were few in number.

At this point in the history of archaeology in Nova Scotia, archaeological practice was experiencing a professional hiatus since approximately the 1930s (Murphy 1998:40). Archaeologists were few and usually avocational. Excavations were executed with a combination of goals that included both contemporary archaeological practice, such as the desire for scientific explanation of the past, alongside Antiquarian-style collecting and excavating that resulted in large private collections and amateur archaeological papers. Significant evidence of coastal populations, usually from the Woodland Period, had been reported by Smith and Wintemberg during the 1920s (e.g., Smith and Wintemberg 1929), and Archaic period sites were increasingly coming to light. During the 1960s, the large Paleoindian site of Debert was excavated by the archaeologist George MacDonald (1966; Davis 1998:199–200), establishing Nova Scotia for the first time as a region with an impressive archaeological record. In the following decade, professional archaeology began the process of writing Nova Scotia's culture history, but at the time of Erskine's excavations at Gaspereau Lake, only a handful of amateurs and experts had any real knowledge of Nova Scotia's prehistory.

Although Gaspereau Lake appeared to be of smaller significance compared with other sites, it remained an area of interest. MacDonald had also searched for sites using an excavator, but had turned up little new information (Michael Deal, pers. comm. July 6th, 2017). Gaspereau Lake was reconsidered after the Melanson site, a large base camp on the Gaspereau River ca. 10 km downstream from Gaspereau Lake, was excavated (Nash and Stewart 1990, Nash et al. 1991). This site raised the possibility that Gaspereau Lake may have been more connected to the coast than had previously been thought, part of the economic strategies of the people occupying the Melanson site through time. The Melanson site was mainly occupied during the Woodland Period, however, while Gaspereau Lake was understood to represent mainly an Archaic period occupation. Nash and Stewart concluded

[10] The Erskine Site, BfDd-5.

that Melanson was the main site while surrounding sites, including those at Gaspereau Lake, were satellites.

In 1989, two surveys of Gaspereau Lake were conducted: a walkover survey by Michael Deal as part of the Minas Basin Archaeological Survey (1991), and an archaeological survey by Dawn Laybolt, a Master's student from Memorial University. Deal's interest was partly in delineating the extent and concentrations of the distribution of Minas Basin chert matching the Davidson Cove quarry (Deal 2005). He was interested in Gaspereau Lake because of the large number of lithics made on Minas Basin chert in the Melanson assemblage along the Gaspereau River and the possibility of a distribution network extending even further inland. He dedicated two weeks to investigating Gaspereau Lake and the private collections that came from Gaspereau Lake (Deal 1991), developing an updated inventory of sites and artifacts.

Laybolt was seeking to better understand Archaic settlement and subsistence patterns, although she later expanded the scope of her research to encompass the Paleoindian and Woodland Period occupations as well, and added several sites to those already recorded. Laybolt's survey uncovered a longer and more subsistence-oriented occupation at Gaspereau Lake that included the Woodland Period. She found that people were exploiting various resources over prolonged periods; nevertheless, she, too, concluded that Gaspereau Lake was secondary to other sites, including the "central place" (Nash and Stewart 1990, Nash et al. 1991) of Melanson (Laybolt 1999:151). Gaspereau Lake continued to be regarded as a stop-over for people logistically exploiting a broad base of resources from a number of locales, from the Paleoindian period up to European contact and beyond. Laybolt reached this conclusion on the basis of site locations and their proximity to one another, a reasonable strategy when testing has been areally exhaustive. However, her survey encompassed a rather small portion of the shoreline, and moreover, it was judgemental and confined by certain constraints such as inaccessible private property. The GLR Site Complex occurs within some of this inaccessible land owned by Nova Scotia Power (Michael Deal, pers. comm. July 6th, 2017).

In 2007, archaeological testing began in preparation for the refurbishing of the dam, and the End of Dyke Site was identified from flake scatters on the surface and test pits. Mike Sanders of Cultural Resource Management Group Ltd. quickly realized that significant cultural resources existed in the planned spillway of the dam (Sanders, Finnie, et al. 2014:4). This area is in the northernmost corner of Gaspereau Lake and had been off-limits to previous surveys.

The End of Dyke Site was substantially excavated in the field season of 2012, which proved to be a massive undertaking, one of the largest in the history of the Maine–Maritimes Region. Crews of up to 50 field technicians were employed full time while the weather permitted to excavate 395 square meters of the End of Dyke Site and a total of 743 square meters from all sites identified in the proposed impacted area around the Gaspereau River outlet (Sanders, Finnie, et al. 2014:7). The End of Dyke Site alone rivalled the Turner Farm and Goddard sites in artifact density and overall numbers (*n*=173,485), and in total area excavated, it is likely the largest site in the Maine–Maritimes Region. Taken as a cluster of sites in close proximity, the Gaspereau Lake Reservoir Site Complex may have been the more central place in relation to Melanson and other sites such as the St. Croix site, from at least the Late Archaic onwards.[11]

The size of the GLR site complex raises a troublesome question about current practices for evaluating sites and inferring settlement patterns. Because Gaspereau Lake looked like many other sites in this region—composed of many small camp sites, occurring next to obvious resources—it was analyzed in the same way these other sites were analyzed. Artifacts, characterized by poor chronological control, were fit into existing regional chronologies, and the explanation for their similarities with other sites (if explanations were given at all) rested on highly mobile populations to whom mental templates diffused from each other or from other regions, and who travelled around the region leaving the artifacts they fabricated behind them. Given the evidence prior to Sanders' discovery of the End of Dyke Site, this is not at all an unreasonable proposition, but the discovery of the End of Dyke Site necessarily throws not only Gaspereau Lake's occupational history, but that of the entire Maine–Maritimes Region, into doubt. For, although it is tempting to look at the End of Dyke Site as simply a larger and longer occupation than previously suspected, several noteworthy attributes suggest a difference in kind rather than degree.

Obviously, Gaspereau Lake cannot now be thought of only as a stop-over sporadically accessed, nor as a camp site supporting other, more central places; yet, more importantly, Gaspereau Lake resembles an aggregation site more than a base camp. The evidence from the large number of trade items shows that Gaspereau Lake was relatively economically powerful, and red ochre, shark's teeth, and groundstone rod fragments may indicate that burials exist near the End of Dyke Site (Sanders, Finnie, et al. 2014:26, 44, and 52, respectively). A number of hearth features exhibit the defining traits of earth ovens (cobble paving, large numbers of fire-cracked rocks, evidence of reuse, and large beds of charcoal and fire-reddened soil—Black and Thoms 2014), which—according to Hayden (2001:40)—is one of the "archaeological signatures" of feasting, and therefore, of greater social complexity (Hayden 2001; Hayden and Cousins 2004). Although the lithic assemblage has not been thoroughly studied to date, one striking feature that has already been observed is the high number of single-source imported lithic materials. Minas Basin material makes up a significant proportion of the assemblage, a source that would have been acquired at a distance of more than 70 km by water and more than 30 km on foot as the crow flies. Additionally, several visually striking projectile points are made from exquisite gemstone-quality material that was clearly acquired from somewhere outside the Maine–Maritimes Region (Sanders, Finnie, et al. 2014:82). Finally, the ceramic assemblage exhibits several unusual characteristics for assemblages in this region: the number of vessels represented is high; a significant portion of the vessels are unexpectedly large, unexpectedly small, or unusual in some other way; and the breakage rate appears to have been unusually high and use-lives unusually short (discussed more fully in Chapter 3 and 4). All of these site attributes are considered by Hayden (2001:39–40) to indicate feasting, which has repeatedly been argued to correspond with the emergence of transegalitarian and chiefdom societies (Hayden

[11] It is noted, however, that the Melanson site was not fully excavated and the full extent of the site is unknown at the time of this writing (Michael Deal pers. comm. July 6th, 2017). The main camp appears to have moved up the river as the head of tide also moved (Nash and Stewart 1990:114–15). More exploration in the area may reveal a larger settlement.

and Cousins 2004; Hayden and Deitler 2001). Importantly, one of the activities such societies engage in to varying degrees is aggrandizing events in order to bring many people together from disparate places and groups.

Ceramics are an important piece of the puzzle of the GLR Site Complex, but how can such an assemblage be approached so as to yield meaningful interpretations? Given that types do not readily emerge, the classification system needs to be carefully constructed and monitored to ensure that classes reflect something real about the manufacture of ceramics during the Woodland Period. Statistical analysis is worse than false if the attributes and measurements used are not meaningful or mean something different than what is projected. Therefore, classifying requires a significant qualitative investigation before quantitative analysis or specimen sorting can even begin. Because the significance of attributes is so important to valid quantitative and classification methods, qualitative analysis must be geared towards finding explanations. This means considering mechanisms for how artifacts come to be in the archaeological record.

In this research, I focus on two mechanisms responsible for the forms ceramics take and how they are deposited in the archaeological record. The first is the process of knowledge transfer and the structures that reproduce knowledge in humans through time, namely, learning lineages. Style is a means of approaching ceramic change through time, but has little explanatory power without examining the means by which style is perpetuated. Learning lineages are a means of investigating how style, technological know-how, and traditions are passed on and changed through time. However, they are not themselves visible to archaeologists but need to be inferred from empirical evidence, which is patterning in assemblages through time. Later in this chapter, I will discuss how the concept of learning lineages can be apprehended by looking for traditions, the material traces of those lineages (Pauketat 2001:10). The second is the process of changing production demands through time and the fact that ceramic production is eventful, responding to conditions within the larger group or even the region. Although evidence for manufacturing is not always directly visible in archaeological contexts, multiple lines of indirect evidence can be studied to build a case for a manufacturing context. In the section on production, I introduce Costin's (1991) model of craft production to indicate which lines of evidence can be used with the GLR ceramic assemblage to indicate scale of production and degree of specialization, as well as whether local manufacture can be inferred. First, though, I examine existing regional ceramic models and make the case for going beyond them into broader realms of cultural phenomena.

CERAMIC MANUFACTURING TRADITIONS IN THE MAINE–MARITIMES REGION

Classifying ceramics in the far Northeast is not a straightforward proposition. Similar to other regions traditionally inhabited by Algonkian-speaking peoples (e.g., J. Wright 1967; Clark et al. 1992), pottery from the far Northeast tends to exhibit loose stylistic continuity rather than resolving into types or standards that are in evidence elsewhere (e.g., Ramey Incised—Emerson and Pauketat 2008). Broad changes occur through time across the far Northeast, namely, a move from coarsely-tempered, fabric-impressed pots during the Early Woodland to thinner, finer-tempered pottery decorated with pseudo-scallop shell (PSS) or dentate decorations during the Middle Woodland to thicker, coarser-tempered pottery decorated with cord marks during the Late Woodland (Allen 1981; Bourque 2001; Davis 1991; Foulkes 1981; Keenlyside 1999; Kimball 2011; Kristmanson 1992; Petersen and Sanger 1991; Rutherford 1991; Sheldon 1988; Taché 2013; J. Wright 1967).[12] Yet within this gestural sketch of ceramic change through time in the far Northeast, a great deal of variability exists in the forms pots take. Decorations exhibit many variations such that classifying them is often a challenge (Dawson 1980), and although Middle Woodland pots tend to be thinner than Late Woodland pots, the rule is by no means hard and fast, as both periods exhibit both unusually thick (>1 cm) and unusually thin (<0.5 cm) neck walls. Recognition of the lack of self-evident types prompted archaeologists in the Maine–Maritimes Region to agree formally to using a ceramic analytical method based on attributes rather than on types (Sanger 1974). Some have gone so far as to call this variability "chaotic" (Brose, qtd. in Clark et al. 1992) and "erratic" (MacIntyre 1988:322), implying that stylistic continuity either does not exist below a certain scale of analysis, or else it cannot be traced.

The approach to pottery classification in the Maine–Maritimes Region has been predominantly culture-historical. By this I mean that pottery has been studied for chronologically sensitive attributes that are organized into a seriation or chronology, which is subsequently used to infer time periods of assemblages and strata. Technological concerns have remained secondary. The most comprehensive push toward developing a regional chronology was Petersen and Sanger's (1991) study *An Aboriginal Ceramic Sequence for Maine and the Maritime Provinces*, and it has remained the foremost sequence against which ceramics are compared. Because radiocarbon dating is expensive, this regionally accepted sequence has sometimes been the only evidence invoked to infer time period in the study of sites and stratigraphy (e.g., Sheldon 2001:10).

The Petersen and Sanger Sequence

The Petersen and Sanger Sequence was developed in the context of many archaeologists' efforts to build an evidence base, develop models for increasingly prevalent cultural resource management activities, and write the culture history for the Maine−Maritimes Region (e.g., Allen 1981, Bourque 1973; Davis 1978; Deal 1985, 1986; Erskine 1972; Foulkes 1981; Hamilton and Yessner 1985; Nash 1977, 1978; Sanger 1987; Sheldon 1988; Snow 1970). Its aims were to synthesize existing data on dated ceramics and to show that (and how) ceramics changed at specific (broad) moments, such that periods could be identified. Although Petersen and Sanger worked to find ceramic attributes that are specific to certain periods, and that therefore definitively indicate those periods, they found that most ceramic attributes had somewhat indistinct or overlapping temporal boundaries. Even decorations such as PSS, generally acknowledged to indicate the earlier Middle Woodland Period across the Northeast (Mason 1970; J. Wright 1966), seems to occur both earlier (e.g., Allen 1981; Godfrey-Smith et a. 1997) and later (e.g., Blair 2004) than the main period of occurrence. Thus, while there are certainly patterned changes that can be roughly

[12] Pseudo-scallop shell, dentate, and cord-wrapped stick decorations are standard terms in the Northeast literature for decoration tool types. These terms are used throughout this writing and are fully defined and discussed in the section on decorations in Chapter 3. These tools are also illustrated in the figures at the end of Chapter 3.

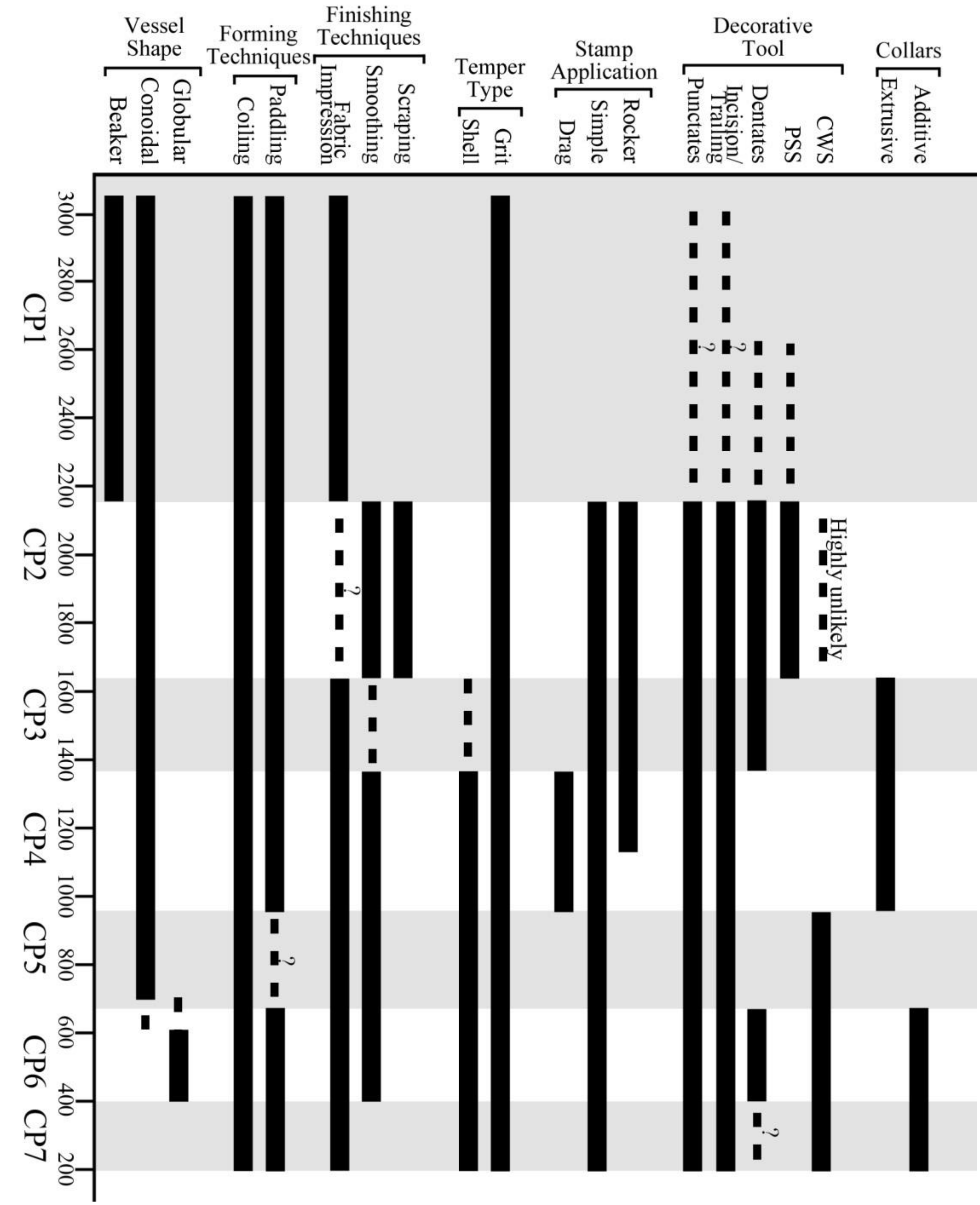
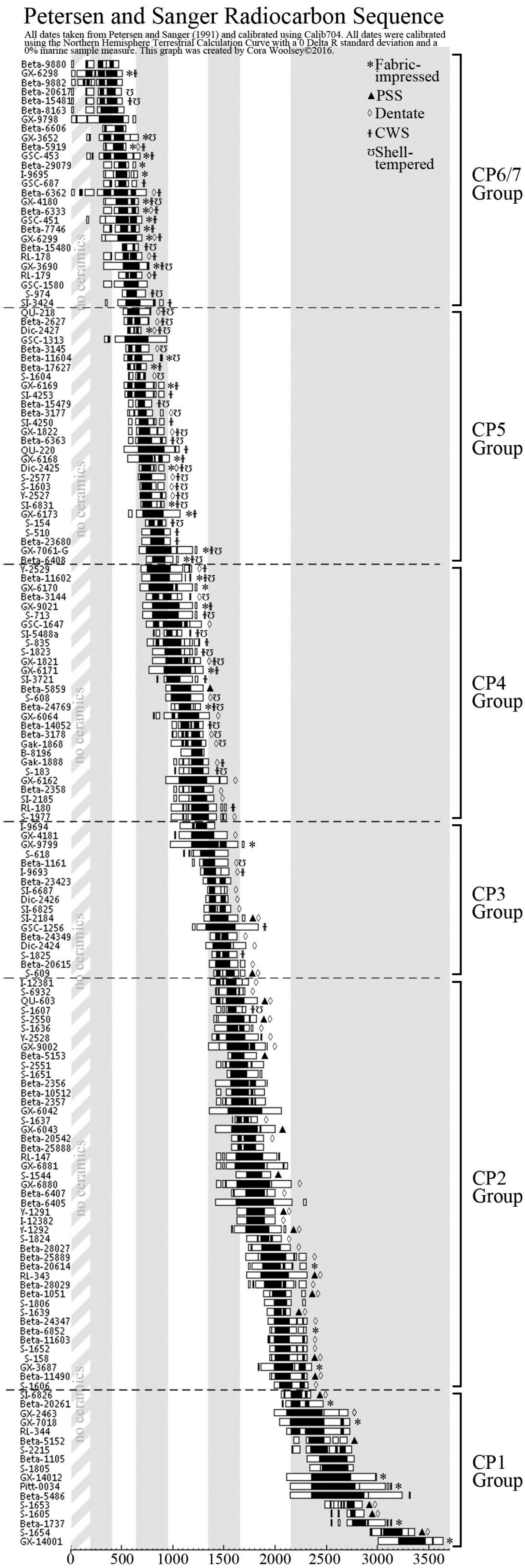


Figure 2: Attributes and their time ranges as listed by Petersen and Sanger (1991). Solid lines indicate confirmed observations. Dashed lines indicate that the authors have proposed this occurrence during the time period. Question marks indicate ambiguous wording by the authors.

Figure 3 (next page): Calibration bars for all dates included in the Petersen and Sanger sequence (1991).


Petersen and Sanger Radiocarbon Sequence
All dates taken from Petersen and Sanger (1991) and calibrated using Calib704. All dates were calibrated using the Northern Hemisphere Terrestrial Calculation Curve with a 0 Delta R standard deviation and a 0% marine sample measure. This graph was created by Cora Woolsey©2016.
*Fabric-impressed
▲PSS
◊Dentate
ǂCWS
ʊShell-tempered
Beta-9880
GX-6298
Beta-9882
Beta-20617
Beta-15481
Beta-8163
GX-9798
Beta-6606
GX-3652
Beta-5919
GSC-453
Beta-29079
I-9695
GSC-687
Beta-6362
GX-4180
Beta-6333
GSC-451
Beta-7746
GX-6299
Beta-15480
RL-178
GX-3690
RL-179
GSC-1580
S-974
SI-3424
QU-218
Beta-2627
Dic-2427
GSC-1313
Beta-3145
Beta-11604
Beta-17627
S-1604
GX-6169
SI-4253
Beta-15479
Beta-3177
SI-4250
GX-1822
Beta-6363
QU-220
GX-6168
Dic-2425
S-2577
S-1603
Y-2527
SI-6831
GX-6173
S-154
S-510
Beta-23680
GX-7061-G
Beta-6408
Y-2529
Beta-11602
GX-6170
Beta-3144
GX-9021
S-713
GSC-1647
SI-5488a
S-835
S-1823
GX-1821
GX-6171
SI-3721
Beta-5859
S-608
Beta-24769
GX-6064
Beta-14052
Beta-3178
Gak-1868
B-8196
Gak-1888
S-183
GX-6162
Beta-2358
SI-2185
RL-180
S-1977
I-9694
GX-4181
GX-9799
S-618
Beta-1161
I-9693
Beta-23423
SI-6687
Dic-2426
SI-6825
SI-2184
GSC-1256
Beta-24349
Dic-2424
S-1825
Beta-20615
S-609
I-12381
S-6932
QU-603
S-1607
S-2550
S-1636
Y-2528
GX-9002
Beta-5153
S-2551
S-1651
Beta-2356
Beta-10512
Beta-2357
GX-6042
S-1637
GX-6043
Beta-20542
Beta-25888
RL-147
GX-6881
S-1544
GX-6880
Beta-6407
Beta-6405
Y-1291
I-12382
Y-1292
S-1824
Beta-28027
Beta-25889
Beta-20614
RL-343
Beta-28029
Beta-1051
S-1806
S-1639
Beta-24347
Beta-6852
Beta-11603
S-1652
S-158
GX-3687
Beta-11490
S-1606
SI-6826
Beta-20261
GX-2463
GX-7018
RL-344
Beta-5152
S-2215
Beta-1105
S-1805
GX-14012
Pitt-0034
Beta-5486
S-1653
S-1605
Beta-1737
S-1654
GX-14001
no ceramics
CP6/7 Group
CP5 Group
CP4 Group
CP3 Group
CP2 Group
CP1 Group
0
500
1000
1500
2000
2500
3000
3500

divided into periods, Petersen and Sanger did not create a typology, but rather, a chronological classification based on a complicated mixture of inferences about attributes and time periods in which these are likely to have occurred.[13]

The culture-historical approach is important and valid as long as the theoretical stance is clearly stated or at least practiced. Issues occur when mixing of theoretical stances lead to contradictions or when theory-induced assumptions are not explicit. One issue with using the Petersen and Sanger sequence to date assemblages (or associated strata) is that those same assemblages cannot go on to support the sequence because to do so would be circular; refinements, therefore, must rely on evidence other than the established sequence in order to prove the validity of it. This separation of the model and evidence for the model has rarely occurred, however. Another issue is that the theoretical basis of inferring time period of ceramics from the Petersen and Sanger sequence is usually under-explored, and so the consequences and difficulties are often downplayed. In order to effectively mine the evidence accruing from ceramics, it is important to acknowledge that the proxy data ("diagnostic" attributes) are several degrees removed from direct evidence. It is therefore important to understand how the authors constructed their argument.

First is the problem of how to interpret the sample used by the Petersen and Sanger sequence. Their sample, though relatively large (*n*=165), is far from random, and therefore cannot be treated statistically as a simple random sample. It comprises all the radiocarbon-dated ceramics in existence up to that point (1991), and the dated material was a mixture of direct (carbonized residue on the interiors) and general (charcoal from an associated feature or layer) associations with the ceramics included in the study. Importantly, these ceramics were—for the most part—chosen by the respective researchers, not for the maximum information they could give about ceramics, but rather, about site chronologies, as has been the practice through much of archaeology's history in this region. Although the distinction may seem inconsequential, it means that the sample was skewed (consciously or unconsciously) towards certain ceramics because of researchers' pre-formed ideas about the time periods associated with cord marks, fabric impression, PSS, dentates, and shell temper. Another level of skewed sample selection exists in ceramics that were excluded because they were never dated. Only ceramics from sites with a budget for radiocarbon dating ceramics would have been included, and research on sites with small or poorly preserved ceramics would likely not have opted for radiocarbon dates for those ceramics (e.g., Sheldon 2001). Additionally, some dates were rejected because Petersen and Sanger did not trust the context, while other dates are simply not included for unknown reasons (e.g., dates listed by Foulkes 1981:228–30). Theoretically, there is also a skewing effect of any results in which

[13] The importance of this distinction lies in how the model is used, and how it was intended to be used. If researchers acknowledge the muddiness of the Petersen and Sanger ceramic period boundaries and the occurrences of pottery attributes that do not fit with the model (as Petersen and Sanger do themselves), then it is not possible to go on to place every case of PSS-decorated pottery in the earlier Middle Woodland, every case of cord-marked pottery after the later Middle Woodland, and so on unproblematically. These attributes cannot be used as index fossils after having acknowledged the existence of overlapping periods and outliers. Rather, the sequence is best used comparatively at the level of population or sample, such that if many PSS-marked vessels occur in a given context, the earlier Middle Woodland is likely well-represented in the assemblage, whereas many cord-marked vessels likely indicate a strong Late Woodland occupation.

carbon directly associated with a ceramic is used to date the ceramic and assemblage. This is because carbonized encrustations may well have occurred only on certain vessels, while other vessels (possibly even vessel types) must necessarily remain undated by archaeologists, and therefore, unincorporated into any sequence of radiocarbon-dated ceramics that relies on direct dates only.[14] This is less of an issue in general associations because radiocarbon dates for an associated feature can include a range of pottery, including pieces that do not necessarily fit assumptions about periods. To recap, the ceramics in the sample were first selected because they were recovered in an archaeological excavation; they were further selected because they had carbonized encrustations or were associated with charcoal; the sample was further reduced to only those used for radiocarbon dating; and finally the sample was pared down to what Petersen and Sanger chose to include. Taken together, these skewing effects mean that the sample compiled by Petersen and Sanger is not a simple random sample of ceramic manufacture as a whole throughout the Woodland Period, and could be quite far from representative as well.

This is not to say that the sample is uninformative or of no use. According to their analysis, some attributes cluster around certain time periods, while others persist throughout the entire sequence. Their observations about the clustering of PSS, fabric impressions, cord marks, and shell temper has been echoed by other researchers both in the Maine–Maritimes Region and further abroad (e.g., Allen 1981; Bourgeois 1999, 2004; Deal 1986; Foulkes 1981; Kristmanson 1992; Keenlyside 1978; Nash 1977; Nash and Stewart 1986; Sheldon 1988, 1991). Issues of skewness aside, the sequence shows the following trends (all mean dates are uncalibrated, just as they are reported by Petersen and Sanger): 1) fabric impression dates most commonly fall between 3050 to 2100 BP; 2) PSS dates tend to cluster most strongly between 2150 to 1600 BP; 3) dentates seem to occur from the beginning of the sequence well into the Late Woodland Period, but dates most commonly range between 2250 to 1250 BP; 4) although dates for cord marked pots stretch back to before 2400 BP, the main concentration is from 1650 BP on; 5) shell tempering dates occur as a concentration from 1290 BP on (see Figure 2 for a visual model of the Petersen and Sanger sequence). In all of these five trends, the salient attributes are not limited to the ranges stated, and significant deviation occurs in the PSS trend as well as the cord-mark trend. Also, these trends do not take into consideration error ranges attached to each date, some of which are quite large (>150 for 1 Sigma). Nevertheless, these trends show that decorative attributes changed through time in a somewhat coherent manner.

The picture changes somewhat when the dates are calibrated. The dates are generally nudged to later, so that many of the periods should properly have their boundaries pushed 50 or 75 years later to match. Particularly in the case of CP4 and CP5, many dates' 1-Sigma ranges overlap the later boundaries of those periods. In every group except CP1 (and this is especially true of the CP2 group), several dates' 1-Sigma ranges fall entirely within the proceeding group. For the purposes of this study, the Northern Hemisphere Terrestrial Calculation Curve was used, with a 0 Delta R standard deviation and assuming no marine reservoir effect (Stuiver and Reimer 1986). However, many dates used in the sequence

[14] Such a sequence was proposed by Taché and Hart (2013).

probably have a significant marine signature, and so are likely to have occurred even later than shown in this graph.

Petersen and Sanger insisted that their dates be reported uncalibrated because this was the generally agreed-upon format in this region, as archaeologists anticipated (quite rightly) that radiocarbon calibration technology was likely to change significantly over the next three decades. It is difficult to imagine, however, that the authors did not understand the implications of calibrating the dates they reported, and though they posited some well-delineated time periods (CP1–7), they nevertheless emphasized that their sequence be used as a starting point for more research. In short, the trends they identified were more like material culture traditions and less like periods of fixed calendar dates.

Unfortunately, the Petersen and Sanger sequence has become the main means by which ceramics are dated. Radiocarbon dating tends to be reserved for features and layers, while ceramics are used as a supporting line of evidence. Thus, rather than testing the model with new assemblages and better radiocarbon dates, the sequence is now considered the basis for translating single specimen ceramics into well-defined date ranges.

Typologies vs. Traditions: Going beyond the Petersen and Sanger Sequence

The Petersen and Sanger sequence was explicitly meant to be an outline for the building up of new data. I would add that it should also be used as a model that can be accessed as necessary when researchers are ready to go beyond chronology building into explorations of technological function and use, materiality, on-the-ground processes of ceramic evolution, and so on. The model should not take priority over these other goals but should be used to strengthen their cases. Classifications with goals other than chronology will not be constructed in the same way as a chronological classification (e.g., Costin 1991:5; Jeffra 2011:104; Neupert 2007; Teltser 1993). Therefore, where the primary goal of this research is something other than chronology building, then categories should be constructed to address the primary goal—learning lineages—even if these categories conflict with the Petersen and Sanger sequence.

Types and chronologies are basic aspects of archaeology, and ceramic types in particular have been relied upon to clarify chronology and spatial relationships (Lyman et al. 1997). However, types, which are defined as a specific phenomenon in which attributes tightly cluster (Adams and Adams 1991; Krieger 1944), do not occur in all manufacturing contexts (Sanger 1974). Likewise, chronologies pose the challenge of how to keep periods from becoming reified as types because they tend to represent periods as homogeneous (Martell 2002:15–18). To supress variability among categories by claiming that types or homogeneous periods exist is to assume, out-of-hand, a learning framework that is not in evidence and may actually be disproved by the variability (Martelle 2002:15; Ramsden 1977; White 2017:67). While building typologies on loosely patterned assemblages may result in coarse chronological sequences, it cannot reveal emic categories or learning lineages in any kind of detail, nor can it decipher technological or production categories effectively (White 2017:67).

A Tradition-Based Classification

The alternative to a typology or typological chronology is a classification based on a behavioural mechanism. Because I have explicitly investigated learning lineages as a mechanism for ceramic change and stability, the classification system I used is based on traditions, or (in other words) the observable material traces and outcomes of learning within a community. A tradition-based classification would therefore consider, as its primary focus, the categories of attributes that can reveal choices made at the different stages of the *chaîne opératoire*, to the extent that this is possible. Because some attributes (i.e., forming and firing attributes) are more likely to be held stable through time as a result of their requirements of lengthy skill-building (White 2017:71), these attributes are particularly valuable in understanding learning and norms within a community of practice. In this classification scheme, ceramics can be grouped by similarity but individual units are allowed to differ from each other in a way not allowed in a type-based classification. This is because both evolution and continuity are assumed to be dimensions within each group, and may extend beyond groups. As such, groups are not mutually exclusive: a unit may belong to more than one group and the criteria (or *significata*—Dunnell 1978) that specify membership within a group are allowed to be subjective and shifting rather than set out beforehand and maintained as a present/absent analytical system (e.g., van der Leeuw 1991). My tradition-based classification explicitly incorporates subjective impressions, shifting category boundaries, and significant intra-group variation so as to get at pottery's importance to its cultural context. Where there is similarity, is there also conformity? Where there is difference, is there also continuity? Can individual marks be identified, or are tools similar but clearly different on each vessel? What is the dominant mechanism (if any)? What are the subordinate mechanisms (if these can be identified)? Can the answers to any of these questions be tied to an absolute date range? These questions can be answered, little by little, through developing a high-resolution dataset and by employing a "close reading," or deeply observational, approach to the assemblage.[15]

MECHANISMS OF KNOWLEDGE TRANSFER

The high-resolution dataset acquired from such an investigation is well-suited to the identifying knowledge transfer, or the set of actions within a community of practice that results in knowledge passed from teachers to learners. Knowledge transfer can be accepted as a mechanism for patterning in ceramics without having to investigate its veracity;

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[15] "Close reading" is a term and a technique borrowed from literary criticism that originally looked at poetry. I used it as a guiding principle throughout my analysis in order to maintain a deeply observational approach to the ceramics, paying attention to attributes even when I did not understand their significance. I did this in much the same way that students of poetry are encouraged to think deeply about the way each word in a poem is used, the way each word relates to other words, and about the myriad co-existing meanings a word or phrase might have. Simply put, a close reading approach entails careful consideration of the choices made by an author and what those choices say about what the author thought a poem was and what value poems had, which is not always straightforward or even apparently logical. In the same way, pottery attributes can be considered carefully in terms of intentionality of the potter that goes beyond rational response and strict utilitarian purpose. This approach is built on both objective observation and subjective impressions to build a "literacy" of the tradition over time.

therefore it is a good starting point. In order to understand what knowledge was being transferred, how it was transferred, and why, I conceptually divide knowledge transfer into three constituent parts. The first, the learning lineage, is the fact of knowledge transfer, evident in the continuity of pottery manufacture through a lengthy period of time although not directly investigable in archaeological contexts, and is the mechanism behind patterning. The second is the learning framework, which is determined by the cultural reasons for and constraints on knowledge transfer—in other words, it is the means by which the patterning is maintained, also not directly investigable. Finally, the tradition is the material traces—the observable patterns—of knowledge transfer, which constitutes the only means by which the learning lineage and the learning framework may be investigated. Traditions are defined by their continuity through time, making them historical and meaningful in nature. Thus, to investigate knowledge transfer, the empirical patterning (the tradition) is recorded and analyzed to infer both the skills and techniques that were taught (the learning lineage) and the ideals of the community of practice that reinforced the skills and techniques through incentives and sanctions (the learning framework). In this section, I introduce the rationale for using the mechanism of learning lineages to explain ceramic change and for constructing a tradition-based classification of ceramics.

Continuity as an Indicator of Learning Lineages

The importance of identifying continuity through time is that it indicates an evolving cultural context in which something remained the same, resisting change, in response to events through time. Continuity is defined here as *patterning, in material culture, that results from a behaviour, an artifact class, or an attribute state (or states) that remains similar or shows a relation through time*. Continuity is different from stasis, the latter referring to an unchanging state and held by many researchers to be impossible in a cultural context (Callinicos 2004:79–80, 146). Continuity, on the other hand, can be evident in material culture by identifying “aggregate patterns” even when fast-paced change was occurring and/or causing breaks in other dimensions of material culture (Emerson and Pauketat 2008:173; Alt 2001). Continuity in material culture can be ascribed to many factors, including environmental constraints (Neupert 2007:141), functional requirements (Schiffer et al. 1994; Schiffer and Skibo 1997), economic factors (Pool 2000; Sassaman 1992, 2011), and so on. However, the most ubiquitous incentive for human compliance with a norm or a tradition is the passing on of knowledge and customs (Emerson and Pauketat 2008; Crown 2007). Therefore, the investigation of continuity and of changes alongside continuity reveals which kinds of knowledge—and associated meanings, identities, entanglements, and power relations—were being passed on and which were not (Budden and Sofaer 2009; Smith 2005; Tehrani and Reide 2008) and, potentially, why this was the case (Pauketat 2001:12). Furthermore, continuity indicates a deeply meaningful history of practice even if the meaning of the constituent symbols, behaviours, heterodoxies, and identities changed through time (Alt 2001:143–44).

In other contexts, archaeologists have used ethnoarchaeology to understand artifact continuity and variability and the responsible mechanisms (e.g., Arnold 2008; Crown 2001, 2007, 2014; Gosselain 1992, 1999, 2000, 2008, 2017; Graves 1985; Ingold 2001; Longacre 1970; Naji 2009; Singleton 1989; Skibo and Schiffer 1999). One of the important concepts to have emerged from this work is learning lineages (Crown 2001). Although any number of factors affects the forms ceramics take, learning lineages—whose structures are protected by identity building within the community of practice (Budden and Sofaer 2009; Lave and Wenger 1991; Michelaki 2008; Tehrani and Reide 2008) appear to be the most immediate identifiable mechanism through which stylistic and technological continuity is maintained (Gosselain 2008; Minar 2001; Smith 2005; White 2017). Additionally, learning lineages are a reflection of other social realms and change in parallel ways (Crown 2007:204; e.g., Gosselain 2017). Learning and knowledge transfer come about because of specific cultural conditions that determine the size of the pool from which potters can be drawn, the movement of potters both before and after they have learned to make pottery, and the degree to which pottery manufacture is controlled by other potters or the larger group (Gosselain 2001; Hosler 1996; Michelaki 2008). When structures of learning are examined, it can be seen that pottery forms are in fact the logical outcomes of these structures and different configurations of pottery forms retrodict different learning situations (at least to some extent) (Crown 2007).[16]

I hasten to add that artifact forms are the result of many factors, and some researchers (e.g., Arnold 2008; Costin 1991:2; Neupert 2000; Sassaman 1992) would argue that environmental and economic constraints are the largest force in this regard. Ceramic ecology has been instrumental in forcing archaeologists to see ceramics as creative and dynamic responses to equally dynamic needs. In particular, Arnold (1985, 2008) showed evidence for many direct relationships between environmental factors and specific ceramic traditions. It could even be argued that every ceramic attribute state is, in some sense, the outcome of environmental factors. Examining learning lineages in no way disputes this position. Ethnographic work and my own experiences of modern studio potters show that potters almost always learn their craft from a human source in one of the most important and common human interactions—the teacher–learner relationship (Minar and Crown 2001:376). This makes it an important site for cultural transmission and it tends to resist change, even environmental and economic change (Sillar and Tite 2000:10), but it can also induce change, depending on the environmental feedback. Therefore, environmental

[16] Here, I invoke the sense of "logical" used by Lemonnier (1990, 1992) when he speaks of "cultural logics," or the idea that, while cultural meaning may be arbitrary, it is not random but rather historically contingent, and therefore logical—within the bounds of the culture system, at any rate. Culture itself is a system of logic, although it is not therefore rational. The term "logical" in reference to pots as the outcomes of behaviours is perhaps contentious for some (e.g., Lave 1991; Lave and Wenger 1991), who may find it evokes ideas of rational actors and early cultural evolution models (e.g., Steward 1955). However, I intend it rather to mean the likelihood that certain conditions (e.g., the existence of market economies) will result in certain material outcomes (e.g., increased scale of production), as cultures create material culture that is in line with their goals, aesthetics, sets of constraints, and abilities. The goal to predict how varying conditions in the community of practice will affect the material outcome has been of concern to researchers of learning for some time (e.g., Crown 2007, 2014; Gosselain 1992, 2000, 2008; Henrich 2001; Minar and Crown 2001; Pauketat 2001; Roddick and Stahl 2016; Schiffer and Skibo 1987; Smith 2005; Tehrani and Reide 2008; Wallaert-Pêtre 2001; Wendrich 2013), and though undoubtedly some aspects of material culture as the result of structuration are specific only to that culture, other aspects are more cross-culturally observable and result from factors archaeologists can predict..

constraints can be understood as negative or amplifying feedback (Arnold 1985, 2008), while teachers can be understood as the behavioural outcome of that feedback.[17]

Archaeologists have often touched on the issue of historical continuity and group affiliations across space, but have often treated these problems through the lens of style and typologies rather than through pedagogical approaches (e.g., Dunnell 1978; Hardin 1970; Hill 1985; Lechtman 1978; Longacre 1966, 1970; Sackett 1993). Although style and typological analysis are important archaeological tools, they have allowed researchers to avoid identifying mechanisms for continuity of material culture (van der Leeuw 1991:20–21). This is not to say that archaeologists have not thought deeply about mechanisms and worked hard to explain stylistic phenomena; rather, the opposite is true (e.g., Carr and Neitzel 1995; Chilton 2000; Conkey 1989, 2006; Conkey and Hastorf 1993; Dunnell 1978; Gosselain 1992; Hodder 1979; Lathrap 1983; Lechtman 1977; Sackett 1993; Schiffer and Skibo 1997; Washburn 1983). But mechanisms responsible for the phenomenon called "style" that is observable in objects have only begun to be empirically tested. It is apparent now, however, that knowledge transfer is key in what we recognize as styles, while traditions—style that has evolved and endured through a recognizable lineage—is an important means of grasping the significance of patterning and continuity in archaeological pottery assemblages.

Style and Continuity in Material Culture

Style is a familiar and necessary concept in archaeological methods. Yet the different ways style has been understood by different analytical approaches have been so diverse that some definitions of style scarcely resemble each other and seem incompatible. Style has been treated at length elsewhere; because stylistic analysis is not central to the methodology of this research, it is not treated in depth here, except to note the property of style that most agree on, and which is crucial to an understanding of learning lineages as an explanation for variability in material culture. This property is that style is historical in nature (Allen 2008:167; Davis 1993:19).

Style is not itself an empirical phenomenon. Only patterns, to which archaeologists assign meanings and explanations, are empirical. Patterns can take many forms and can have many (and multiple) causes, and so interpreting them as styles is necessarily a theoretical practice. To do so is to assert that patterning in an archaeological assemblage is a result of people sharing a visual field in which techniques and imagery may be intentionally or unintentionally passed on (Hill 1985), or they may be withheld (e.g., Townsend-Gault 2004) or constrained (Hosler 1996; Washburn 1983). In other words, style is patterning that comes from links between people—even distant or indirect links.

In contrast, patterning *can* occur in the absence of a visual field shared by makers. People who do not know each other and are entirely unrelated may nevertheless create material culture with the same attribute states (Arnold 2008:18). Across North America, temper particles occur in Aboriginal pottery from nearly every culture group. This cannot

[17] Non-teacher potters are obviously also subject to behavioural modifications based on feedback, but if they do not pass on their skills to others, then they probably do not show up in the archaeological record to any great extent.

possibly be the result of the passing on of techniques across the entire continent, and a much better explanation is an adaptive one: pottery tempered with non-clay inclusions withstands thermal shock better than pottery without these inclusions (Bronitsky and Hamer 1986; Skibo and Schiffer 2001; Tite et al. 2001). The difference is described by Lyman et al. (1997) as homologous vs. analogous similarity, the former (i.e., style) existing where there *is* some reason to assume descent from a common ancestor. The interpretation of how a pattern came to be has significant explanatory power, but it also has the potential for fallacious reasoning that can lead to unfounded conclusions if the mechanisms responsible for patterning are not investigated or are taken for granted.

To assert that a style is in evidence in material culture, therefore, is also to assert that people in contact shared a visual literacy in that style,[18] and that people developed the style together through time, albeit to varying degrees (Pauketat 2001). It is to assert a culture group existed in some form, whether this was a technological population (members who use the same technology—Gosselain 2000; Petersen 1996), a work group (members who aggregate to work on projects—Deal 2011:154; Graves 1981, 1985), a kin group (members who are related by blood or marriage—Longacre 1966), a ritual group (members who engage in ritual practices governed by a single set of overarching ideas—Stahl 2013), a social or caste group (members who understand themselves to belong to a group larger than their immediate group—Gosselain 2008b, 2016; Saunders 2001), and so on. The mechanisms responsible for the development of a particular style need not be known to the researcher to assert that a style is, nevertheless, occurring on a particular set of artifacts, as long as an inference of cultural transmission and a shared visual field is justified. Thus, a pattern is the empirical evidence, while a style is the interpretation of that evidence.

In the next section I delimit a theoretical model for understanding a particular kind of style—traditions—as a historically contingent, creative as well as proscriptive knowledge that is transferred through people and material objects via a series of investigable mechanisms. These mechanisms can be summed up as learning mechanisms, and though not all styles are always maintained through person-to-person transfer, it is probably safe to assume that most of what archaeologists deem to be stylistic comes about in this way (Crown 2007:201; e.g., Arnold 2008; Deal 1988b; Gosselain 1992, 2000; Graves 1985; Hosler 1996; Ingold 2001; Keller and Keller 1996; Lave 1991; Longacre 1970, 1992; Naji 2009).

[18] The visual literacy concept consists of identifying the way people "read" their surroundings, including material culture, landscape, and other people. It is based on the premise that objects contain patterned information that the brain organizes syntactically (Goin 2001) based on previous experience. When people make objects, they encode this information, which is then accessible to other people who see and interact with those objects (Griffin 2002:32; Knupfer 2000:40). Visual literacy takes account of the tremendous volume of patterned information that is continually being assimilated through practice and experience, and which individuals are capable of drawing on and of themselves encoding creatively into actions and made objects, just as they draw on and use language. There is no structure to speak of, only categorical and relational principles, which can change entirely in an instant (Griffin 2002:33), though they are almost always augmented rather than discarded. As Goin (2001:367) states, concerning how people interpret photographs, "the visual language of photography, which includes elements of light, angle, scale, diagonal line, motion, hue, saturation, tone, value, frame of reference, among many, many others, incorporates syntactic order." Without registering the fact, people read photographs in the very act of observing them; this is true of all things in the visual field.

Traditions and Learning

If style influences those viewing it (or sensing it in other ways), style passed on through kinship systems and other learning lineages ought to influence through additional structures that encourage participation and identity building.[19] In this section, I develop a terminology for describing and understanding the specific phenomenon of knowledge transfer at close range—that is, within communities, as part of formal training centres and apprenticeships, and along kinship lines.[20] Communities of practice are the unit of organization responsible for this kind of knowledge transfer (e.g., Wendrich 2013), but cannot be assumed to always be only, or even the primary, mode of knowledge delivery (e.g., influence of other groups, learning from books, and innovation or experimentation).

Included in the concept of knowledge transfer at close range and within a community of practice are the intentional and unintentional transfer of skills, techniques, perceptual inspirations, and aesthetic considerations of styles as well as the rationalizations, ethics, group affiliations, mannerisms, and politics that also attend knowledge transfer (Dobres 2001; Hosler 1996; Ingold 2001; Lave and Wenger 1991; Lemonnier 1992; Naji 2009; Pfaffenberger 2001). I also include the ways in which knowledge is transferred only to some and withheld from others (G. Braun 2015:5; Hosler 1996).[21] Although significantly more complexity is likely to inhere in almost any specific knowledge-transfer situation, a simplified model is necessary for investigating this phenomenon in material culture.

The model I set forth consists of three necessary parts: 1) on-the-ground, operationalized processes (ethnographically but not archaeologically visible); 2) structuring principles that induce and maintain these processes (also not archaeologically visible); and 3) empirically investigable, material products of those processes (the main source of evidence about knowledge transfer for archaeologists). Based on the way archaeologists use the concepts developed around learning, I propose that a *learning lineage* best describes the process of knowledge transfer (e.g., Crown 2007), while a *learning framework* fits best with the structures that promote knowledge transfer. The material products of knowledge transfer

[19] Some of these influential structures would include loyalty to and admiration for family members, a desire to identify with a kinship (or other kind of) group, or a desire to make viable products without the trouble and time of individually discovering the method and experiencing all the failures and experiments this would entail. Knowledge transfer necessarily involves filtering of information (Crown 2007:203; Hosler 1996; Pauketat 2001:12),, on the one hand, and copying techniques on the other (Minar and Crown 2001:376),, which causes the wealth of potential knowledge and technological choices to be narrowed. Conversely, being a student also involves individual agency (Crown 2001:454; Ingold 2001),, self-expression (Lathrap 1983),, and errors in copying (Hill 1985: 367),, all of which result in new ideas that widen the scope of the practice.

[20] Knowledge transfer at more distant ranges would include interaction at markets (Gosselain 2016) or gatherings from across a large region (Hayden and Cousins 2004). Gosselain notes that these less direct means of knowledge transfer occur through imagination rather than the building of scaffolding (Greenfield 2002). Typically the skills acquired in this manner are less reliant on muscle memory and more a matter of applying previous experience to new subject matter (Crown 2007:206; Gosselain 2008a, Wallaert-Pêtre 2008:196).

[21] G. Braun (2015) notes that learning to make pottery among the Iroquois was also learning to be a girl and the rights and responsibilities that entailed, as mothers would sit down with their daughters to make pots but not with their sons.

and performance of structures have often been described using the concept of *tradition* (Pauketat 2001; Willey and Phillips 1962; J. Wright 1967).[22]

In this model, a learning lineage consists of a teacher passing on skills to one or more neophytes. It is the behaviour that results in artifacts (in this case, pottery), and it can be studied without recourse to ideology, cultural context, environmental constraints, and so on. When a learning lineage *is* related to broader concerns such as economy and cultural ideals, it becomes a learning framework, in which the practice of making pottery as well as learning and teaching the skills creatively construct the community, the ideals, the identities, and the best practices that go along with pottery making in that particular context (G. Braun 2015; Gosselain 2000:189; Lave and Wenger 1991). Only after a learning lineage has been established across a number of generations and/or laterally to other teachers teaching neophytes the same learning lineage does it become a learning framework, because at this point, a structure is in place to maintain the same practices across multiple people. It is here that the community of practice and the construction of identities within the community can be studied. The structure is assumed in the case of extended learning lineages because, if no structure exists, then the learning lineage would not be extended, and this fact is the site of many studies on knowledge transfer (e.g., Gosselain 1992, 2001; Ingold 2001; Keller and Keller 1996; Lave and Wenger 1991; Schiffer 2001). It is the structuring forces of the learning framework (identities, power relations, and so on), that dictate the forms of the materials found in the archaeological record. These structuring forces dictate factors such as work ethic (how many pots are made), aesthetics (how pots look), technological requirements (how pots work), hierarchy of potters and auxiliary workers (who makes the pots, and who aids in pottery making), and consumption habits (who uses the pots, how the pots are used, and where they finally end up). The forms actually taken by pots (rather than the behaviour that leads to learned skills or the guiding forces of pottery manufacture) are what I have called a tradition: this is the outcome of learning lineages and learning frameworks and it is what archaeologists (e.g., Crown 2007) use to retro-engineer learning lineages (the genealogies of knowledge transfer) and learning frameworks (the mechanisms through which knowledge is transferred). I focus on traditions in this research because learning lineages and frameworks are invisible to archaeologists and require complex inference-building from material culture.

Importantly, the learning lineage does not refer to kinship lineages or group integration, although these other forms of transfer may be part of the learning framework; it refers only to the fact of the chain of knowledge acquisition from teacher to learner who becomes teacher and passes on to other learners and so on through time.[23] Traditions can

[22] I acknowledge that these authors use the concept of tradition in different ways. However, their definitions are not as different as might at first be assumed based on their quite divergent theoretical stances. In particular, they both maintain the concept of traditions as *material* rather than social, behavioural, or mental, and as *historical* in nature (and therefore having fuzzy boundaries) rather than categorical (e.g., Mason 1970:803). Many researchers (e.g., Chilton 2000; Emerson and Pauketat 2008; Neff 1993; Pauketat and Alt 2005; Saunders 2001; Sassaman 2010:77) use the tradition concept within different theoretical frameworks and paradigms, but they consistently emphasize the material and historical aspects of traditions in their definitions.

[23] Graves (1985:24) published an early example that explicitly separated a "lineage" (quotations in the original) through which knowledge passes from a kinship lineage, although he acknowledges that the two may involve the same group members. In his study, he found that the learning lineage was passed on through the same

indicate something about the learning framework (i.e., whether the structure is rigid or flexible, or whether pottery is produced by everyone, part-time specialists, or full-time specialists—Costin 1986, 1991), but details of the learning lineage are inaccessible without other lines of evidence. It is therefore difficult to make any clear statements about who the teachers and the learners were in terms of gender, age, status, relationships to others, and so on. Nevertheless, learning lineages are responsible for the sustained styles evident in some pottery in this region, and even as styles change, the learning lineages remain apparent in the continuation of some attributes through time. Therefore, the learning lineage is the theoretical starting point for investigating continuity.

My starting point for understanding knowledge transfer in ceramic manufacture at Gaspereau Lake is the delimiting of traditions, accomplished through the investigation of patterning to identify continuity, breaks, and hybridizations. The bulk of the following chapters is concerned with outlining these traditions. Inferences from the traditions are used to reconstruct the learning lineages insofar as the people involved are accessible (for instance, by identifying patrilocal or matrilocal residence patterns and the resulting degree of influence-mixing). Simultaneously, inferences about the mechanisms of knowledge transfer are inferred insomuch as priorities and constraints are recognizable (for instance, by identifying the degree of specialization and self-expression evident). These inferences must come from studying (to the degree that available evidence permits) the variability across the full range of the manufacturing sequence, vessel use life, and depositional history so as to form the largest evidence base possible. The accumulation of a high-resolution dataset is essential for applying the model set out here.

ORGANIZATION OF PRODUCTION

As a preface to his study of ceramics from Moosehead Lake in Maine, Will (2014) described a fictional scene of an elderly woman making pottery with a young girl helping out in a childish but dutiful manner. He described the old woman as skilled but efficient, and managed, in his short depiction, to portray how the skills might have been transferred to the next generation, what the scheduling might have been like, how the materials may have been acquired and processed, what gender may have been responsible, and what the potter's status might have been in relation to others who were not "eager to risk her wrath by disturbing her drying pots" (Will 2014:5). This appealing picture of a potter's life in pre-Columbian Maine left out some important details. For instance, Will made no mention of whether there were other potters like her, or if she was responsible for the entire group's pottery production. Additionally, he left out any indication of the potter's ethnicity, leaving to readers the task of linking (or not linking) her to the modern Abenaki or Penobscot groups whose traditional territories both touched Moosehead Lake. Will also left out any details that might indicate time period: he deliberately did not specify whether the canoe used to gather clay was a birch bark or dugout, and he did not specify the kind of tool the potter used to

lineage as kinship from mother to daughter. He went on to further distinguish a kinship lineage, which may in all ways be the same as a learning lineage, from a work group, which may be composed of members from different kin groups/learning lineages. These work groups are responsible for the variability seen in pottery decorations as learning lineages come into contact and are influenced by each other.

make her impressions in the wet clay. He did this despite his careful research about the different tools used in different time periods, and how they related to other attributes. In essence, Will put forth a timeless, pan-Indian archetype that could be universally conjured up in the context of pottery manufacture any time (and anywhere) within the Woodland Period.

The idea of the unchanging, generalized context of pottery manufacture throughout the Woodland Period is not explicitly stated in the vast majority of studies, but probably is assumed nonetheless. This is apparent in the complete lack of studies concerning manufacturing contexts (*sensu* Costin 1991) and the treatment of the regional chronology as technologically and spatially continuous, despite evidence for breaks and transformations in ceramic technology. It is also evident in the dearth of explanatory models for ceramic variability: no explanation for change or stability is needed for people who, by their technological nature, were unchanging.

This view of ceramic manufacture in the Maine–Maritimes Region has obscured the evidence from archaeological ceramics that manufacturing *did* change through time. Similarities of decorative attributes across the region (i.e., regional chronologies) have been taken as more significant than relative numbers of ceramics at various sites (i.e., manufacturing and aggregation sites), changes in paste composition (i.e., manufacturing contexts and technological function), and possible *in situ* ceramic evolutions (i.e., learning linages and history). As Rosenmeier (2011) has pointed out, similarity does not mean continuity, and by the same token, dissimilarity and difference does not mean discontinuity. The lack of recognition of this fact has led to problematic archaeological models. The focus on regional chronologies shows a real disconnect between the models and the on-the-ground processes of ceramic manufacture.

In this research, I explicitly set out to historicize (*sensu* Sassaman 2010) ceramic manufacture in the Maine–Maritimes Region. Understanding the history of ceramics at Gaspereau Lake involves investigating knowledge transfer on the one hand and the changes in manufacturing contexts through time on the other. Production and knowledge transfer are intimately linked and are both embedded in the community of practice. In this section, I examine the production model of Costin (1991) in order to investigate how production changed through time at Gaspereau Lake, and what the causes for change may have been.

The Changing Contexts of Ceramic Production, Distribution, and Consumption

Caution is called for in assuming a constant domestic level of production throughout the Woodland Period in Nova Scotia. Evidence must be cited before building a model of production, and ethnographic evidence from elsewhere must be taken into account (Martelle 2002:44). Researchers in this region have tended to take the stance that specialization did not occur during the Woodland Period, and that production was always for domestic use. However, truly generalized contexts—those situations in which every woman makes pottery for her own and her family's use—may in fact be rare (Costin 2001:271),[24] and has not

[24] See also Trigger (1981) for an evaluation of whether evidence is sufficient to conclude that all women in Iroquoian groups made pottery.

shown up to a great extent in ethnographic studies (but see Deal 1988; Hayden and Cannon 1983). There are certainly numerous ethnographic examples in which everyone (of appropriate age and gender) both makes pottery for personal use and sells it, but this situation shows up in relationships with other communities that do not make pottery for the most part (e.g., Arnold 2008; Gosselain 1992; Graves 1981, 1985; Skibo 1992). There are also numerous ethnographic examples of villages living non-industrial ways of life in which one person is the resident potter and is expected to train one or a few bright students to take over (e.g., Miller 1985), so that while other material culture can be seen to be more-or-less generalized, the pottery is made by what could only be called a specialist (*sensu* Costin 1991; Arnold 1985; e.g., Martelle 2002; Trigger 1981:28–29). Furthermore, specialization has been demonstrated in situations traditionally maintained by archaeologists to have been domestic-scale, non-specialist pottery manufacture, such as in the case of Huron potters in the Great Lakes Region (Martelle 2002). Specialization and increasing production are therefore more than possible in small-scale and even the most egalitarian societies, meaning that their presence in the Maine–Maritimes Region during the Woodland Period should not be ruled out, at least in regard to pottery.

I point this out because the explanation of domestic-scale, non-specialist pottery manufacture for a period of 2500 years has seemed unlikely to me in the past and during this research. This is based on the levels of skill observable in Woodland pottery from New Brunswick and Nova Scotia. Although pottery manufacture was undoubtedly a skill with which all women during the Woodland Period were familiar, sporadic pottery manufacture does not tend to result in assemblages where risky manufacturing practices have mostly been successfully executed. Examples of risky manufacturing processes are thin walls (>5mm at the neck) and coarse pastes (<40%), because these attribute states can endanger the entire pot during forming. In my own experience of learning pottery (both modern and Woodland-style), and of teaching the techniques of coil-built pottery, I have found that sporadic pottery manufacture does little to increase skill beyond the essential techniques, and the resulting pots tend to be lumpy in appearance, thick-walled, and low in temper percentages. In contrast, the ethnographic literature finds that potters who spend most of a day or several days on only one manufacturing stage, as in the case of part- or full-time specialists, tend to make pots that are even, symmetrical, thin-walled, and sometimes containing high amounts of temper (e.g., Arnold 1985:202–12, 2008; Graves 1985; Herbert 2008; Miller 1985; Neupert 2007; Roux 2003). Trigger (1981) was also skeptical about a domestic-scale, as-needed manufacturing context in Iroquoian ceramics on the basis of evident skill and the unlikelihood that women could develop to such a proficiency if they practiced only occasional pottery production activities.

The model of domestic-scale production commonly in use, in which each woman made pottery for her own needs, comes from Sahlins (1972). Although this state of affairs is often thought to be an important (and possibly common) context found among pottery producers (e.g., Arnold 1985; Rice 2005:184), in fact, few examples of this situation have been studied (but see Deal 1998).[25] Additionally, a great deal of variability has been shown to

[25] Deal (pers. comm. July 6th, 2017) found that, in the largest of the five Mayan villages he studied ranged from pottery production by a domestic potter "producing once a year for the household" to part-time specialization

inhere in the organization of pottery production cross-culturally (Arnold 1985; Costin 1991; Wendrich 2013),[26] which I posit is the result of the complexity of the pottery manufacturing process itself (also, see Martelle 2002). Although pottery production has been studied economically for several decades (e.g., Rice 1987), the first attempt to systematize classes of pottery production to take account of all possible variability was undertaken by Costin (1991). Costin's system has been the most widely cited in the contexts of economic and political studies, although important contributions have also been made by Arnold (2008) and Rice (2005) in the contexts of technological and environmental studies. Since Costin's classification of pottery production, researchers have either challenged aspects of her system (e.g., Pool 2000) or refined aspects of the system or evidence for one aspect of the system (e.g., Roux 2003); however, nothing has been proposed to take the place of the Costin classification.[27]

Looking for the Evidence

As Costin (1991, 2001) has pointed out, evidence for increased levels of production and for specialization is not easily recognized in the archaeological record. Although ceramic manufacture leaves some definite residues, including scraper tools, unused clay, wasters, firing features, and pigments, this alone does not constitute evidence for specialization, which she defines as differential participation in manufacture (Costin 1991:20). Evidence generally inheres in the patterning and distribution of artifacts, which can be an exercise in deductive logic. For example, the number of artifacts of a single class in each of a number of sites in an area should give an indication of whether the manufacture of those artifacts is concentrated in one area, or whether it is manufactured at many sites. In the latter case, specialization may or may not exist, but in the former, specialization almost certainly exists—provided there is also evidence that such a site does not in fact represent increased consumption by generalists (Costin 1991:27). Costin (1991:19) also indicates that lower numbers of artifacts with use wear (i.e., carbonized encrustations) in non-domestic relative to domestic contexts is a good indication of specialization. The important term is "relative," since the various traces Costin sets out are really best used alongside each other to build a

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in which a potter was "producing for her household and extra to sell." Additionally, in some villages, all the women made pottery on a large scale.

[26] Sources of variability identified by Costin (1991) include whether manufactures are generalized, part-time specialists, or full-time specialists (Arnold 1985, 2008; Costin 1991; Crown 2014), whether specialists are attached to an elite or independent (Costin 1986, 1991, 2001), whether pottery is produced in household contexts or workshops (Arnold 1985; Rice 2005), and whether manufacturers recruit close kin, extended kin, or unrelated people as workers (Crown 2007). Other sources of variability include whether males, females, both, or other genders (Arnold 1985; Crown 2014; Senior 2000) are responsible for pottery production, whether pottery is sold by the potter or by a different person such as a middle man (Arnold 1985), and whether potters learn their craft through formal apprenticeship, peripheral participation, or some combination of the two (Crown 2014; Lancy 2012; Lave and Wenger 1991).

[27] The system is complex and would require more space than can be dedicated here. Rather than rephrasing the system, I have synthesized the evidence listed by Costin for indications of local manufacture, standardization, increasing scale of production, and specialization in Chapter 5. Readers are referred to Costin's (1991) publication in the Journal of Archaeological Method and Theory for the full classification.

strong case for specialization and larger production levels, rather than as single lines of evidence, which do not prove much of anything. Such a case is built in Chapter 5.

Much of the literature on specialization (e.g., Arnold 1985, 2008; Brumfiel and Earle 1987; Costin 1991; Lancy 2012; Neupert 2000) is concerned with explaining the phenomenon in terms of evolution and materialist models. For instance, Arnold (2008) posits that craftspeople will move toward specialization and increased production because efficiency is improved and returns on investment are better with increased production. Evolutionary models of specialization rest on an assumption that greater efficiency allows greater specialization, and can be traced back to White (1949:368–69), who argued that "culture evolves as the amount of energy harnessed per capita per year is increased, or as the efficiency of the instrumental means of putting the energy to work is increased." However, it may be just as profitable to examine increased production and specialization from the perspective of historical contingency, such that levels of production are seen to rise and fall as great events and less eventful periods demand. Such a view takes into consideration the possibility that increasing production and specialization might be seen, in a broader context, to be selfish and self-serving behaviour, but this view may be provisionally relaxed if other social dynamics are aided thereby. Examples might be a political gathering in which many people from distant regions are expected, or a new partnership with a neighbouring group that promotes trade of particular commodities. These events need not entail greater complexity or population growth and are expected to have occurred in the history of any society.

CONCLUSION: THE TRADITION-BASED CLASSIFICATION SYSTEM

For the purposes of this study the difficulty of variability must be met head on with high-resolution analysis rather than circumvented with regional chronologies that tell little about on-the-ground processes of ceramic manufacture and knowledge transfer. High resolution datasets are achieved by recording a large number of attributes, prioritizing chronological and spatial control, and constructing groups based on primary (manufacturing) rather than secondary (decorative) attributes (Jeffra 2011:103–03). This method could be characterized as a "close reading" of ceramic assemblages using hermeneutics.

The main difficulty of the method I have laid out here is that the groups formed through this kind of analysis are not very easy to illustrate in terms of their degree of clustering. Because they are not hierarchically ordered, and because they each say different things about the behaviour of the people making the ceramics, overlapping of groups prevents a concise ordering either through time or across attributes. Analyzing the data thus takes a necessarily piecemeal and specific approach. Questions must be answered by looking at groups individually in relation to other groups rather than at the groups as a whole. This could be characterized as a "from-the-ground-up" approach rather than a "top-down," or hierarchical approach (e.g., Neff 1993) such as is used in the type-variety system. Patterning across groups is revealed by exploring variability within each group, and so treating each group like a mini-assemblage to understand the chronological and behavioural spread allows a nuanced understanding of the assemblage from multiple perspectives and levels. The outcome of this approach is not overarching groups, types, or chronological classes, but rather a series of conclusions about the history of manufacture. These conclusions are then used to construct the traditions.

While the drawbacks mainly concern the degree to which the final categories—traditions—can be linked through a broad clustering model, the benefits are substantial and worth the difficulties of conceptualizing the big picture. The benefits include—but are not limited to—the ability to explore data at a fine resolution, such that spreads across classes (chronological, techno-functional, and so on) are meaningful in terms of behaviour. Continuity and breaks are revealed by looking at temporal attributes within each group. Scheduling or economic concerns may be shown to be important in relation to certain groups (such as temper or clay) to a greater degree than others. In the next chapter, I show how groups were constructed and I look at the kinds of data those groups reveal. The groups defined in the next chapter are the basis of inferring change and continuity through time to construct a history of ceramic manufacture at Gaspereau Lake.

CHAPTER 3: VARIATION AND VARIABILITY IN THE GLR CERAMIC ASSEMBLAGE

In the previous two chapters, I introduced the GLR Site Complex and its ceramic assemblage and the factors involved in considering Aboriginal ceramics in this region. Doing research in Nova Scotia necessitates incorporating, in some fashion, the Petersen and Sanger sequence—the single-most comprehensive examination of ceramics conducted in the Maine–Maritimes Region—even if chronological models do not form the primary aims of classification, as in the case of this research. I have shown the reasons to go beyond the Petersen and Sanger sequence by identifying some overarching mechanisms for ceramic change, explained in terms of learning lineages and changing economic and production contexts. I now turn to answering the questions I set forth in the first two chapters by identifying patterning that indicates participation in learning lineages and shifts in manufacturing practices. This is done with the broad goal of historicizing ceramic manufacture, and therefore, the people who participated in ceramic manufacture, at Gaspereau Lake.

In this chapter, I look at how the analyzed sample resolves into groups within the broad dimensions of morphology, forming, decoration, and paste. These groups, defined along attributes rather than sherds, form the foundation for my examination of several types of information detailed in later chapters: 1) the degree to which the attribute groups line up with each other to form bounded groups of sherds (in other words, self-evident classes); 2) the changing priorities of potters through time revealed by temporal change within these broad dimensions of manufacture; and 3) the definition of a history of manufacture at Gaspereau Lake. While, ideally, each stage of the manufacturing sequence would be investigated in depth, as well as depositional history and use-life, not all of these dimensions of manufacture and use were accessible at the time of this research. The analysis is mostly concerned with these particular manufacturing attributes due to several confining factors including the disturbed and mixed stratigraphic context of the ceramics, evidence obscured on the sherds themselves (such as traces that may have been erased by weathering), and the moratorium on destructive analysis of artifacts in the Maritime Provinces.

I discuss each of these broad categories of attributes in the order of complexity of classification. In other words, the relatively complex classification of pastes is discussed prior to the classification of surface modification, followed by morphology and forming attributes. This was done in order to avoid—as much as was possible—referring to groups before they had been discussed in detail.

Kinds of Analysis

Analysis was conducted using several analytical tools. The groups are chronologically situated based on 10 AMS dates acquired on carbonized residues adhering to ceramics. Composition and micro-morphology of clay and temper were superficially examined using Scanning Electron Microscope (SEM), X-Ray Fluorescence (XRF), and Laser Ablation Inductively-Coupled Plasma Mass-Spectroscopy (LA-ICP-MS or laser ablation).

Experimental tiles were used to test principles or fill in blanks in my understanding about ceramic manufacture. These are discussed in the sections where they are relevant. Methods are more fully discussed in the appendices.

The End of Dyke Site and Its Ceramic Assemblage

The largest of the sites in the GLR site complex, the End of Dyke Site yielded 14,601 sherds out of a total of 18,609 sherds found throughout the complex—78% of the total GLR assemblage. The analysis focused on one section of the End of Dyke Site called Locus 3, a discrete area that is separated from the main site by a small hill (Figure 20). In this area, ceramic density per unit is highest, with some units containing over 50% ceramics relative to other artifacts, not seen on any other part of the site. Ceramics from the main part of the site, Locus 1, were also analyzed for comparison. Total artifacts for the End of Dyke Site numbered 173,485, with 22,078 artifacts from Locus 3, or 13% of the assemblage. In contrast, of the 18,609 ceramic sherds, 3,559 come from Locus 3, or 19%. This higher density of ceramics may indicate that this area was a special-use area involving ceramics or else it was a midden where ceramics were dumped in higher proportions.

Ceramics at Gaspereau Lake could potentially represent a period spanning the entire Woodland. Within the bulk sample from Locus 3, a small amount of sherds are pseudo-scallop shell- (PSS) decorated vessel lots, usually thought to correspond with the Middle Woodland, while cord-marked vessels are in the clear majority, usually an indication of the Late Woodland (Kristmanson 1992; Petersen and Sanger 1991). Only a small number are fabric impressed, potentially representing a very minimal presence during the Early Woodland Period. Radiocarbon dates confirm larger numbers of ceramics later in time.

Table 2: Distribution of decorative types in the assemblage. Note that weight is not accurate due to many sherds missing a weight measurement (see Appendix 2: The Analytical Strategy for methodological procedures concerning samples and weight). This number is meant only to give a comparative number quantity.

	Fabric Impression	PSS	Dentate	CWS	Other/ None
Vessels	3	22	43	97	16
Weight	21g	598g	1418g	4968g	241g
Sherds	23	632	202	2791	121

AMS Dates

Continuous occupation during at least 500 years at the End of Dyke Site is indicated by the radiocarbon sequence acquired from carbonized residue on ceramic interiors. The sequence spans ca. 700 years, beginning as early as 1550 Cal BP and ending ca. 700 Cal BP, with an absence of evidence for occupation between ca. 950 BP and ca. 700 BP.[28] PSS decorations on some vessel lots indicate that the ceramic manufacturing tradition probably

[28] ^{13}C levels indicate that none of the dates are likely to be affected by Marine Reservoir Effect to a significant degree (Figure 5).

began earlier than the first radiocarbon date, and manufacturing probably continued after the last radiocarbon date. The majority of dates were acquired from ceramics in the Locus 3 sample, so earlier dates may yet be acquired as further study of the assemblage progresses. For a full discussion, see Appendix 10.

Table 3: Calibrated dates showing probability distributions for each age range at the 1- and 2-Sigma range, following Stuiver et al. (2005).

VL	^{14}C Age Year BP	68.3% (1-Sigma) Cal Age Ranges	Relative Area Under Distribu-tion	95.4% (2-Sigma) Cal Age Ranges	Relative Area Under Distribu-tion	d13C Value	Lab No.
28	870 ±30	732–796* 887–891	0.97 0.03	702–803* 809–830 857–905	0.77 0.05 0.18	-29.6	Beta - 417104
143	1160 ±30	1006–1026 1052–1091* 1107–1146 11591173	0.19 0.38 0.3 0.13	988–1035 1045–1176*	0.25 0.75	-28.4	Beta - 417671
135	1270 ±32	1182-1213 1223–1263	0.43 0.57	1089–1109 1126–1136 1146–1159 1173–1287*	0.02 0.01 0.02 0.95	-24.1	AA28675
93	1346 ±55	1186–1205 1239–1308*	0.17 0.83	1175–1368	1	-22.6	AA29675
61	1410 ±30	1296–1332	1	1285–1359	1	-21.2	Beta - 407748
94	1460 ±30	1314–1368	1	1302–1396	1	-31.5	Beta - 417672
122	1470 ±30	1327–1383	1	1306–1404	1	-29	Beta - 417101
160	1540 ±30	1387–1419 1460–1518	0.38 0.62	1365–1524	1	-31.3	Beta - 407749
82	1550 ±30	1400–1421 1433–1438 1457–1520	0.23 0.04 0.72	1377–1527	1	-32.5	Beta - 417673
86	1610 ±30	1418–1461 1484–1489 1517–1550	0.53 0.04 0.43	1413–1557	1	-29.6	Beta - 417674

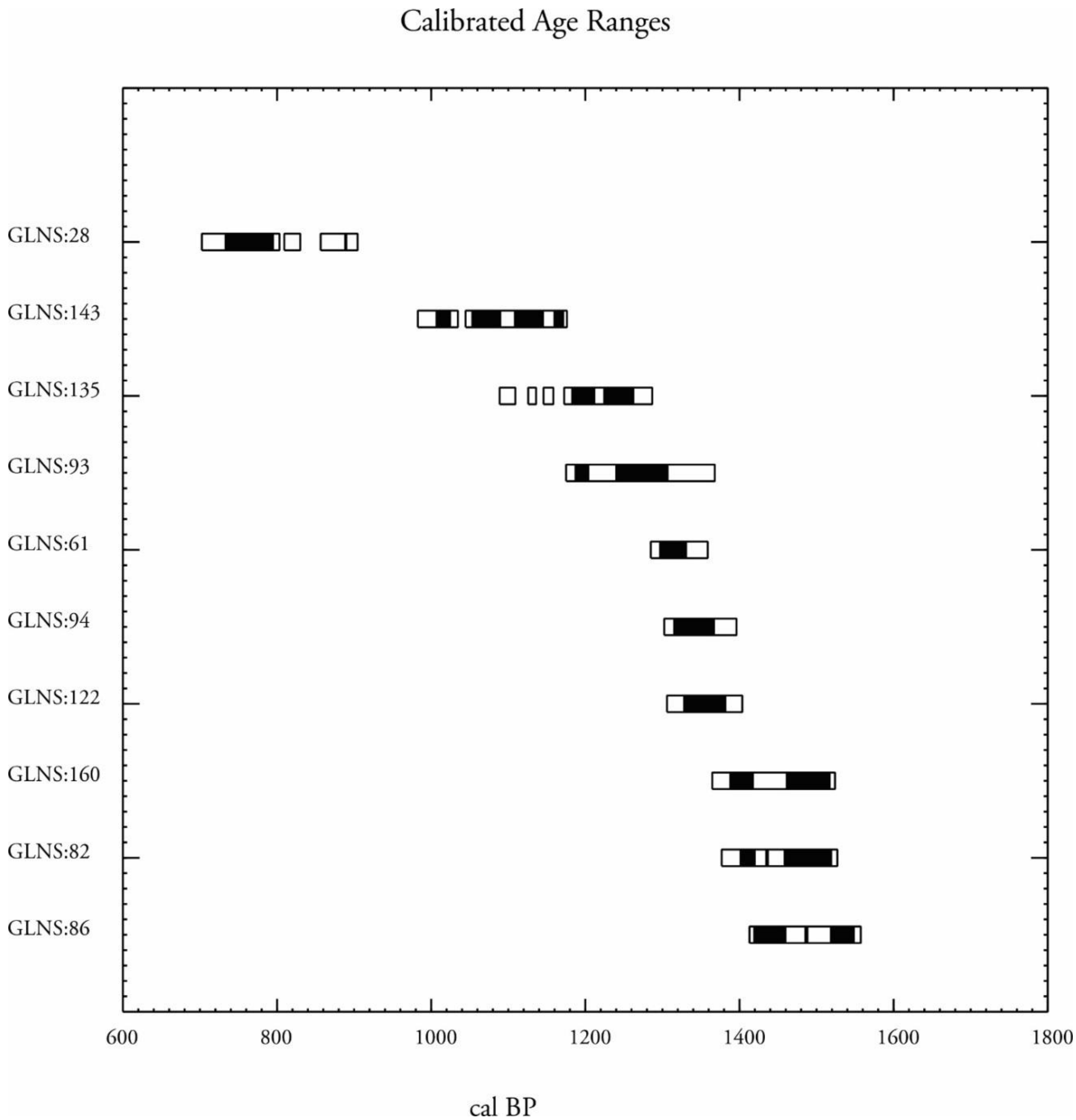

Figure 4: Calibrated age ranges for ten AMS dates acquired from carbonized encrustations on the interiors of sherds in the End of Dyke Site. Samples are listed by their vessel lots. A list of specimen names corresponding to dates can be found in Appendix 9. Two vessel lots listed here, GLNS:82 and GLNS:28, come from Locus 1; the remaining eight come from Locus 3.

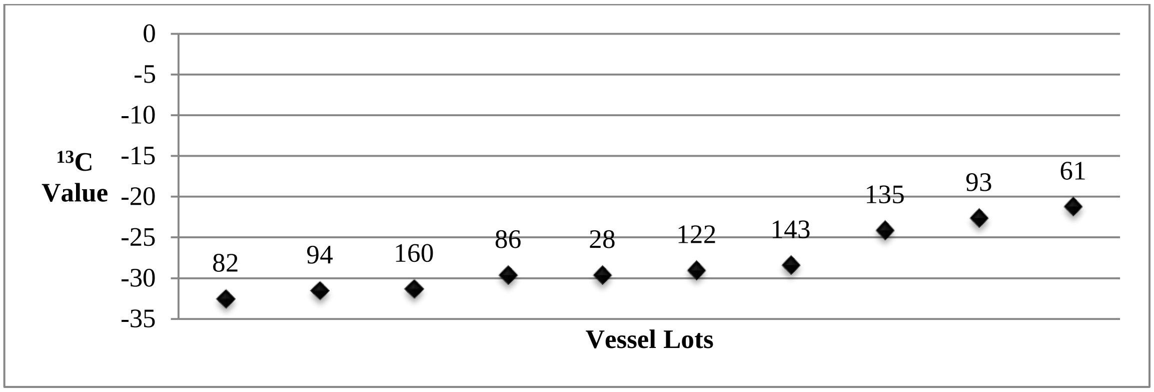

Figure 5: Plot of $D^{13}C$ measured in carbonized samples used for AMS dates. Samples are labeled with their respective vessel lot numbers.

Constitution of the Ceramic Assemblage

The ceramics are in good shape, mostly not disintegrating or coming apart, although there are signs that they have experienced significant weathering, bioturbation, and fracturing due to site disturbance. Many of the ceramics are harder than expected considering that they were subjected to repeated episodes of flooding and freeze-thaw action and probably to leaching. In some units, ceramics that obviously came from the same vessel have no or very few refittable edges, indicating that they fractured a long time ago and have since weathered. In other units, there are many refits possible among sherds, indicating relatively recent breakage, probably from the modern disturbances caused by the roads and dykes.

The ceramics tend to exhibit abrasion that probably resulted from the combination of repeated flooding while they were still buried and from having been cleaned with a brush upon retrieval. Many sherds have slightly scoured surfaces with pedestalled temper particles and uneven topography of pocks and cracks. These make the identification of surface finishing marks difficult in many cases. Additionally, many sherds exhibit even, directional striations over much of their interior and exterior surfaces. Because these striations run inside decoration impressions, they cannot be finishing marks such as slip-brushing or finger-smoothing, which would have been smoothed by the stamp elements. Their often oblique orientation, even distribution across surfaces, and occurrence on both interior and exterior surfaces indicates that they are not related to events during the life of the cooking pot, the signs of which are quite specific to the region of the vessel upon which they occur, and are usually horizontally oriented (Skibo 1992, 2013). However, the possibility exists that some of these striations may have accrued after the pot was broken but before deposition (in other words, reuse for digging or scraping) (e.g., Sullivan et al. 1991; Van Buren 1992). Nevertheless, post-excavation processes are responsible for at least some of the observed striations. The ceramics frequently are caked in hard-packed soil probably consisting in part of reconstituted ceramic matter, and their original cleaning would have required significant brushing to get this material off the surface. Unfortunately, whatever the cause, the abrasion (though light) obscured use wear and finishing marks.

The ceramics are coated in a medium-brown fine silt that appears to have stained and altered the original colour of the sherds somewhat. In places, the silt is apparent as a concretion difficult to remove from the ceramics, indicating that chemical weathering and replacement between the ceramics and the matrix has taken place. This colouration and staining obscures the broken wall edges in a large number of sherds, limiting what can be learned about the carbon core, fabric, and temper. However, enough recent breaks have occurred that the pastes are mostly analyzable.

The Sample

Three samples were analyzed in this research. The first sample was chosen judgementally across the site for preliminary research and consisted of 50 vessel lots, mostly represented by one or two sherds. The second and main sample analyzed in this research is a bulk, or cluster sample (Orton 2000), from Locus 3. This sample consisted of 120 vessel lots composed of 2,186 sherds. The third sample is supplemental to the other two, and its purpose was to compare the findings from the main sample with other parts of the site; it comes from the section of Locus 1 with the greatest artifact (though not ceramic) density. In this supplemental sample, 61 vessel lots were defined on 470 sherds. Both the main, or Locus 3, sample, and the supplemental, or Locus 1 sample, used vessel lots from the preliminary sample of 50 vessel lots. In all, 181 vessel lots were defined, consisting of 2,685 sherds.[29] Out of a total of 14,601 sherds, the ceramics so far analyzed represent roughly 20% of the End of Dyke assemblage, and the remainder of the sherds theoretically could belong to over 700 more vessel lots. A full discussion of the methodology of vessel lot construction can be found in Appendix 2.

The Main Sample: Ceramics from Locus 3

Within Locus 3, 3,559 sherds were retrieved from 76 units. The units encompass the features F27 and F29, two large hearth complexes with multiple foci, as well as a number of smaller features summarized in Table 4. Density of ceramics by unit is high in this area, with the largest average number of ceramics per unit of all the sites in the GLR Site Complex. Sanders, Finnie, et al. (2014:232) write that this area appears to have been a dwelling site with many associated activities including flint-napping, painting, abrading, and food preparation and disposal. However, no post-molds were found, and the transgressive hearths and large artifact counts (especially pottery) suggest a more dedicated activity area with large intervals between uses rather than a continuous- or seasonal-use area. Sanders et al. sum the area thus:

> Its full extent will not be known until mitigation of the area is complete, but it appears that Locus 3 is roughly oval in shape and measures at least 15 metres long (northeast/southwest) and 8 metres wide (northwest/southeast). Compared to Locus 1 and Locus 2, it is intermediate in size and represents a moderate artifact concentration. The centre of Locus 3 currently consists of five contiguous units that each yielded more than 1,000 artifacts. Since

[29] Not all sherds analyzed were placed in vessel lots because many sherds did not yield enough information to confidently assign them even to a broad tradition let alone a vessel lot. Ca. 1000 sherds were looked at and their attributes recorded as possible, but were are not included in vessel lot statistics. Where possible and relevant, however, these sherds were used in sherd statistics.

several of the surrounding units are unfinished or completely unexcavated, the number of unit counts exceeding 1,000 could rise during continued excavation. At present, the highest individual count is 2,036 artifacts (Unit 973N/985E). Units with counts in the hundreds, rather than the thousands, exist all around the centre of Locus 3. (Sanders, Finnie, et al. 2014:17)

Table 4: Features in Locus 3, including pottery distributions. This table does not include modern features. Note that pottery associated with F28 does not have a weight measurement. It was not available during the research.

Feature Name	Feature Type	Description from Sanders, Finnie, et al. (2014)	Sherd Count	Sherd Weight
F27	Hearth complex	"Multiple depressions in the subsoil connected by scorching and hearth accumulation"	711	1508
F28	Pottery accumulation	"Depression in subsoil containing a concentration of pottery"	2	N/A
F29	Hearth complex	"Multiple depressions in the subsoil connected by scorching and hearth accumulation"	422	1870
F30	Hearth	"Depression in subsoil with evidence of *in situ* burning"	1	5
F31	Hearth	"Depression in subsoil with evidence of *in situ* burning"	0	0
F32	Hearth	"Depression in subsoil with evidence of *in situ* burning"	2	22
F33	Hearth	"Depression in subsoil with evidence of *in situ* burning"	0	0
F34	Precontact fill	"Deposit of mixed topsoil and subsoil"	0	0
F35	Disturbed hearth	"Mottled hearth material"	7	37.9
F36	Hearth	"Depression in subsoil with evidence of *in situ* burning"	12	102.6
F37	Precontact fill	"Deposit of mixed topsoil and subsoil"	0	0
F38	Disturbed hearth	"Mixed hearth material"	0	0

The two largest features in Locus 3, F27 and F29, are transgressive hearths with multiple hearth centres. These hearths are not particularly associated with ceramics, the largest number of ceramics occurring outside either feature. Because of this, and because

F29 was dated by Sanders, Finnie, et al. (2014:346) to 760±30,[30] these features appear to correspond to a period after the majority of the ceramics were deposited.

The Supplemental Sample from Locus 1

The third sample, studied to supplement the main bulk sample, was taken from Locus 1, the area of the greatest artifact density and the location of some of the most interesting features on the End of Dyke Site. The centre of Locus 1 is described by Sanders as:

> a 10 metre long (north/south) and six metre wide (east/west) area of contiguous units with artifact counts exceeding 1,000 per square metre. Registering a maximum count of 4,670 artifacts per square metre (Unit 924N/1017E), this likely represents the greatest artifact density ever recorded for a Precontact habitation site in Nova Scotia. Outward from this locus centre, contiguous units with counts in the hundreds generally extended a distance of at least two to four metres within the mitigation area. Elements of Locus 1 extended outward to the north and southwest, with contiguous unit counts in the hundreds and occasionally a thousand plus. (Sanders, Finnie, et al. 2014:17)

The supplemental sample came from north of the area of greatest density, in the area of the feature F44. F44 is a large, stone-lined hearth dated to 1550±30 BP and 1520±30 BP on the north side, and 2490±30 on the south side. (see Figure 28).[31] Ceramics were analyzed from units around F44 in which more than 100 sherds were retrieved, ensuring that numerous vessel lots composed of multiple sherds would be constructed. Because time was a factor, I chose a more adaptive strategy with the goal of defining a large number of vessel lots for comparison with the main sample. For rigorous statistical analysis, the same methodology would have to be applied to the supplemental sample as to the main sample, but in the interest of time, and also because great rigour is not necessary to evaluate whether some patterns differ between the two samples, the supplemental sample did not include all ceramics from all units.

Vessel lots are listed below. The full data on vessel lots are included in an Excel file with this document. The database is also available by contacting the author.

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30 This date is conventional. When it is calibrated with CALIB, the date range is 729–667 BP at the 2-Sigma range, with a high probability that it falls within 704–671 BP at the 1-Sigma range (66.6% distribution under the curve).

31 These dates are conventional. When calibrated with CALIB, the date ranges at the 2-Sigma level are as follows:1527–1377 BP; 1424–1341, 1444–1428 BP, and 1522–1454; and 2730–2459 BP.

Table 5: List of vessel lots.

Vessel Lot	Sherds (n)	Weight (g)	Area	Decorative Tool	Temper Minerals	Temper Per cent	Neck Thickness	Lip dia (cm)	Neck dia (cm)
1	99		Locus 1	Dentate	Mica, Quartz, and Feldspar	40	1.15		
2	1		Locus 1		Mica, Quartz, and Feldspar		1.43		
3	1		Locus 1		Mica, Quartz, and Feldspar				
4	18		Locus 3	Pseudo-Scallop Shell	Mica and Feldspar		0.87		
5	1		Locus 1	Cord-Wrapped Stick	Mica and Feldspar	10			
6	1		Locus 1	Dentate	Mica and Feldspar				
7	1		Locus 1	Dentate	Mica and Feldspar				
8	1		Locus 1	Dentate	Mica and Feldspar				
9	1		Locus 1	Dentate	Mica and Feldspar	20			
10	1		Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Feldspar				
11	1	4	Locus 1		Mica and Quartz	20	0.8		
12	1	1.3	Locus 1		Mica, Quartz, and Iron Oxide/Grog	20	0.58		
13	1	4.5	Locus 1	Dentate	Mica and Quartz	10	0.49	14	12
14	4	16.5	Locus 1	Cord-Wrapped Stick	Mica, Quartz, and Organic	10	0.82	21	20
15	3	20.2	Locus 1	Cord-Wrapped Stick	Organic and Unspecified Grit	13.33	0.89		
16	1		Locus 1	Cord-Wrapped Stick	Mica, Quartz, Feldspar, and Shell	10			
17	2	41	Locus 1	Cord-Wrapped Stick	Mica, Quartz, and Feldspar	30	0.99	14	20
18	1	19.6	Locus 1	Dentate	Mica, Quartz, and Feldspar	30	0.76	16	12
19	1		Locus 3	Cord-Wrapped Stick	Mica, Quartz, Feldspar, and Iron Oxide/Grog				
20	9	57.4	Locus 1	Cord-Wrapped Stick	Mica, Quartz, Feldspar, and Iron Oxide/Grog	13	0.7	30	
21	28	167	Locus 1	Dentate	Mica, Quartz, Feldspar, and Iron Oxide/Grog	20	0.83	28	
22	2		Locus 1	Dentate	Mica, Quartz, and Feldspar	20	0.67		
23	4		Locus 3	Pseudo-Scallop Shell	Mica, Quartz, and Feldspar	20	0.65		
24	38		Locus 1	Cord-Wrapped Stick	Shell				
25	14	45.3	Locus 1	Dentate	Mica, Quartz, and Iron Oxide/Grog	24.44	0.62		30
26	7	30.7	Locus 1	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	26.67			
27	1	6	Locus 1	Cord-Wrapped Stick	Mica and Quartz	20	0.71	26	18
28	10	90.9	Locus 1	Cord-Wrapped Stick	Mica, Quartz, Feldspar, and Organic	21	0.85		32
29	8	63.6	Locus 1	Cord-Wrapped Stick	Mica, Quartz, Feldspar, Organic, and Iron Oxide/Grog	30	1		
30	104		Locus 1	Channeling	Mica, Quartz, and Feldspar	20			
31	1		Locus 1	Dentate	Mica and Feldspar	10	0.78		
32			Locus 3	Dentate	Mica and Feldspar		0.66		

Vessel Lot	Sherds (n)	Weight (g)	Area	Decorative Tool	Temper Minerals	Temper Per cent	Neck Thickness	Lip dia (cm)	Neck dia (cm)
33	1		Locus 1	Pseudo-Scallop Shell	Mica	5	0.33		
34	30		Locus 1	Cord-Wrapped Stick	Mica, Quartz, and Feldspar		0.72		
35	1		Locus 1	Channeling	Mica and Feldspar	10			
36	7	213.2	Locus 1	Dentate	Mica, Quartz, Feldspar, and Iron Oxide/Grog	30	1.45	22	18
37	1		Locus 1	Dentate	Mica, Quartz, and Feldspar		0.91		
38	1		Locus 1	Dentate	Mica, Quartz, and Feldspar	10			
39	1		Locus 1	Dentate	Mica, Quartz, and Feldspar	40	1.09		
40	1		Locus 1	Dentate	Mica, Quartz, and Feldspar	10	0.81		
41	6		Locus 3	Cord-Wrapped Stick	Mica, Quartz, Feldspar, and Shell		0.81		
42	1		Locus 3	Pseudo-Scallop Shell	Mica, Quartz, and Feldspar		0.82		
43				Cord-Wrapped Stick	Mica, Quartz, and Feldspar		0.48		
44	1		Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Feldspar	30	0.84		
45	2		Locus 3	Pseudo-Scallop Shell	Quartz, Feldspar, and Iron Oxide/Grog	10	0.48		
46	1		Locus 3	Dentate	Mica, Quartz, and Feldspar	10	0.45		
47	1		Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Feldspar	30			
48	5		Locus 3	Fabric-Impressed	Mica and Feldspar	10			
49	1		Locus 3	Channeling	Mica, Quartz, Feldspar, Shell, and Iron Oxide/Grog				
50	1		Locus 3	Cord-Wrapped Stick	Mica, Quartz, Feldspar, and Iron Oxide/Grog		0.82		
51	16	93.9	Locus 3	Dentate	Quartz and Iron Oxide/Grog	10	0.83		
52	16	46.7	Locus 3	Pseudo-Scallop Shell	Mica and Quartz	15	0.52		
53	10	28.8	Locus 3	Cord-Wrapped Stick	Sand and Iron Oxide/Grog	7.5	0.76		
54	11	67.6	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	10	0.74		
55	56	300.5	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	30	0.7		26
56	9	45.2	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	21	0.75		
57	1	2.9	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	25			
58	3	12	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	17.5	0.76		
59	1		Locus 3	Dentate	Quartz				
60	4	16.1	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Feldspar	40	0.65		
61	27	174.9	Locus 3	Cord-Wrapped Stick	Mica, Quartz, Feldspar, Shell, and Iron Oxide/Grog	41.25	0.75	21.33	24.67
62	200	517.5	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	20	0.9		21
63	5	26.2	Locus 3	Cord-Wrapped Stick	Mica and Quartz	40	0.63	20	14
64	7	72	Locus 3	Cord-Wrapped Stick	Mica and Quartz	40	0.87		
65	34	271.2	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	23.33	0.71	17	20
66	11	111.9	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	20	0.61		

Vessel Lot	Sherds (n)	Weight (g)	Area	Decorative Tool	Temper Minerals	Temper Per cent	Neck Thickness	Lip dia (cm)	Neck dia (cm)
67	4	13.7	Locus 3	Pseudo-Scallop Shell	Quartz and Iron Oxide/Grog	20	0.63		32
68	12	26.6	Locus 3	Pseudo-Scallop Shell	Mica, Quartz, and Iron Oxide/Grog	12.5	0.66		
69	14	55.8	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	17.5	0.7		
70	7	11.9	Locus 3	Pseudo-Scallop Shell	Mica, Quartz, Feldspar, and Iron Oxide/Grog	10	0.43	28	28
71	7	15.8	Locus 3	Pseudo-Scallop Shell	Mica and Quartz	40	0.6		
72	41	177	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Organic	20	0.7	26	
73	126	312.77	Locus 3	Channeling	Mica and Quartz	35	0.74	31	23.33
74	14	43.5	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	20	0.57	30	
75	1	7.9	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	30	0.79		
76	3	5.5	Locus 3	Dentate	Mica, Quartz, and Feldspar	30	0.59		26
77	83	190.5	Locus 3	Cord-Wrapped Stick	Mica, Quartz, Feldspar, Organic, and Iron Oxide/Grog	20	0.63	24	25
78	3	28.3	Locus 3	Cord-Wrapped Stick	Quartz	13.33	0.53		19
79	4	8.9	Locus 3	Pseudo-Scallop Shell	Quartz and Iron Oxide/Grog	25	0.44		22
80	1	5.5	Locus 3	Cord-Wrapped Stick	Organic and Iron Oxide/Grog	10	0.54		16
81	56	113.9	Locus 3	Cord-Wrapped Stick	Quartz	30	0.59		
82	4	173.5	Locus 1	Dentate	Mica and Quartz	30	0.82	18	25
83	50	169.9	Locus 3	Cord-Wrapped Stick	Mica and Quartz	50	0.85		20
84	7	5.2	Locus 3	Fabric-Impressed	Mica, Quartz, and Iron Oxide/Grog	40			
85	25	55.9	Locus 3	Channeling	Mica and Quartz	20			
86	32	106.2	Locus 3	Channeling	Mica, Quartz, and Iron Oxide/Grog	47.5	0.66	30	
87	10	8.6	Locus 3	Cord-Wrapped Stick	Organic		0.6		
88	205	343.4	Locus 3	Dentate	Mica, Quartz, and Feldspar	33.75	0.66		28
89	4	21.2	Locus 3	Channeling	Organic and Unspecified Grit		0.75		
90	14	50.6	Locus 3	Cord-Wrapped Stick	Organic		0.75		
91	10	22.9	Locus 3		Unspecified Grit				
92	15	63.2	Locus 3	Cord-Wrapped Stick	Organic and Unspecified Grit		0.79		
93	119	456.1	Locus 3	Cord-Wrapped Stick	No Temper	2	0.79		27.6
94	62	239.9	Locus 3	Cord-Wrapped Stick	Mica and Quartz	30	0.79		18
95	11	84.7	Locus 3	Cord-Wrapped Stick	Mica and Quartz	35	0.95		
96	42	180.5	Locus 3	Cord-Wrapped Stick	Mica and Quartz	30	0.73		
97	19	128.3	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	40	0.95		20
98	14	73.2	Locus 3	Cord-Wrapped Stick	Quartz	30	0.73		
99	35	81.1	Locus 3	Pseudo-Scallop Shell	Mica and Quartz	10	0.5		

Vessel Lot	Sherds (n)	Weight (g)	Area	Decorative Tool	Temper Minerals	Temper Per cent	Neck Thickness	Lip dia (cm)	Neck dia (cm)
100	2	15.2	Locus 3	Incision/Trailing	Mica, Quartz, Feldspar, and Iron Oxide/Grog	20	0.61	22	18
101	17	22.4	Locus 3	Channeling	Organic and Unspecified Grit		0.67		
102	1	11.3	Locus 1	Dentate	Mica, Quartz, and Feldspar	40	0.7		
103	19	17.4	Locus 3	Pseudo-Scallop Shell	Quartz	10			
104	77	318.8	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Feldspar	30	0.8		
105	26	89.7	Locus 3	Incision/Trailing	Mica, Quartz, and Feldspar	40	0.85		
106	15	46.3	Locus 3	Cord-Wrapped Stick	Organic and Unspecified Grit	6.67	0.81		
107	1	2.9	Locus 3		Quartz and Iron Oxide/Grog	5	0.5		
108	11	16.1	Locus 3	Fabric-Impressed	Mica, Quartz, and Feldspar	30			
109	37	425.8	Locus 3	Cord-Wrapped Stick	Mica and Quartz	43.33	0.86		
110	86	112.4	Locus 3	Cord-Wrapped Stick	Organic and Unspecified Grit		0.77		
111	10	26.4	Locus 3	Cord-Wrapped Stick	Organic and Unspecified Grit		1.03		
112	32	76.2	Locus 3	Dentate	Mica, Quartz, and Feldspar	30	0.71		30
113	16	29.4	Locus 3	Pseudo-Scallop Shell	Mica and Quartz	30	0.64		
114	1	5.5	Locus 3	Cord-Wrapped Stick	Organic		0.81		
115	15	46.5	Locus 3	Cord-Wrapped Stick	Quartz and Iron Oxide/Grog	17.5	0.78		
116	14	35.4	Locus 3	Cord-Wrapped Stick	Organic		0.71		
117	5	36.9	Locus 1	Cord-Wrapped Stick	Unknown	22.5			
118	4	9	Locus 3	Cord-Wrapped Stick	Mica and Quartz	30	0.53		
119	2	4.8	Locus 3	Dentate	Mica, Quartz, and Iron Oxide/Grog	5	0.51		
120	9	37.9	Locus 3	Dentate	Mica, Quartz, Feldspar, and Iron Oxide/Grog	35	0.89		
121	1	6.6	Locus 3	Cord-Wrapped Stick	Quartz	50	0.89		18
122	13	40.4	Locus 3	Cord-Wrapped Stick	Quartz and Iron Oxide/Grog	45	0.85		
123	9	50.9	Locus 1	Dentate	Mica, Quartz, and Iron Oxide/Grog	22.22	0.72	33	28
124	2	6	Locus 3	Pseudo-Scallop Shell	No Temper				
125	2	2.9	Locus 3	Pseudo-Scallop Shell					
126	1	1.5	Locus 3		Mica and Quartz	20	0.47	14	
127	2	1.8	Locus 3		Organic		0.7		
128	5	75.4	Locus 3		Mica and Quartz	40	0.94	23	35
129	6	22.9	Locus 3	Cord-Wrapped Stick	Mica and Quartz	40			
130	7	11.5	Locus 3		Quartz and Organic				
131	47	443	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	26	0.64		34
132	11	48.6	Locus 3	Pseudo-Scallop Shell	No Temper		0.61		22
133	2	15.4	Locus 1		Mica, Quartz, and Iron Oxide/Grog	40	0.78		

Vessel Lot	Sherds (n)	Weight (g)	Area	Decorative Tool	Temper Minerals	Temper Per cent	Neck Thickness	Lip dia (cm)	Neck dia (cm)
135	39	126.6	Locus 3	Cord-Wrapped Stick	Organic and Unspecified Grit	20	0.72		
136	4	43.4	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Feldspar	30	0.95		
137	1	2.5	Locus 3	Dentate	No Temper	0			
138	17	62	Locus 3	Cord-Wrapped Stick	Quartz and Iron Oxide/Grog	40	0.73		
139	2	20.8	Locus 3	Cord-Wrapped Stick	Mica and Quartz	22.5	0.78		
140	5	9.7	Locus 3	Dentate	Quartz	30	0.7		
141	1	2.7	Locus 3	Dentate	Mica and Quartz	5			
142	1	9.2	Locus 3	Cord-Wrapped Stick	Mica and Quartz	30			
143	5	16.1	Locus 3	Quills Punctate	Quartz	30	0.78		
144	2	1	Locus 3	Dentate	Quartz	5	0.25		
145	5	2.6	Locus 3	Dentate	Mica and Quartz	10	0.83		
146	1	3.8	Locus 3	Dentate	Quartz and Iron Oxide/Grog	10			
147	2	4.9	Locus 3						
148	1	13.5	Locus 3	Dentate	Mica, Quartz, and Feldspar	40	1.01	36	36
149	3	17.55	Locus 3	Cord-Wrapped Stick	Mica and Quartz	20			
150	6	22	Locus 3	Dentate	Mica, Quartz, and Iron Oxide/Grog	10	0.4	22	22
151	4	7.9	Locus 3	Cord-Wrapped Stick	Unspecified Grit, Iron Oxide/Grog, and Organic		0.54		
152	3	16.1	Locus 1		Unknown	20	0.71		
153	4	32.5	Locus 3	Cord-Wrapped Stick	Mica, Quartz, and Iron Oxide/Grog	35	0.78		
154	1	4.3	Locus 3	Pseudo-Scallop Shell	Quartz	30	0.58		
155	2	22.1	Locus 3	Cord-Wrapped Stick	Mica and Quartz	60	0.97		
156	2	10.2	Locus 3	Dentate	Quartz	10			
157	6	8.9	Locus 3	Pseudo-Scallop Shell	Quartz	5			
158	1	2.1	Locus 3	Cord-Wrapped Stick	Organic				
159	1	1.7	Locus 3	Pseudo-Scallop Shell	Quartz	10			
160	64	299.3	Locus 3	Pseudo-Scallop Shell	Mica, Quartz, and Feldspar	26.67	0.95		32
161	2	17.1	Locus 3	Thumbnail	Mica, Quartz, and Feldspar	30	0.84		
162	11	31.1	Locus 3	Channeling	Mica and Quartz	50			
163	4	10.5	Locus 3				0.88		
164	4	32.6	Locus 3	Cord-Wrapped Stick	Mica and Quartz	20	0.83		34
165	8	64.8	Locus 3	Cord-Wrapped Stick	Mica and Quartz	20			
166	4	58.3	Locus 3			45			
167	6	27.9	Locus 3	Dentate	Mica, Quartz, and Iron Oxide/Grog	20	0.58		
168	8	29.7	Locus 1		Unknown	15	1.05		

Vessel Lot	Sherds (n)	Weight (g)	Area	Decorative Tool	Temper Minerals	Temper Per cent	Neck Thickness	Lip dia (cm)	Neck dia (cm)
169	7	43.6	Locus 1			26.67	0.84		
170	1	18.7	Locus 1	Dentate	Mica, Quartz, and Iron Oxide/Grog	30	0.53	18	24
171	4	20.8	Locus 1	Dentate	Mica, Quartz, and Feldspar	23.33	0.81		
172	6	23.1	Locus 1	Dentate	Mica, Quartz, Feldspar, and Iron Oxide/Grog	36.67	0.58		10
173	4	26.8	Locus 3	Cord-Wrapped Stick	Unknown	20	1.02		
174	5	41	Locus 3	Cord-Wrapped Stick	Unknown		0.86		
175	4	7	Locus 3		Unknown				
176	1	3	Locus 1			10	0.5		
177	7	52.5	Locus 1	Dentate		18.57	0.72		
178	3	16.6	Locus 1	Dentate		25	0.77		18
179	2	4.6	Locus 1			22.5	0.67		
180	2	19.2	Locus 1	Cord-Wrapped Stick	Mica and Quartz	25			
181	7	22.7	Locus 1	Dentate		28.57	0.5		
182	1	4.1	Locus 1				0.67		

PASTE

Paste groups result from economic and logistical mechanisms (e.g., Fowles et al. 2007; Poblome 2004:494) that shape learning lineages through time (Gosselain 2008b:72; Lizee et al. 1995; Nicklin 1979; Wilmsen 2016).

These manufacturing attributes tend to remain stable through time because they require specific knowledge inherited through communities of practice (Hegmon et al. 2000:219; but see White 2017:71). Defining groups of temper and clay therefore plays a crucial role in defining traditions. Patterning in paste attributes needs to be carefully evaluated for whether the mechanisms causing repetition resulted from learned and intentional behaviour of different groups of potters (e.g., Vitelli 1995) or from another mechanism such as losing or gaining access to locally available resources (e.g., Neupert 2000). For example, non-organic temper in the Maine–Maritimes Region is almost always crushed granite, with three main constituent parts: mica, quartz, and feldspar. This patterning is certainly significant in terms of technological functionality, but it does not constitute evidence for a region-wide learning lineage. Looking within assemblages, some patterning does emerge with different-coloured minerals (Woolsey 2010), some of which possibly results from differentially accessed sources. This may simply mean that, when one source ran out, another was accessed, which does not say much about the concerns of the potters. Conversely, many vessel lots in the GLR assemblage contain a distinctively coloured particle while others do not, and these vessel lots also exhibit clustering of other attributes such as lighter clay and a distinctive decoration. In this case, the temper patterning probably results from an intentional procurement of different sources by different groups of potters.[32] Since this source is accessed during the same period as other sources, the case can be made for group ownership or territoriality of certain sources (Neupert 2000; Vitelli 1999). Getting at the patterning in clay and temper is the subject of this section, and—once delineated—groups are examined for what they say about the economic and social dimensions of pottery manufacture.

In the analyzed samples, several trends emerged that likely represent manufacturing concerns and different learning lineages. The most significant in terms of characterizing the assemblage is the presence of a distinctive bluish-grey quartz particle in many of the specimens, particularly later in time. Another is the unusually poor separation among the broad temper types of grit, organic, and iron oxide, with high variability in how these types occur together, such that they do not appear to have been so conceptually separate in the minds of Woodland potters as current research tends to make them. A third is the prevalence of light-coloured clay occurring later in time. Temper and paste attributes indicate stability of resource procurement through time, with the same temper materials occurring in

[32] An example from lithic artifacts also illustrates the importance of identifying the significance of temporal and spatial distributions of materials. Lepper (2006) explored the implications of the abandonment of the Flint River quarry after the Hopewell Period, noting later negative associations with the quarry and the complete lack of that material in Mississippian assemblages, despite the high quality of the material. In this case, the switching to new sources is significant to understanding the historical and social significance of lithic manufacturing practices.

vessel lots throughout the sequence and in all decoration tools (fabric impression, PSS, dentate, and cord marks).

Methods

Groups of clay and temper were first identified during stereoscopic examination and unaided observation during cataloguing. These groups were delineated on the basis of the following attributes: temper type (grit, shell, or organic), minerals (such as mica, feldspar, and quartz), mineral characteristics (colours of minerals, angularity), particle size, and temper percent. The temper was preliminarily investigated using SEM, XRF, and laser ablation in order to identify minerals and to indicate composition. Only a small number of sherds were sampled for these techniques; these were intended to be as representational of the assemblage as possible. Clay was also investigated using SEM and XRF. Temper was assessed with the main goal of defining local manufacture as opposed to imported pots. Other goals included delineating paste groups that could be tied to temporal changes or other attribute clusters. Finally, recipes were examined for evidence of a manufacturing locale—in other words, with the aim of tying paste groups to locally available materials. This last was accomplished by comparing the results of analysis with geological literature on the locally occurring clay and granite deposits in the vicinity of Gaspereau Lake.

Comparisons were made with other sets of data. These included the SEM compositional data for the George Frederick Clarke (GFC) ceramic assemblage from central New Brunswick that I acquired during my MA research, as well as compositional data reported in Owen et al. (2014) on SEM analysis of ceramics from LBR to the southwest of Gaspereau Lake.

For a full report of data and analysis performed on paste attributes, see Appendix 6 and 7.

Temper

The importance of temper in ceramic analysis cannot be overstated. The selection of temper is a significant technological as well as economic choice for potters (Arnold 1985:24–26; Braun 1986; Bronitsky and Hamer 1986; Kilikoglou et al. 2007; Tite et al. 2001; Waggoner 2009), so that it is a glimpse at the landscape of opportunities and constraints out of which pots emerged (Feathers 2008; Hoard et al. 1995; Sillar and Tite 2001:4; Skibo et al. 1989). Because cooking pots require a fine balance between the expansion rate of the temper particles and the clay, inclusions can lead to structural failure of the pot if not properly matched (Arnold 1985:24–26; O'Brien et al. 1994:278; Rye 1981:5). The best tempering material (whatever that may be) is presumably not available in all landscapes, so although the idea of pottery may have been imported from elsewhere, the practice of pottery manufacture always represents a local adaptation to economic, environmental, population, and subsistence constraints. This implies that at least some trial and error was necessary in any landscape where pottery occurs, which—in turn—implies that the optimal temper material was eventually settled on by a group with any continuous occupation history at a site (Skibo and Schiffer 2001:146). Furthermore, optimal materials change as other social dynamics change (Feathers 2003; O'Brian et al. 1994). Homogeneity of temper within a time period therefore should indicate strong traditions of pottery manufacture and in situ development. Heterogeneity, however, does not mean the opposite of in situ, but rather, a more complex set of processes and possibly changes through time. Thus, when homogeneity is encountered along one axis (e.g., temper minerals) but heterogeneity is encountered along another (e.g., particle size), in situ manufacturing traditions have likely developed and changed through time.

Temper Types

Temper in the GLR samples mostly comes from three sources: organic material that could be harvested during the spring, summer, and fall, such as cattail fluff or cut-up grass; iron oxide that was also used for a variety of purposes besides pottery manufacture; and crushed granite from a pegmatitic source that allowed separation of crystals.[33] These three sources (and a very small minority of shell temper) were mixed and matched in pastes such that categorizing them by broad temper type is challenging and does not capture the manufacturing tradition very accurately. The same sources were used repeatedly, but potters employed different configurations of the materials yielded by those sources.

The tripartite division of grit, shell, or organic temper used in the literature on Northeast pottery broke down early on in the analysis of the Locus 3 sample. These types did not work as distinct categories because of the significant overlap in temper types within individual vessels as well as the variable percentages of each temper type in individual vessels across the assemblage. Categorization by broad temper types was therefore impossible or, at least, meaningless.

The significant question is whether the variability observed in this sample has been overlooked or obscured by other researchers, or whether this variability is salient to understanding the site. Having looked at ceramic assemblages from New Brunswick and noting none of the overlap of temper types observable in the GLR samples, I favour the latter explanation.

Temper percentages and particle sizes also vary considerably, making categories of these attributes untenable. These two attributes are expected to co-vary to some extent, because the more temper content in a paste, the more likely that larger particles will be included. This principle was shown in experimental test tiles and can be easily seen in photos. However, the relationship was not shown to be particularly strong in the GLR samples, meaning that more complex processes were occurring.

Paste coarseness (temper percent and particle size) increased, on average, through time, agreeing with other ceramic studies (e.g., Petersen and Sanger 1991). A relationship was shown to exist between PSS decorations and small amounts of temper, on the one hand, and to cord marks occurring alongside larger amounts of temper on the other. This finding agrees with other researchers that pastes tended to be finer during the Middle Woodland, and coarser during the Late Woodland. A Chi-square test showed that paste texture is likely to be dependent to some degree on decorative tool (χ^2=20.1106, p<0.009, n=91), and a Wilcoxon Signed-Rank test indicated that paste texture is probably dependent on decoration

[33] For a discussion of how tempers were identified, see the methods sections in Appendix 1.

tool (Z=-2.7055, p=0.007, W=658.5, n=91). Although the distribution of paste textures by decoration tool shown below (Table 6) indicates some obvious clustering, it is also easy to see that the dependency is not absolute, and—particularly in the case of cord-marked pottery—a range of variation exists. Therefore, although potters appear to have been conforming to certain rules or ideas about pots that changed through time, they were by no means bound to those rules.

Table 6: Distribution of paste textures compared with decoration tools.

	Fine	Medium-Fine	Medium	Medium-Coarse	Coarse	Total
CWS	11	4	20	7	17	**59**
Dentate	9	3	2	4	1	**19**
PSS	6	0	6	0	1	**13**
Total	**26**	**7**	**28**	**11**	**19**	**91**

Patterning in Temper Minerals: Feldspar-Poor Granite and the South Mountain Batholith

Temper in the Locus 3 sample exhibits an absence of feldspar—a common granite component—and the inclusion of a distinctive bluish-grey quartz particle in many vessel lots. The common absence of particles of feldspar identifiable with a stereoscopic microscope in the Locus 3 sample probably indicates an unusual granite source that allowed a sorting behaviour during processing, rather than a feldspar-poor material. In contrast to the GLR ceramics, pottery from New Brunswick nearly always contains feldspar along with the other two components of granite, mica and quartz. Crushed granite, the most obvious explanation for these minerals in New Brunswick ceramics, cannot by itself explain the temper in the GLR ceramics, because the separation of feldspar, usually composed of crystals no larger than 0.5 cm across, from other crystals would not have been possible. Additionally, the distinctive bluish-grey quartz shows up only rarely in New Brunswick ceramics, so its common presence in the GLR ceramics is noteworthy. These two observations indicate that a different kind of granite—pegmatites associated with the South Mountain Batholith with outcrops found all around south-central Nova Scotia—were being regularly accessed.

Pegmatites in Nova Scotia

The Locus 3 ceramics contain quartz particles similar in colour to descriptions of megacrystic leucogranite—called the Brazil Lake Pegmatite—outcrops in the Yarmouth area reported by Kontak (2003) (see also Clarke et al. 1993; MacDonald et al. 1992). In the southwestern part of Nova Scotia, pegmatitic granites (crystals larger than 3 cm) outcrop in a number of locations, including along the South Shore and in the Yarmouth area (Kontak 2003; MacDonald 2001). These rocks are related to a Middle Devonian intrusion called the South Mountain Batholith (MacDonald 2001; MacDonald et al. 1992) that underlies much of the Annapolis and Kings counties, including Gaspereau Lake (MacDonald and Ham 1992).

The granitic pegmatites examined by Kontak and others exhibit many of the same characteristics in hand specimen as do the pegmatites scattered around the beaches along Nova Scotia's South Shore near Port Joli. These characteristics are a translucent mega-crystalline quartz ranging in colour from clear to nearly black, but mostly exhibiting a bluish-grey colour (Kontak 2003:53–54), probably as a result of the presence of trace tantalum and niobium oxide amounts (Kontak 2003:54). Also characteristic of these rocks is "blocky K-feldspar" (potassium feldspar) that occurs as quite large grey to light pink crystals (Kontak 2003:62). Similar minerals are reported to underlie the areas around Gaspereau Lake (Lowe 1978; Lowe and Farstad 1978), with granitic rocks that are part of the South Mountain Batholith ranging from megacrystalline monzo- and leucogranites to finer grained granodiorites and leucogranites (MacDonald et al. 1992:13). Particularly in the case of leucogranites that lack dark-coloured minerals and may tend toward larger crystals of quartz, mica, and feldspars may be relatively easily separated from each other.

Compositional Analysis of Temper Minerals

A small sample of sherds were analysed using compositional techniques, including SEM, XRF, and laser ablation. SEM and XRF helped identify minerals including distinct grains of quartz, muscovite, biotite, K-feldspar (microcline), plagioclase (albite), and chlorite. Using the SEM, relatively high abundance levels of phosphorus were noted in all samples. Several different iron oxides were also noticed, including iron alumino-phosphate oxides and titanium-iron oxides (limonite, goethite, and hematite).

Compositional analysis showed definitively that temper came from a granitic source that was most likely a "primitive" (weakly fractionated) granitic pegmatite (Larsen 2002:146). Particles of feldspar typically observable using a microscope were noticeably absent, although feldspar particles were observed in all samples analyzed compositionally. Trace elements obtained by LA ICP-MS were used to compare with known compositions of pegmatites, both in Nova Scotia and elsewhere.

One of the strongest indicators of pegmatitic potassium feldspar is the potassium–rubidium (K/Rb) ratio (Shaw 1968; Shmakin 1979). This ratio (K/Rb) tends to be lower in pegmatites as a result of fractionation as potassium is removed from the melt and crystals form with incrementally higher rubidium (as well as other alkali metals, such as cesium and lithium) replacing potassium in the alkali feldspar to higher amounts. High amounts of lithium and cesium can also therefore indicate pegmatitic rocks (Shaw 1968:595). Additionally, plots of ratios of various trace elements can indicate the degree to which pegmatitic granites are "primitive" or underdeveloped in terms of pegmatitic crystallization as opposed to evolved (more highly fractionated) (Larson 2002:143).

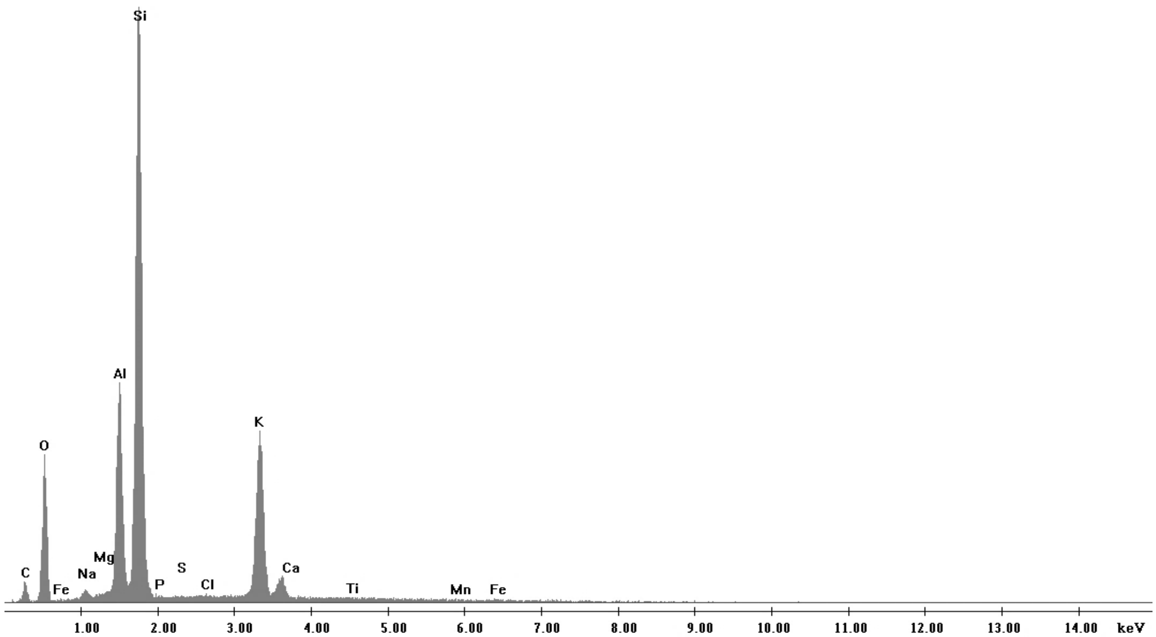

Figure 6: SEM-EDS spectra of a potassium feldspar particle in GLNS:88.

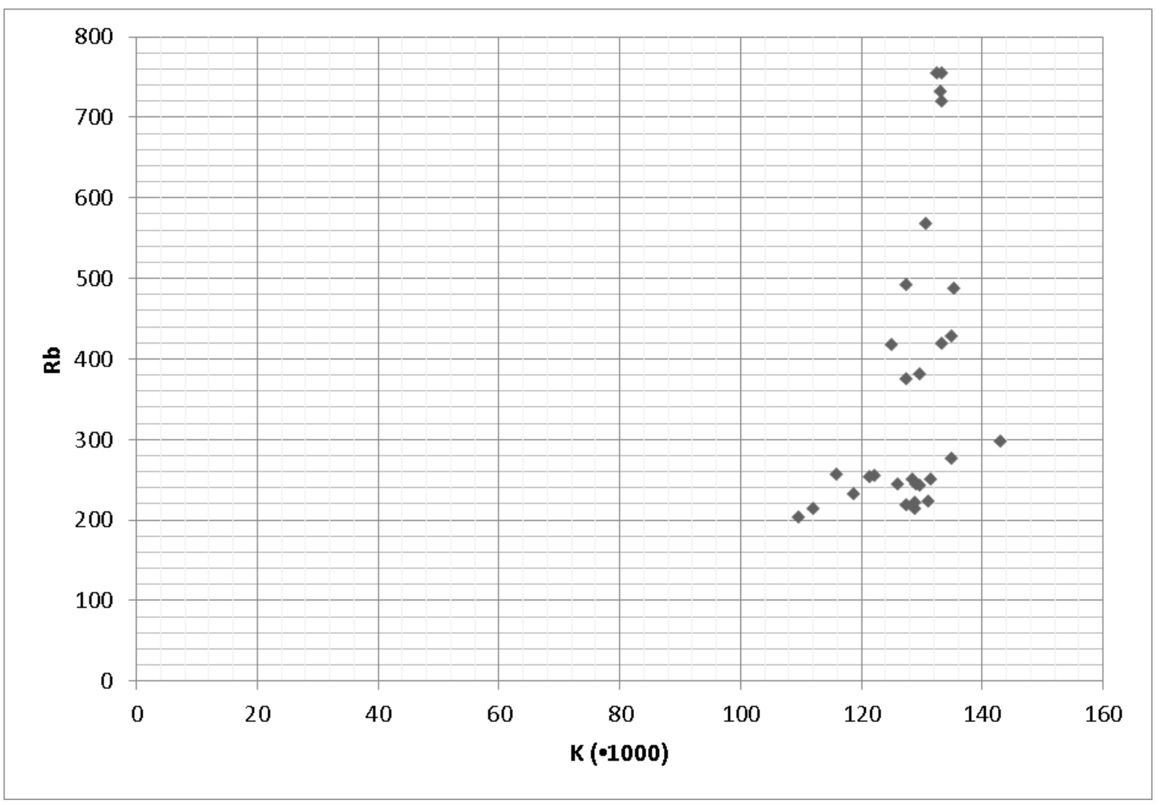

Figure 7: Plot of potassium (K) against rubidium (Rb ppm). Values of potassium are thousands of parts per million (ppm).

Table 7: Some elements used in evaluating the likelihood of pegmatites used as temper in the GLR ceramic assemblage.

VL	K	Ba	Rb	Sr	Rb/Sr	K/Rb
61	128900	1067	245	254.2	0.96	526.12
61	111900	1758	215	227.7	0.94	520.47
61	143000	2240	298	100.0	2.98	479.87
61	131400	10800	251	292.4	0.86	524.13
62	125000	818	418	102.1	4.09	299.04
62	130500	1166	568	111.9	5.08	229.75
62	127400	949	492	88.9	5.54	258.89
62	134800	2431	428	113.2	3.78	314.95
62	133300	1244	756	107.9	7.01	176.32
62	132400	1238	755	120.9	6.24	175.36
62	128700	5720	215	296.7	0.72	599.44
62	133200	827	420	90.6	4.64	317.14
62	127400	971	376	105.6	3.56	338.83
62	135300	721	488	89.0	5.48	277.25
62	129500	485	381	75.9	5.02	339.9
82	115900	3850	257	194.0	1.32	450.97
82	129600	2886	243	220.2	1.10	533.33
82	122100	1658	255	207.3	1.23	478.82
82	128800	3106	222	172.2	1.29	581.49
82	127300	2659	220	199.4	1.10	579.43
82	130900	3960	224	196.0	1.14	583.85
82	134800	549	277	103.6	2.67	486.64
82	128300	2466	251	172.9	1.45	511.36
88	109600	3238	204	238.2	0.85	538.05
88	118700	3804	233	242.1	0.96	509.44
88	121200	819	255	137.8	1.85	476.23
88	125900	1268	246	182.1	1.35	512.83
160	133100	2232	733	100.5	7.29	181.58
160	133200	2178	720	121.6	5.92	185

Some of the K/Rb ratios from the K-feldspars in the sample are slightly lower than some values expected in "normal" granitic K-feldspar (Shaw 1968:574). A normal granite usually is considered to be somewhere above 250, but can range much higher. Although the lower values (particularly those for GLNS:160) are well within the range of pagmatites, many of the values are unexpectedly high for pegmatites, suggesting that different granite sources are evident and the pegmatite hypothesis may be incorrect. In order to test the likelihood that the range represents a number of different sources, several paired elements were tested using a Pearson Product correlations. If sources have different geological histories (i.e., are

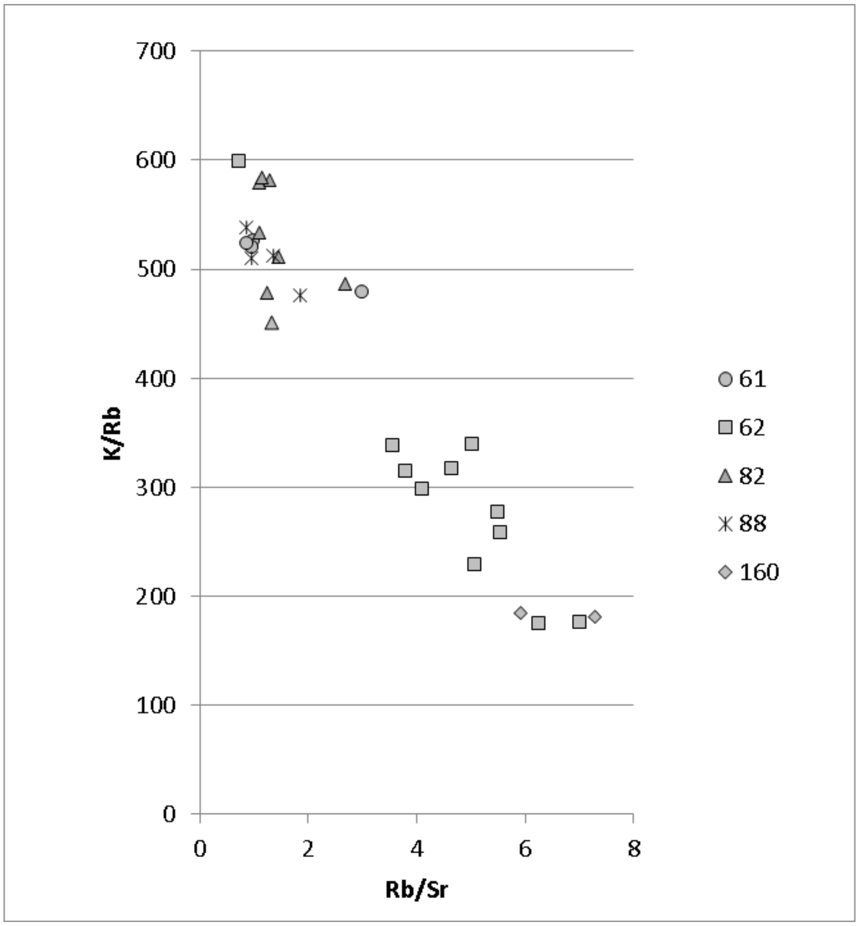

Figure 8: Rb/Sr compared with K/Rb contents of K-feldspar particles following Larson (2002:143-44).

geographically and geologically different from each other), then fractionation degrees and elemental composition should be different, which would show up as lower correlations between paired elements. However, most pairs tested show a high degree of correlation, indicating they had the same geological history. For example, a plot of strontium and barium were strongly associated with an R^2 value of 0.90 in plagioclase particles across four vessel lots. Similarly, vanadium was plotted against titanium in K-feldspar particles giving a correlation statistic of R^2=0.91. These are good indications that all the temper materials originated from the same granitic source.

Larson notes that pegmatites commonly show a mixed range as a result of differential crystallization, and suggests that further confidence of pegmatitic identification can be obtained by comparing two sets of ratios: Rb/Sr and K/Rb. This reveals the degree to which a pegmatite has fully formed (evolved or fractionated) or rather has only partially formed in amidst other, finer grained granites (primitive). A plot of Rb/Sr against K/Rb was performed on K-feldspar particles from a sample of five vessel lots and the plot reveals that the feldspars fall on the relatively primitive side. This fits with descriptions from Lowe (1978) and also O'Reilly et al. (1982:62) that pegmatitic crystals do not occur homogeneously within the granites, but rather could be found in pockets throughout the leucomonzogranites observable in outcrops towards the southwestern end of Gaspereau Lake. Nevertheless, the sample falls within the ranges set forth by Larson (2002) and therefore appears to have come from pegmatite dykes, pegmatitic pods in granites, or pegmatite-related granites. As a result, the pegmatite source hypothesis remains the most viable.

Pegmatite Processing

If these pegmatitic granites were accessible around Gaspereau Lake and were being processed for temper, one mineral type—feldspar, in this case—could easily be sorted out, so that small particles and the occasional larger particle would appear in a clay paste, but for the most part, only mica and quartz would be included. Sorting out feldspar would be made easier by the early break-down of feldspar compared with quartz and mica. Some quartz and mica crystals may actually have been lying on the ground in these pegmatite outcrops. This would also explain why some pastes contain significant mica particles while others do not. Mica also occurs in large "books" or crystals (Kontak 2003:50), and depending on the portion of pegmatitic granite being processed, mica may be highly integrated with quartz or entirely contained in one crystal or even absent. On the other hand, earlier pottery (PSS- and dentate-decorated) less frequently contains the same feldspar-poor granite, probably indicating a different source or transport of vessels from elsewhere. Granite cobbles found throughout Nova Scotia were glacially transported from a variety of sources and over potentially great distances, providing an easily acquired temper source. Many granite cobbles were found in the GLR Site Complex, some associated with hearths, which may mean they were being roasted to speed up decomposition and make processing for temper easier. Also, vessel lots from Locus 1 exhibit more feldspar in their pastes, indicating a different processing behaviour that promoted the inclusion of feldspar particles. These other feldspars appear different from each other in colour and in particle shape and size, and they give no indication of coming from a common source, probably indicating glacially transported granite cobbles.

Following is a summary of the defined temper groups that are referred to in later chapters. For full descriptions, see Appendix 6.

Feldspar-Poor Granite

This temper class consists of quartz and mica and the occasional feldspar particle, such that it is recognizable as having come from granite. The particles are generally angular to sub-angular, indicating that they were manually crushed and do not come from sand. Unlike grit temper from New Brunswick, which almost always contains mica, quartz, and feldspar (Woolsey 2010), this temper lacks feldspar particles. Iron oxide frequently co-occurs with feldspar-poor granite. It is the most common temper type, and was used in vessel lots with all the major decorative tools and various combinations of forming and firing attributes.

Bluish-Grey Quartz

Similar to the previous category, this temper type contains very little feldspar, and in addition, a distinctively coloured translucent quartz particle. Coloured bluish-grey, it is similar in colour to quartz in pegmatites outcropping around south-central Nova Scotia and associated with the South Mountain Batholith (Kontak 2003; MacDonald et. al 1992). It clusters fairly strongly with Blended-Edge Dentate and Cord-Marked Fan decorative groups, and with hard, buff-coloured clay. Vessel lots with this temper and decorated with cord marks consistently exhibit aggressive channeling that is unidirectional in orientation. It is likely that the previous temper group is related to this one because many vessel lots probably were not identified as containing bluish-grey quartz prior to it having been defined as an important group.

White Quartz

This temper type is characterized by white quartz particles and a lack of translucent quartz and feldspar particles. It often occurs alongside sooty brown or black pastes. This suggests either a particular firing regime or a post-depositional process such as fire damage from an overlying hearth. It does not cluster with any decorative groups or manufacturing attributes, suggesting that it is not significant as a procurement or manufacturing practice; it may therefore be a subset of the Feldspar-Poor Granite group.

Mica-Poor Quartz

This temper contains white and clear quartz, some feldspar, and little to no mica. It is more closely associated with ceramics from earlier in the manufacturing sequence, most vessel lots in this group having been decorated with PSS/dentate decorations. Necks are relatively thin and pastes relatively reddish. All lip shapes are squared or semi-squared, a morphological homogeneity not seen in any other category. The group may be another variation of the Feldspar-Poor Granite considering that the same mechanisms that allow the exclusion of feldspar would also work for mica. Although the sample size is small, the relative homogeneity within this group along other dimensions indicates that it should possibly be considered behaviourally significant.

Mica-Rich Granite

This temper is characterized by a large amount of mica flakes and an overall small range of particle size. Where many vessel lots contain a large portion of particles easily over 4 mm, none of these vessel lots had particles measuring more than 2 mm. The percentage of temper, however, ranges widely. This probably resulted from a situation where stored processed granite was getting low, and the smallest particles that had sorted to the bottom of a storage container over time were being used. The vessel lots included in this group are also in the Tightly Plied Cord-Wrapped Edge group, and two of the three have similar channeling marks.

Iron Oxide

This temper's main characteristic is the high amount of iron oxide, usually mixed with organic and/or Bluish-Grey Quartz temper. Clay tempered with Iron Oxide is relatively pinker or redder than most vessels, but usually, the buff colour of the clay is still discernible. These vessel lots are also noticeably harder than average. In all except one case, this temper type occurred along with cord marks, with a majority belonging to the Unplied Cord-Marked Fan group and all having been channeled on their interiors with a distinctive Channeled-and-Burnished treatment. The group of vessel lots with Iron Oxide temper is one of the best candidates for defining a tradition of all the temper groups because it clusters so strongly with other groups.

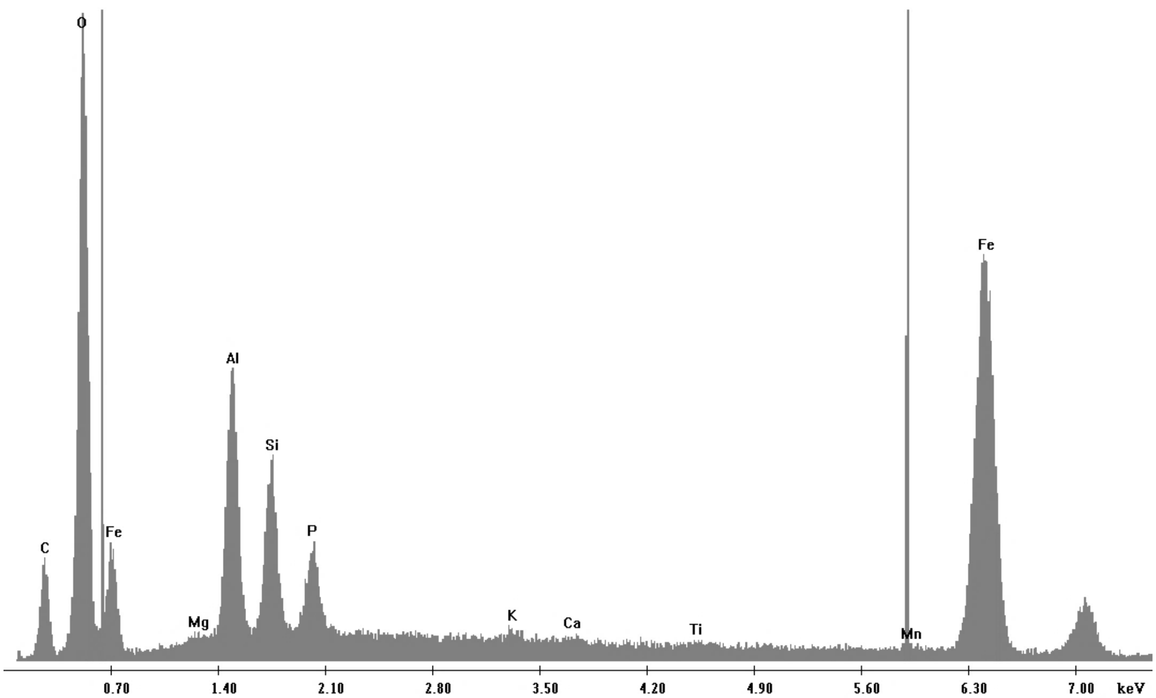

Figure 9: SEM spectra of an iron-rich particle in a sherd belonging to the Iron Oxide temper group. Compositional data are given in Appendix 10.

Clay

In order to assess the likelihood that the clay came from a single source, homogeneity relative to other assemblages—that is, the ability to tell the GLR ceramics from other ceramics—was assessed. Three elemental constituents illustrate that the GLR ceramics can be differentiated from the GFC ceramics in New Brunswick: these are silica, alumina, and iron. Alumina content is higher in the GFC ceramics, whereas silica tends to be higher in the GLR assemblage. Although there is overlap, the means of the two groups are significantly different (Table 8). Similarly, iron content of the clay minerals (not the pastes) are different between GLR and GFC ceramics, the latter tending toward relatively iron-poor clay compared with the New Brunswick ceramics. Because these two assemblages are significantly different, their relative homogeneity can be assessed; in the case of the GLR ceramics, this entails comparison not only with New Brunswick assemblages, but also those nearby the GLR site complex in Nova Scotia.

Table 8: Comparison of constituent elements using a Student t Test to distinguish between the GLR ceramics and the GFC ceramics. Semi-quantitative data of samples were obtained using SEM-EDS. Numbers were normalized to 100%.

	GLR (*n*=22)	GFC (*n*=48)	*t*-value	*p*-value
Silica (SiO_2 wt.%)				
Mean	52.23	61.36	2.6016	0 .011346
Median	52.10	63.77		
Mode	52.10	60.53		
S.D.	11.02	14.69		
Alumina (Al_2O_3 wt.%)				
Mean	39.91	24.96	5.55523	0.00001
Median	41.12	23.17		
Mode	43.51	32.65		
S.D.	8.45	11.25		
Ratio of Silica to Alumina				
Mean	1.473	3.053	-3.83733	0 .000272
Median	1.219	2.694		
Mode	1.197	1.854		
S.D.	0.92	1.83		
Iron (Fe wt.%)				
Mean	7.86	13.68	-2.55637	0.012782
Median	5.53	11.50		
Mode	4.39	6.82		
S.D.	5.93	9.88		

Comparison with Other Nova Scotia Sites

The compositional data that are available reveal differences between New Brunswick and Nova Scotia materials, as well as between the GLR assemblage and ceramics from other sites in south-central Nova Scotia. The LBR site (BdDk-1), approximately 6 km inland from the Annapolis Basin on the western shore of Nova Scotia, could be reached from Gaspereau Lake via the navigable Annapolis River with some portaging. The two sites are therefore potentially connected, and their ceramic assemblages can be evaluated for overlap in order to assess whether ceramics were imported from this site. Originally excavated by Erskine, the L'sitkuk Bear River (LBR) ceramic assemblage was later analyzed compositionally by Owen et al. (2014) to determine source materials for the ceramics and to postulate local manufacture. Their data suggest that LBR was indeed a manufacturing locale, exhibiting relatively high homogeneity in clay and a compositional similarity to surrounding sand and granodiorite sources (Owen et al. 2014). Compared with the GLR ceramics, they exhibit a smaller range of variability both in an Al-Si-Fe tri-plot (Figure 11) and in a Ca-Na-K tri-plot, even though they potentially span a wider time period. Gaspereau Lake shows less homogeneity, but nevertheless exhibits differences from both the LBR ceramics and the New Brunswick ceramics. Ceramics at Gaspereau Lake, therefore, do not appear to have been coming from LBR, one of the more obvious locations from which ceramics might have been obtained.

Some pastes appear to have been made with different clay that exhibits smaller particles and more reddish colouration typical of ceramics in other areas, such as at the Oxbow site or the Fulton Island site in New Brunswick. These vessel lots are most often associated with the Middle Woodland Period or with unusual attributes in relation to the whole sample. This may mean that more sources were being accessed earlier in time but fewer or only one source was accessed later in time. The clays in this category do not show a different Al–Si relationship, however, and therefore appear to come from somewhere not too distant. In both cases, local extraction is likely.

Significantly more study is necessary to determine the degree of homogeneity of the GLR clay than the current study allowed. A hypothesis to account for the distinctive clay seen in a majority of sherds is that the clay was locally mined from a primary (*in situ*) deposit that was poorly sorted and that contained low iron content. Two possibilities are put forward here: 1) that clay came from a kaolinite deposit somewhere around Gaspereau Lake, and 2) that clay came from weathered feldspar somewhere around Gaspereau Lake.

Nova Scotia has several longstanding kaolinite mining operations around the central/western portions, not far from where the GLR site complex is located. Stea et al. (1996) showed that Cretaceous-aged silica sand and kaolinite occur together in large deposits resulting from glacial lakes in the Shubenacadie and Musquodoboit areas of central Nova Scotia. These deposits have a history of mining operations, because they are large, pure, and accessible, in some places occurring very close to the surface (Stea Surficial Geology Services http://www.steasurficial.ca/kaolin.html), so that they could have been accessible in places without large-scale mining operations. The closest deposit to Gaspereau Lake that has been commercially mined is the Avonport Shaw Brick Factory (The Shaw Group: History, <http://shawgroupltd.com/about-shaw/history/> accessed on 04/08/2016). Clay deposits from Annapolis Royal up to Wolfville have been investigated (Reise and Keele 1991), though none I have seen that investigated Gaspereau Lake or vicinity. These sources, located from along the western shore of Nova Scotia, typically fire red, so their relationship to the kaolinite deposits further north is not well understood. Considering the light colour of the GLR ceramics, the low content of iron, sodium, potassium, and calcium, and the relatively hard paste, a kaolinite-rich clay is possible. Unfortunately, the current research did not allow this problem to be assessed in any detail.

The other possibility is that ceramics were made from a poorly developed clay (illite and smectite) with significant amounts of non-clay alteration products of feldspar. These might include limonite and goethite, chlorite, mica, and apatite, all having been found in amongst sediments and/or bedrock granites during prospecting at Gaspereau Lake (e.g., Lowe 1978; Lowe and Farstad 1978; O'Reilly et al. 1982:64; Clarke et al. 1993). This scenario would explain the coarse particle size, speckled appearance, relatively heterogeneous compositions relative to L'sitkuk Bear River, and the inclusion of iron oxide particles in the clay body to a more satisfactory degree than the first hypothesis. It would also explain why both clay and temper exhibit unusually high levels of phosphorus.

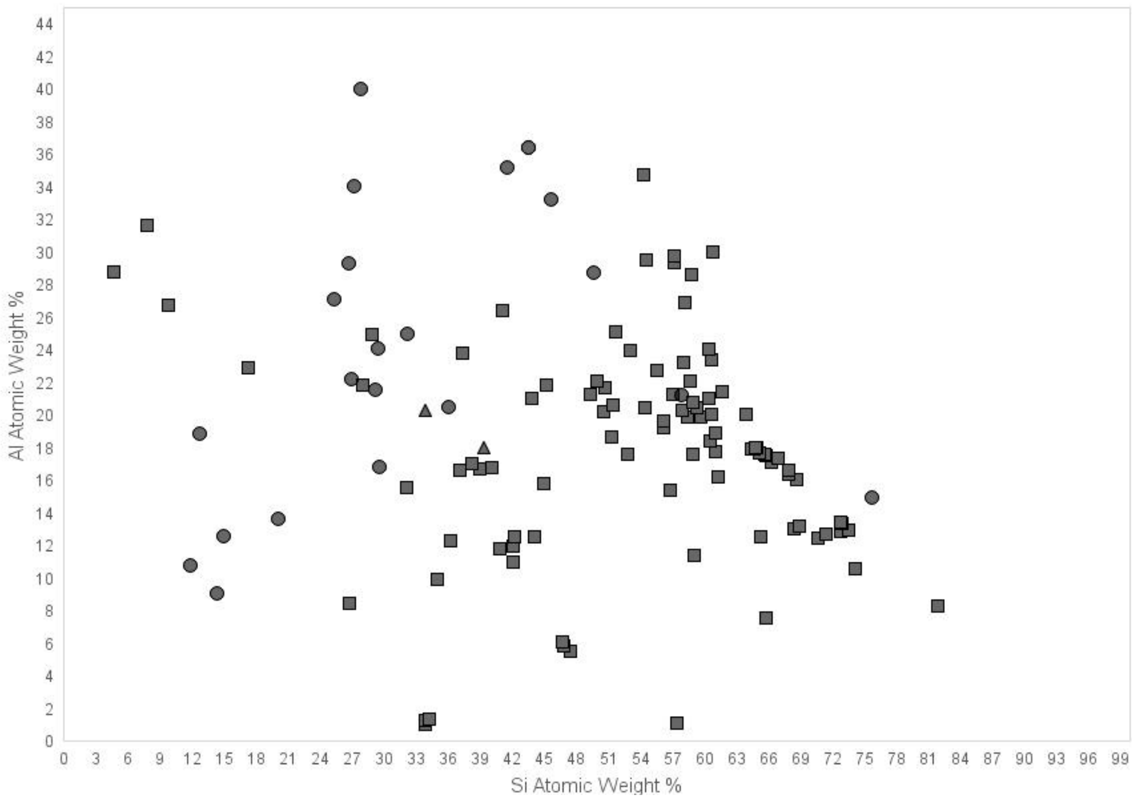

Figure 10: Comparison of alumina to silica (atomic weight %) in vessel lots from the GLR assemblage (circles) and from the George Frederick Clarke (GFC) assemblage (squares) from New Brunswick. Iron is assumed to be Fe_2O_3. Note that the GLR ceramics cluster around the smaller silica percent but have similar alumina percent to the GFC ceramics, while the GFC ceramics cluster with larger silica percents. Note also that the two control samples (triangles), using clay from Parsboro, show more similarity to the GLR ceramics, reflecting their closer proximity and—probably—their similar geological history and source material to the GLR clays.

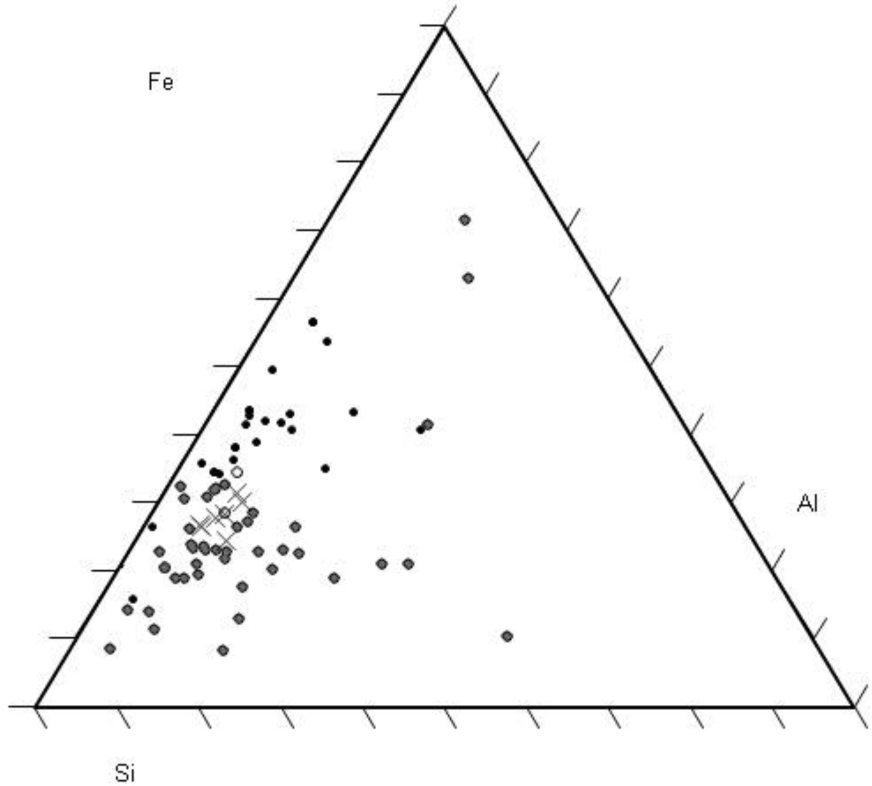

Figure 11: Tri-plot of Si-Al-Fe in clays from the GLR assemblage (black solid dots) and the GFC assemblage (grey dots with black outlines). The GLR ceramics cluster, tending to exhibit more silica on average than the GFC ceramics from New Brunswick. Iron content is also slightly different, with the GLR ceramics exhibiting relatively iron-poor clay compared with their GFC counterparts. LBR ceramics (grey X's) also cluster, showing difference from both the GLR and the GFC ceramics. The two samples made with clay from Parsboro are represented by hollow circles.

Table 9: Composition of clays from vessel lots in the GLR assemblage obtained from Scanning Electron Microscopy. The percentages are of atomic mass. Quantities should be regarded as estimates only. Oxygen is not listed. Iron is assumed to be Fe0 in calculations of atomic mass.

VL#ID	Al%	C%	Ca%	Cl%	Fe%	K%	Mg%	Mn%	Na%	P%	Si%	Ti%
control	7.88	11.57	0.66	0.04	1.67	1.33	1.34	0.03	1.04	0.02	13.23	0.16
control	7.56	10.31	1.21	0.04	2.39	1.83	1.29	0.13	0.36	0.03	16.65	0.15
GLNS:20	7.58	0	0.05	0	0.3	5.96	0.1	0.19	0.68	0.12	20.65	0.05
GLNS:20	11.75	0	1.27	0	4.68	1.07	0.64	5.85	0.68	3.07	10.71	0.38
GLNS:61	11.7	0	0.3	0	1.18	1.75	0.28	0.1	0.74	1.74	14.01	0.34
GLNS:61	9.92	0	0.56	0	1.94	0.81	0.38	0.11	0.33	1.75	13.64	0.38
GLNS:61	12.13	0	1.4	0	2	0.93	0.65	0.18	0.16	4.07	8.43	0.39
GLNS:61	10.28	0	1.79	0	0.71	0.91	0.52	0.08	3	0.6	17.73	0.09
GLNS:61	10.49	12.4	0.16	0	0.89	1.51	0.29	0.07	0.21	2.65	9.79	0.23
GLNS:61	8.27	25.49	0.13	0.06	0.83	0.62	0.26	0.04	0.16	2.22	5.56	0.12
GLNS:62	10.85	0	0.27	0	2.39	1.64	0.92	0.22	0.16	1.29	12.81	0.28
GLNS:62	5.16	0	0.13	0	1.32	0.64	0.5	0.1	0.12	0.23	26.1	0.14
GLNS:62	13.62	0	0.45	0	8.94	1.11	0.68	0.51	0	3.33	10.87	0.5
GLNS:77	9.18	12.78	0.14	0.06	4.72	1.17	1.05	0.19	0.13	0.39	12.41	0.33
GLNS:77	5.03	41.58	0.2	0.07	1.28	0.38	0.31	0.03	0.11	0.89	4.9	0.18
GLNS:88	10.49	16.71	0.05	0	1.18	1.03	0.72	0	0.1	0.36	12.83	0.13
GLNS:90	8.54	15.81	0.02	0	1.45	0.79	0.35	0	0.16	0.76	10.38	0.16
GLNS:93	5.35	35.54	0.08	0.11	1.2	0.33	0.23	0	0.07	0.51	5.85	0.17
GLNS:108	8.07	13.94	0	0	1.09	0.67	0.66	0.06	0.21	0.31	14.17	0.13
GLNS:109	10.9	14.2	0.1	0.05	1.31	1.67	0.4	0.17	0.14	0.35	14.06	0.32
GLNS:131	7.24	19.68	0.06	0.16	1.13	0.78	0.53	0	0.18	0.28	12.7	0.2
GLNS:143	5.42	43.43	0	0	0.91	0.57	0.48	0	0.1	0.06	8.59	0.14
GLNS:144	6.69	34.68	0.36	0.04	1.81	0.48	0.38	0	0.22	0.29	7.94	0.15
GLNS:160	6.65	29.95	0	0.02	0.94	0.55	0.46	0.01	0.13	0.14	9.83	0.1

Clay Groups

The clay groups defined in this research are not based on mineralogy but rather on paste characteristics that have to do with the behaviour of the clay. Aside from the mineralogical work being largely outside the scope of the present research, defining groups this way might have resulted in one majority group with a number of minority groups, which would not have helped with the endeavour of defining traditions. Instead, the groups that have been defined are more properly thought of as wares in that differences rested on additives such as iron oxide and firing practices such as oxidizing or reducing atmospheres.[34] Because so little is understood at this point of the firing practices, I have opted to call the groups "pastes" rather than "wares" so as to avoid unnecessary assumptions. Full descriptions can be found in Appendix 6.

Buff-to-White

This clay group represents the oxidized and uncoloured version of the GLR clay, characterized by a light-coloured or off-white body that is easily coloured by other things such as carbon or iron oxide. It frequently exhibits a foliated look. It is most commonly tempered with Bluish-Grey Quartz or Feldspar-Poor Granite temper, and though it is not restricted to the Cord-Marked Fan decoration, more vessel lots are decorated this way than any other decoration. One AMS date was acquired on a vessel in this group: GLNS:61 was dated to between 1350–1290 Cal BP at the 2-sigma range.

Buff-to-Pink

This group is similar to the previous group in its layered texture and its light colour compared with ceramics from New Brunswick, but it tends towards pink as a result of its iron oxide content. This iron oxide particulate was observed in the majority of the vessels belonging to this group. Vessel lots with Buff-to-Pink clay also often contained other tempering materials, the two main subgroups being Feldspar-Poor Quartz and Organic temper. While a gradation clearly exists between Buff-to-White and Buff-to-Pink clay, the latter is more often associated with pronounced coil breaks, angular breakage patterns, and compact pastes.

Brown-Buff

This group is again similar to the Buff-to-White Group, with the major difference that most surface area has been coloured a grey-brown colour with off-white patches showing through. The dark colour appears to result from a moderately reduced atmosphere during firing or from heat damage during use-lives. All decorative tools are represented, and

[34] The term "wares" was not used because it imports many theoretical stances that cannot be sustained with the present research. However, conceptually, the ware concept is probably the best fit for the groups I have defined.

no clustering with morphology is apparent. The most common temper in this group is Feldspar-Poor Granite. It is one of the most common paste colours, with three dates acquired on vessel lots in this group. These vessel lots were dated to 1560–1410 Cal BP, 1405–1305, and 1368–1175Cal BP, at the 2-sigma range.

Brown Reduced

This group clearly results from fire-deposited carbon, though whether this occurred during firing (reducing atmosphere), during cooking (use wear) or post-depositionally (hearth paving, for instance) is not always clear. Many of the vessels have larger and darker carbon cores ringed by layers of iron oxide. They tend to be cord-marked, but PSS and dentate decorated vessels are also in this group. Constitutions range from very hard to soft and crumbly, indicating that a range of processes are responsible for the colouration. Three AMS dates were acquired for this group: at the 2-Sigma range, 1400–1300 Cal BP, 1287–1089 Cal BP, and 900–725 Cal BP.

Sooty Brown

This group is characterized by dark brown or black colour over most of the surface that results from charring. Because the sherds in this group do not exhibit evidence of cooking events during their use lives, and because of their supra-position relative to scorched earth and hearth layers, it is inferred to have resulted from post-breakage fire damage. One date was acquired on a vessel lot from this group, 1175 and 980Cal BP at the 2-Sigma range.

Iron Oxide Red

The vessel lots in this group exhibit iron oxide staining (orange to red), lack of visible iron oxide particles in the clay, reddish to orangish clay colour even where it is not stained, and grit temper. The vessels tend to be thin and most are decorated with PSS/dentate decorations, probably indicating a Middle Woodland context. The staining may come from the paste from which iron oxide leached, the iron oxide particles found in places around the site, or the surrounding soil. The group exhibits some homogeneity in temper type (Feldspar-Poor Granite) and fine PSS/dentate decorations as well as difference from other groups in its non-concoidal breakage patterns such that it is considered a paste group with possible technological importance.

Light Red

This group is characterized by light reddish brown ceramics, and is similar to the Iron Oxide Red group with several differences. Iron oxide particles are occasionally visible in the clay matrix, where they are not in the Iron Oxide Red group; also, while neck thicknesses are thin, they are not quite as thin as in the Iron Oxide group. Several similarities with the previous group are evident, including the majority of vessels decorated with PSS/dentates, though they are not as fine as in the previous group. Also, breakage patterns are similar, tending to break in unpredictable configurations—that is, not along coil joins, temper particles, lamellar splitting, or other obvious sources of structural weakness. The group is also characterized by a number of unusual attributes in its constituent vessel lots, including the inclusion of pink feldspar particles and some unusual decorative strategies. This group and the previous group appear to be related and also to be unrelated or less well related to the other paste groups.

Discussion of Pastes

The grouping of sherds by paste characteristics shows that some behaviours were continuous almost from the beginning of the manufacturing history, such as the use of a temper source with bluish-grey quartz and a dearth of feldspar particles. A distinctive, light-coloured clay was also accessed throughout the sequence. Changes in behaviour are apparent in the increase of iron oxide in pastes through time, the decrease in grit-temper through time, and the introduction of organic temper later in the sequence. Several sherds with fabric impressions that may come from the Early Woodland contain these distinctive bluish-grey particles and are made with light-coloured, coarse-particle clay. When pastes are chronologically situated, there is a trend from lighter pastes earlier in time moving toward darker pastes.

There is a good argument to be made for a distinctive ware category, tempered with iron oxide and sometimes organic or grit, that is red-bodied and compact. This ware occurred somewhere between 1300 and 1150 CAL BP. The delineation of this ware is significant because a red-bodied, cord-marked paste has not previously been noted in the Maine–Maritimes literature. This will be more fully discussed in Chapters 4 and 5.

SURFACE MODIFICATIONS

I have used the term "surface modifications" encompasses decorations, surface treatment, and finishing marks. They are so divided because, although they sometimes use the same tools and accomplish similar effects, the intentions behind each are different and their co-occurrence or absence shows particular concerns of the potter. To lump them together (as is frequently done) is both to conflate separate steps in the *chaîne opératoire* and to treat some modifications as exclusionary to each other when they are not. A more comprehensive treatment of the three surface modifications can be found in Woolsey (2010).

The surface modifications in the Locus 1 and Locus 3 samples are in some ways typical of the Maine–Maritimes Region, but in other ways, the assemblage is unusual in its decorations and finishing marks. It is typical in that the assemblage exhibits PSS/dentate decorations, cord marks, and a small amount of fabric-impressed pottery, as well as a range of punctates and some examples of incision/trailing. Additionally, PSS/dentate decorations tend to be associated with thinner walls and harder and finer pastes while cord marks tend to be associated with thicker walls and coarser pastes, although this is by no means a hard and fast rule, and significant deviation from this generalization is observable. As in other collections, PSS/dentate decorations also appear to have been overall more carefully applied, whereas some cord decorations appear to have been more expediently applied; again, however, this generalization is frequently contradicted by individual specimens. Finally, it is not unusual that almost no Early Woodland pottery exists in an assemblage from this region.

One unusual thing about the assemblage's surface modifications compared with other sites is the prevalence of channeling on cord-marked vessels. Channeling is the scraping of a wet clay surface with a toothed tool, resulting in a grooved or corrugated surface. According to Petersen and Sanger (1991:124–25), this is an attribute state that occurs during the early Middle Woodland (2150–1650 uncalibrated BP) in association with PSS- and dentate-decorated vessels. It is not a particularly common attribute state in New Brunswick pottery from any period. However, when I have found it on pottery from other sites, it is usually associated with PSS or dentate decorations. The fact that it nearly ubiquitously occurs on cord-marked vessels at Gaspereau Lake poses an intriguing question about technological function and is a possible indicator of provenance for ceramics in other assemblages with the same cord-mark/channeling combination.

Another unusual feature of the assemblage is the rocked-on, curvilinear dentate and cord-mark patterns that characterize a relatively large number of vessel lots. In the case of dentates applied in this manner, rocked-on, curvilinear tool application appears to be a variation within a convention, whereas in the case of cord-marked pottery, this application strategy appears to be part of a decorative type whose variation is more restricted. This last is undoubtedly partly a product of the larger number of cord-marked vessel lots, but taken together with other attributes also exhibiting standardization such as paste and temper, it also probably indicates a level of conformity not seen in other decorative groups in the sample.

Decorations

The most often-cited decoration groupings—fabric impression, pseudo-scallop shell (PSS) stamping, dentate stamping, and cord marks or cord-wrapped stick (CWS)—are all represented in the assemblage (Table 10). These groups are exclusionary and considered chronologically sensitive (Petersen and Sanger 1991) (discussed previously in Chapter 2 and see Appendix 2). Distributions of the decorative groups in all samples are listed in Table 10, but it is noteworthy that the majority of vessel lots are cord-marked. As expected, fabric impression comprises a very small amount, less than 1%, of the assemblage. Punctates, incision/trailing, and thumbnail impressions are not included here because, unlike the other four categories, they are not exclusionary and frequently co-occur with other decoration types. Although fabric impression is not a decoration but rather a treatment, it is used by archaeologists in this classification, and so I have listed it here.

Table 10: Distribution of decorative types in the assemblage. Note that weight is not accurate due to many sherds missing a weight measurement (see Chapter 2 for methodological procedures concerning samples and weight). This number is meant only to give a comparative number quantity. "Other/None" refers to ceramics with decorations other than the chronological categories employed by Petersen and Sanger, such as incision and punctates, as well as undecorated vessel lots.

	Fabric Impression	**PSS**	**Dentate**	**CWS**	**Other/None**	**Total**
Vessels	3	22	43	97	16	**181**
Weight (g)	21	593	1240	5998	964	**8816**
Sherds	**18**	**632**	**202**	**2791**	**n/a**	**3643**

Table 11: Distribution of decoration types divided up by the subgroups of simple (discrete), rocked-on, and unknown applications. The numbers represent tools recorded rather than of vessel lots. Note that one vessel with cord marks exhibited both simple and rocker-stamping.

	PSS	**Dentate**	**CWS**	**Total**
Simple (Discrete) Impressions	16	28	57	**101**
Rocked-On Impressions	5	15	23	**43**
Drag/Unknown	0	2	1	**3**
Total	**21**	**45**	**81**	**147**

Table 12: Distribution of rocked-on tools by curvilinear and straight impressions.

	PSS	**Dentate**	**CWS**	**Total**
Curvilinear	1	4	10	**15**
Straight	4	9	8	**21**
Total	**5**	**13**	**18**	**36**

Table 13: Distribution of decoration types by their orientation on the pot.

	Horizontal	**Vertical**	**Oblique Left**	**Oblique Right**	**Left Chevron**	**Right Chevron**	**Total**
PSS	4	2	1	3	2	0	**12**
Dentate	15	4	0	4	1	1	**25**
CWS	20	7	1	10	0	1	**39**
Unknown/ Other	1	0	0	2	0	0	**3**
Total	**40**	**13**	**2**	**19**	**3**	**2**	**79**

Table 14: Distribution of element shapes on straight-edge and curvilinear tools for both dentate and PSS decoration from the End of Dyke Site.

	Rounded Corners	**Squared Corners**	**Triang-ular**	**Trapez-oidal**	**Parallel-ogram**	**Single-Element**	**Irreg-ular**	**Ttl**
Straight-Edge	12	10	5	11	1	0	1	**40**
Curvi-linear	1	1	2	3	0	1	0	**8**
Total	**13**	**11**	**7**	**14**	**1**	**1**	**1**	**48**

Throughout the sequence, horizontal impressions represent the most common orientation. Impressions are most often discrete (simple) but closely spaced, but rocker stamping is common on PSS, dentate, and cord-marked vessels. Unlike in some other assemblages, such as the Bliss Islands assemblages (Black 2004), very little original surface tends to be left undecorated; in contrast, the Bliss Island ceramics are decorated with wide-angle rocked-on decorations that leave most of the surface untouched by impressions.

The most common variation of rocker stamping is a distinctive fan-like design created by rocker stamping with a curvilinear tool. Rocking on the impressions vertically (with the tool oriented horizontally) creates a fan-like column down the side of the vessel, and frequently, these columns occur all around the vessel circumference. Rocking on impressions horizontally (with the tool oriented vertically) creates a zoned band around the vessel. Only one instance of oblique rocker impressions was noted; this occurred on a PSS-decorated vessel (GLNS:160) and was only one of a number of unusual things about the vessel. This design seems to be distinctive to Nova Scotia, at least in the far Northeast: I have been unable to find a reference to curvilinear rocker stamping that creates such a visually striking impression. J. Wright (1967:172–73) identified a sherd with impressions made by a small, curved tool that had been rocked on as a "Saugeen Focus Ceramic" but did not distinguish it from ceramics with straight tool impressions. Another example of curvilinear rocker stamping was reported by Allen (1981), but only in a diagram showing the design; she made no reference to a distinctive design created by the tool, and it appears from the diagram that the tool is not very curved. Some ceramics from the Bliss Islands in New Brunswick (Black 2004) are impressed with moderately curved tools, but these designs could not be described as similar to the Gaspereau Lake fan-like decorations because they are more wide-angled and do not create the effect of a column or band. In contrast, I excavated a ceramic sherd from the Port Joli site on the south shore of Nova Scotia in 2010 that exhibited a similar fan-like column, suggesting that, while the decoration may have existed elsewhere, it was particularly popular in Nova Scotia. Although the sample size is too small to test with any confidence, a chronological trend is apparent, moving from only one instance of PSS curvilinear, to nearly one third of all rocked on dentates being curvilinear, to, finally, a majority of rocked-on cord impressions being curvilinear.

Dentates/PSS

A large degree of variability exists among dentate decorations, and as such, they have required significant refining in order to get a handle on the patterning that exists in the sample. Usually, a dentate decoration refers to discrete elements that are squared or somewhat rounded but that seem like marks that might be left by a row of teeth—hence "dentates." I have separated dentates in the sample into several categories based on recurring element shapes and attributes. All dentate decorations are considered linear except for one example of possible checked-stamp impressions.[35] Therefore, except for this one possible non-linear decoration, tools have been classed as either straight or curvilinear. The tool has also been classed according to whether the elements blend (dentate/PSS) or are discrete (dentate) or continuous (PSS). Finally, individual elements have been classed according to their shape: squared, rounded, triangular, trapezoidal, and parallelogram (no elements were classed as elongate, though I have seen this in other assemblages). One extra category is represented in the End of Dyke assemblage, called "single-element," because the individual elements are indistinguishable and so, even though the tool is not validly classed as a dentate, it cannot be considered anything else, and is most likely to be a very shallow-toothed dentate with some obscuring after impression, possibly by smoothing.

[35] Check-stamping entails applying the decoration with a carved surface area such as a paddle or cylinder stamp.

Cord Marks

Cord marks have been reported here with an eye toward several attributes. Cordage twist (or lack thereof) has been reported and, as Petersen (1996) recommends, the direction has been reported in mirror image to what appears on the pot surface to reflect the original (or positive) cord. Element size has also been reported to better understand the cord character and material. Application technique, orientation relative to the lip, and tool length have been reported to capture data about the tool.

Cordage twist has been of interest to researchers (e.g., Carr and Maslowski 1995; Hurley 1979; Maslowski 1996; Petersen 1996; Petersen and Sanger 1991; Sanger 2003) because it presumably represents direct evidence of a learning lineage. Cordage must be spun (twisted in one direction) in order to make it strong and for the structure of an individual thread, yarn, cord, or rope to be maintained and not fray or come apart (Gibson-Roberts 2006). In order for cord to remain spun, it is often plied, or counter-twisted (or, more simply, twisted), against another cord of the same fibre (Maslowski 1996:89). The original spin direction (two possible directions: counter-clockwise or S-twist, vs. clockwise or Z-twist) is the direction spinners learn to spin. The ply or secondary twist direction is the twist usually recorded by archaeologists (e.g., Petersen 1996) because it is usually discernible, as opposed to spin, which usually is not discernible unless the fibres are particularly coarse. There is no *a priori* aesthetic advantage of one direction over another (Maslowski 1996:89), nor does handedness[36] appear to make one direction more advantageous or comfortable (Petersen and Hamilton 1984; Sanger 2003). Therefore, it would seem that the direction a spinner learns to spin is the direction passed on from the teacher. Because this skill is in large part muscle memory and the development of the ability to perform an unconscious action, it is presumed to remain stable over a person's lifetime and also to be passed on unchanged from generation to generation. Therefore, a break in twist direction is presumed to mean that a new learning lineage was introduced (Maslowski 1996:90).

Claassen (2002:535) proposes that S-twist is most often an indication of thigh-rolled cordage, while the change to Z-twist occurs because of a switch to drop spindles. It would be expected in this situation that drop spindles would be evident in the archaeological record, which Claassen admits does not occur frequently. However, if drop spindles were made of wood as they are in modern contexts, they would be unlikely to be preserved. In any case, the twist direction visible in cord impressions on ceramic surfaces is therefore of interest in understanding ethnicity and learning lineages.

[36] Maslowski (1996:90) acknowledges that deviations from the majority twist direction could result from handedness, as well as from possible differences in learning lineages between the genders. However, most researchers (e.g., Petersen and Hamilton 1984; Petersen and Sanger 1991; Sanger 2003) do not believe handedness should make a difference. My own feeling is that, if there is truly no advantage to one direction over another, as Maslowski and others assert, then handedness should not then be a factor in twist direction. In order to understand the phenomenon better, I looked at modern spinners to see if handedness played a role in twist direction. To do this, I performed an online survey of spinners. Chi-square tests of association between handedness and spin direction, spin direction and spinning method, and spin direction and learning type(book, informal teacher, formal instruction, or self-taught) did not reveal any relationships of statistical significance.

Decorative Groups

The following are summaries of decorative groups defined for the GLR assemblage. These groups were defined based on clustering of the decorative attributes listed above. The full descriptions are listed in Appendix 5.

Fine Straight-Edge Dentate

A straight tool with very small dentates, it is the only tool characterized by truly discrete elements. It occurs on finely tempered, smoothed, thin, reddish ceramics. The dentates tend towards triangular on some sherds, likely the result of a slight angle during impression.

Blended-Edge Dentate

Dentates are connected by a ridge on one side, making the tool look more like a PSS tool on some sherds. Dentates are squared but tend towards trapezoidal. The decoration occurs on brown to buff, moderately thin vessels with Bluish-Grey Quartz temper (see section on temper groups) and represents one of the most standardized of the decorative groups. One vessel lot with this decoration was dated to 1530 to 1375 Cal BP.

Trapezoidal Continuous-Element PSS

This tool is a series of trapezoids connected on one side by a wavy line. It is a PSS tool in that elements are continuous, but with squared corners, causing it to resemble a dentate tool sometimes. Its distinctive shape makes it easily recognizable. It occurs on vessel lots that are thin, evenly formed, and reddish, with variable temper minerals and percentages and predominantly hard pastes; these vessels do not exhibit any particular homogeneity in manufacturing or material attributes.

Precisely Impressed Classic PSS

Impressions made by this tool are crisp and even, and always discrete; they are often laid on in different orientations around the pot to create bands of decoration. The vessels decorated with this tool tend to be thin, reddish, and highly smoothed or even burnished, with various grit temper minerals in low percentages creating fine, hard pastes.

Deeply Impressed Classic PSS

Similar to Precisely Impressed Classic PSS, this tool is characterized by continuous elements, but the tool is so deeply impressed that individual elements are difficult to discern. The two groups would have been placed together except that Deeply Impressed PSS, in all cases, shows a greater tendency toward distinct zoning created by different orientations of the tool to the extent that it seems to be a distinct style. Additionally, the vessels that use this tool are noticeably different from the Precisely Impressed PSS vessels: they are sooty brown to black, thicker, coarser (more temper), and temper minerals are usually white quartz and sometimes mica.

Fine Triangular PSS

This tool is highly variable, occurring on one hand as fine triangular dentates, and on the other, as a continuous-element tool of triangles connected by a thick base. It also occurs as both straight and curvilinear. It is generally rocked on, and in the case of curvilinear tools, creates a distinctive fan-like pattern. This tool group appears to grade into the Fine Straight-Edge Dentate group because each group shares similar highly smoothed surfaces, reddish colour, fine pastes, and temper minerals.

PSS/Dentate Treatment

Surface treatment with a PSS or dentate tool occurs when the tool is rocked on in very tight angles such that no unimpressed surface remains. This creates an all-over texture within which the individual elements are difficult, but not impossible, to discern. Treatment in this manner can often be lightly zoned, often in bands around the vessel or in columns moving down the vessel. At least six vessels were treated in this way, several using a curvilinear tool that created a fan-like appearance similar to the Cord-Marked Fan design. The difference between that group and the PSS/Dentate Treatment group, aside from the different kinds of tools, is that in the former group, the rocker angles are wider such that the individual elements can be discerned and much surface remains undecorated.

Discussion of Dentates/PSS Tools

The above classes show some degree of relatedness to other manufacturing classes. The Triangular PSS/Dentate decorative class occurs on vessels with fine pastes, similar tempering materials, highly smoothed surfaces, distinct and even carbon coring, and reddish-brown colour on both surfaces. Deeply Impressed PSS decorated vessel lots also show some similarities, including a sooty brown colouration, a white-quartz temper, rounded lips and excurvate necks, and a tendency towards horizontal bands consisting of different orientations of discrete impressions. These groups therefore appear to be different not just in decoration tool but in paste and firing attributes as well. Different from both these groups, the Precisely Impressed PSS vessel lots exhibit thin necks, fine pastes, and highly smoothed surfaces. Also, their bright-red to reddish-brown colouration, lack of carbon core, and hard constitutions indicate that they probably experienced oxidizing, high-temperature firing regimes. A similarity among temper types and clay colouration can be observed in the case of Blended-Edge Dentate decorated vessels, many of which contain distinctive blue-grey quartz as well as grog/iron oxide, and are made with white to buff-coloured clay. The relatedness of PSS/dentate decorative groups to differing manufacturing attribute clusters likely means that decoration tools indicate different technological groups.

Some attributes are common across most classes of PSS/dentate decorations. These attributes include a tendency toward hard pastes, a predominant lack of coil breaks and vertically oriented lamellae, smoothed interiors, and gently scalloped lips.

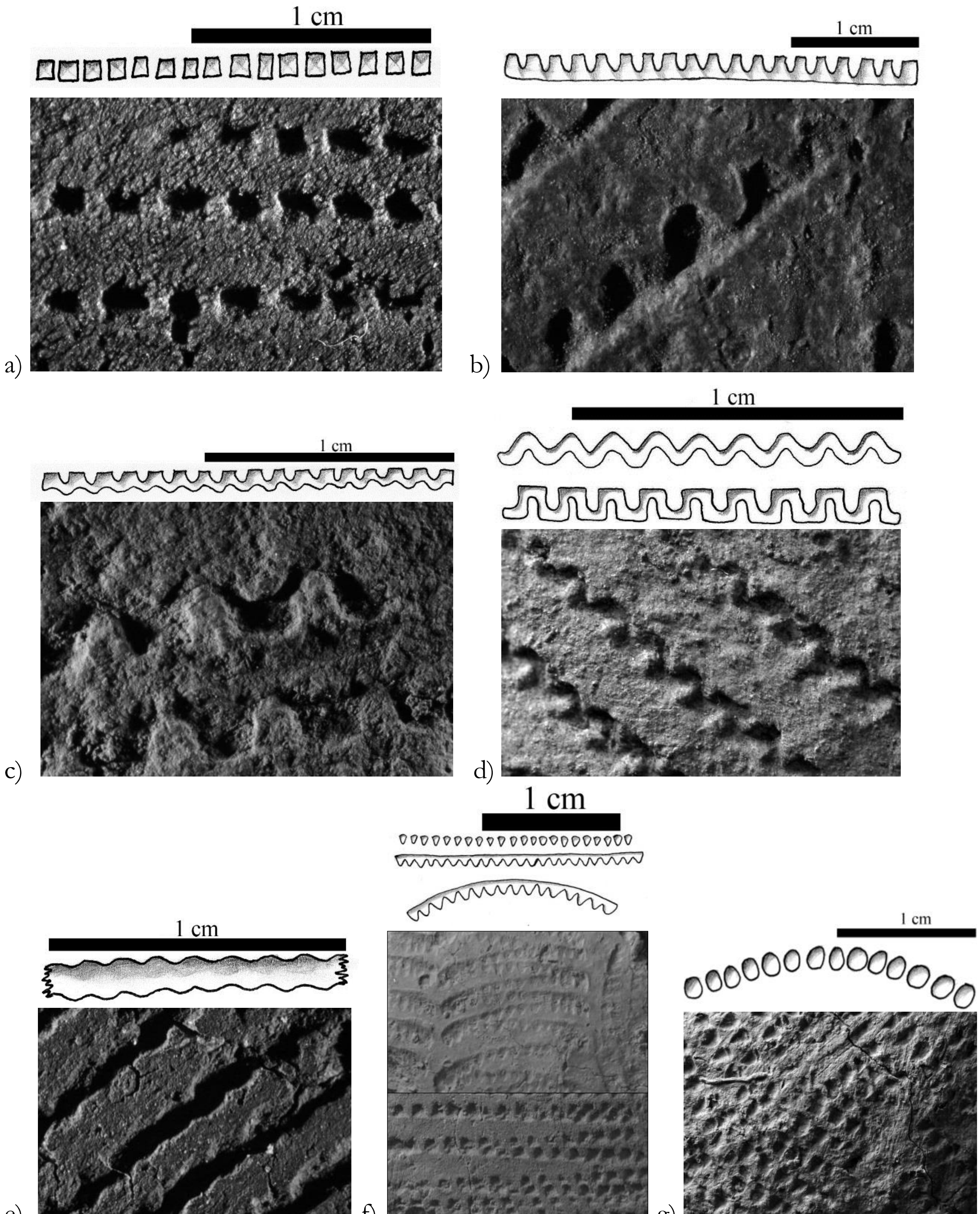

Figure 12: PSS and dentate decorative groups in the GLR assemblage: a) Fine Straight-Edge Dentate; b) Blended-Edge Dentate; c) Trapezoidal Continuous-Element PSS; d) Precisely Impressed Classic PSS; e) Deeply Impressed Classic PSS; f) Fine Triangular Dentate; g) PSS/Dentate Treatment.

Tightly Plied Cord-Wrapped Edge

This decoration tool consists of discretely spaced cordage elements that have a tight ply, as the name implies. I arbitrarily divided this group from a similar group, Loosely Plied Cord-Wrapped Edge, using the criteria that it should have an average of three or more beads across all elements. The group does not exhibit significant clustering of other manufacturing attributes, but as with many cord-marked pots, the vessels tend to be relatively thick (>7mm) and temper percentages tend to be relatively high (>20%). Two vessel lots were AMS dated and calibrated to 1350 to 1290 BP (GLNS:61) and 1400 to 1300 BP (GLNS:94).

Loosely Plied Cord-Wrapped Edge

This tool is a variety of the previous group, the only difference consisting in fewer than three beads averaged across all elements. The group is similarly heterogeneous to its tightly plied counterpart, indicating that it does not line up with manufacturing attributes and therefore does not represent a technological group. Two vessels in this group, GLNS:135 and GLNS:38, have been AMS dated and calibrated to a two-sigma range of 1290 to 1090 Cal BP and 900 to 725 Cal BP, respectively.

Unplied Cord-Marked Fan

The Unplied Cord-Marked Fan group is characterized by a curvilinear tool that has been rocked on at tight angles, creating a fan-like pattern down the side of the vessel or in a band around the vessel. Many of the tools appear to have been made by affixing porcupine quills to a curved edge. Unlike some other cord-marked pottery, this group exhibits the tightest clustering of any decorative group along lines of forming, firing, and paste attributes, making the tool and its accompanying decorative strategy a marker for one of the most distinctive and homogeneous groups in the sample. Two subgroups are apparent within the group: one is tempered with grit and iron oxide, while the other contains organic temper or a mixture of organic and grit temper alongside iron oxide. All grit temper is feldspar-poor and many vessel lots contain Bluish Grey Quartz temper. As discussed in the section in this chapter on temper and in Chapter 4, the significance of the lack of feldspar is that a single, non-glacially moved source of granitic pegmatites is likely represented in these ceramics, and therefore, a single, local source was repeatedly accessed. Ubiquitous U-shaped or oblique wall lamellae and pronounced coil breaks indicate a homogeneous manufacturing practice, and the hard pastes with distinct carbon core appear to represent a common firing practice that probably involved high heat and fast cycles. The heterogeneity of these attributes in contrast with other decorative groups probably represents increased production and standardization (see Chapter 4).

Cord-Wrapped Stick (CWS)

As previously discussed, CWS has been designated only for those tools that exhibit evidence of being cord wrapped on a dowel rather than on an edge. The group named CWS exhibits this evidence: a slight tilt of the elements relative to the axis of the dowel, a trough where the dowel has been impressed into the clay, and a semi-circular shape to the cross-section of the elements. The group comes in two varieties: tightly wrapped, in which the elements articulate and loosely wrapped, in which the elements are discrete. While there is not a great deal of homogeneity in the other attributes of this group, it is significant that they appear to ubiquitously lack the Bluish-Grey Quartz temper, meaning that the decoration tool is indicative of a technological group that did not access this popular temper source (see the next section on temper).

Tightly Wrapped Variety

This variation of CWS occurs on hard vessel lots with grit temper that is not Bluish Grey Quartz temper and that are not channeled on their interiors. This suggests that they were made in a different manufacturing context than the majority of cord-marked vessels at Gaspereau Lake. However, the sample size is insufficient to evaluate whether they constitute a cohesive group.

Loosely Wrapped Variety

This variety of CWS exhibits homogeneity in the forming attributes of oblique-to-the-outside lamellae and pronounced coil joins, but lacks homogeneity of paste characteristics. Importantly, the temper materials in this group range widely, but as in the tightly wrapped variety, no instance of bluish grey quartz was noted, meaning the materials are somewhat different from the majority of cord-marked pottery in the sample.

Fine Plied Cord-Wrapped Stick

This tool consists of markedly fine cord elements that are applied discretely as well as rocked on to create delicate, crisp impressions. They occur on four vessel lots that bear similarities to each other in their buff-coloured clay, their inclusion of organic temper, and their thickened lip forms. Only one is channeled.

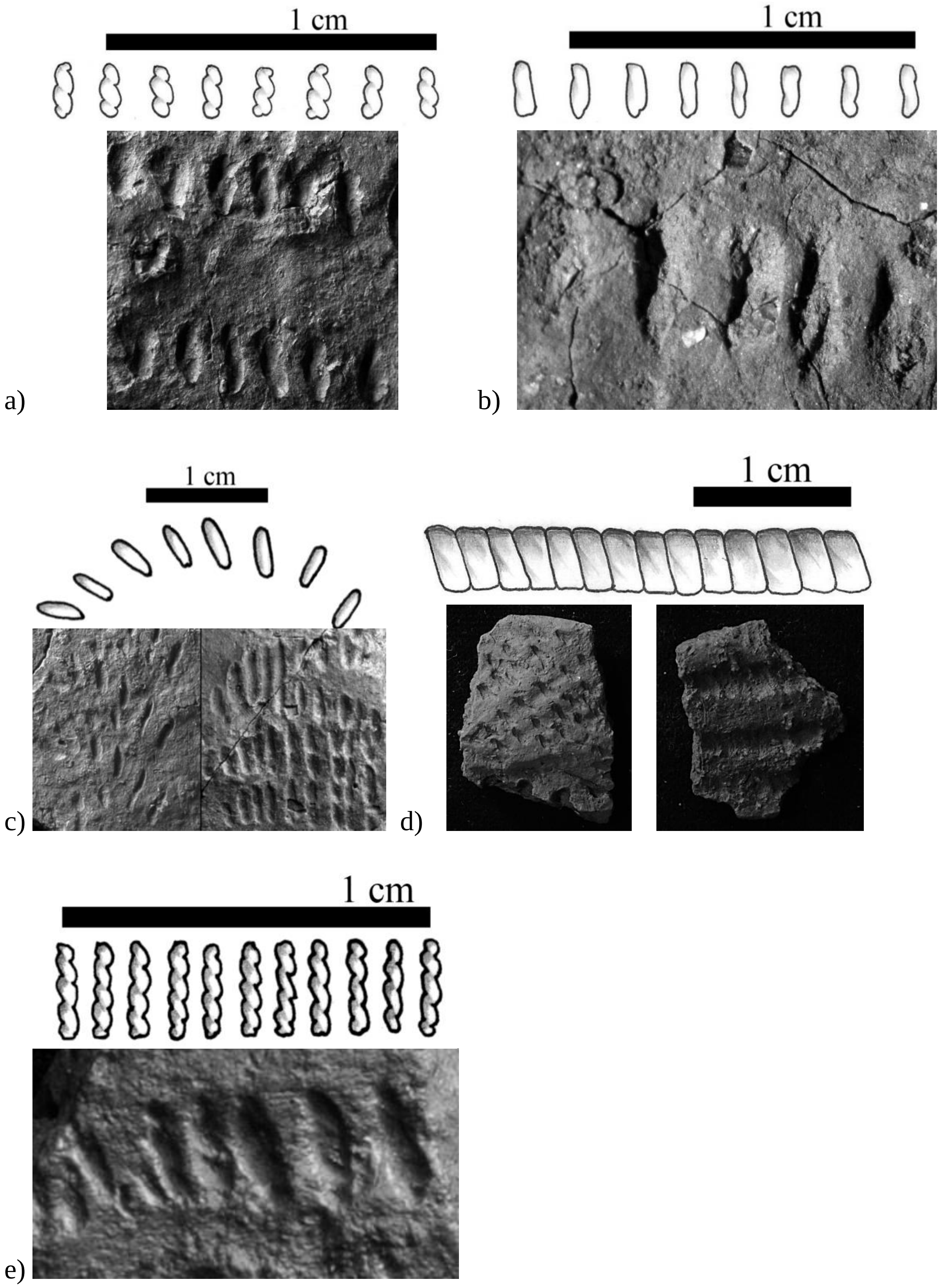

Figure 13: Cord mark decorative groups in the GLR assemblage: a) Tightly Plied Cord-Wrapped Edge; b) Loosely Plied Cord-Wrapped Edge; c) Unplied Cord Fan; d) Cord-Wrapped Stick (loose and tight varieties); e) Fine Plied Cord.

Discussion of Cord Marks

Cord-mark decoration classes show homogeneity within some classes, particularly the Unplied Cord-Mark Fan class, but heterogeneity within other classes. This may indicate that some manufacturing traditions were tied to particular decorative techniques while others were not. This is in contrast to the dentate and PSS decorative groups, which mostly exhibit some degree of homogeneity of other attributes within groups.

One feature of many cord-mark decorations observed in the GLR ceramics is that these decorations are frequently applied in less careful manner than many PSS and dentate decorations. Cord marks are often obscured by overlapping decorations made by other tools. Also, cord marks are often difficult to discern because less care has been taken in precisely impressing them into the surface, in contrast to many carefully placed and pressed PSS and dentate decorations (but see Foulkes 1981:205). This situation has been remarked upon by other researchers (Keenlyside 1999:66; Nash and Stewart 1990:108). Not all cord-mark decorations in the GLR assemblage are carelessly or hastily applied, and there is no easy way to quantify the difference between cord-marked, PSS, and dentate decorations on the basis of "messiness" that I have found. Nevertheless, the difference is discernible among later ceramics, not only from the End of Dyke Site, but other sites in the Maine–Maritimes Woodland as well (e.g., Bourgeois 1999; Bourque 1995; Foulkes 1981).

Table 15: Date ranges for decorative types acquired from AMS dating of carbonized residues from vessel interiors.

VL	Date (2 Sigma)	Decorative Class
28	Cal BP 900 to 725)	Loosely Plied Cord-Wrapped Edge
143	Cal BP 1175 to 980	n/a
135	Cal BP 1287 to 1089	Loosely Plied Cord-Wrapped Edge
61	Cal BP 1350 to 1290	Tightly Plied Cord-Wrapped Edge
93	Cal BP 1368 to 1175	Cord-Wrapped Stick (Loose Wrap)
94	Cal BP 1400 to 1300	Cord-Wrapped Stick (Loose Wrap)
122	Cal BP 1405 to 1305	Unplied Cord-Marked Fan
160	Cal BP 1525 to 1355	Fine Triangular PSS
82	Cal BP 1530 to 1375	Blended-Edge Dentate
86	Cal BP 1560 to 1410	n/a

Decorations: Discussion and Conclusions

Capturing more nuanced categories of surface decorations yields tenable categories of vessel lots that have both manufacturing and chronological significance. For both PSS/dentate decorations and cord marks, some categories exhibit more adherence to a set of criteria, while others exhibit the opposite. There are some general trends that can be delineated. First, PSS/dentate decorations are strongly associated with vertical lamellae and a lack of coil breaks, while cord marks are strongly associated with oblique lamellae and many coil breaks, some of which are pronounced. This strongly suggests a difference in manufacturing practices between the Middle and Late Woodland Periods. In addition, some cord-marked groups exhibit more pronounced coil breaks than others, suggesting that certain decorative cord marks are associated with more paddling during manufacture.

MORPHOLOGY AND FORMING ATTRIBUTES

In this section, I examine the attributes connected with morphology and forming techniques. In the cases of both dimensions of the GLR ceramic assemblage, a relatively small amount of information can be gained by looking at the pottery sherds. In the case of morphology, this is because the sherds are generally not large enough to take account of shape, thickness, diameters, or capacities across more than a handful of samples, and so analysis is limited to fairly low-level inferences. In the case of forming techniques, unravelling the practices is difficult based only on sherd attributes, since many of the traces of forming—such as finger marks, anvil marks, or cord impressions—have been obscured by subsequent treatments and decorations. Nevertheless, the data presented below lead to some rich insights about manufacturing changes through time.

MORPHOLOGY

The GLR ceramics fit assumptions about morphology to some extent. The conoidal jar reported ubiquitously across the Maine–Maritimes Region also is the majority shape in the GLR assemblage (Figure 22). In this section, I show through statistical analysis that the prediction by Petersen and Sanger that vessel necks are thinner in association with PSS- (and possibly dentate-) decorated vessels is accurate for the Locus 1 and Locus 3 samples. However, the relationship is not rigid, and plenty of variability exists in neck thickness among all decorative classes. I also examine diameters of vessel lots in order to estimate capacities and the relationship to thickness. This helps in understanding the skill level of potters through time and the degree of standardization.

Neck Thicknesses

The most significant morphological finding is that neck thickness increased through time. The importance of this finding lies in its correlation with decreased paddling and the ubiquitous practice of channeling later in the sequence, because it indicates that vessel manufacture became less labour-intensive through time. Vessel lots decorated with PSS tend to be thinnest, especially compared with cord-marked vessel lots (see Appendix 8). Dentate-decorated vessel lots also tended to be thinner than cord-marked vessel lots, but the range of variation is wider than for PSS-decorated vessels. Statistically, the three groups of decorative tools are distinguishable by neck thickness, indicating that manufacturing practices changed through time; however, in all three groups, significant variability is apparent, showing that no hard and fast rules or restricting mechanisms caused thicknesses to vary reliably and predictably.

Although little difference exists between the thicknesses of PSS- and dentate-decorated vessels, a high probability ($p<0.0001$) exists that differences between cord-marked vessels ($n=50$, mean=0.75 cm, s.d.=0.12 cm) and PSS-decorated vessels ($n=12$, mean=0.56 cm, s.d.=0.16 cm) are significant (t-score=4.6). There is also a slightly less strong, but still significant at the 0.1 level (*p*=0.06, *t*-score=1.97), difference between cord-marked vessels and dentate-decorated vessels (*n*=12, mean=0.66 cm, s.d.=0.21 cm). Taking decoration groups as coarse-resolution time periods, these differences indicate a progression from a tendency to be thinner during the early Middle Woodland to thicker during the late Middle Woodland and finally to be even thicker during the Late Woodland.

Vessel Diameters

It is expected that neck thickness would be dependent on vessel size to some extent because the larger the pot size, the greater the wall thickness has to be to support the pot's weight during manufacture. However, the relationship between vessel capacity and thickness is more complicated than expected. The only attribute that could be reliably compared with thickness is rim diameter, which is not necessarily indicative of vessel capacity, but because the range of shapes is limited to open-mouthed jars, its relationship with capacity is at least partly predictive. Interestingly, the only group of vessel lots that exhibited this relationship was the dentate-decorated group, which showed a very strong correlation between diameter and wall thickness within the (albeit small) Locus 3 sample consisting of five vessel lots (*n*=5, R=1, R^2=0.99, *p*=0.0003) and a similar result for dentate-decorated vessel lots in the entire sample when outliers are removed (*n*=8, R=0.9, R^2=0.95, *p*=0.001 (see Appendix 8:). In contrast, the larger group exhibits no correlation between neck thickness and neck diameter (R^2=0.025 on *n*=40), with similar results for the smaller PSS-decorated and cord-marked groups.

Vessel Capacities

The nature of the assemblage prohibits comprehensive comparisons of vessel morphology. Because most of the pieces are small (<5 cm maximum length), and vessel lot reconstruction has proven time consuming and tentative, only fragmentary morphology is accessible for most of the assemblage. This narrows the problems that can be investigated using morphology, and in particular, the identification of groups or classes is not possible.

In some cases, more of the vessel remains and refits are possible, making the shape and size of the original vessel apprehensible. Some of the vessel lots for which this is the case are unusual in their shapes and sizes, and the range of vessel sizes is impressive. Some are unusually small and thin-walled (~2 ltrs), while others are remarkably large and seem most likely to have been intended for serving large groups (>25 ltrs). Unfortunately, little else can be said about the quantitative distribution of morphological attributes because of the fragmentary nature of the assemblage.

Forming Techniques in the GLR Ceramic Assemblage: Coiling and Paddling

The GLR ceramics appear to have been built predominantly using the coiling and paddling method based on the observation of coil breaks and lamellar character in a majority of vessel lots. Evidence for this comes from frequent occurrences of coil breaks, occasional anvil marks on interior surfaces, lamellar wall character, and lamellar splitting (Rye 1981:84–85). 97 vessel lots in the Locus 1 and Locus 3 samples have coil breaks on at least one sherd, whereas 84 vessel lots have no reported coil breaks on any sherds. This ratio represents roughly equal numbers of vessels with and without coil breaks (54% and 46%, respectively). Although many vessels lack visible coil breaks, lamellae—another attribute indicating paddling—are ubiquitous with only a few specimens having no or minimal lamellar character.

Coil-building consists of rolling out clay into snake-shaped coils, placing them in rings each above the last, and using the thumb and forefinger to smooth each coil into the last until an approximate bowl or jar shape has been achieved. In the ethnographic literature, this method is almost always accompanied by subsequent paddling to further join the coils together, thin the walls, shape the jar more precisely, and smooth or texturize the exterior surface (e.g., Arnold 1985:202–12; Gosselain 1992, 2000, 2008; Neupert 2007; Wallaert-Pêtre:2001:478). Despite this paddling and strengthening process following the coiling process, coils often represent a source of weakness in the walls, evident in a tendency for coil-built vessels to break along these horizontal fault lines (Shepard 1956:183).

Evidence for Coiling and Paddling

Lamellar character is the tendency of the clay body to foliate (separate into plates or sheets) as a result of the paddling. The foliated appearance is visible in broken wall cross-sections of sherds, except where the break occurs along a coil join. Paddling compresses the wall, evenly thinning sections of the wall while at the same time encouraging layers of clay to divide where the clay body slides past temper particles (Rye 1981:85). Because of the striking angle of the paddle perpendicular to the exterior vessel surface, clay spreads in all directions parallel to the wall axis; therefore, foliation tends to occur parallel to this axis also, and lamellae (the sheets thus created) become increasingly regular, straight, and parallel to the wall axis with increasing degrees of paddling. Therefore, vessels that have received no paddling exhibit no foliated appearance or lamellar character, while vessels that have received intensive paddling exhibit perfectly vertical lamellae relative to the wall axis. Some paddling will result in imperfectly smoothed lamellae, and lamellar character can exhibit a range of oblique and curved orientations.

Coil breaks and lamellar character are variables dependent on the degree and technique of paddling. Therefore, they are indices of amount of paddling and also give clues about how paddling was used and at what stage in the manufacturing sequence. The importance of understanding paddling degree and technique consists of understanding the overall labour-intensity of the manufacturing process. Because the paddling stage is not, strictly speaking, necessary to vessel construction, it can be decreased or skipped if the potter prioritizes quick turn-around of vessels or is less worried about vessel failure.

Statistical Analysis

In order to better understand and recognize the traces of how potters treated this stage of the manufacturing process, I investigated the relationship of coil breaks to lamellar character using statistics.

Initially, I sought to identify the most likely source of compression in the wall. Because lamellae can potentially have developed as part of another activity that compresses the wall and squeezes clay past temper particles, I looked at a number of ethnographic sources to determine the likelihood that the lamellae were developed as a result of paddling or another action. By no means an exhaustive sample of ethnographic examples was compiled (*n*=54). It was nevertheless enough to test the likelihood that paddling occurred alongside coiling as a rule. Forming practices noted included coiling, throwing on a wheel, moulds, and drawing of a lump. Paddling was noted where it was mentioned as part of the manufacturing practice. A Chi-square test showed that paddling is likely to be associated with coiling, while moulds and wheel throwing are likely to entail no paddling as part of the manufacturing process (χ^2=26.9402; *p*<0.001, *n*=54). Distributions are reported in

Table 16: Distribution of ethnographic examples of ceramic manufacture that use paddling compared with those that use coiling.

	Coiled	**Not coiled**	**Other**	**Total**
Paddled	13	6	3	**22**
Not Paddled	1	13	0	**14**
Other	5	3	9	**17**
Total	**19**	**22**	**12**	**53**

Lamellar coarseness and direction (oblique inside, oblique outside, horizontal, vertical, and U-shaped) were tested against proportion of vessel lots with coil breaks with a Chi-square test. The result shows that lamellae are more likely to be vertical when associated with a lack of coil breaks and vice versa, significant at the *p*<0.05 level and just shy of the 0.01 level (χ^2=6.1, *p*=0.014, *n*=69). These results show that vertical lamellae result from the same process that causes a lack of coil breaks, while oblique and U-shaped lamellae result from the same process that causes coil breaks.

Table 17: Table 2: Distribution of vessel lots with coil breaks compared with lamellar direction.

	Oblique/U-Shaped	**Vertical**	**Total**
Coil Breaks	34	11	**45**
No Coil Breaks	11	13	**24**
Total	**45**	**24**	**69**

Table 18: Distribution of vessels with coil breaks compared with decorative type.

	PSS	**Dentate**	**Cord Marks**	**Total**
Coil Breaks	4	10	57	**71**
No Coil Breaks	12	35	24	**71**
Total	**16**	**45**	**81**	**142**

A Chi-square test found a high probability that the presence of coil breaks depends on the decorative class to which the vessel lot belongs (χ^2=31.3, *p*<0.0001, *n*=142). As can be seen in

Table 18, a much larger number of cord-marked vessel lots exhibit coil breaks than lack them, while for both dentate- and PSS-decorated vessels, coil breaks are much less frequent. One possible explanation for this is that cord-marked vessel lots tend to include larger numbers of sherds, likely increasing the chance that they will include coil breaks. To test for this, I performed the same test on 100 randomly selected sherds that met the criterion that they belong to one of the three main decorative classes. Significance was not as high, but still revealed a high probability of dependence (χ^2= 7.9, p=0.019, n=100). Another test of randomly selected sherds resulted in a similar score.

Results

Despite the ubiquity of evidence for coil-building, there is significant variability in paddling practices. This is evidenced by a range of coil break attribute states, from completely obscured coils (no coil breaks) to rough coil surfaces that were well-joined to smooth coil surfaces that were poorly joined. The last case indicates that paddling was minimal or did not occur at all. Lamellar character also indicates the degree of paddling, with extensive paddling accompanied by coarser lamellar character, while fine lamellae indicate less extensive paddling. A lack of lamellae indicates that no paddling occurred.

Lamellar character can be roughly divided into two groups that indicate differential paddling. In the first, intensively paddled, group, vertical lamellae are statistically correlated with a lack of coil breaks or very rough coil breaks, and these ceramics are strongly associated with PSS and dentate decorations. This group also frequently exhibits lamellar splitting and thin walls. The other, minimally paddled, group is characterized by oblique and U-shaped lamellae, which correlates with pronounced and smooth coil breaks, and is strongly associated with cord marks. The three decorative groups show a progression as follows: 1) PSS-decorated vessel lots exhibits the fewest coil breaks, the thinnest walls, and the most vertically oriented lamellae; 2) dentate vessel lots exhibit some coil breaks (usually rough), usually vertical but some oblique and U-shaped lamellae with variably thick walls; and 3) cord marked vessel lots exhibit the most coil breaks (usually pronounced), with predominantly U-shaped or oblique lamellae and thicker walls on average. Therefore, a decrease in paddling through time is evident, and the shift appears to occur during the period when dentates were popular decorations.

Decorative Associations with Coil Breaks

In order to investigate whether forming practices changed through time, I tested the distribution of coil breaks compared with the decorative classes of PSS, dentate, and cord marks. As previously noted, these decorative classes are often reported as chronological categories, the first two typically representing the Middle Woodland while the last represents the Late Woodland. Based on this assumption, a difference in forming attributes among the decorative classes indicates a substantial change in learning lineages from the Middle to the Late Woodland. The attributes that changed through time—coil breaks and lamellar direction—indicate that paddling became less intensive through time.

Discussion

Forming attributes indicate different manufacturing practices between the Middle and the Late Woodland Periods. These attributes result from coil building and paddling, and differences in these attributes, such as lamellar direction and presence/absence of coil breaks, indicate differential degrees of paddling. The association of coil breaks with cord marks indicates a chronological significance for decreased paddling, meaning that variability in the number of coil breaks and lamellar texture and direction are not simply a function of natural variation expected within a learning framework in which potters were often imported by marriage and possibly by other means. Instead, this indicates a shift in the priorities of potters, such that intensive paddling was not a concern during the Late Woodland, although paddling was not abandoned as a technique. The benefits of smoothing out coil joins and compacting the wall through paddling were clearly still desirable during the Late Woodland, but the highly precise, thin pots characteristic of the Middle Woodland were no longer a high priority.

The fact that dentate decorations overlap the two paddling groups probably indicates that a shift was occurring at the transition from the later Middle Woodland to the earlier Late Woodland. Perhaps more importantly, it indicates that dentates do not line up well with this manufacturing practice since the dentate decorative group spans two different manufacturing groups. A closer look at the decorative groups within the dentate category shows that some groups exhibiting more clustering of attributes, such as the Blended-Edge Dentate group, have a higher incidence of coil breaks and oblique lamellae, whereas vessel lots that do not cluster with other vessel lots tend to have no coil breaks and vertical lamellae. This indicates that some dentate-decorated pottery was being produced in larger amounts and was being less extensively paddled than the earlier PSS-decorated pottery. The fact that Blended-Edge Dentate pottery shares paste similarities with later cord-marked groups (see the section in this chapter on paste groups) shows that a break from earlier dentate- and PSS-decorated pottery occurred sometime before or at the transition to the Late Woodland.

Explanations for the shift may partially lie in the benefits and drawbacks of intensive compared with expedient paddling. While in the latter case, coil breaks are clearly a source of weakness in the structural integrity of the vessel, the importance of this weakness to the performance of the pot in its intended capacity is not necessarily great. Archaeologists frequently find sherds with coil breaks evident, but must remain cognizant of the likelihood that this common breakage pattern may be the result of post-depositional mechanics such as trampling, interment amidst other heavy and sharp material, and disturbance. In these cases, the strains placed on the vessel wall will be different from the stresses of cooking, storage, and transport. Therefore, decreased paddling may not represent a weakened cooking vessel.

In contrast, there is some evidence that a highly compacted and thinned wall, such as that achieved through intensive paddling, will be susceptible to thermal stresses to a greater degree than a less compacted wall. Lamellar splitting is a direct result of heat in some cases; GLNS:79 is one such case. It appears to have suffered significantly more heat than its walls were capable of handling, and the interior surface is severely exfoliated where it is the worst charred. Thus, although in some cases exfoliation and lamellar splitting may well be the result of post-depositional factors such as freeze-thaw action, in at least this one case, heat expansion of temper particles was the primary cause, showing the dangers of a too-compact, too-thin wall.

CONCLUSION

The GLR ceramics assemblage reveals a change through time in manufacturing practices that shows a complicated shift from the Middle to the Late Woodland Periods. Earlier in the sequence, ceramics marked with PSS and dentate decorations tended to have been well paddled and carefully decorated. They also tended to exhibit loose clustering, but no degree of standardization is evident, and self-expression appears to have been important in the manufacture and decoration of early vessels. Conversely, later in time, potters changed their firing regimes and increased amounts of iron oxide temper, both of which increase fabric hardness. However, the degree of paddling went down, causing coil breaks to become nearly ubiquitous and probably constituting a significant source of weakness in the vessels that were produced. At the end of the sequence, temper percentages increased and firings tended towards reduced atmospheres and softer fabrics—probably the result of lower firing temperatures—that may have been better able to withstand thermal shock. These changes were not gradual; rather, successive traditions appear to have modified manufacturing practices to accomplish somewhat different goals.

The variability reported in this chapter leads to some inferences about the ceramic manufacturing tradition at Gaspereau Lake. These inferences are the subject of the next chapter, and, briefly, can be summarized as follows. First, ceramic manufacture very likely took place at Gaspereau Lake and produced the majority of the ceramics in the Locus 3 sample. Second, paddling decreased significantly from the Middle Woodland to the Late Woodland periods, indicating that manufacturing practices had changed, and therefore, potters' priorities had changed. In the next chapter I propose that pottery made later in time was manufactured in larger numbers than early pottery was, and also that pottery exhibits increasing standardization later in time.

CHAPTER 4: CERAMIC MANUFACTURE AT GASPEREAU LAKE

In the previous chapter, I identified groups defined along the ceramic manufacturing dimensions of paste attributes (temper and clay), decorations, morphology, and forming techniques. Grouping the ceramic attributes in this way allowed a glimpse into the mechanisms that may have caused the ceramics to take the forms that they did, and to see how those forms changed through time. This allowed a number of low-level inferences to be formed about the ceramics, which led to several higher-level inferences about the history of ceramic manufacture at Gaspereau Lake. These inferences are the subject of this chapter, and can be summed as follows: 1) ceramic manufacture likely occurred locally at Gaspereau Lake; 2) potters increasingly cut corners later in time; 3) scale of production increased through time; and 4) pots exhibit increasing standardization in some attributes. These broad premises add up to a conclusion of increasing specialization of pottery manufacture through time.

The GLR Ceramic Assemblage: Shifts and Trends

Middle Woodland pots were clearly intended as cooking vessels. This is evident in the fact that they are almost all tempered, a practice that is only important if a vessel needs to withstand thermal shock (Braun 1986; Bronitsky and Hamer 1986). This is also most likely the cause for the enduring open-mouthed and conoidal-based jar form found throughout the Middle and Late Woodland Periods. The fact that Middle Woodland vessels *were* used as cooking pots is evident in exterior sooting, carbonized foodstuffs on interiors, and—in rare cases in the GLR assemblage—use-wear in the form of abrasion from stirring and being placed on rocks in a fire. Therefore, the interest of Middle Woodland potters in also incorporating highly compacted walls, finer pastes, intricate surface decorations, and highly smoothed surfaces into their pots seems to indicate an additional concern with signalling something through pottery. Because this additional concern can be detrimental—and is, on occasion, in the form of lamellar splitting—the signalling is costly and represents an investment of labour into identity in addition to resource procurement and processing (Carr 1995; Hayden 1995; Neff 2014; Voss and Young 1995; Wiessner 1983).

In contrast, Late Woodland pottery does not show this same degree of concern with signalling. Walls tend to be thicker and less intensively paddled, and decorations—a wide variety of cord mark types and applications, as well as punctates, trailing and incision, and other decorative tools—are less precisely spaced, more variable in zoning, and more expediently applied (see Chapter 3). There is also some indication that some vessels were significantly larger during the Late Woodland. One attribute of Late Woodland pottery that may have resulted in greater labour costs is that paste textures appear to increase in coarseness to the point of decreased workability, making vessel wall forming more difficult and probably requiring significant skill to handle. Increased coarseness of the paste seems to indicate a singular focus on better thermal shock resistance, because other performance characteristics (Skibo and Schiffer 2001) are compromised in a coarser paste, including green strength, clay workability, abrasion resistance, and impermeability (Skibo and Schiffer 2001). Finally, channeling is reserved entirely for Late Woodland pots, whereas channeling appears to be an early Middle Woodland attribute in some other parts of the Maine–Maritimes Region (Petersen and Sanger 1991:124–25). The reason for this near-ubiquitous channeling of Late Woodland pots is not clear, but some (Schiffer et al. 1994) have suggested that a corrugated surface, such as that created by channeling, would increase thermal shock resistance. In contrast to Middle Woodland pots, then, Late Woodland pots seem to show the potters' interest in high-performance, specialized cooking pots uncompromised by aesthetic concerns with fineness, smoothness, and daintiness, and also with multi-purpose accessibility and faster turn-around times. Late Woodland pots signal instead a connection to food resources and a more defined consumer group (cooks), prioritizing an emphasis on pots as more dependable tools.

The Question of Specialization

In this chapter, I will argue for increasing specialization in ceramic manufacture at Gaspereau Lake toward the Late Woodland. The argument is based on Costin's (1991, 2001) definition of specialization as manufacture with the intention of distributing surplus for personal gain as well as on her evidence base for specialization. The case cannot be made with certainty because too little evidence currently exists for manufacturing locale, residential and other structures, and the importance of ceramics in economic, political, and subsistence terms. However, evidence from the ceramics and from the End of Dyke Site as a whole suggests that part-time specialization is responsible for the increased emphasis on expediency later in time. Although these attributes do not constitute evidence for specialization, they suggest the possibility of specialization. One difficulty that will be looked at is whether specialization can also encompass a situation in which there is no evidence for surplus but instead evidence for high-quality products, such as the pottery produced earlier in time at Gaspereau Lake. A careful examination of the evidence will be used to support a hypothesis that specialization was occurring from the Middle Woodland onwards, but that increased production and different organizational structures came into existence during the transition to the Late Woodland Period. Costin's framework for recognizing specialization will be used to build the hypothesis.

Costin sets out several conditions for evidence of specialization. First is identifying the mode of distribution of artifacts (Costin 1991:21). When an artifact class or type is a majority item at one site and is made at that site, but also occurs at other sites in smaller numbers, the fact of distribution can be inferred, even if the details cannot. Differential participation is another indication of specialization, and can be inferred if some households contain evidence of manufacture of an item while others do not. A third line of evidence comes from finding fewer production facilities than previously, which can indicate that specialists are pushing each other out or consolidating resources; however, it is important to recognize the difference between consolidation and simple decreased demand (Costin 1991:22). A fourth line of evidence is the increased standardization of attributes that have to do with unconscious habits, motor skills, and low-level economic concerns (Costin 1991:36). Fifth is the absence or lower numbers of student pots and mistake pots, as it is presumed that students will learn in a different context and mistake pots will be recycled before being fired (Costin 1991:36). Finally, Costin (1986; 1991:20) shows that the percentage of used pots should be low.

In the following sections, I make comparisons to the GLR ceramics using data from other sites and assemblages in Nova Scotia and New Brunswick. These assemblages include the L'sitkuk Bear River (LBR) ceramics studied by Erskine and later by Owen et al. (2014), the St. Croix ceramics studied by Godfrey-Smith et al. 1997), the George Frederick Clarke (GFC) assemblage that I researched previously (Woolsey 2010), and several other assemblages from around New Brunswick held by Archaeological Services (Woolsey n.d.). In the former two cases, I use data published by the authors. In the latter two cases, data were acquired during my own research. As such, the datasets may not be precisely comparable, and they are meant as a preliminary investigation only.

CERAMIC MANUFACTURE AT GASPEREAU LAKE: AN *IN SITU* MANUFACTURING TRADITION

Evidence from the GLR assemblage suggests ceramic manufacture at or near the End of Dyke Site, as discussed in Chapter 3. The large assemblage and the presence of many hearths on the site initially suggest this hypothesis, but evidence from homogeneous raw materials and low numbers of use wear observations support a nearby manufacturing locale. Because the site was probably related to local manufacture, the ceramic assemblage can be treated as an *in situ* manufacturing tradition; additionally, very few imports were discernible and most vessels could be contextualized chronologically. The result was a number of fairly well-delineated traditions, which will be dealt with in the next chapter.

The most obvious characteristic of the GLR assemblage is the large degree of variability. This is easiest to perceive in the decorative tools and strategies that have been used, but vessel shapes and pastes are also quite heterogeneous. However, the assemblage is homogeneous in several respects that are important to understanding the internal logic of the assemblage. Perhaps most important is the repetition of certain temper minerals and of clay colour. While decorations do not easily line up into categories of similarity, sources of raw materials appear to have been regularly accessed through time. The variability in decorative tools and strategies suggests that many people, with slightly different decorating techniques, made pottery at Gaspereau Lake, while the similarities of temper minerals across multiple categories of decoration show that these differing ceramic traditions all occurred at Gaspereau Lake or nearby. Further evidence comes from some ceramic objects that conform to these homogeneous attributes of the majority of sherds, but in addition, are not likely to have been found outside of a manufacturing locale. The distribution of artifacts is best understood as a palimpsest in which much of the evidence for manufacture has been scraped away by subsequent occupational surfaces.

Raw Materials Acquisition

One of the most influential models for understanding raw materials and ceramic manufacture is Arnold's (1985:53) proposal that—according to the ethnographic literature—potters generally will not travel more than 3 km from their manufacturing location to acquire clay, while the distance is somewhat more for temper (also Druc 2013:490–91). He added that distances may increase if potters have access to boats for transport, which potters in this region almost certainly did (Blair 2009; Bourque 1994, 2001; Clarke 1968; Rutherford 1991; Tappen-Adney 1964). The materials used to make the pots in the GLR assemblage were probably acquired within the vicinity of Gaspereau Lake based on the patterning in clay and temper; however, this could reasonably encompass an area longer than 10 km if travelling by boat, and long if on foot. According to Druc (2013; see also Kramer 1991:225–28), such a range is conceivably still within what could be considered "local." Evidence was presented in Chapter 3 for homogeneity along two axes of raw materials attributes: 1) feldspar-poor granite with a distinctive bluish-grey quartz particle in a majority of sherds, and 2) an unusually large-particled and light-coloured clay in a majority of sherds. These majority attribute states suggest that manufacture occurred at or near the End of Dyke Site, since it is more likely that the same raw materials, rather than the same source of finished pots, would be carried over any kind of distance unless a relatively complex economic system—such as markets or central place redistribution that dealt in pots—were in effect.[37]

Two problems arise in identifying a manufacturing location based on the compositional and archaeological data reported here. The first issue is that a geographical location for sources of temper and clay have not been identified because sourcing materials was outside the scope of this research. Homogeneity of tempers and clays point to a single source from which the majority of pots were produced, and without motivating factors for unidirectional transport to Gaspereau Lake from only one source (such as a supplier as part of direct trade in ceramics), local manufacture is the most likely explanation. However, this does not constitute proof of local manufacture. Additionally, the materials used might have come from a wide range of places since the South Mountain Batholith is associated with pegmatites and blocky alkali feldspar crystals outcropping in many places around south-central Nova Scotia. The homogeneity of the (albeit small) sample analyzed with physico-chemical characterization techniques points to only one source, but does not indicate where that source would be, nor can it be considered representative. Conditions at Gaspereau Lake would likely have provided these materials, but still, this remains speculative. Evidence for a local source therefore cannot be firmly established through compositional analysis alone.

Clay scraps

The most direct evidence for local manufacture is a number of clay scrap pieces, apparently fired, and found within the stone-lined hearth (F44) on Locus 1. These pieces are not tempered but exhibit the same buff colour and large particles as the majority of vessel lots. There are several possibilities for how these fired pieces came to be in the End of Dyke Site, but they all involve local clay use, if not actual ceramic manufacture. The most obvious, but not necessarily convincing, explanation is stockpiled clay that was accidentally fired. Another possibility is that the clay was intended to be a "kiln god" (Rice 1999:4; also Crown 2001:454 for an example of a sacrificial pot).[38]A third possibility is that the clay was part of an adobe covering over a firebox for a firing structure. One of the indications of a kiln or

[37] In essence, this is an economies of scale argument—Eerkins 2011—for, although the number of vessels at Gaspereau Lake is unusually high, it is not so high that the cost of transporting them would have been acceptable relative to the economic benefits.
[38] A kiln god is a tiny clay sculpture, figurine, or vessel that is placed in a firing as a superstitious or religious protective act. Each kiln god is made specifically for one firing and is often discarded afterwards. It is a practice that has been observed in cultures around the world (Rice 1999:4).

more permanent firing structure, according to Balkansky et al. (1997:148), is "clay concretions" that occur in amongst the layers of soot after the structure has collapsed, and results from using clay as a mortar or wattle-and-daub-style construct that may or may not use masonry and a stone lining (Borregaard 2006). This last would not necessarily indicate ceramic manufacture *per se*, because potentially anything could have been roasted in such a structure, but it does indicate that the same clay used for pots was being used in other constructs. This means that clay, rather than pots, was brought to the site. It also circumstantially suggests that pottery *was* fired in the structure because few other operations would have required heat produced by a firebox and a clay-covered structure. Some kind of covered structure seems most likely during at least some point in Gaspereau Lake's ceramic manufacturing history given the hard pastes of a number of ceramics, particularly later in time.

In any case, the presence of fired clay not used in a pot is fairly strong evidence for local manufacture. There is no reason for fired lumps of clay to have been transported to the site, so the doubt that can always exist about the movement of pots does not exist in this case. The fact that it appears to be the same clay but untempered, with a distinctive buff colour and fairly large particles, as that used in the majority of Locus 3 pots strongly suggests that manufacture was occurring on the site.

Wasters

Another source of evidence for local manufacture is at least one vessel lot that appears to be a waster (a vessel that was ruined during firing). GLNS:20 is a vessel lot exhibiting significantly darker colouration and harder paste than the majority of sherds in the sample (Figure 54). The sherd appears to have reached partial or full vitrification because it makes a "ping" sound when tapped with a fingernail. The vessel lot is not easy to place within defined groups as a result of some unusual paste characteristics. However, another vessel lot—GLNS:93—dated to 1175–1368 at the 2 Sigma range,[39] may share a manufacturing relationship given the similar decorative strategy (alternating horizontal and vertical cord marks) and channeling marks as well as the same well-developed and smooth coil breaks.

Some other sherds associated with the large hearth feature in Locus 1 (F44) also exhibit shiny (melted?) surface, unusually dark colour, relatively hard paste, and lack of use wear. Unlike GLNS:20, these sherds exhibit only a shiny surface rather than a vitrified fabric all the way through the wall. This may indicate that the sherds were over-fired only minimally. It may also indicate that the sherds were used to cover other firings or as a paving in the hearth, receiving extra heat-work as a result and causing the surfaces to melt. The shine and colouration may also indicate an organic residue; an attempt to clarify the issue was conducted using SEM, but the results were inconclusive; the surface exhibited increased iron, alumina, and phosphate, but not carbon, as would have been expected for an organic compound such as animal fat. In any case, the sherds exhibiting this dark, shiny surface are related stratigraphically, most occurring in the sooty layer of the hearth (F44A) and some

[39] The date most likely occurs in the range 1239–1308 Cal BP.

occurring above in the modern grubbing-and-grading feature (MF8). They are also related by manufacturing attributes, most bearing S-twist cord marks and similar channeling marks.

The presence of at least one waster is good evidence for local manufacture because it is unlikely that a waster would be transported from a manufacturing context to a consumption context (Costin 1991:19; Deal 1988:124). The exceptions to this might involve the reuse of ceramic sherds for food processing (e.g., Sullivan 1991) or as ceramic tools (Varela et al. 2002); however, the reuse of broken pottery typically involves consumed pottery (Deal 2011; Deal and Hagstrum 1995) and therefore reuse does not involve transport of wasters, which would never have been used (e.g., Beck 2009; Longacre and Stark 1992).

Sherd Tools

Another possible line of evidence for local manufacture is the presence of some sherds that exhibit smoothing on some edges, possibly resulting from scraping clay surfaces. These sherds are typically pentagonal in shape, exhibit smoothed or polished edges on two or three sides, and sometimes cannot be grouped with other sherds in vessel lots (Figure 55 and Figure 56). These attribute states are listed by Varela et al. (2002) as characteristics of sherds used in pottery manufacture at the K'axob site in Belize. Use wear analysis should be able to answer this problem definitively, but unfortunately, the resemblance of some sherds in the GLR sample to sherds illustrated by Varela et al. (2002) was noticed late in the analysis and was not thoroughly investigated beyond noting polish and smoothing on edges.

Palimpsests and Missing Evidence

Admittedly, more than one waster would be expected in a context in which pots were fired high enough to be overfired. Clay scraps would also be expected to be more plentiful if they were serving as adobe in a covered firing structure. Long-term manufacturing contexts typically yield large amounts of debris, by-products, failed pots, and so on (e.g., Charlton et al. 1991; Scarlett et al. 2007). Other hypotheses for how wasters and a scrap of fired, untempered clay could have arrived in Gaspereau Lake's archaeological record are even more difficult to show convincingly, however. No other explanation has so many lines of evidence supporting it. The best explanation has to do with the depositional nature of Locus 3 and possibly the rest of the site, specifically its nature as a palimpsest, which is evident in the relationship of hearth features to artifacts.

Two transgressive hearths (F27 and F29) exhibit negative association with ceramic distributions in Locus 3 (Figure 50 to Figure 53) and one is also dated later than any of the ceramics in Locus 3 at 760±30 (Table 4; Appendix 10:). This indicates that the hearths were in use after the majority of the ceramics were discarded. Also in support of a later use of the hearths is the fact that some ceramics in the same units as the hearths are charred, while other sherds from the same vessel lots occurring outside units with those features are not charred. This indicates that some ceramics were moved to another location in the process of digging the pits to be used in the hearths while those that were not dug received heat damage from the hearths stratigraphically above them. One unit, 971N/981 (Figure 51) contained a concentration of sherds that represented primary discard of stored pots, some of which ended up in an apparent dirt pile surrounding the unit 973N/983E to the north. Pots in

971N/981E appear to have largely escaped the digging activities that happened over most of the rest of Locus 3 and show unusually similar attributes (cord-marked fan decorations, bluish-grey quartz particles, light-coloured clay, plentiful but poorly developed coil breaks, and similar channeling marks) and appear to represent a manufacturing and consumption moment in time not seen elsewhere on Locus 3. Evidence also exists for scraping out material from F44 in the form of two AMS dates from the hearth, the earlier stratigraphically positioned above the later, consistent with the action of mixing charcoal and soil while scraping out a hearth. These two circumstances indicate that much of the evidence of manufacture and/or use has been erased by subsequent actions, what Bailey (2007:203–04) calls a "true" palimpsest, or a situation in which occupational surfaces are scraped of all or most of their traces in the process of creating new occupational surfaces.

Because Locus 3 appears to have been dug over most of its surface, and because the hearth feature (F44) from which the clay scraps were retrieved was also scraped, it is likely that traces of manufacture were partially or mostly removed. This appears to be the best explanation for why only one confirmed waster and only a few small clay scraps were retrieved during excavation. However, the explanation is tentative and requires further study to more fully answer the question of local manufacture.

Expectations of a Manufacturing Locale

Another issue that requires consideration is the fact that no manufacturing locales have ever been confirmed in the Maritimes (although manufacturing is suspected to have taken place at several sites). Current understandings of how a manufacturing locale would manifest in the archaeological record in this region are therefore poorly developed. Assumptions about the traces that would be left after pottery manufacture must not be imported from other contexts without taking great care, particularly since many contexts that have been studied involve fully sedentary and often urban residence patterns (e.g., Roux 2003), agricultural and pastoral subsistence bases (e.g., Arnold 1985; Deal and Hagstrum 1995), market economies (e.g., Balkansky et al. 1997), well-entrenched paths of pottery transport and distribution (Charlton et al. 1991), and much more complex social organization (e.g., Santley et al. 1989). Models have been developed for recognizing manufacturing locales (e.g., Arnold 2008; Costin 1991, 2001; Rice 2005), but the degree to which evidence from the Maine–Maritimes Region would conform to these models—developed largely on case studies of complex hierarchical societies that practice sedentism, agriculture or pastoralism, and often engage in market economies—cannot be assessed or assumed given the available information. Given the traces of local manufacture that do exist in the GLR assemblage, and the fact that some degree of conformity with Costin's model is apparent, I tentatively infer that local manufacture was carried on throughout a lengthy period at Gaspereau Lake.

TRADE-OFFS AND CUT CORNERS: EVIDENCE FOR EXPEDIENCY IN CERAMIC MANUFACTURE

While Middle Woodland pottery at Gaspereau Lake exhibits careful forming, decorating, and firing techniques, later pottery lacks many of the hallmarks of the Middle Woodland, indicating more expedient manufacture later in time. Later pottery exhibits prolific coil breaks, less extensive exterior surface decorations, increased temper percent, and ubiquitous interior channeling. These attributes are symptomatic of an evolving technological tradition that values certain attributes—in this case, thermal shock resistance, primarily—in which practitioners increasingly seek to "cut corners" in order to decrease production time. In order to compensate for decreased structural integrity owing to more poorly fused coils, potters during the earlier Late Woodland appear to have increased firing temperatures to produce harder pastes, and also may have increased percentages of iron oxide in a deliberate attempt to flux the paste.

Later during the Late Woodland, pottery manufacture shifted to coarser-tempered, lower-fired fabrics that also would have demanded significant skill to work. These coarser wares often have upwards of 40% grit temper, which would have made forming and paddling difficult. The trade-off for higher temper percentages and decreased plasticity is greater thermal shock resistance, which would have not only benefited the consumer (the user of the pottery) because of increased longevity of the pot, but also the manufacturer doing the firing, because of increased success rates during firings.

Strategies to decrease production time are not an indication of decreased skill. Rather, they entail a lengthy tradition in which technological constraints were well understood and experimentation had occurred or was occurring (e.g., Roux and Courty 1998; Roux 2003).[40] The ceramics that exhibit the most expedient forming stages also were harder in their pastes and probably higher fired, which would have required even more skill and knowledge than earlier ceramics did. Even though potters cut corners to increase output, they compensated by increasing strength through other means.

Differing Manufacturing Processes from the Middle to the Late Woodland

The Locus 1 and Locus 3 samples indicate a significant shift in manufacturing processes beginning toward the end of the Middle Woodland Period and intensifying toward the earlier Late Woodland Period. Interior channeling became prominent during the Late Woodland, while shifts in tempering practices also characterize the Late Woodland. Also, the decrease in paddling through time is evidenced by the increase in coil breaks and by the difference in lamellar orientation between the two periods. PSS/dentate decorations are

[40] The advent of the potter's wheel, or fast rotation (Courty and Roux 1998), is a good illustration of the principle of increasing expediency as an expression of skill, increased need for expediency, and a long technological tradition. The potter's wheel is sometimes known about by potters long before it is implemented as a regular manufacturing tool, and as van der Leeuw (1993) shows, potters with the capability of fast rotation often use the wheel instead for slow rotation. Courty and Roux (1998) showed that Neolithic potters from eastern Iran and northwestern India during the 3rd and 4th Millennia adopted the use of fast rotation for different parts of the manufacturing process (for example, after the coils were placed and smoothed, the pot was placed on a fast-rotation wheel for additional smoothing and shaping), but did not adopt fast rotation for the entire forming process. This means that fast rotation is not in itself advantageous enough for wholesale adoption wherever it is known about. The adoption of fast rotation in any form represents a move toward expediency, as Courty and Roux show, but the elements of the previous tradition are retained because of the advantages they continue to bestow. Potters therefore required the skill and knowledge of the earlier techniques as well as the ability to adapt these techniques to faster or more expedient ways of doing things, a more dynamic skillset than would be required to learn and never deviate from a standard way of doing things.

strongly associated with vertical lamellae and a lack of coil breaks, while cord marks are strongly associated with oblique lamellae and many coil breaks, some of which are pronounced. In addition, some cord-marked groups exhibit more pronounced coil breaks than others, suggesting that certain decorative cord marks are associated with more paddling during manufacture.

The ceramic group exhibiting the most pronounced coil breaks is characterized by harder pastes, larger amounts of iron oxide, channeled-and-burnished interiors, thick walls, and cord-marked fan decorations. This group came from a later period than the PSS and dentate-decorated pots, evidenced by three dates in the group ranging between ca. 1300 and 800 years ago, and also because the paste and forming practices in this group are quite different from the dentate and PSS-decorated vessels. Conversely, the group exhibiting the fewest coil breaks is PSS-decorated with smoothed interiors, and is characterized by mostly hard but variable fabrics, smaller amounts of iron oxide, thin walls, and fine pastes. The PSS-decorated vessel lots show that each pot was invested with significant labour to achieve an elaborately decorated and finely wrought vessel. The move from elaboration to expediency seems to indicate that pottery manufacture moved from an emphasis on personal expression within a convention to increased production of pottery for a group of consumers.

Paddling

Paddling accomplishes a number of objectives. Paddling a ceramic wall compacts it so that it is at once thinned and strengthened, aligning all particles along the axis of the wall and allowing ceramic "platelets" to achieve their maximum plasticity and strength (Rye 1981:84). At the same time, paddling causes the ceramic paste to be broken up and foliated by the temper particles. This creates pore spaces and hairline cracks that are well suited to halting otherwise catastrophic cracks induced by thermal stress and expansion of the different particles within the paste (D. Braun 1986; Hasselman 1963; Kingery 1955; Schiffer et al. 1994; Woolsey 2012).

Ceramics that have been coil-built are subject to failure at the joins between coils. Strategies that can be employed to lessen this weakness include scoring the coil surfaces to be joined, coating the surfaces with slip, and smoothing the coil joins together using the thumb and fingers, but by far the best way to join coils thoroughly is through paddling. The drawbacks of paddling are that at least one, and up to four, extra stages are added to the manufacturing sequence (e.g., Rice 2005:141–44); as well, the act of paddling causes stress on the not-yet-dry pot, such that pots are often ruined during this stage. A further consideration is that paddling can add twice as much time to the manufacture of pots because they must be allowed to dry to the proper hardness before paddling can be attempted. Therefore, although paddling has many benefits, it is also a relatively costly strategy.

The difference in wall texture between heavily paddled and less well paddled walls is well illustrated by the GLR sample (Figure 43 to Figure 46). In the former case, broken wall edges show vertically oriented lamellae, usually in fine layers, with a lack of interruptions in the layer orientations. In these ceramics, there is also a near-complete lack of coil breaks, and walls tend to be thin and even. In the latter case, lamellae exhibit a number of orientations (except for vertical), including oblique towards the interior or exterior, rounded following the curvature of coils, or oriented in different directions (Figure 45). Coils are ubiquitous in ceramics with oblique or rounded lamellar orientation and often occur in ceramics with multiple lamellar orientations. Lamellar character can range from fine layers to coarse chunks that exhibit very little layering. Coil breaks can range from rough and only poorly developed to smooth and well developed. This last indicates quite poorly joined coils. Usually, but by no means ubiquitously, vessels that exhibit coil breaks are thicker overall.

Table 19: Distribution of AMS dated pottery showing their coil group and decorative group. * indicates vessel lots with no channeling.

VL	^{14}C Age Year BP	68.3% (1-Sigma) Cal Age Ranges	Coil Group	Decorative Group
28	870±30	732–796 887–891	Well Developed	Loosely Plied CWE (S)
143	1160±30	1006–1026 1052–1091 1107–1146 11591173	Well Developed	Unknown
135	1270±32	1182-1213 1223–1263	Well Developed	Loosely Plied CWE (S)
93	1346±55	1186–1205 1239–1308	Well Developed	CWS (Loose) (unplied)
61	1410±30	1296–1332	Poorly Developed	Tightly Plied CRE (S)
94	1460±30	1314–1368	Poorly Developed	Complex CWS (Z)
122	1470±30	1327–1383	None	Plied Cord Fan (S)
160*	1540±30	1387–1419 1460–1518	None	Fine Triangular Dentate/PSS
82*	1550±30	1400–1421 1433–1438 1457–1520	None	Blended-Edge Dentate
86*	1610±30	1418–1461 1484–1489 1517–1550	None	Undecorated

Paddling was more extensive during the Middle Woodland than the Late Woodland. The presence of coil breaks in vessel lots is shown by the Locus 1 and Locus 3 samples to be highly dependent on decorative (and hence, chronological) category. PSS-decorated vessel lots are the least likely to exhibit coil breaks, while cord-marked vessel lots are the most likely. Dentate-decorated vessel lots exhibited a range of coil break attribute states from none present to rough and poorly developed to smooth and well developed. Chi-square tests performed on the relationship between decoration tool and presence or absence of coil breaks showed a statistically significant relationship (see Chapter 3; Appendix 9), confirming observations during analysis of the samples that coil breaks occur most often on cord-marked pottery. In addition, some paste groups, particularly those with more iron oxide, show more coil breaks overall, more well developed coil breaks, and a lack of lamellar character altogether. The attribute state of smooth, well-developed coil breaks would seem to indicate that paddling simply did not occur as part of the manufacture of these vessel lots, which are organic- and iron oxide-tempered, reddish-pink, and hard; however, lamellar character can still be observed, meaning that some compressing action took place, possibly by compacting with a smoothing stone (Michael Deal, pers. comm. July 6th, 2017). These vessel lots cluster so strongly in their decorative attributes—the majority exhibiting unplied or plied cord fan decorations—that they appear to represent not only the peak of expedient manufacture at Gaspereau Lake but also a measure of standardization, which will be taken up in the next section.

The apparent reasons for the absence of paddling on these vessel lots—a group that also exhibits signs of increased standardization and production—are entirely expedient. By skipping the paddling stage, potters could turn out pots much faster. The weakness in the coil joins might have been overcome by adding more iron oxide and/or by firing the pots higher, at least as far as would have been necessary for the pot to function as a cooking vessel. The fact that many of these pots have organic temper probably also indicates that drying time was being cut down as much as possible, because organic temper promotes aeration during drying and decreases cracking. Considering that this group is the largest, the impetus for decreasing production time per pot is most likely because of increased demand for pottery and a desire for faster turnaround times.

Table 20: Distribution of vessels with coil breaks compared with decorative type.

	Fabric-Impressed	**PSS**	**Dentate**	**Cord Marks**	**Other/ None**	**Total**
Well-Developed	0	0	1	37	1	**39**
Poorly Developed	0	0	2	17	1	**20**
No Coil Breaks	3	21	40	41	8	**113**
Total	**3**	**21**	**43**	**95**	**10**	**172**

Interior Channeling

Another change that occurred later in time is the switch from smooth vessel interiors to channeled interiors. Channeling is the scraping of a wet clay surface with a toothed tool, resulting in a grooved or corrugated surface. The surface can be smoothed over afterwards, but the majority of vessel lots with cord mark decorations were unsmoothed, partially smoothed, or burnished. This is interesting for two reasons. First, it contradicts the prediction of Petersen and Sanger, who found that channeling is only associated with earlier Middle Woodland, or "CP2,"[41] ceramics (Petersen and Sanger 1991:125),[42] and second, its

[41] CP2 is designated as the period lasting from 1250 to 1650 BP (uncalibrated).

strong association with Late Woodland ceramics indicates an unusually stable practice that is not also seen in other areas. It may therefore represent a distinctive manufacturing practice specific to Gaspereau Lake.

Table 21 shows that interior channeling occurs much more frequently alongside cord marks than it does with PSS- or dentate-decorated vessels. A Chi-square test results in a high probability (χ^2= 58.86, p>0.00001) that channeling and cord marks are related (dependent) variables, meaning that channeling is an attribute of the Late Woodland Period at Gaspereau Lake.

Table 21: Distribution of interior channeling by decoration types.

	PSS	**Dentate**	**CWS**	**Other**	**Total**
Vessel Lots with Interior Channeling	3	3	62	13	**81**
Vessel Lots with No Channeling	16	38	21	15	**90**
Total	**19**	**41**	**83**	**28**	**171**

At present, the best explanation for the high incidence of channeling on Late Woodland pots is that it is a technological trade-off for the concomitant decrease in paddling. Because less or no paddling would result in a thicker wall, scraping would be one means of making a thinner wall in place of paddling. A toothed tool would certainly accomplish this in less time than an edged tool and would be less likely to puncture the wall. Additionally, scraping would presumably join the coils together more extensively, and scraping with a toothed tool might do this more effectively than a straight-edged tool. Scraping would also remove any lumpiness caused by compressing the wall using a smoothing stone. Another consideration is that channeling might improve thermal shock resistance by increasing the surface area. Cracks may be more likely to form on the interior surface first as a result of the spherical shape of the pot and the differential surface area between the interior and exterior surfaces (Schiffer et al. 1994:199–200). This happens because increased stress is placed on the still-cool interior surface as the exterior expands during cooking, but a corrugated surface halts cracks and increases elastic energy through increased surface area (Schiffer et al. 1994). These explanations have not been tested in any form; however, considering that a corrugated interior surface would seem like a disadvantage in a pot meant to hold edible liquids and that would need to be cleaned between uses, the stability of channeling across Late Woodland pots deserves further investigation.

Firing practices

Firing practices seem to have shifted through time to accommodate other attribute shifts. Based on paste hardness and colour, earlier Middle Woodland (PSS-decorated) pottery was variably fired, whereas later, cord-marked pottery clusters somewhat more in terms of firing related attributes. Harder pastes are associated with some of the most pronounced coil breaks during the Late Woodland, so that higher firing temperatures may have compensated for decreased structural integrity resulting from decreased paddling. Coarser pastes,

[42] I have also observed channeling to occur in association with PSS decorations. However, I have not studied this phenomenon systematically because it was a minority attribute state in collections I worked with.

conversely, are associated with lower temperatures. Earlier cord-marked pottery tends to be lighter-coloured, while later pottery (after ca. 1100 BP) tends towards browner or sootier colouration (Figure 39).

There is insufficient evidence to conclude that firing practices changed from the Middle to the Late Woodland, but some attributes suggest that firing practices are important in the shift. An increase in redder, harder pastes and fewer and lighter carbon cores occurred somewhere between 1300 and 1100 Cal. BP. These characteristics suggest a firing practice that included higher temperatures and oxidizing conditions and appear to have been a shift both temporally and away from practices at other sites.

In contrast, later pottery is often brown, sooty brown, or brown-buff, suggesting more reducing conditions. Pots later in time (after ca. 1100 BP) were tempered more coarsely, making a coarser and, sometimes, more crumbly paste. Some vessel lots from this late period also show even carbon cores, sometimes (but not always) dark. It therefore appears that firing practices changed during the middle Late Woodland Period such that pots were fired in covered structures at lower temperatures but allowed to soak at peak temperature for some time. These structures may have been pits dug for bonfires that were covered in broken sherds or some other material that caused partially reduced conditions.

Temper

The increase in temper percent and the switch from organic to fully grit temper also probably served an expedient role by making firings more successful and wasters fewer in number. Where, previously, pots may have been produced with decreased time, effort, and risk by decreasing or cutting out the paddling stage(s), later in time, potters looked for ways to decrease the drying stage and mitigate the risks involved in firing pots. The greater the amount of temper in a paste, the larger the thermal shock resistance, at least in theory (Schiffer et al. 1994:200), although Bronitsky and Hamer (1986) found that other factors, such as grain size and shape and temper material had significantly more effect on ceramic crack resistance under stress. An even greater advantage than strength would be that vessels would be more likely to survive firing if they were coarsely tempered (Gosselain 1992:257). This is because, with decreasing clay content, shrinkage also goes down, and it is the shrinkage, both overall and in uneven rates, that endangers ceramics during firing. However, the most obvious advantage to potters is not that heavily tempered pots would succeed in firings more regularly but rather that potters could reduce their drying times before firing. Reduced drying times and lowered risk during firing are strategies for greater production efficiency, attributes that are found in contexts where production is intensifying (Costin 1991:17, 37–39; 2001:280).

Although some period of drying is required before pots are fired, the large percentage of temper would cut down on the strict necessity that pots be bone-dry. The reason not-quite-dry pots are in danger of exploding during a firing is that any water left in the vessel wall is heated to steam and released, sometimes explosively, from pockets within the pot. If this water is forced to go through solid clay, the pore spaces may not be large or numerous enough to allow the steam to escape before it blasts its way through. Coarsely tempered vessels have many more pockets and much thinner solid clay walls to go through, meaning that steam can escape more gently. The pottery-production schedule can last quite long if weather does not cooperate to make pots as dry as possible, and even in optimal conditions, much time and care (shaded structures, pots covered and periodically turned) is required to allow pots slow drying time. Eliminating this time could potentially save a potter weeks' worth of drying time, and at a minimum, days.

Evidence for Tight Manufacturing Schedules

Making coarsely tempered pots would be an advantage to potters who need to turn out pots rapidly and with short notice or small windows of opportunity. Coarsely tempered pots may indicate that potters worked around more frequent moves and shorter stays than previously such that their pottery-making windows shrank compared with earlier times. Another possibility, not necessarily ruling out the first, is that pots were being commissioned for feasts, funerals, or other large events, requiring large numbers to be turned out quickly. Costin (1991:13) notes that the best way to identify attached as opposed to independent specialists is to characterize the demand, which—in the absence of written records—must be indirectly deduced. Two circumstances suggest that Late Woodland pottery manufacture was moving in the direction of attached specialization: the advent of shell-tempered pottery and the Skull Island ceramic assemblage. Although shell tempering is not in evidence at the GLR Site Complex, its context in the Maine–Maritimes Region is nonetheless important in understanding the developments of ceramic manufacture during the Late Woodland Period. Evidence from other sites suggests that shell temper is absent from many sites because it was interred as part of burials.

Shell Temper: How to Meet a Tight Deadline

Shell temper is a continuation of the expedient trend seen in the Late Woodland. It is much easier to process than granite, especially after it has been burned (Rice 2005:81), and it has the advantage over any other tempering material that it appears to increase green strength[43] as well as requiring a lower firing temperature (Feathers 2006; Herbert 2008). It also opens up the ceramic wall, creating an "Aero Bar" texture, so that steam has plenty of escape routes. Although shell-tempered pottery has been shown to have an advantage over grit-tempered pottery in its strength (Bronitsky and Hamer 1986), Feathers (2003, 2006:111; also, Sillar and Tite 2000) points out that such an advantage cannot alone account for the spread of shell temper, because in many places it was not adopted or was partially adopted. Also, people in many places in eastern North America knew about shell temper before this kind of pottery became widely adopted as the majority type; therefore, increased strength is

[43] Green strength is the strength of the clay body prior to firing. Rice (2005:64) notes that atomic structure of tempering materials can have a significant impact on fired and green strength. Monovalents and divalents affect the chemical structure of clay particles differently because, while monovalents can fit into the atomic structure of clay particles, they are attached only by one electron, causing them usually to be attached to the periphery of particles and easily knocked off. Conversely, divalents fit into the atomic structure more soundly and increase structural integrity. Because sodium is a monovalent and calcium is a divalent, crushed shells (the more burnt and pulverized, the better) may increase structural strength to a greater extent than non-calcareous materials such as granite, with bonding occurring even prior to firing. This property of shell temper probably accounts for instances of shell temper being used in non-fired clay contexts such as wattle-and-daub houses, but other temper types being used in pottery from the same contexts (e.g., Michelaki 2008:361).

not a sufficient explanation for its adoption (Sillar and Tite 2002). Expediency is a better explanation, because potters looking for ways to turn out pots faster and under tighter time restrictions would benefit from shell temper.

Increased grit temper, such as has been noted by many researchers during the Late Woodland Period in this region, would allow faster turn-around times for pottery. However, processing granite is labour-intensive, whereas shell temper takes significantly less time to process. Herbert (2008:277) estimates from timed experiments that crushing calcined (burnt) shell would have reduced processing times by 80%. Such a reduction in time required for one manufacturing stage would not necessarily appeal to a potter interested in loading up labour into a highly prized vessel intended for personal use or as a prestigious gift, but would likely be attractive to a potter looking for strategies to cut corners while still producing a quality product. Shell tempering therefore fits with other strategies being employed during the Late Woodland to increase turn-around times of pots.

Sacred Pottery?

Another piece of the Late Woodland pottery puzzle comes from the only Late Woodland burial context known from the Maritimes, the Skull Island Site (CbDd-1). The site, dated to 680±70 and 610±60 (Leonard 1996:34, 114) is a burial with several pots associated with the bones of interred individuals, apparently all made by a single person or, at least, fewer potters than there are pots (Leonard 1996:120). This suggests that a potter or group of potters with a constrained style was commissioned to make the pots, possibly by the families of the individuals, but considering the lavish grave goods accompanying the burials,[44] more likely all were commissioned by an elite. In this site, pots are associated with mortuary rituals during a time when fewer pots appear in profane contexts such as domestic and workshop sites (e.g., Allen 1981; Foulkes 1981:234–35; Hedden 1983; Nash and Stewart 1990; Sheldon 1988, 1991; Sanger 1979:113). This decline led Bourgeois (1999:78) and Sanger (1979:113) to postulate a decline of the technology prior to its abandonment during the Contact Period and Foulkes (1981:58) to propose a "postceramic" period. The appearance of large amounts of pottery in the Skull Island site suggests that what appeared to be a decline was in fact a manufacturing and contextual shift resulting in an absence of evidence.

The region-wide shift to coarsely tempered ceramics and, in some places, shell temper seems to indicate a shifting context of manufacture, such that both expediency and short production schedules were prioritized. This shift may have had to do with a move to transegalitarian or chiefdom-style hierarchies and increased demand for commodities meant

[44] Leonard (1996) reported finely made projectile points, ground-stone tools, copper nuggets and copper awls, red ochre and paintstones, and stone pipes, in addition to human remains and ceramics. Some of these artifacts appear to have been ritually "killed" (Leonard 1996:210), potentially including the ceramics. Each pot may have been associated with a single individual (Leonard 1996:115–16), and several of the pots appear to have been made using the same decorative tool, and fashioned with the same somewhat unusual lip shape, and with similar forming attributes such as roughly equal coil break heights, suggesting that they were made by the same person (Woolsey n.d.). They also contained the similar temper and their colouration was similar, suggesting that they may all have been made at the same time. These last assertions are highly tentative and require more study to be confirmed, but the homogeneity already observed within the Skull Island assemblage—even greater than that observed in the GLR ceramics—warrants attention.

for aggrandizing activities and building group cohesion (Hayden and Deitler 2001; Leonard 1996). Pottery could have played a role in this shift as the craft became associated with sacred in addition to profane contexts, and made by a part- or full-time specialist alongside the tradition in which all women possessed pottery-making knowledge. As for the absence of shell tempered pottery at Gaspereau Lake (as in many other sites in the region, especially interior ones), the reason may be that it is interred in the burials that are suspected to occur near the GLR Site Complex and on the islands in Gaspereau Lake.

Decorations

Another trend toward greater expediency is the shift in decorative styles from PSS and dentate impressions to cord marks. Cord marks basically continued the same traditions of decoration and treatment from the Middle Woodland Period: cord marks were applied using linear tools, the same as dentate and PSS tools of the Middle Woodland, and the decorative strategies are often the same as in the earlier period, including bands of discrete horizontal, vertical, and oblique elements, both simple-stamped and rocked on. Surface treatment is more-or-less absent in the Late Woodland, except in the form of fabric impression, a difference from the tightly angled rocked-on impressions of the Middle Woodland that created a distinctive texture over the pot surface. Because the cord marks are frequently less carefully applied and tend to be larger and more distantly spaced than dentate or PSS impressions, there is an overall aesthetic sense that they are more expediently applied.

Cord marks are sometimes the result of "hopping," a practice of rolling a cord-wrapped stick over a surface and pressing down at intervals so that the cord impresses the clay in rows across the surface. This is indeed a fast decorative technique compared with the painstaking technique of rocking on linear tools in very tight angles to cover the pot surface. This technique allows a potter to decorate a pot surface in minutes, as opposed to up to several hours, as would be expected for some of the finer PSS- and dentate-decorated pottery from the Middle Woodland. The move from fine PSS and dentate decorations to expedient cord marks reinforces the conclusion that earlier pots served as a focal point for the loading up of labour to express identify and affiliation, whereas later pots served this function to a lesser extent.

A difference among the tool types of PSS, dentate, and cord-marked stick is that the tools themselves increase in size through time. Tool widths move from an average of 1.3 mm on PSS decorated vessel lots, to an average of 1.65 mm on dentate-decorated vessel lots, to an average of 3.5 mm on cord-marked vessel lots. Additionally, cord marks often take up less than one third of the surface area, whereas dentates and PSS decorations usually cover the entire surface area or leave only small spaces undecorated. Cord marks, therefore, appear to be the more expedient means of decorating pots on the whole.

A final clue that cord marks were applied without the same attention to detail as were dentates and PSS decorations during the Middle Woodland is the apparent sloppiness with which some vessel lots were impressed. Cord marks frequently appear to slide across the clay surface as though the tool was placed quickly and lifted again. Impressions sometimes overlap or are unevenly spaced. Sometimes, pot surfaces are impressed with seemingly random shapes and tools, as though they were accidentally pressed against something and the potter did not bother to smooth the surface afterwards. The elements themselves also seem to have often been expediently created: some cord tools are almost certainly blades of grass wrapped on a stick, a tool that could have been created almost anywhere and in under two minutes. Even sticks wrapped with true plied cord would have represented much less work and time than carving an edge with dentates or alternate notches (PSS). The adoption of cord marks cannot be said to have come about as a result of expediency, but it can be seen that cord marks were both associated with more expedient manufacturing strategies and were themselves more expedient than previous decorative strategies.

BEYOND DOMESTIC USE: EVIDENCE FOR INCREASING SCALE OF PRODUCTION

There are several lines of evidence pointing to increasing scale of production. The large number of ceramics later in time is suggestive of increased scale of production later in time, but cannot be relied upon to make the case. In this section, I discuss a number of indirect lines of evidence supporting the likelihood that potters were increasing their output during the transition to the Late Woodland Period.

Temper

The GLR ceramics exhibit variation in temper character—particle size, proportions of minerals, mixed-and-matched temper types, and so on—but comparatively little variation in temper minerals, particularly later in time. This is almost certainly a result of the increased production of pottery after the transition to the Late Woodland Period.

The range of tempering materials in the GLR samples indicates a complicated set of processes through time. Homogeneity is observable in temper minerals, but particle size, percentages, and mixing and matching of different temper types do not clearly fall into categories. In other ceramic analyses in this region, this kind of variability seems to have not been encountered, because temper is generally reported as one of the following: grit, shell, or organic. No in-between categories are reported in any of the ceramic studies that exist to date in the Maritime Provinces, and while new studies are always being released in Maine, I have not encountered any in-between categories from that area either.[45] Neither has grog or iron oxide been reported in this region (but see Woolsey 2010). The fact that temper types were so fluid in the GLR pottery manufacturing tradition, with this trend only becoming well-established after the Middle Woodland, seems to indicate that mixing and matching is an important characteristic of the assemblage and of the trajectory of ceramic production towards increasing scale.

The case is particularly well illustrated by looking at grit-tempered pottery from the Late Woodland. As discussed in Chapter 3, a majority of vessels are tempered with a homogeneous source of granite that likely came from pegmatites in the area. The distinctive

[45] This could be a problem of researchers not recognizing the in-between categories. However, as I have come to understand the work of other researchers looking at ceramics, I have increasingly become convinced that, for the most part, temper has been examined very carefully, particularly by MacIntyre (1988, Appendix in Sheldon 1988), Allen (1981, 2004), Foulkes (1981), Deal (1986), and Petersen and Sanger (1991). Therefore, it seems most likely to me that the in-between categories of temper I observed in the GLR ceramics are particular to this site.

bluish-grey quartz particles and the lack of feldspar are highly homogeneous attribute states belonging to a majority of vessels. However, significant variability exists in particle size and amount of temper. One temper group defined in Chapter 3, called Mica-Rich Granite, is defined by the same minerals as in the Feldspar-Poor Granite and Bluish-Grey Quartz tempers, but particle size is much smaller and mica particles are more numerous. There are no other decorative or manufacturing attributes of this group of vessel lots that set them apart from the majority of vessels. Therefore, this group does not appear to constitute a different manufacturing tradition. The best explanation for the difference in particle size is that granite temper was processed and stored in amounts larger than needed for a single manufacturing event. The processed temper was stored and then used each time a clay batch was mixed; smaller particles settled to the bottom, while larger particles were continuously being taken from the top. As the processed temper was gradually used up, the smaller particles became more numerous. The vessel lots in the Mica-Rich Granite temper group are those that were made using temper from the bottom of the barrel.

Temper stored and used as needed suggests a commitment to a pottery manufacturing locale (Deal 1998). At the very least, it indicates that potters returned year after year to the same place. Possibly, it resulted from potters residing and making pottery at Gaspereau Lake for extended periods, possibly even year-round. GLNS:109 is a vessel lot tempered with Mica-Rich Granite and is estimated at a volume of between 25 and 40 litres. Because the temper percent is high (>40%), the amount of temper used to make this vessel lot would have amounted to between 1 and three litres (7.5 ltrs of clay body • 40% = 3 ltrs) (Figure 14). The particles are uniformly below 2 mm (with a few outliers of 2.5 mm or less). The amount of temper that would have originally been processed to leave this much sorted-out fine particulate would have been substantial, and would seem to indicate that processing was done in volumes fitting a continuous manufacturing context rather than a sporadic and opportunistic activity.[46]

Temper was also used in a mixing-and-matching strategy that suggests flexibility about recipes. Although the ingredients were fairly set—granite from pegmatites, organic material, and iron oxide—the ratios of each varied considerably, particularly after the transition to the Late Woodland. Blended-Edge Dentate and Unplied Cord Fan are decorative groups that represent two distinct periods and are associated with particular combinations of the same temper minerals and ingredients. Blended-Edge Dentate pottery used mostly grit temper made of feldspar-poor granite, usually with a small amount of iron oxide mixed in. Conversely, Unplied Cord Fan pots tended to contain large amounts of the same grit temper along with considerable amounts of iron oxide; however, the amount of iron oxide ranged from only a small percentage to ca. one third of the entire temper content.

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[46] However, it is important to consider the possibility that temper was pounded finer for this vessel. The main objection to this possibility is that, as the particulate becomes finer, the time and labour expended exponentially increases, at least from what I have found in experimental temper processing. The likelihood that a potter spent significantly more time on processing temper seems low, particularly because the vessel is unusual in the small size of its temper particles. This indicates that it was probably not a majority practice. Additionally, with smaller particles comes greater particle size homogeneity, an attribute that Bronitsky and Hamer (1986) have proposed is less conducive to thermal shock resistance. Taken together, these two factors would seem a discouragement to potters, although not necessarily in a case where an exception is made when supplies are running low.

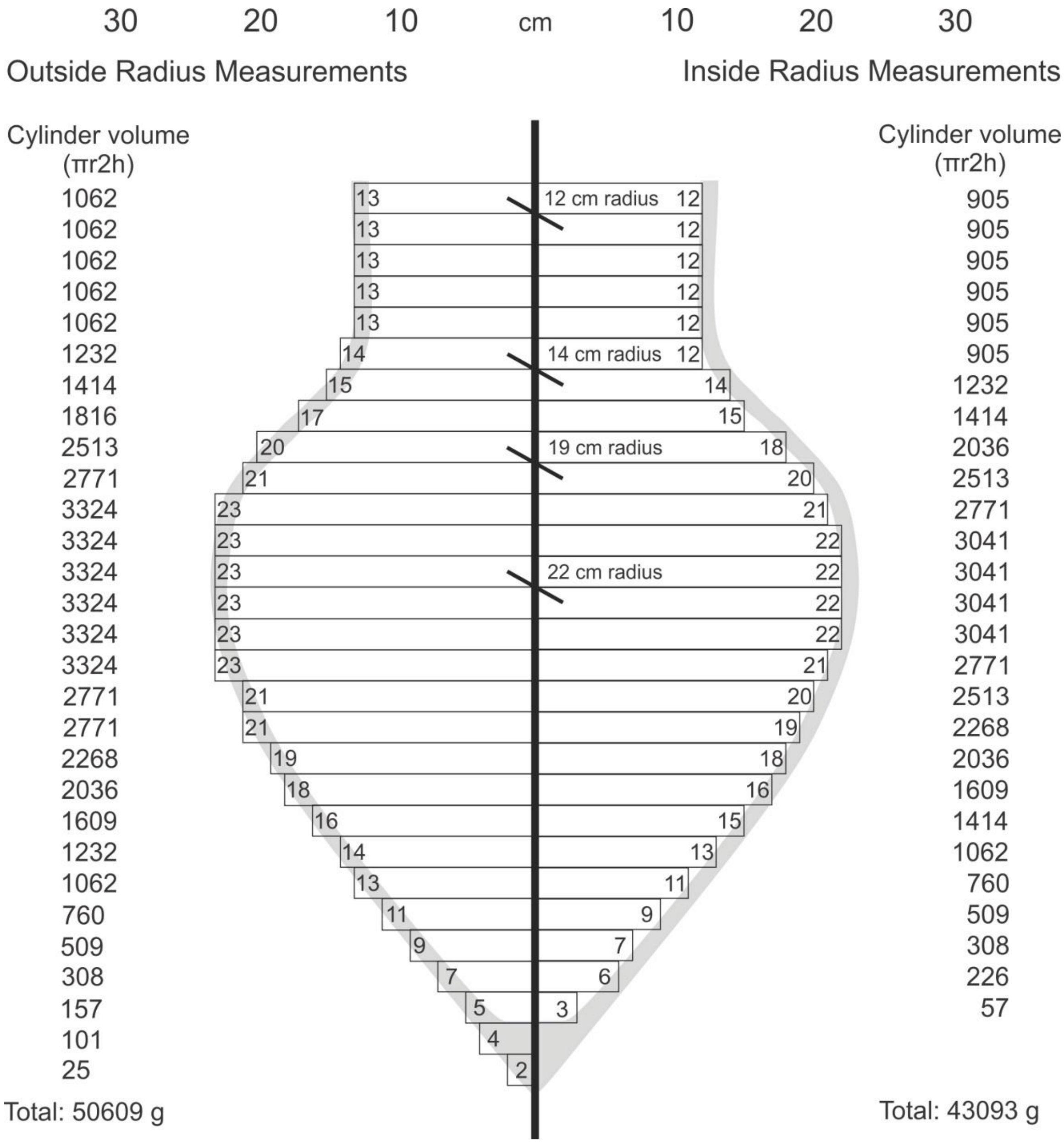

Figure 14: Diagram of estimated vessel capacity of GLNS:109 using the summed-cylinders method. The interior diameter is reconstructed based on four interior diameter measurements. The upper two measurements are accurate in their vertical placement although the topmost neck measurement radius is inaccurate due to irregular curvature and was partially inferred from other measurements. The bottommost two measurements are accurate in their radii but their vertical placement is not certain. An effort to be conservative was made in all reconstructions. The exterior diameter was estimated based on an assumption of even wall thickness throughout the vessel of 0.8 cm. It was calculated in order to estimate the amount of clay and temper used in the vessel. Capacity was estimated at ca. 43 ltrs. Total clay body (calculated by subtracting the interior from the exterior capacity) was estimated at 7.5 ltrs. All measurements are in centimetres. This reconstruction relies on the assumption that vessel shape was conoidal; however, a globular shape was also estimated and yielded an estimate of no less than 25 ltrs.

Later pottery contains similar proportions and the same feldspar-poor granite, but also frequently contains organic temper. Sometimes grit was reduced drastically or omitted altogether, while organic temper was sometimes a majority constituent.

Mixing and Matching: A Pottery Skillset

In the ethnographic and archaeological literature, the axes of heterogeneity and homogeneity are usually the reverse situation. That is to say that temper minerals can be different, reflecting a number of temper sources (heterogeneity), although the predominant temper type, especially in the case of grit or sand temper, remains the same, or homogeneous (e.g., Carr and Komorowski 1995; Dickinson 2001; Hoard et al. 1995; Vitelli 1984, 1999; Woolsey 2010). Shell temper in the Northeast has been extensively studied but rarely has the mixing of shell and grit temper types in a single sherd been reported (e.g., Bourque 1995; Feathers 2003; 2006, 2009; Feathers and Peacock 2008; Fitzgerald 1982; Lafferty 2008; Lennox 1981, 1984; O'Brien et al. 1994; Pollack et al. 2008; Roper 2011; Roper et al. 2010; Sheldon 1988, 2001; J. Wright 1981). This is an artifact of the way temper type is usually reported; in other words, researchers may be imposing overly clean-cut categories on the ceramics they study. My own research on collections from around New Brunswick leads me to believe that this is not the case for the most part in this region, and that the GLR ceramic assemblage is exceptional in this regard.

An explanation for the variability in temper types is not easily apprehended. However, given the other evidence that suggests local manufacture, increasing scale of production during the transition to the Late Woodland, and increasing specialization, the following hypothesis is offered. The ability to mix and match ingredients is a skillset seen in modern studio potters, who may prefer one type of temper, but will use other types in certain circumstances, including 1) teaching, where a different technique requiring different materials is demonstrated to a group of neophytes, such as in the case of raku or sculptural pottery; 2) changing techniques based on market demand or special orders, such as when a larger-than-usual piece is ordered and a potter may need to temper clay with paper to promote flexibility and optimal drying; 3) experimentation to achieve a desired effect, such as increased strength or a different colour; 4) decreased access to materials, so that substitutes are sought; 5) need for more expedient or cheaper manufacturing processes, so that substitutes are sought; 6) a material runs out and a potter is forced to make due with materials on hand in order to meet a deadline. Studio potters are expected both to be able to produce the same style and type of pottery and to change as needed, for instance, in the case of a special commission, so switching tempering materials is not usually a major hardship. It is possible that Woodland potters also treated their practice as highly regular but flexible in the case of dwindling supplies, commissions, or changing consumer demands. The fact that the largest pottery concentration in the Maritime Provinces shows such flexibility in tempering strategies may be an indication that potters at Gaspereau Lake were more consumer-oriented. Although scale of production is probably quite different between Woodland and modern potters owing to the numerous tools that currently exist promoting larger output (particularly the potter's wheel), both situations may be considered cottage industries in terms of their relationships to a consuming group. This is only a hypothesis put forward based on other evidence and an attempt to explain a rather unusual characteristic of the GLR assemblage.

Decorations

One difference between the GLR and the GFC ceramics is that, in the former assemblage, juvenile pots and poorly scheduled pots are absent. The absence of juvenile pots is noteworthy, according to Costin (1991:40), because, in a situation where production increases, so does skill; as well, juveniles or beginners are not likely to be participating in the manufacturing context until they have mastered the necessary skills. As such, their pots will be found elsewhere. Poorly scheduled pots, on the other hand, are not an indication of skill but rather of priorities. Their absence indicates that pottery manufacture was given a higher priority than other activities, such that the potter was not called away from drying pots to attend to more pressing matters. It may also mean that the potter could call on others to help in order to stay on schedule (e.g., London 1991:192).[47] Both situations result from a potter's status as partially or fully exempt from some activities carried on by others.

A very small number of channeling marks show spillage—excess clay scraped off the surface accumulating along the sides of the striations—indicating that the clay was quite wet when the surface was channeled (Figure 45). Others (though rarely) show micro-breakage along the edges of striations, indicating that the clay was too dry when the surface was channeled. Both these cases suggest that the potter did not time channeling activities with the ideal stage of dryness, indicating either the potter was called away to do other things and returned either too early or too late, or that the clay was not drying optimally. If the former, then these pots may have been made by intermittent potters who had other duties, such as children, called away for chores (e.g., Costin 1991:14), apprentices who are only allowed to make pottery amidst other activities (Lancy 1994:118), or opportunistic potters who are expected to make pottery manufacture a low priority compared with other activities such as gathering—if the latter, these pots may indicate poor drying conditions such as constant rain

[47] In my own development as a potter, I reached an important milestone when I attended a class in which the instructor demonstrated the proper technique for making teapots. Teapots are tricky because they require four separate parts to be manufactured, three of which need to be thrown on the wheel: these include the body, the spout, the lid, and the handle. Getting the timing right in the process of drying is crucial to the success of the teapot. In the past, I had thrown the three parts and "pulled" the handle, after which I covered them and did other things, but in almost every case, when I returned to assemble the pieces, I inevitably broke one or more parts in the process. In the class that made such a difference in my cognitive understanding, the instructor threw the body, lid, and spout, set them aside, and talked to us for approximately twenty minutes, leaning over now and then to check the drying of the clay, and when he was satisfied, he neatly and easily joined the spout to the body, before pulling a handle and attaching it. He did not explain any principle of timing or dryness of clay; he merely allowed us to observe the timing, the sequence of events, and, most importantly, the fact that he never left the teapot to do other things. His whole attention was on the clay. Once I grasped this principle—that pottery is a full-time activity—I was able to make teapots consistently. More importantly, I learned that leaving pots unattended resulted too often in bad trimming and decorating work because I had often missed my window of opportunity. I learned to schedule my pottery activities so that I was finished everything I needed to finish in one day, rather than coming back to complete projects when next I had the opportunity. I have since come to believe, on seeing the work of others and learning about their processes, that this principle often marks the difference between full-time potters and hobbyists.

that caused usual expectations about drying times to be off. The majority of pots, however, do not exhibit either of these characteristics, suggesting that they were made by experienced and dedicated potters who, generally speaking, did not have other duties that called them away, and who tended to recycle pots that had flaws due to poor weather.

In contrast to this situation, ceramics from the GFC assemblage more frequently exhibit surface modifications that indicate too-wet or too-dry clay when they were decorated (Figure 45). Some trailing marks exhibit micro-breakage because they were worked in leather-hard or bone-dry clay, usually called "incision" in the literature and treated as its own technique, but probably at least sometimes representing poor timing on the part of the potter. In other cases, suction marks can be observed inside impressions, indicating that the clay was too wet to receive the impressions. This can result either from the clay being too wet and tacky, or from the clay being too dry, so that the surface has to be re-wet again. Although this does not indicate an inexperienced potter necessarily, it does indicate that the potter was not consistently monitoring the drying pot, a situation that occurs when pottery making is an intermittent activity. Conversely, at Gaspereau Lake, the lack of poorly-timed applications of decorations and channeling probably indicates that pottery manufacture was a more full-time activity—at least for the duration of the pottery-making season—where drying pots were monitored consistently at the same time that other pots were being made.[48]

Use Wear

Another major difference between the GLR ceramics and other assemblages in this region is the lack of use wear connected with cooking or storage evident on the ceramics. According to Costin (1991:19), a lack of use wear compared with other contexts can indicate that ceramics were made in such large numbers that they were considered more expendable. Because people at the manufacturing locale were so numerous, people making and using them discarded pottery at a higher rate—for instance, when they became discoloured or slightly broken. This is in contrast to other archaeological contexts where pots were evidently used long after their performance began to decline. Skibo (1992) and others (Hally 1983; Schiffer et al. 1997) have undertaken ethnographic and experimental studies to define a series of expected use traces on pottery and the activities that would make them. A list summary of use wear attribute states complied from Hally (1983), Schiffer et al. (1997), and Skibo (1992, 2013) are provided in Table 22. Some of the most important among these are 1) a ring of horizontal striations on the interior surface at the neck construction, where a stirring implement would have repeatedly abraded the surface; 2) microchipping along the exterior or interior edge of the lip, usually obtained during upside down cleaning or stacking, respectively; and 3) carbonized encrustations from foodstuffs burnt while cooking. Although many signs of use wear occur on pottery, these three are the most common in cooking pots, and any length of use life ought to produce at least one of these traces. The Fulton Island assemblage that I studied previously contained five vessel lots out of a sample of 11 with

[48] Support for this inference comes from Charlton et al.'s (1991:106) study of Aztec craft specialization in Otumba, Mexico. In this study, the authors noted that ceramic figurines and spindle whorls were prone to cracking during drying. Because of this, the artisans would have carefully monitored drying. Evidence for this comes from the low numbers of cracked products in the assemblage compared with other assemblages.

directional abrasion on their interiors, usually around the neck and body, indicating that they had been subject to abrasion by stirring implements. Interestingly, on only one pot in the

Table 22: List of use-wear descriptions and the function indicated, compiled from Skibo (1992), Hally (1983), and Schiffer and Skibo (1989).

Indicator	Use Indicated	Description	Reason
Thermal spalls	Cooking	Cone-shaped depressions, 1–3 mm diameter, on the middle interior and, less often, the upper interior and interior rim Distinguished from pits by the round shape, the hemispherical or conical shape in cross-section, and the frequent co-occurrence of microscopic cracks	• Rapid escape of vaporized water that was absorbed by a porous ceramic • Water in the pot's contents is completely evaporated, and water from the wall's interior begins to evaporate quickly in the direction away from the heat source. The interior surface creates a barrier because it is less permeable, and is forcefully blown off as steam escapes. • May indicate resin, smudging, or well-sealing slip • Likely occurs in conjunction with carbonized encrustation • Distinct from salt spalls, which form as a result of the expansion of salt in the ceramic body when it crystallizes during water evaporation • Distinct from calcium spalls, which form during or after firing when the calcium carbonate converts to quicklime and contacts water, causing expansion • Distinct from mineral grain expansion, which form as a result of temper particle expansion and is identifiable by a series of cracks running from a temper [article in a star pattern
Chips	Unspecified (covering with a lid; tapping a stirring implement; knocking against other ceramics during storage, transport, or washing; setting down; knocking over)	Occur with great frequency on rims	• Indicate a single action • Random blows occurring during the course of use • Can indicate the angle and direction of the blow, the size of the abrader, and the point of impact • Can indicate covering with a lid; greater frequency of chips of this kind can indicate close monitoring as the pot is frequently uncovered and the contents stirred (however, this is not always the case—Skibo 1992:130) • Chips occur most frequently during transport, storage, and washing • Fresh chips indicated by sharp edges. One edge worn down indicates a directional contact, as during washing

Polish	Grasping by the rim	On the upper exterior and lip, a patch of fine scratches not visible to the naked eye	• Light abrasion caused by contact with the human hand or with a carrier • Potentially does not survive deposition because it is often registered on the layer of soot, which may flake off
Surface scratches	Cleaning: rotating the pot on the ground while scrubbing	Deep, linear, parallel to the rim, located on lower and middle exterior, >1cm long, forms a band >2 cm wide	• The ceramic surface is abraded by the movement of its surface over the ground • Direction of scratches indicates handedness • Difference in direction of scratches between the lower and middle exterior indicates cleaning of both the interior surface and the exterior surface
		Also located on the rim parallel to the wall	• Rim scratches indicate scrubbing of the pot bottom
		Light, linear, randomly oriented, located on lower, middle, and upper exterior and the entire interior from the upper region down	• Gentle abrasive action caused by sand or vegetable material • Probably only registered in a surface coating or soot layer • More pronounced on the middle than the lower exterior • On the upper region, both interior and exterior, the scratches are more aligned with the rim • Action is frequently repeated
	Cleaning: scrubbing with abrasive material	Patch on the base, scratches oriented primarily from the centre to the periphery, but with other directions possibly evident	• Sliding the pot across a surface • Abrader is harder than ceramic and individual particles are small
	Cooking?: dragging the pot a short distance	Rough, circular abraded surface on base, temper particles showing	• Pitted surface becomes continuous over time • Heavily used pots have a centre and a periphery
Surface completely removed	Cooking: pot is set down with impact in the hearth or during serving	Rough-feeling band on interior surface, not easily apparent by looking at it, most intense where the neck is most constricted Also occurs on the base and lower interior as the pot is stirred	• Gentle abrasion by material that has a diameter greater than the distance between temper particles • Force of contact is weak • Temper particles are partially pedestalled • More intense as harder implements are used • More intense depending on how often contents are stirred (rice: stirred only while serving; vegetable meat: stirred frequently during simmering)

Exposed temper particles	Cooking: stirring with a metal or wood implement	Not sure. Possibly material missing from around particles of temper?	• Gentle abrasion by material that has a diameter less than the distance between temper particles • Force of contact is weak • For example: contact with hearth soil
Pedestalled temper particles	Unspecified: turning, tipping, and rotating pot on the ground (cooking?)	Rough, jagged depressions	• Removal of temper particles, especially after they have been pedestalled • Force of contact is great • Also by single impacts causing nicks and gouges
Pits	Setting the pot down on this surface	Isolated depressions on upper interior, angled upward and to one side, with point of initiation usually on the lower side	• Contact with a serving implement usually occurs just below where the neck is most constricted • Abrader is harder than ceramic • Occurs on vegetable/meat pots, but not rice pots—liquid? • Indicates handedness (clockwise motion, or right-upward direction of pit, indicates right-handed server) • Far fewer marks in smaller vessels—not enough room to generate sufficient velocity)
	Cooking: serving with a wood or metal implement	Unknown	• Long-term contact with corrosive material causes the interior surface to break down
	Cooking or storage: corrosive material	Rough, jagged depressions	•
	Accidental impact	Thick, glossy, brown or black layer, hard (not easily scratched with fingernail)	•
Carbonized encrustations	Cooking: charring of foodstuff	No carbonized encrustation (stage 1)	Few to no cooking events have occurred
		Band or patches of carbon on the middle interior (stage 2)	• Foodstuff has charred while sitting next to the fire in the "simmer position" • Likely indicates a thick foodstuff such as rice • Likely indicates that foodstuff was not stirred during cooking
		Band of carbon on the middle interior and a patch on the interior base (stage 3)	• Carbonization of foodstuff (rice) occurs on a patch on the middle interior when the pot is placed next to the fire to simmer. Over time, individual patches become a continuous band. –OR–

			• Carbonization of foodstuff (meat/vegetables) after food particles adhere to the wall at the water level. Over time, different levels of water cause the band to expand vertically. Tends to be wider and further up the pot than in the case of rice-cooking vessels. • Foodstuff saturated with liquid permeates the wall of the interior base, then is carbonized at the next cooking event when the base is hottest and moisture has been cooked out • Basal carbonized encrustations indicate fire or a bed of coals focussed on the base • Middle interior carbonized encrustations may indicate that the pot was placed next to the fire in the "simmer position" • Most pots used regularly for cooking are at this stage
		Continuous patch of carbon from the upper interior to the base (stage 4)	• Heavily used • No longer effective as a cooking pot
		Lighter- or brighter-coloured patch, circular or oval, extends from exterior through to interior surfaces, no soot co-occurs	• Focussed heat in an oxidizing atmosphere causes iron to oxidize, turning clay a range of colours depending on heat intensity and type of clay. Dark: poorly oxidized. light and colourless: moderately oxidized. Bright-coloured: well-oxidized. • Organic matter is burned off • Soot is burned off • Area of oxidation corresponds with carbonized encrustations and thermal spalling on interior • Indicates temperature and type of last cooking event; at least 400°C • Centre of oxidation patch was closest to the heat source • Oxidation pattern is obscured by soot and subsequent oxidation pattern during each new cooking event • Greater water content in foodstuffs reduces the likelihood of oxidation patches • Larger patches indicate a hotter-burning fuel: greater amount of lignin?
Oxidation	Cooking: intense heat	Concentric rings of different colours.	• *Interior:* lighter centre colour is less oxidized than

		Interior: light pink, buff, or grey centre with bright red or orange surrounding area. *Exterior:* dark centre with bright red or orange outer area.	surrounding bright-coloured area because foodstuff inhibited oxidation. Bright-coloured surrounding area is more oxidized because it corresponds with the edge of the foodstuff • *Exterior:* Dark centre was in direct contact with fuel, creating a reducing atmosphere. Surrounding bright-coloured area is highly oxidized. • May indicate a griddle • May indicate roasted ingredients such as nuts, or batter such as corn cakes • Near-absence of water content in foodstuffs allows for greater oxidation
	Cooking: dry ingredients	Concentric rings of lighter colours radiating toward darker colours	• Exterior and interior: greater oxidation is increasingly unlikely with greater amount of water • Absence of soot • May indicate simmered or boiled ingredients such as stew or rice
	Cooking: wet ingredients	Colour at the surface is duller or darker than the colour directly below the surface	• Heated in a reducing atmosphere (smoky or wet) • Indicates temperature and type of last few cooking events • Oxidation pattern is obscured by soot and subsequent oxidation pattern during each new cooking event • May occur with soot
	Cooking: less intense heat?	Large, bright-coloured ring with base coincident with the circle's centre, ring of soot just outside and the rest of the way up the exterior wall	• Large area of the wall is exposed to high heat, with soot forming beyond this area
	Cooking: directly over the fire	Slightly lustrous, black layer that cannot be removed by scrubbing	• Carbonized resin • Resin in fuel vaporizes and is deposited, along with incompletely combusted ash, on the cooler parts of the pot—that is, the sides, but not the base • Greater water content in foodstuff results in greater soot deposition and higher glossy appearance • Further distance from the fire results in less intense blackening • Greater duration over the fire results in greater blackening and thicker layer

Soot	Cooking: fuel combustion	Dark grey or black colouration, evenly coated, exterior or interior surface, not a distinct layer, no cracking evident	• Occurs when resinous or smoky material is burned in very close contact with the ceramic, either inside the vessel or in the fire used to fire the vessel. Can also be smudged after the firing in a distinct manufacturing stage. • The result of carbon and hydrocarbon deposition

GLR assemblage (GLNS:36) could the interior ring of striations from stirring be positively identified, and only 10 vessels exhibited significant carbonized encrustations. Microchipping on lip edges and removal of basal surface was not extensively identified on any vessels, two use-wear traces that usually accompany storage jars, although some may have minor microchipping. This indicates that the assemblage as a whole is characterized by short use lives.

Table 23: Distribution of abrasion types on a sample of vessel lots from the Fulton Island, Bliss Islands, Skull Island, and Grand Lake Region ceramic assemblages from New Brunswick, compared with the GLR sample. Vessels were classed by the abrasion type that most strongly characterized their use wear. Vessel lots listed as "none" exhibited no abrasion of any type. Note that, in the case of the GLR ceramics, "Directional" includes striations not related to use wear as a cooking or storage vessel (such as those on exterior surface). Only one case of striations related to cooking was noted.

Abrasion Type	Other		GLR	
	n	%	n	%
Missing surface	18	29.6	26	14.4
Thermal spalls	1	1.3	0	0
Patches	8	13.2	8	4.4
Pitted	12	19.8	2	1.1
Pedestalled temper	3	4.9	2	1.1
Directional	3	4.9	10	5.5
Occasional impact	2	3.3	7	3.9
None	14	23	126	69.6
Total	**61**	**100**	**181**	**100**

Several explanations for this situation could be put forth. First, and the explanation I favour, is that ceramics were manufactured in large numbers, making them readily available and, therefore, less precious. In the Maine–Maritimes region, it is not uncommon to find a ceramic vessel with a hole drilled through and smoothing around the hole from cord where the sherd was bound, by the hole, to another object, presumably the other portion of the pot. These ceramics are considered to have been repaired, and the holes are referred to as "repair holes." This indicates that repairing the ceramic was preferable to making or acquiring another one, at least for the time being, which, in turn, indicates a certain preciousness (however temporary) of the ceramic. Another occasional find in this region is a jar that has been so thoroughly used that it is greyish-white from having been oxidized so many times during cooking and is missing much of its surface from all the abrasive actions it has been subjected to.[49] This also indicates that vessels were, at least in some places, used so long and hard that they probably ceased to be able to work properly. Most vessels exhibit at least some use wear in the form of a horizontal ring around the interior neck surface, microchipping from cleaning and stacking, exterior sooting and oxidation from contact with an open flame, missing or abraded surfaces around the exterior base from having been set on rocks or in sand, missing or abraded surfaces around the interior bottom from stirring, pedestalling of temper particles around the interior also from stirring, and surface cracking from repeatedly having been heated. Carbonized encrustations are also common. These traces are often apparent on small sherds, so it is unlikely that these traces were simply

[49] Such a vessel is held by the New Brunswick Museum.

missed on the GLR ceramics. Without significant traces of use wear, particularly on such a large assemblage, the only logical explanation is that these ceramics were not used for as long or as hard as pots from other sites.

Table 24: Distribution of sherds with carbonized encrustations in three assemblages. Only assemblages for which these data are available are listed. Note that, in the case of the GLR ceramics, each ceramic with even a tiny bit of residue, on interiors or exteriors, were included, meaning that some of the encrustations may not be use-related but instead may have been acquired post-depositionally.

Collection	Carbonized Encrustation		No Carbonized Encrustation		Total
	n	%	n	%	
Bliss Islands	7	22.6	24	77.4	**131**
GFC	32	28.3	81	71.7	**213**
GLR	13	7.2	168	92.8	**181**

Clearly, some *were* used, however. Carbonized encrustations occur primarily on the interior neck surfaces, indicating that the contents they held were burned in one place that was too close to a fire. Even these ceramics do not exhibit other forms of use wear. The large number of sherds without signs of use wear suggests that some ceramics were used only once or a few times before being discarded, and many pots may never have been used at all.

It is possible that the lack of use wear resulted from these traces having been obscured. Some vessel lots show a considerable amount of surficial degradation resulting from an unknown abrasion, possibly the result of post-depositional processes. This degradation almost certainly obliterated minor traces such as polish, striations, and pedestalled temper, but may also have obscured missing surfaces or deep striations, both resulting from repeated contact with harder materials. It seems unlikely, however, that no extant traces of any kind were detected except for some possible pedestalling and striations. Also, because one pot (GLNS:36) had such prominent and easily identified use wear, this explanation is unsatisfactory.

Another, more interesting possibility is that the ceramics were transported from elsewhere and used as scraping tools, or as paving and covering in hearths during food processing or, possibly, ceramic firing (Deal and Hagstrum1995; Skibo 2013:148–49). The unknown abrasion may have resulted from the scraping of food or soot off the broken ceramic surfaces (Sullivan et al. 1991), or from using the sherds themselves to scrape food from other surfaces or to dig out hearths in the earth. They may also have been used as pottery manufacturing tools, specifically as scrapers (e.g., Varela et al. 2002). The abrasion marks consist of tiny parallel striations that all move in the same direction. Occasionally, they can be observed passing along the insides of surface impressions, indicating that they were definitely acquired after the pots had been decorated. They also sometimes run over broken wall edges, indicating that they occurred post-breakage; additionally, some wall edges have smoothed topography, indicating that these edges were subjected to heavy smoothing action such as would occur if the edges were used to scrape a surface with less hardness than the sherd. Loosely compacted earth or soot in a hearth would fit this description, as would wet clay.

These explanations could all be simultaneously and partly true. In any event, the large number of ceramics and the low degree of use wear are both attributes of a production locale whose scale is larger than domestic use, according to Costin (1991:20).

Vessel Morphology

The unusual shapes and sizes of vessel lots in the GLR assemblage may indicate increased production for the purposes of aggrandizing events such as large communal gatherings, funerals, and weddings. One of the attributes listed by Hayden and Dietler (2001:40–41) as an indication of aggrandizing events is an expanded range of pottery shapes and sizes, in addition to an increase in pottery production overall. In the Northeast, the conoidal vessel shape, along with a number of variations, predominates without much competition from other shapes except in some Late Woodland contexts (Petersen and Sanger 1991:152; B. Smith 2007; Steponaitis 2009; Sturtevant and Fogelson 2001).[50] Petersen and Sanger (1991) assert that the majority shape was the conoidal jar with the exception of the beaker shape during the Early Woodland and the invention of new vessel shapes during the later Late Woodland and Protohistoric period (Petersen and Sanger 1991:152), and that vessel capacity never greatly exceed ca. 10 ltrs. Unfortunately, as Stapelfeldt (2009) has shown, the range of vessel morphology in this region cannot be easily evaluated because of the extremely small number of jars complete enough to be evaluated for their shapes.

A few vessel lots in the GLR assemblage have been physically reconstructed, and these show that the typical conoidal shape prevalent in the Maine–Maritimes Region also occurred at Gaspereau Lake. Some more complete vessel portions show that vessels may have deviated from the conoidal shape in some cases. GLNS:109 is a vessel lot containing unusually large fragments that indicate a relatively large diameter and height. Most unusually, the straight neck section is at least 10 cm long. The mouth diameter measurement was not reliable because of some irregular curvature, but the shoulder diameter may have been as much as 44 cm, and the shoulder profile exhibits a wide-diameter curvature, indicating that it was either very large or only weakly present, or both. In either case, a large vessel is implied. Using the summed cylinders method (Rice 2005:222), a very rough estimate based on a 44 cm diameter at the shoulder puts the capacity at no less than 40 litres, which is extremely large compared with known vessel sizes in this region (Stapelfeldt 2009), which typically range from 4 to 8 ltrs (Petersen and Sanger 1991). If 44 cm is taken to be erroneously large, and the other shoulder measurement of 28 cm is used—measured where the neck begins its excurvature, meaning it is probably erroneously small—the capacity is still larger than 25 litres, an impressive size. Particularly where actual height cannot be known but is certainly larger than what was recorded, both these estimates are, in fact, conservative.

[50] One of these contexts is the Mississippian cultures on the periphery of the Northeast (1000–1500 BP), where effigy pots and elaborately decorated jars of many shapes became prevalent alongside the more common conoidal jar.

At the opposite extreme, a number of vessels are unusually thin relative to their size. These tend to have fine pastes and to be decorated with fine, blended-element and/or triangular dentate stamps, usually vertically oriented. The most striking example, GLNS:150, maintains an even, smooth 0.4 cm wall thickness along its entire neck region (what remains of it). It has a lip and neck diameter of 22 cm, making it somewhat smaller-than-average. Because no morphological data are available below the neck, capacity and shape cannot be guessed. It is possible the portion in existence represents the upper part of a bowl, but the straight sides probably mean this is not the case.

Another dentate-decorated vessel lot, GLNS:79, makes an interesting comparison in regard to intended use and paste composition of these thin vessels. Although GLNS:150 is dark-coloured, there is no evidence that it experienced a cooking event, and indeed, such an intended use for the hard, thin, finely-tempered vessel seems unlikely. The grit temper comprises ca. 10% of the overall fabric, lower than many vessels in the sample, and the paste does not seem capable of withstanding significant thermal shock. In contrast, GLNS:79 has clearly been exposed to significant thermal shock, and has not withstood the heat well. It appears to have been made in the same way and probably for the same purpose as GLNS:150; less exists of the overall vessel, but the thickness is similarly thin and even along the neck, which is predominantly straight. The temper is also the same, composed of quartz, probably mica, and grog or iron oxide. The decorations are slightly different, and so they are confirmed as being two separate vessels. The largest portion of GLNS:79 (BfDd-24:6753) has been exposed to heat on both interior and exterior surfaces, indicating that the event that caused the structural damage to the sherd probably occurred post-breakage. The temper particles have expanded and caused major cracking along the interior surface and some spalling on the exterior surface. In thicker vessel walls, the expansion of grit temper would be less severe because there would be more room to move to accommodate the expansion. Additionally, most pastes are probably not as hard as in the case of these two vessel lots.

These vessels suggest that not all pottery manufacture was intended solely for domestic use as cooking jars. Additionally, these vessels add to evidence for skilled potters. Larger vessels take more skill to keep from collapsing during forming (Crown 2014:75), while thinner, smaller vessels take more skill to make symmetrical. Vessels that are not necessarily larger or smaller than predicted by Petersen and Sanger and others nevertheless show more skill in the use of tempering materials than in previous periods, particularly in experimentation and mixing and matching. Surface treatments and decorations also appear to have been well-timed, an indication both of skilled and of dedicated potters. The skill suggested by these lines evidence is likely to have come about as a result of increased scale of production.

Distributions of Ceramics on Locus 1 and Locus 3

As discussed in Chapter 3, the distribution of ceramics decorated with PSS decorations, dentates, and cord marks apparently increased from the Middle to the Late Woodland Periods. Fabric-impressed sherds are the least common, comprising less than 1% of the sample size. PSS-decorated vessel lots are the next common, comprising ca. 15% of the overall sample. Dentate-decorated vessel lots comprise approximately one quarter, while cord marked-vessel lots comprise over one half of the sample. Because dentates can potentially indicate either the Middle or the Late Woodland, but cord marks are restricted to the Late Woodland, the Middle Woodland is clearly underrepresented compared to the Late Woodland in the sample. This would seem to indicate increased production during the Late Woodland.

Table 25: Distribution of decoration groups in the Locus 1 and Locus 3 samples.

	PSS	Dentate	Cord-Mark	Other	Total
n	29	49	97	6	**181**
%	16	27.1	53.6	3.3	**100**

Such a distribution could be argued to reflect simply the deterioration of ceramics further back in time. Cord-marked vessels being the most recent, they may also have survived to a greater extent having experienced less time exposed to freeze-thaw action and other degrading forces. The reverse is true for PSS-decorated ceramics, and more so for fabric-impressed ceramics. Undoubtedly, this plays a part in the distribution of differentially aged ceramics, but it does not explain the distribution fully. The AMS chronology acquired for the sample shows that the concentration of ceramic use (and therefore probably of ceramic manufacture) occurred between 1550 and 1150 Cal BP. The last two AMS dates are more spread out, spanning as much as 1100 to 600 Cal BP. If ceramic manufacture had continued steadily throughout the Middle and Late Woodland, and if increasing numbers of ceramics occurred towards the present as a result of a steady rate of taphonomic decay, it would be expected that more dates, not fewer, would fill in this last gap prior to European arrival at ca. 500 years ago. In fact, the Locus 1 and Locus 3 samples show a peak in manufacture and use at the transition to the Late Woodland, after which the numbers decline.

One problem with this observation is that the Locus 1 and Locus 3 samples are not necessarily representative of the overall assemblage. In the case of chronology, this could constitute a real problem for interpreting the site, because the Locus 3 area may have been used for entirely different activities at different times. The decline in the number of AMS dates during the later Late Woodland may represent a decline in manufacture or a shifting of pottery use away from this area to another part of the site or to another site within the GLR Site Complex. A study of ceramics from a different part of the site may yield a large number from the later Late Woodland, showing that the Locus 3 sample is chronologically biased in relation to the rest of the site. The Locus 1 sample was designed to address this problem, and to some extent, it is clear from the Locus 1 sample that similar processes and chronologies occurred on both sections of the End of Dyke Site; however, there are enough differences between the samples that it is clear that only more research on a larger sample will answer the question of whether ceramic manufacture did decline later in time. Nevertheless, the declining manufacture hypothesis is currently favoured because other evidence from other sites supports it, at least in part, as discussed earlier in this chapter.

EVIDENCE FOR SPECIALIZATION

I return now to the evidence called for by Costin in assessing the degree of specialization, discussed earlier. As noted at the beginning of this chapter, the evidence for specialization is far from overwhelming, but nevertheless is suggestive of specialization moving from the Middle Woodland to the Late Woodland. The majority of ceramics locally manufactured, the increased expediency of ceramics towards the Late Woodland, and the increased production scale towards the Late Woodland are all customary of increasing specialization. I will now examine evidence specifically cited by Costin for specialization.

Differential Distribution

Because the present research is concerned with a fine-grained analysis of the ceramics from the End of Dyke Site, a search for evidence of ceramic distribution is beyond the scope of the thesis. However, some points can be made in this regard. The likelihood that few ceramics were brought to the site after the Middle Woodland, and the large numbers of ceramics made locally, suggest a situation in which pots were being made for consumption at the site rather than a situation where people were arriving with their pots and expecting to need their own. In such a situation, pots leaving with people also seems likely, although entirely unsubstantiated at present. However, while briefly revisiting the GFC ceramic assemblage, I noticed that some of the sherds from the Big Clearwater site in central New Brunswick were characterized by light buff-coloured clay and bluish-grey temper particles, a fact I had noted before but whose potential significance I had not comprehended. The minerals in these sherds resemble those from the GLR assemblage, especially sherds with the distinctive Bluish-Grey Quartz temper and the Buff-to-Pink or Buff-to-White clay, and they could have come from the End of Dyke Site. Perhaps this is too speculative, but I mention it because these kinds of observations are the next step in answering questions about production and distribution. Regardless, it must be admitted that little of analytical value can be said of ceramic distribution at present.

Differential Participation

Unfortunately, at present, nothing can be said about differential participation.

Production Facilities

Production facilities are a problem for archaeologists in this region because none have yet been confirmed. Obviously, this does not mean that the GLR Site Complex is the only place where ceramics may have been manufactured (e.g., Owen et al. 2014), but ceramic production does appear to have dwindled later in time at many sites. The GLR ceramics are somewhat atypical in this regard, since earlier Late Woodland ceramic production increased, whereas other sites show a decrease in Late Woodland ceramics (Foulkes 1981; Godfrey-Smith 1997). Later Late Woodland ceramics at the End of Dyke Site appear to follow the trajectory of other sites with only one confirmed ceramic after 900 Cal BP. Nevertheless, at the transition to the Late Woodland, the End of Dyke Site shows a marked increase in ceramic production compared with other sites, which suggests that production areas were becoming fewer and that the existing facilities increased their production.

Standardization in Attributes Determined by Motor Skills

In attempting to understand pottery standardization, the character of wall lamellae and coil breaks in archaeological ceramics a good place to start. They are the direct result of forming practices, which are considered by numerous authors to be good evidence of learning lineages by virtue of their tendency to be passed on unchanged from teacher to learner (Crown 2014:76; Gosselain 1992; Roddick 2009:85; Wallaert-Pêtre 2001:489; White 2017:71; see also Minar 2001). The actions that cause these attributes—coiling and paddling—are presumed to have been learned in childhood, so that they become rote by adulthood and are not easily changed (White 2017:71). Differences in these attributes are expected to come about when potters from different learning lineages deposit their pots in the same site, even if they had contact with each other (Wright 1972; Lucier and VanStone1992; e.g., Lennox 1984; Longacre and Stark 1992; also see Sassaman and Rudolphi 2001:421). Potters from the same learning lineage would make pottery that would all exhibit the same attribute states (e.g., Engelbrecht 1972). A third situation occurs when pottery producers recruit others to make pots to specifications, creating a range of possibilities of attribute states. However, in this third situation, recruitment of kin is a common strategy mentioned in the ethnographic literature (Arnold 1985, 2008; Costin 1991:15). In this case, attributes are likely to be even more standardized than any of the other scenarios. Because standardization is the result of increased skill through increasing the number of times an action is taken (Budden and Sofaer 2009:209; Deal 2001:154)—in this case, making pots—I looked for this standardization across the range of attributes I recorded, but found they most strongly occurred in forming attributes, agreeing with the many authors who have previously noted the stability of this set of attributes.

The repetition of certain forming attributes across many vessel lots was a characteristic of the GLR assemblage that was noted early on. Ceramics decorated with PSS and, to a lesser extent, dentate tools tended to exhibit a vertical orientation to their lamellae and a lack of coil breaks, two indications of extensive paddling (discussed in Chapter 3). In contrast, ceramics later in time (i.e., those decorated with cord) tended to exhibit oblique or U-shaped lamellae and many coil breaks. In addition, pots belonging to certain decorative groups show similarities of lamellar character and coil breaks. The Blended Edge Dentate group contains vessel lots that exhibit coil breaks that are almost all oblique oriented up to the exterior, with rough coil joins and mostly vertical lamellae. In contrast, the Unplied Cord Fan vessel lots tend to exhibit very smooth coil breaks and homogeneous oblique U-shaped lamellae tending toward oblique-exterior. This is in comparison to the group of PSS-decorated vessel lots that, although on average are thin and even-walled, exhibit little recognizable repetition of forming attributes.

Although, at present, I have no ready way of quantifying the effect, my repeated subjective impression of the vessel lots in these two groups were that each set of vessel lots exhibited forming attributes that were somewhat easy to recognize as a coherent group. In the case of vessel lots with lamellae that tend to be evenly angled out and upward (oblique exterior), coil breaks tend to be smooth, and these two attribute states clustered tightly with brownish-pink paste, low amounts of temper, and smoothed-and burnished interiors. Although I do not know the precise paddling actions that would have created this effect, it seems best explained by a combination of finger movements during coiling and subsequent paddling with some directionality. In the case of Blended Edge Dentate-decorated vessel lots, on the other hand, paddling is clearly more extensive, with rough coil breaks and lamellae ranging between vertically oriented and angled up and outward (oblique exterior). The clustering of coil break and lamellae types with other attributes, such as paste, suggests that pots made later in time are more likely the result of tight learning frameworks with learning lineages involving more systematic kin recruitment. However, the speculative nature of this statement is acknowledged fully and more in-depth treatment of the subject, involving a larger sample and more experimentation to clearly define groups of forming attributes, is called for to make the case conclusively.

Lack of Learners and Mistake Pots

Evidence for specialization can come from the lack of pots clearly made by neophytes or made with mistakes. Rather, pottery shows evidence that potters managed to avoid the common errors that even advanced potters make when they are not full- or part-time potters, such as poorly timed decorations. Poor timing results from trying to make pots in among other activities that can distract the potter from proper monitoring of the pot's dryness. Additionally, there are no pots that are obviously "juvenile" or student pots. In contrast, a student pot was identified in the GFC assemblage, and its nature was apparent from the lack of motor skills in using the rocker stamp technique, in shaping the lip smoothly and consistently, and in maintaining an even thickness around the rim. No such pot can be said to exist in the sample studied for this research. If Locus 3 were a house floor or associated with domestic activities, and pots were being produced by every woman on an as-needed basis, it would be expected that student pots would be somewhat common as family members were taught the skills of pottery making. The absence of these pots suggests that learning was occurring somewhere else.

In ethnographic situations, the recycling of learner pots has been observed (Deal 2011:151; Gosselain 1999:207). Evidence in archaeological assemblages for recycling of pots also comes in the form of grog (crushed pottery) evident in ceramic pastes (Harry 2010:25; Herbert and Smith 2010; Michelaki 2008:362). It is possible that learner pots made at or near the GLR Site Complex were recycled as grog, and initially during the research the red particles in pastes appeared to be grog and were classified as such. However, according to Herbert and Smith (2010), grog particles can be recognized by their predominantly angular edges, and most of the particles I classed as grog are rounded. They are also uniformly red, while Herbert and Smith (2010) mention that grog can take on a variety of colours depending on firing conditions and fabrics of the original ceramics. Further, compositional analysis of the particles revealed that they were very high in iron (>50% atomic weight not including oxygen), whereas the same iron content would be expected (more or less) as the surrounding matrix. These particles were subsequently reclassed as iron oxide particles. Nevertheless, recycling of failed posts in the form of grog is a possibility (Figure 58).

Low Percentage of Used Pots

Pottery at the End of Dyke Site showed a remarkably low amount of use wear. Carbonized encrustations occurred only a small percentage, and only ten vessels had a substantial carbonized encrustation that could be said to have definitely been acquired during cooking. Use-related striations on the interiors and microchipping on the lip edges were not detected during analysis except in the case of one pot. This appears to have been a situation in which pots were discarded not because they had come to the end of their natural use lives but because it was easier to discard ceramics than to fix, clean, or otherwise maintain them. In contrast, many ceramics I have examined from other sites show signs of significant use wear and evidence of repairs is not infrequent. The situation at Gaspereau Lake is different from other situations found in this region, and suggests a context whereby ceramics were made in such large numbers that they were not considered as precious as they would have been in other contexts.[51] This suggests to Costin (1991:20) that a manufacturing context is likely.

CONCLUSION

The forgoing discussion of ceramic manufacturing trends through time points to a situation in which potters were part-time specialists at the transition to the Late Woodland Period. Specialization is sometimes thought to inhere only in situations where more hierarchical social structures exist—namely, that markets, elites, and/or states or incipient states give rise to specialization (Costin 2001; e.g. Arnold 1985; Charlton et al. 1991; Wailes 1996). However, increasingly, researchers are challenging this view, and specialization is now thought to be possible in a wide array of social contexts and to take a large number of forms (Costin 1991, 2001; Martelle 2002).

As Costin (2001) has pointed out, although the idea of specialization seems straightforward, the actual definition or criteria for recognizing specialization is problematic. There is a tendency for researchers to fall back on a Western conception of specialization (Martelle 2002), and for mechanisms to be drawn from the ethnographic literature, much of which connects specialization with local markets or tourist trades, both of which are heavily influenced by a modern, globalized context. The usual definition of specialization as it has been used by Brumfiel and Earle (1987), Childe (1981), Service (1962), and Wailes (1996) is that it is 1) "suprahousehold"—that is, it occurs outside the context of domestic manufacture for personal needs; 2) artisans are freed from some or all subsistence activities in order to concentrate more fully on the act of crafting; 3) as a result, artisans do not produce all the goods needed for subsistence, requiring instead to acquire these from others; and 4) artisans are compensated for their products in the form of money or other goods that contribute to their subsistence. However, a number of problems with this definition have been discussed (e.g., Costin 2001; Clark 1995; Cross 1993; Crown and Wills1995). The definition assumes that the household is workable as a unit of analysis, and that competition and tensions do not compromise productivity or uniformity. It also assumes that compensation is in some measure quantifiable, which may not always be the case; rather, compensation may inhere in the fulfilling of a social obligation or being allowed to remain within the group unharmed, such as in the case of enslaved artisans (e.g., the slave-

[51] Costin found that even ceramics in homes, where no manufacture was taking place, also bore light use wear prior to discard, which I propose may indicate that ceramics were generally discarded earlier by all inhabitants because the manufacturing context made pots in that place less precious.

descended potters of Cameroon—Gosselain 2016:39–40) or captive wives (e.g., the Neutral's captives from the Fire Nation—Fitzgerald 1982; Lennox 1984). There is also the matter of whether specialization occurs when one member of a group is responsible for production of a commodity but only sporadically (Costin 2001:275–76). Costin argues that a simpler definition is in order. She (2001:276) writes that "central to most definitions is the concept that production is variable across time, space, and/or personnel, and that the specialist produces more of some good or service than she or he (personally) uses."

The difficulty with deciding whether specialization exists in a context such as Gaspereau Lake is the fact that, in the absence of clearly defined mechanisms that can be linked to real-world objects, specialization can only be rated on a relative scale. It would be inappropriate, for instance, to compare the GLR assemblage with European pottery such as Pearlware, since the distribution mechanisms, economic significance, materials, methods, technologies, and skills are not comparable (cf. Miller and Hunter 2001). It would be equally inappropriate to compare southeastern pottery specialization with Gaspereau Lake, even though the contexts are somewhat more similar (cf. Beck and Neff 2007). In fact, even a comparison with a neighbouring village would be inappropriate because if two sites produce differential degrees of homogeneity in their assemblages, specialization may be inferred erroneously for the site with more homogeneous pastes. Actually, differentially available materials may be the responsible mechanism. Therefore, sites need to be evaluated on the basis of their own evidence, not on the basis of other sites, no matter how physically comparable they seem.

Instead, evidence for (lack of) specialization must come from either a fairly homogeneous manufacturing tradition or of a tradition that shows evolution and, possibly, of ebbs and flows in some dimensions related to specialization. At the End of Dyke Site, there is certainly evidence of ebbs and flows, but the nature of the site precludes a definitive answer as to whether specialization existed here, and part of this has to do with the differential ways in which researchers may define specialization (Costin 2001:276). More problematic, however, is the possibility that the units of analysis used to formulate a hypothesis about specialization at Gaspereau Lake may not be appropriate or give an inaccurate picture. What can be done toward resolving the issue is a statement of the evidence for specialization.

I favour Costin's feeling that the central argument for specialization hinges on whether the artisan makes more than what she or he intends to use, but I add that the artisan disposes of the remainder for personal gain. Evidence for this case at Gaspereau Lake inheres in the following, discussed above: 1) pots show increasing standardization through time; 2) pottery pastes show evidence for having been mixed in large batches with the intention of making many pots, which most likely indicates that the potter did not intend to use all the pottery herself; 3) pots are increasingly made using expedient techniques that promoted faster turn-around, a situation that would be likely to come about if potters experienced pressure to increase production and/or produce pots quickly (implying a market demand); 4) although some attributes, such as decoration, became less carefully executed through time, there is evidence that potters were increasingly skilled as time went on; 5) larger quantities of pots later in time suggest more specialized pottery manufacturers who had the time to make these larger quantities; 6) evidence from the ceramics suggests that production was ongoing rather than intermittent or opportunistic. This would seem to address the first part of my definition for specialization; however, there is no evidence that potters accepted compensation, except by inferring that if more pots were made than were intended for use by the potter, the remainder were probably meant to be exchanged for personal gain.

CHAPTER 5: A HISTORY OF CERAMIC MANUFACTURE AT GASPEREAU LAKE

Ceramics in the Maine–Maritimes Region have been dramatically under-used for what they can say about the people and societies who made them. This is because ceramics have been treated in one of two unhelpful ways: either they have been thought of as more-or-less unchanging throughout ca. 2500 years except superficially in their decoration and wall thickness, or else as having changed primarily in quality, the first ceramics having been crude, then peaking in proficiency around 2000 years ago, and finally declining after ca. 1000 years ago.

This is not to say that researchers have not investigated ceramic change, but for the most part, they have focussed on decoration, temper percentages, and morphology—attributes that are relatively unconstrained by technological considerations. Petersen and Sanger (1991:130) made one of the most thorough assays of ceramic change, yet they noted "technological continuities" from each period into the next, while at the same time characterizing all the periods on an implicit scale of "technological proficiency" (Petersen and Sanger 1991:123). They also found that shell temper, usually thought of as at least partly technological in nature, "was largely a stylistic, not strictly functional change from the earlier usage of various forms of grit" (Petersen and Sanger 1991:139). Unflattering assessments of declining ceramic quality after the early Middle Woodland—that "much of the change is, technologically speaking, for the worse" (Bourque 2001:79)—have been justified by observations of increased frequencies of coil breaks, coarser pastes, crumblier textures, duller colour, and thicker walls (e.g., Black 2004; Bourque 2001; Davis 1991; Kristmanson 1992; Sanger 1979). Unfortunately, most researchers have not proposed the cause of this supposed peak and later decline.

Generally, the "poorly made artifacts" explanation has not worked very well in any context, and the case of pottery manufacture in the Maine–Maritimes Region is a good example. Although the changes in pottery through time may appear to researchers used to drinking out of glazed, untempered porcelain or refined earthenware mugs as declining workmanship, there is a better explanation for crumbly ceramics that have been buried in the ground for hundreds or thousands of years. Larger percentages of temper put archaeological ceramics at greater risk for post-depositional disintegration by freeze-thaw action and leaching (Fagan 1996:128; Skibo et al. 1989), although by the same token, larger temper percentages protect ceramics more effectively from thermal shock. The pastes of the Late Woodland may in fact be improved over Middle Woodland pastes considering their use in cooking vessels, and their fragile appearance is the result of taphonomic conditions rather than inferior quality. Along with the evidence of increased coil breaks, ceramic manufacture appears to have undergone an important change having to do with expedient manufacture and increased effectiveness as cooking pots. This is one example of the importance of considering ceramics in terms of changing technological contexts rather than as technologically static but unevenly executed.

In fact, ceramic manufacture shows considerable shifts in social and economic contexts throughout the Woodland Period. The great dearth of Early Woodland pots, usually identified as the "type" called Vinette 1,[52] manifests in the archaeological record very differently from early Middle Woodland pottery, which occurs in much greater numbers and was made with a significant degree of care and self-expression. The shift from Early to Middle Woodland pottery shows a sudden break in manufacturing practices, while the shift to later Middle Woodland and Late Woodland pottery is much more gradual. Increasingly coarse fabrics, thick walls, and less red surface and wall colour are among the observations made by researchers in the past (e.g., Bourque 1995; Nash and Stewart 1991; Sheldon 1988), but perhaps more importantly, the distribution of these later pots changed significantly. At some sites, later Middle and Late Woodland pottery decreased or ceased altogether (e.g., Blair 2004:160–161), leading Foulkes (1981:58) to propose a "postceramic period." At others, ceramics appear to increase dramatically (e.g., Cox 1983; Leonard 1996) during the Late Woodland Period. One such site is Gaspereau Lake.

In this chapter, I use evidence for shifting contexts in ceramic manufacture to build a history of production through time at Gaspereau Lake. The importance of these shifts lies in the broader social context, also shifting, whose needs and demands were being met by potters. Untangling the intentions of potters can never be fully accomplished using archaeological data, but a good starting point is to understand the ways ceramics changed through time and in what numbers. The history I propose combines evidence from the GLR sample with evidence from other sites and regions and traces ceramic contexts from the beginning to the end of the Woodland Period.

FROM FINEWARE TO EXPEDIENTWARE: THE HISTORY OF CERAMIC MANUFACTURE AT GASPEREAU LAKE

The increase in numbers through time suggests increasingly greater aggregations of people at Gaspereau Lake.[53] However, the history appears somewhat more complicated based on evidence of manufacturing practices and ceramic distribution across the site. Standardization is increasingly in evidence through time, as is local manufacture, and a

[52] See Taché et al. (2008) for a contrasting view of whether Vinette 1 is homogeneous enough to be considered a type.

[53] The concept of aggregation and dispersion was proposed by Lee (1972, 1979) and elaborated on by Conkey (1980) to describe a movement pattern whereby people travel from various dispersed locations to a gathering place at set times in order to celebrate events such as marriages or rites of passage, engage in ritual activities, pursue economic interests such as long-distance trade or large-scale hunting and gathering operations, or to broker alliances and marriages. These places are often marked by special monumental art or architecture (such as the Altamira paintings) but of central importance to an aggregation site is an economic base that can support large numbers of people for extended periods. Hayden (2001) notes that increasing aggregation size evident in the archaeological record (e.g., increasing numbers of earth oven) may indicate increasing aggrandizing behaviours—that is, the impetus of some in a community to claim leadership roles through wealth accumulation and redistribution and by solidifying alliances. The Mi'kmaq were repeatedly observed to maintain a committed relationship to an aggregation/dispersal pattern of movement, coming together at locations such as L'sitkuk Bear River, Maligomish (Merigomish Harbour) and Kebec (Québec) (Lelièvre 2016; Lelièvre and Marshall 2015; Ricker 1997).

curious lack of significant use wear or juvenile pots suggests prolific manufacture by a population of experienced potters later in time.

The chronological groups given below show that decorative groups can indeed be used as hallmarks of manufacturing groups—to a limited extent. However, the chronology shows that a better indication of time period comes from the number and character of coil breaks. Because degree of paddling decreased through time, pots from the earlier Middle Woodland show a remarkable lack of coil breaks. During the later Middle Woodland, coil breaks began to emerge regularly, but exhibit a rough character and are not seen on all sherds. During the transition to the Late Woodland, (ca. 1300 BP), coil breaks became nearly ubiquitous, displaying a range of rough to smooth characters. Just before the Late Woodland (ca. 1100 BP), ceramics continued to show near-ubiquity of coil breaks, and nearly all were smooth in character. After this period, coil breaks continued to be common, but characterizing them is not possible with the sample studied in this research. Looking to other assemblages, however, it seems likely that coil breaks displayed a range of attribute states, probably also chronologically sensitive, that—with more study—could be used to delimit more precise periods. The chronological sensitivity of coil breaks indicates that manufacturing practices are held stable through learning lineages that nevertheless respond to changing concerns of the larger group.

Pastes are not as chronologically sensitive because they display a behaviour of mixing and matching. However, broad trends are discernible through time. Finer, redder clays were used during the earlier Middle Woodland, probably accessed from a variety of sources around Gaspereau Lake, and tempering materials are composed of the quartz–feldspar–mica combination indicative of granite temper and typical of the Maine–Maritimes Region. Later on during the late Middle Woodland, clays shifted to a coarser-grained, buff-coloured clay and tempering materials began to lack obvious feldspar minerals. The bluish-grey quartz particles became common in pastes at this time. Later, the same choice of clay and tempering material continued, but increased iron oxide content in many pastes around ca. 1300 changed the pastes considerably to redder, harder, and smoother versions of earlier pastes. Significant variation in paste constituents also characterizes these later vessels so that a recognizable paste type is not really in evidence; rather, there is a move toward overall harder fabrics. By 1000 years ago, fabrics became browner and greyer and temper percentages were at a maximum.

AMS Chronology: Five Ceramic Manufacturing Periods Within the Woodland Period

Ten AMS dates were acquired on carbonized foodstuffs on the interiors of archaeological ceramics from the End of Dyke Site, part of the Gaspereau Lake Reservoir Site Complex excavated between 2012–2013. Nine of the ten date ranges are continuously overlapping or very close together at the 2-Sigma range and show a continuous ceramic use from ca. 1550–950 BP, and probably as late as 700 BP. This continuous ceramic use also indicates continuing occupation during this time.

Comparison of ceramic manufacturing attributes indicates that a change through time occurred in manufacturing priorities of potters at Gaspereau Lake. Specifically, the pots show that manufacture became more expedient through time, with the presence of coil breaks increasing, indicating a decrease in paddling. Because paddling is a risky practice requiring great expertise and skill-building, the decrease of such a practice probably also indicates an emphasis on turning out pots faster and in greater numbers. This may also be reflected in the increase in standardization seen in some traditions as well as the increase in iron oxide temper making a harder paste, which may have compensated for the decrease in stability resulting from poorly fused coils.

The results conclusively show continuing occupation throughout a period of ca. 600 years. While other studies have inferred continuous occupation from a range of non-overlapping dates combined with ceramic decorations (which are thought to indicate specific time periods), the radiocarbon sequence presented here provides the first conclusive evidence in the Maritime provinces achieved by closely dating artifacts—pottery—that would have enjoyed regular use. In addition, it has significantly clarified the ceramic manufacturing context at Gaspereau Lake and made possible the small-scale analysis of manufacturing trends and learning lineages.

The sample of dated ceramics consists of the entire assemblage from Locus 3 on the End of Dyke Site, as well as selected units from Locus 1, the largest part of the site and the area containing the highest density of all classes of artifacts. Considering the bulk sample as a whole, several manufacturing trends or traditions were discernible, whose chronological contexts were clarified using the acquired date ranges. Five periods are discernible from the evidence. These have been discussed in the context of ceramic manufacture in the Maine–Maritimes Region in order to contextualize ceramic manufacture at Gaspereau Lake.

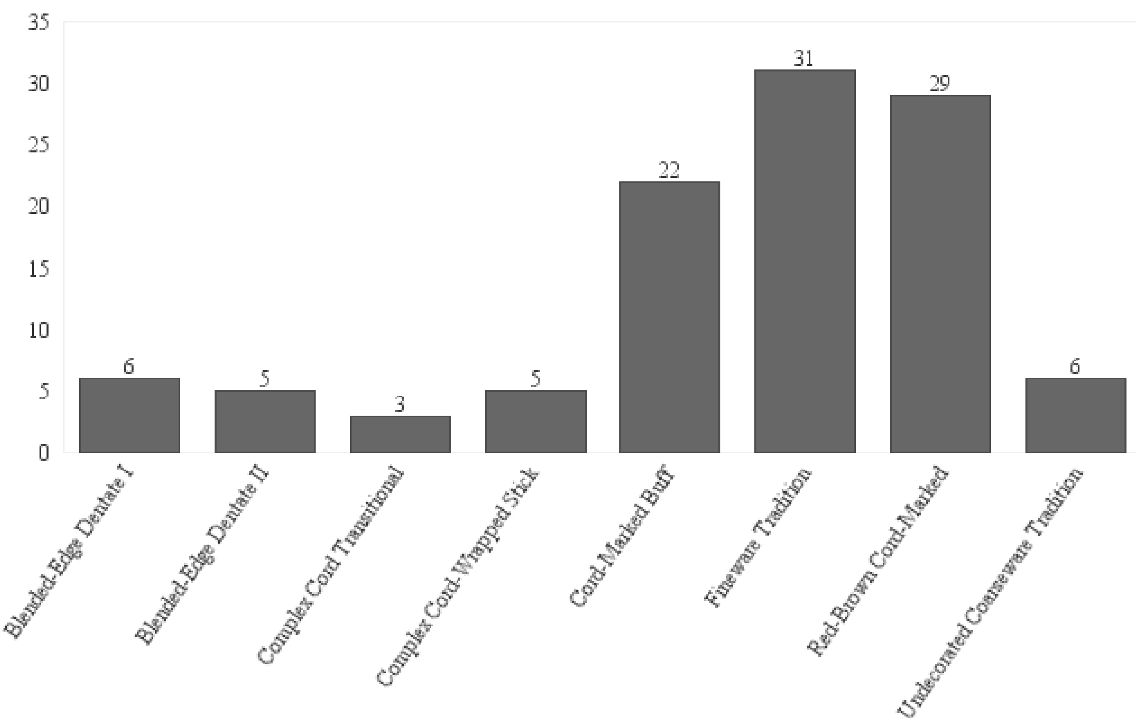

Figure 15: Distribution of ceramics by tradition (*n*=107). Not all vessel lots were assigned to traditions.

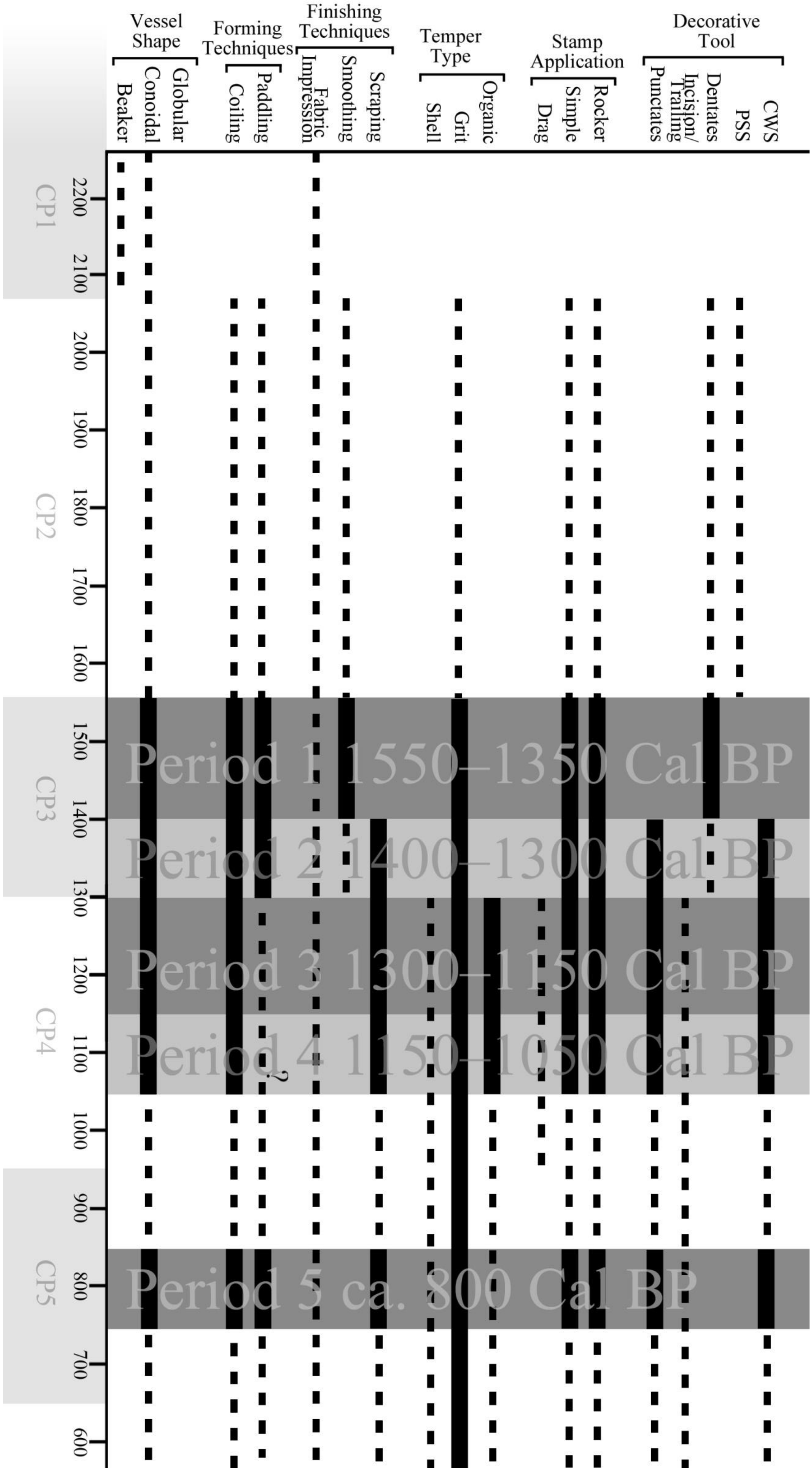

Figure 16: Attributes observed in the GLR sample. Dashed lines are inferred from other research conducted on ceramics (e.g. Petersen and Sanger 1991). Solid lines are observed in the GLR sample and chronologically situated using AMS dates.

Table 26: Distribution of AMS dated pottery showing their coil group and decorative group. * indicates vessel lots with no channeling.

VL	^{14}C Age Year BP	68.3% (1-Sigma) Cal Age Ranges	Tradition
28	870±30	732–796 887–891	[Period 5]
143	1160±30	1006–1026 1052–1091 1107–1146 11591173	[Period 4]
135	1270±32	1182-1213 1223–1263	Red-Brown Cord-Marked
93	1346±55	1186–1205 1239–1308	Red-Brown Cord-Marked
61	1410±30	1296–1332	Cord-Marked Buff
94	1460±30	1314–1368	Complex Cord-Wrapped Stick
122	1470±30	1327–1383	Cord-Marked Buff
160*	1540±30	1387–1419 1460–1518	Fineware
82*	1550±30	1400–1421 1433–1438 1457–1520	Blended-Edge Dentate I
86*	1610±30	1418–1461 1484–1489 1517–1550	Coarseware

The Early Woodland

Pottery manufacture appears to have been minimal or lacking at Gaspereau Lake during the Early Woodland Period. The hallmark of this period, fabric-impressed surfaces with coarse-tempered pastes, is exhibited by 18 sherds and up to three vessel lots. These vessel lots may have come from the Early Woodland, but uncertainty exists because these same attributes can occur later in time as well. The sherds represent less than 0.1% of the End of Dyke assemblage, so if they were made during the Early Woodland, they probably indicate that the economic and subsistence importance of pottery was not significant at Gaspereau Lake. Pottery from this period is similarly rare in other sites in the Maritime Provinces, a major exception being the Jemseg site in New Brunswick (Bourgeois 2004), although it is relatively more common in Maine (Petersen and Sanger 1991).

Some researchers have proposed that the transition from the Archaic to the Woodland Period was not so much a shift in lifeways as it was a continuation of previous lifeways with the addition of pottery. This has led some to prefer the term "Ceramic Period" (Leonard 1995) and to see pottery as one of the main, defining characteristics of the Woodland Period (e.g., Kennlyside 1999:70–71), or even its sole defining characteristic (Sanger 1986, 1988). However, in the Maritime Provinces, Early Woodland pottery is missing or appears only in small numbers compared with later periods except in a few sites, namely the Oxbow Site on the Southwest Miramichi (Allen 1980, 2005) and the Jemseg site on the Saint John River (Bourgeois 2004), both in New Brunswick. The latter site contained a significant Early Woodland and earlier Middle Woodland component. The former site is associated with an Adena mound and shows evidence of imported artifacts and ideas as well as unusually early dates for PSS-decorated pottery. Both these sites may represent outposts of cultures from other regions (Allen 1980; Bourgeois 1999).

When a ceramic type occurs sporadically in the archaeological record and is uncommon compared with other types, a particular economic situation is indicated. Women travelling to a region with their pots or their pottery-making knowledge may leave pots in the archaeological record, but not in significant amounts (Gosselain 1992:564). Their knowledge is not passed on to others because pottery is not part of the economic or subsistence strategy of the group (e.g., Sassaman 1992). The existence of other container technologies at the inception of the Woodland Period is well established, one of which is soapstone. According to Sassaman, in the southeast, trade in soapstone was a major barrier to the adoption of ceramic technology for many hundreds of years; possibly, a similar situation occurred in New Brunswick and Nova Scotia. However, it seems more likely, given the low numbers of soapstone vessels in the archaeological record of the Maritimes,[54] that high mobility coupled with a strong textile container tradition made pottery economically unviable during the Early Woodland.

Comparison between Maine and the Maritime Provinces for Vinette 1 pottery suggests a low or non-existent manufacturing context in the latter. Although it has been suggested that this particular pottery type is more susceptible to decomposition as a result of a coarse fabric and low firing temperature (Brumbach 1979:25), such a suggestion does not account for the larger Vinette 1 assemblage in other parts of the Northeast (Taché and Hart 2008), where climate has a similar effect on pottery. Although freeze-thaw action may not be as significant in New York owing to its slightly more southerly weather, there is such a marked difference in the amount of preserved Vinette 1 pottery between the two areas that the explanation seems instead to lie in the importance of pottery to the different peoples. Petersen and Sanger (1991:118) note that the widespread Vinette 1 horizon style is "reflected in the far-flung trade and/or exchange networks present in eastern North America during what is typically labelled the Early Woodland Period," the most telling evidence for which is the Adena/Middlesex-like Augustine Mound site on the Southwest Miramichi in New Brunswick (Taché 2011; Turnbull 1976; Jarratt 2013) and other Meadowood ritual or burial sites (Rutherford 1991:108−09). Although Rutherford (1991:110) and others (Allen 1981;

[54] To my knowledge, one possible soapstone vessel comes from the Maritimes; it is part of the GFC Artifact Collection.

Turnbull 1976) contend that these complexes were mainly a movement of ideas and goods rather than people, the sporadic distribution, heterogeneously patterned minerals in pastes (Brumbach 1979:25), and low numbers of Early Woodland ceramics (Taché and Hart 2008) is consistent with people (women?) entering groups with their pottery or pottery manufacturing knowledge and remaining a minority. Given the exogamous and patrilineal descent customs of the Mi'kmaq and Wolastoqiyik (as well as the majority of Algonkian-speaking peoples) (Bock 1978; J. Wright 1972), such an arrangement is possible. Another explanation is that pottery moved into the Maritimes along with other exotic goods such as pipestone, although the value of pottery in such a system is not well enough established to make such a conjecture.

The Early–Middle Woodland Transition

The fabric-impressed pottery sherds at Gaspereau Lake have a unique breakage pattern compared with PSS- and dentate-decorated pottery. They do not exhibit coil breaks and are uniformly missing one surface, probably the exterior. Unlike other vessel lots, they do not exhibit lamellar character, an attribute that results from paddling. It therefore seems unlikely that they were constructed using the coiling and paddling method that is clearly in evidence later in time. They also exhibit crisp fabric impressions that tend to get obscured on pottery made later in the Woodland Period, suggesting they are in fact Early Woodland pots. There is no evidence of transitional pottery forms from fabric-impressed to PSS- and dentate-decorated pots, signaling an abrupt shift. This is consistent with other sites where both kinds of pottery have been recovered, a possible exception being, again, the Oxbow site in New Brunswick (Allen 1981; also, see Petersen and Sanger 1991).

It is generally accepted that a new kind of pottery appeared around 2000 years ago across most of the Northeast with relative suddenness. Usually called the Pseudo-Scallop Shell horizon (Chapdelaine 2012:257–58; Petersen 1988), this pottery is decorated with fine, carefully impressed PSS or dentate decorations and tends to be thinner and harder in constitution (Bourque 1995; Sheldon 1988; Nash and Stewart 1990; Petersen 1988; Petersen and Sanger 1991; Robinson). Importantly, pottery from the Middle Woodland marks a significant and rather sudden break from the earlier pottery, not only in the appearance of distinctive decorations but also possibly in manufacture. Where later pottery consistently shows evidence for having been coiled and then thoroughly paddled, earlier pottery appears not have been paddled or coiled at all, and instead may have been constructed by patting clay into a mould (Kutruff and Kutruff 1996:164). This would mark a sharp break in learning lineages, since an entirely new skillset would have to have been introduced at the Middle Woodland threshold.

Kutruff and Kutruff (1996:164, quoting Keslin 1964:50) raised the possibility of mould-made pottery during the Early Woodland. A mould would be made from digging a conical hole and lining it with fabric, after which it would have clay patted into it to form a jar. After drying was complete, the fabric would be peeled off the outside of the pot. This method would explain both the conical beaker shape that was never used again after the Early Woodland (Petersen and Sanger 19991:119) and the pristine cord impressions that in later periods was often obscured ("partially smoothed"): if allowed to dry with the fabric still in place, the cord marks would not be likely to diminish with handling, but if the vessel were "fabric paddled"—that is, hit with a fabric-covered paddle as part of the forming process—then the not-yet-dry marks would have ample opportunity to be obscured through shaping and handling. It would also explain the variable wall thicknesses and the sometimes off-centre profiles of Vinette 1 pots, which are in contrast to the evenly thinned walls and (mostly) symmetrical diameters of the Middle and Late Woodland that result from paddling.

The appearance of a new kind of pottery (PSS-decorated pottery) indicates that people were behaving quite differently during the Middle Woodland Period (Robinson 2012). This behaviour can be summed up by what Neff (2014) calls "costly signalling," meaning that pots were now intended to convey affiliations (e.g., Bowser, 2000; Neff 2014; Sassaman 2010; Wiessner 1983) or skill levels (e.g., Dobres 2001; Hayden 1995; Naji 2009) along with other functions. Where, previously, pottery suggests a secondary importance—as a skeuomorph, or a replica of an artifact class in another medium (Flannery and Marcus 1994:4750; see also Griffin 1965:105–06; Rice 1999:7; Speck 1931)—to other artifact classes such as basketry, during the Middle Woodland, potters emphasized its importance in its own right. Potters signalled this by using designs not evocative of other materials and by investing significantly more effort into manufacturing thin-walled, hard-bodied, intricately decorated pots easily recognizable and distinguishable from Vinette 1 pots. Hayden (1995) proposes that this kind of loading up of labour onto objects is a strategy people can employ to attract others to them: it signals their great skill or their ability to acquire sought-after goods, thus making them more attractive.[55]

Importantly, pottery during the Middle Woodland was still intended for cooking. Although pastes are often finer in PSS- or dentate-decorated pots, they invariably contain temper. Additionally, these pots are often found with carbonized encrustations and use wear, confirming that they were used in this manner (Woolsey 2010). Although they were apparently meant to be finer and more elaborate than previous kinds of pottery, they were never divorced from their function as tools. This probably indicates that they continued to be associated with women and that they encode affiliative information about women.

[55] The theory of costly signalling comes from the signalling theory originally developed as a biological explanation for behaviours that cannot be accounted for by theories such as the selfish gene or reciprocity. Honest signalling is a phenomenon where organisms expend energy in seemingly pointless activities such as the high and energetic bounding of springboks, which may be intended to show predators that giving chase would only be a wasted effort, and to show mates that they would make a good choice for procreation. Signalling becomes costly when it involves difficulties or significant expenditures of energy or resources for no apparent gain, such as in the case of the peacock's tail. Costly signalling has been proposed for many behaviours in the human species that cannot be easily explained by either cultural or biological mechanisms. For example, the case of male hunters who distribute meat indiscriminately among members of the group cannot be explained by kinship, since meat is given to kin and non-kin alike. It also cannot be explained by reciprocity, since no guarantee of reciprocal gain exists, especially where some group members may be unable or unwilling to give anything back. Further, it cannot be explained by selfish behaviour because such behaviour may be expected and therefore may receive no benefits whatsoever; this is frequently observed in cases of young hunters expected to prove themselves. One possible explanation is that hunters are signalling to group members that they are able to marshal resources, making them an attractive mate, desirable group member, and potential leader.

The Earlier Middle Woodland Period

Ceramics were probably manufactured early in the Middle Woodland at Gaspereau Lake, although no ceramics yielded dates earlier than ca. 1500 BP. The earlier Middle Woodland is probably represented by several groups of PSS-decorated ceramics, which constitute a fairly small amount of the Locus1 and Locus 3 sample. This number is more-or-less reflected in the overall assemblage from the End of Dyke Site.[56] At 19 vessel lots and 632 sherds, this potentially early segment of the ceramic assemblage is similar in numbers to other sites with a significant ceramic assemblage. These vessels range from extremely thin (>0.5 cm thick at the neck) to nearly 1 cm thick, and from bright red or orange to soot black on their interior and exterior surfaces. They also range from extremely fine (<5% temper) to coarse (>40% temper). Additionally, a number of PSS variations are evident, each corresponding to some extent with temper, surface colour, and thickness.

One of the more striking PSS groups is decorated with classic PSS impressions that are fine and uniformly and closely spaced. They occur on vessels that are reddish and compact, with thin walls and fine-to-no temper. There is no mistaking the thin, even width of the wavy line, the continuous, even depth throughout the impression, and the rounded corners on each element. The potters that used this decoration type seem to have wanted the beauty of the decoration tool to be noticed and admired.

Two other groups may also be early ceramics: those with deeply impressed PSS decorations and those with trapezoidal PSS elements. The former group tends toward coarser pastes and sooty brown or black colouration. The main constituent is white quartz, but mica is also visible. They tend to have a crumbly texture. The latter is variable in paste texture but tends towards fine in most vessels. It may be that this decoration does not correspond with manufacturing attributes and has little chronological significance.

The decorations can be grouped both by the shape and application of the PSS impressions but also by other attributes; however, the groups are only loosely delineated. Variability of temper, wall thickness, and morphology indicate that rules, if they existed, were only loosely followed. These vessels tend toward the thin-walled and fine-tempered, and the decorations tend to be discrete and carefully placed, but the trend is not without exception. PSS-decorated vessels therefore appear to have been made by potters working within a tradition but who felt comfortable deviating from conventions while still making pots recognizable as belonging to those conventions. The adherence to the PSS decoration, with a clear intention to make those decorations stand out, seems to indicate what Wiessner (1983:257) has called an "emblemic" intentionality, which she defined as "formal variation in material culture that has a distinct referent and transmits a clear message to a defined target population . . . about conscious group affiliation or identity, such as an emblem or a flag." The variability in how carefully these pots were made indicate varying levels of affiliative intention (such as potters contesting their positions—e.g., Crown 2001:454; also Naji 2009) or legitimate participation (such as relative newcomers to a work group or kin group).

[56] The ceramics were catalogued by CRM Group, including possible age affiliations. Therefore, decorations are noted and classified where applicable.

The Origins of Earlier Middle Woodland Pottery

The question of PSS origins is raised by calling a style emblemic. As Wiessner points out, a "distinct referent" is the underlying mechanism, which implies that an affiliation existed amongst potters across a broad region to which they were referring with their style, or emblem. However, Wiessner specifies that such a scenario of shared emblemic style by widely dispersed hunter-gatherers would be unlikely because the means of transmitting and maintaining membership across such a wide culture area would be untenable due to low contact and mobility. Considering that pottery would indicate the affiliations of women, who may have travelled large distances for marriage, the mechanism for the stability of the PSS decoration may have been exogamy, as J. Wright (1972) proposed for the northern Ontario Algonkians. Another factor to consider is the likelihood of aggregation activities carried since a quite distant past relative to the present (Sassaman 2010), which would also serve to cement group affiliation at multiple scales of distance and "spaces of experience" (Gosselain 2016:46).

During the transition from the Early to the Middle Woodland, significant movements of people were occurring. These movements are evident in the wide dispersal of cultural materials associated with the Hopewell, Laurel, and Point Peninsula cultures and with the movement of raw materials and finished goods. Attributes associated with the Hopewell Interaction Sphere (Pauketat 2012) and the Point Peninsula horizon (Gates St.-Pierre and Chapdelaine 2013) are the decorations of pottery with dentate and PSS decorations, respectively (also, Mason 1970:810–11; Petersen 1997). The pots appearing in these different complexes exhibit local and areal distinctiveness and are made using local materials, meaning that it was the potters, not the pots, that were being exported, indicating a large-scale movement of women and, possibly, their families. A replacement of the population does not fit well with the evidence in most places (no signs of wide-scale conflict, evidence of a hiatus, and so on) so it appears that these people became new members in the native groups. These newcomers would have been economically attractive, associated with (or possibly they themselves were) trading partners with access to exotic goods such as platform pipes, gorgets, cache blades, and shark's teeth, and their presence may have been welcomed by the native populations. It would have been in everyone's best interest that women continue to signal their ties to other regions and to the original trader culture. The fact that there is no evidence for a blending of Early and Middle Woodland styles probably indicates that cooking directly over heat was important to the new lineage of potters from the Middle Woodland on as it had not been earlier.

Because pots may have been meant to communicate affiliation and attractiveness, the importance of skill in producing pottery may have been important. The thin-walled, hard-bodied pottery would have required significant skill to produce, which would likely have enticed potters to maintain their skill levels. Although production may not have been as high as in later periods, pottery was probably produced more often than on an as-needed basis, at least partly to keep up skill levels, and probably also for the purposes of maintaining an identity as skilled and economically important. As such, some women probably emerged as more specialized potters, and were probably asked to make pottery for others (as occurred in the case of the Shipibo–Conibo studied by Lathrap 1983). Children and other female kin would have been encouraged to learn from potters, but not all would have been expected to become highly skilled potters in their own right; therefore, the learning framework would have been rather unstructured, and incentives for participation would probably have come from a desire to signal affiliation or identity (e.g., Budden and Sofaer 2009; Michelaki 2008).

Later Middle Woodland: 1550–1400 BP (Period 1)

Much of the PSS- and dentate-decorated pottery cannot be securely dated to any period, making the beginning of regular manufacture at Gaspereau Lake undatable. The first dated ceramic context begins at ca. 1550 BP. Defined by three tightly agreeing dates around this time, a ceramic use moment is in evidence, indicating increased activity and possibly ceramic production.

This period is defined by three dates obtained on GLNS:82, GLNS:86, and GLNS:160. These vessel lots are fairly dissimilar in decorative and manufacturing attributes and site distribution and probably represent three distinct, co-existing traditions. GLNS:82 and GLNS:160 are both dentate-decorated, although they are from quite different decorative and paste groups. GLNS:86 is undecorated, is coarsely tempered, and exhibits numerous coil breaks, quite unlike the other two dated vessel lots from this period.

Blended-Edge Dentate Tradition I

This group of vessel lots show similarities to each other that indicate a greater degree of standardization than other PSS- and dentate-decorated pots. These similarities consist of easily recognizable dentates connected on one edge, similar colouration, clay, and temper minerals, and an unusually large number of coil breaks relative to other dentate- and PSS-decorated vessels. The tradition appears to change through time, with the vessel lots from Locus 1 clustering more tightly in decorative, paste, forming, and morphological attributes than those from Locus 3.

Named after its distinctive decoration, this tradition is exemplified by GLNS:82, a dentate-decorated vessel lot belonging to the Buff-to-Pink clay group and the Bluish-Grey Quartz temper group. It is part of the easily recognized and relatively homogeneous decorative group called Blended-Edge Dentate, which is divisible into two subgroups (see Blended-Edge Dentate decorative group in the Surface Modifications section of Chapter 3). Although this vessel lot is not from the Locus 3 section of the End of Dyke Site, it is similar to vessel lots coming from Locus 3 as well as other vessel lots from around the site. These vessel lots tend to have buff-coloured clay and temper composed of bluish-grey quartz, mica, and iron oxide. Their walls tend to be relatively thin. A shift is apparent from browner colour, thinner walls, and more standardized horizontal decorations to thicker walls, lighter surface colour, and less standardized placement of decorations; throughout this category, however, decorations are recognizably similar to each other and pastes remain the same. Unlike other vessel lots with PSS/dentate decorations, these vessels exhibit an unusually high number of coil breaks, indicating that their manufacture was more expediently carried out than other dentate or PSS vessel lots.

As in the case of cord-marked vessel lots with the same buff-coloured clay and bluish-grey quartz temper, standardization is evident. This is the first instance of the bluish-grey quartz temper type used ubiquitously across a group, along with a more-or-less complete lack of feldspar, indicating that processing and sorting practices were the same for all vessels in the group. The appearance of coil breaks in most of the vessels also indicates that the forming practices were the same. The use of the same or similar decorative tool(s) seems to indicate that the potters wanted to achieve a standard and recognizable decoration; otherwise, variations, such as occurred in previous periods, would be expected. Self-expression therefore appears to have been less of a goal on these pots. The repeating manufacturing attributes of these vessels links this period to the following one in which the same paste ingredients are recognizable in both dentate-decorated and cord-marked vessel lots.

Fineware Tradition

The Fineware Tradition has been so-named because the vessels it describes tend toward fine pastes, painstaking decoration and expressive decorative strategies, and thinner, harder-walled vessels. Because they are often bright red or red-brown, firing practices probably facilitated an oxidized firing cycle, but their hard pastes suggest an enclosed structure, such as a partly covered pit to retain heat. Although GLNS:160 has been dated to ca. 1550 Cal BP, the tradition it exemplifies could have begun much earlier considering the range of decorations and other attributes that characterize vessels in this group.

GLNS:160 is an unusual vessel lot belonging to the Light Red clay group and the Feldspar-Rich Granite temper group. This indicates that it was made using quite different materials and processing practices from the majority of vessel lots, especially those made later in time. Compared with the more standardized Blended-Edge Dentate vessel lots, clay matrix appears finer and temper includes feldspar as well as mica and quartz, suggesting that temper was procured from a glacially transported granite cobble. GLNS:160 was assigned to the Fine Triangular Dentate decorative group but is decorated with a different zoning strategy than any vessel lot in the Locus 1 and Locus 3 samples: the tool is curvilinear and rocked on, moving obliquely down the side of the pot creating an oblique column around the body and neck and up to the lip. The decoration on this vessel lot demonstrates expressiveness within a convention of PSS/dentate tools, and the care with which the decoration was applied is mirrored in the efforts of obtaining highly smoothed interior and exterior surfaces and the even, red colour across both interior and exterior surfaces. Other vessel lots belonging to PSS/dentate decorative groups, particularly the Precisely Impressed PSS, the Fine Triangular Dentate, and the Trapezoidal Continuous-Element PSS groups, also show this expressiveness within a convention, exhibiting carefully applied decorations in various zoning strategies and orientations. Thicknesses vary, but walls tend toward the thinner side and pastes are generally quite compact, implying intensive paddling, a risky and time-consuming practice. Over all, these vessels show considerable expressive variation but a common theme of fineness and elaboration.

Undecorated Coarseware Tradition

This undecorated, coarsely tempered pottery tradition is exemplified by GLNS:86. It is the earliest vessel lot dated in the sequence. Because it lacks identifiable decorations, it is difficult to place in context. Other vessels bear similarity to GLNS:86 in their lack of decorations, their coarse pastes, and their fairly rough interior and exterior surfaces.

In any case, the early date for this vessel lot is surprising given the impression of many researchers that Middle Woodland pottery is carefully decorated and finely tempered (Petersen and Sanger 1991:123–24; Sanders, Finnie, et al. 2014:231). A separate, undecorated pottery tradition alongside more finely made pottery would fit with patterns of co-existing traditions in other regions. For instance, Caddoan and Moundville pottery comes in many forms, particularly in fineware for serving, coarseware for cooking, and intermediate kinds of pottery for a variety of uses (Perttula et al. 2001; Steponaitis 2009). One further observation about coarseware pots is that the low number of vessels defined in the Locus 1 and Locus 3 samples may not be a reflection of original ratios but rather of multiple original vessels having been combined in this analysis because they are difficult to tell apart. Therefore, coarseware vessels may have been more plentiful than they appear in this analysis.

Middle Woodland–Late Woodland Transition: 1400–1300 BP (Period 2)

This period is defined by three dates obtained on GLNS:61, GLNS:94, and GLNS:122. These three dates, covering a rough span of 1400–1300 Cal BP (2-Sigma range), represent two groups of vessel lots that are related but different enough that they are probably produced by different learning lineages. Evidence for these groups comes from the unusual circumstances (discussed in the following section) surrounding GLNS:61 and from the distinctive character of GLNS:94, which is similar to vessels from other sites.

Cord-Marked Buff

This tradition is exemplified by GLNS:61, which was dated to 1285–1359 Cal BP at the 2-Sigma range. GLNS:61's date is interpreted to apply to a number of vessel lots with very similar pastes and mostly unplied or S-twist impressions (three exceptions exhibit Z-twist), many observed to come from the unit 971N/981E or its vicinity. It includes several decorative groups, including the tightly conforming Cord Fan group and the more loosely conforming Cord-Wrapped Edge and Cord-Wrapped Stick groups. These vessels tend to have strikingly similar pastes of Buff-to-White clay, with Bluish-Grey Quartz temper (or the suspected variation of this temper called Feldspar-Poor Granite), and usually with iron oxide particles visible in the paste. Channeling is usually aggressive and comparison of channeling gestural marks across the vessel lots reveal marked similarity to each other. Morphologically, the vessel lots are fairly dissimilar, although neck thicknesses cluster around 0.8 cm tighter than does the entire population; additionally, necks are predominantly on the thicker side within a relatively small range (0.7–0.9 cm).

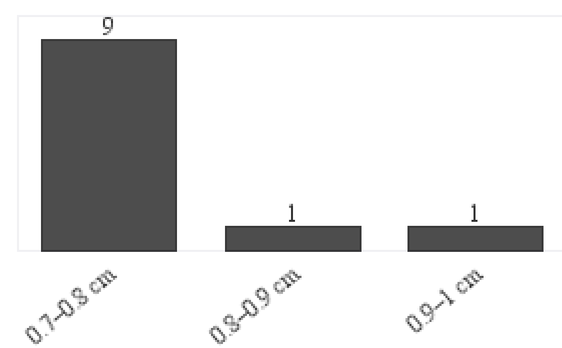

Figure 17: Neck thicknesses for Cord-Marked Buff vessel lots.

Considering that most of the vessels have light-coloured clay and distinct carbon cores, firing practices were probably also standardized and included a moderately oxidizing atmosphere and probably a short firing cycle.

Because a large number of vessel lots are represented in the primary discard feature in unit 971N/981E, these vessels shared a related depositional history. This fact, along with vessel lots having similar channeling marks and decorative strategies and mostly S-twist cordage impressions, probably indicates a single community of practice with a learning lineage that promoted fairly strict adherence to a paste recipe and firing practice, though not to a decorative standard. This probably indicates a situation where one potter or a small group of potters working together formed the pots but others in the family, including the spouse and children, may have decorated the pots (London 1991:192–93).

This group of vessel lots is one of the best understood as a result of being defined by two dates. These dates (both at the 2-Sigma range) are 1285–1359 Cal BP on GLNS:61 and 1306–1404 Cal BP on GLNS:122. Even at the 1-Sigma range, they are close in time, suggesting a period close to 1330 Cal BP. These two dates, together with the tight conformity to paste and temper standards as well as a majority S-twist cordage trend, is good evidence for a manufacturing moment in which vessel lots were made in larger numbers than in previous periods and large batches of clay were mixed in anticipation of large runs of pottery. The large number represented in unit 971N/981E probably indicates that pots in this period were first discarded or stowed here before being moved (presumably as broken pots) to the cluster around unit 973N/983E.

Blended-Edge Dentate II

There is only circumstantial evidence for a separate period called Blended-Edge Dentate II, because no dates were obtained on any of the lighter-coloured pots from Locus 3.There are several indications that this subset of the Blended-Edge Dentate group is temporally distinct, however. First, this subset is differentiated from Blended-Edge Dentate I by a lighter surface colour and a variable stamp alignment as opposed to the more reduced brown colour and ubiquitous horizontal stamp alignment of Blended-Edge Dentate I. The paste and temper of this subset appear very similar to GLNS:61, one of the vessel lots with defining dates for Period 2 and an exemplar of the standardized paste in this period; this may mean that either GLNS:61 is part of a tradition that grew out of the Blended-Edge Dentate II tradition, or that they were concurrent manufacturing traditions sharing access to the same materials and resulting from similar ideas about paste preparation. I tentatively propose that this tradition was transitional between the Blended-Edge Dentate I and Cord-Marked Buff traditions, and as the latter became more standardized, Blended-Edge Dentate II became obsolete and eventually ceased as a tradition altogether.

Complex Cord-Wrapped Stick (CWS) Tradition

This tradition is not easy to define because, while it has distinctive attribute states, it also seems to blend into other traditions. During Period 2, Complex CWS exhibits some shared attributes with Cord-Marked Buff, including similar channeling marks, similar feldspar-poor granite temper, and similar neck thickness. It is differentiated, however, by its cord marks, which show clear signs of being cord-wrapped stick marks with a Z-twist (usually tightly plied) cord. Perhaps most distinctive about this group is the variously oriented impressions creating rich zoning that transcends the usual horizontal and oblique zoning strategies seen on most vessel lots.

The date range defining the Complex CWS tradition, acquired on GLNS:94, is 1302–1396 at the 2-Sigma range, which places it between the two dates for Cord-Marked Buff. There is little doubt that it belongs to the same period, and overlap in manufacturing attributes can be seen in some specimens. At least one vessel lot, GLNS:58, is in all ways part of the Cord-Marked Buff tradition except for its Z-twist cord laid on in an unusual zoning strategy. Because this strategy is more stimulating visually, but also probably required more time and effort to carry out effectively, it may have been too much work to apply to most of the pots made during this period. This decorative strategy is seen on pots from other parts of the region and follows a similar decorative strategy to the Parker Festooned ceramic "type" from the southern Great Lakes Region (Abel 1999), possibly indicating that it is an imported style. Firing regimes appear to be variable (although too little information exists to state this definitively).

The fact that the cord marks are predominantly Z-twist may indicate a different group of people, learning lineage, or technological group (Gosselain 2000:189; Kenyon 1986:20; Petersen 1996:114[57]; Petersen and Hamilton 1984; Sanger 2003). GLNS:58 may represent an overlapping of technological groups, one engaged in a more standardized production practice while the other was more domestically oriented and made up primarily by non-specialist potters whose learning lineage originated outside the group. A domestic, as-needed mode of production would allow a potter more freedom of experimentation and expression. In addition, the variability in firing attributes in this tradition supports a scenario where firings were individual endeavours and ideas about proper firing technique may have come from a variety of backgrounds.

Earlier Late Woodland: 1300–1150 BP (Period 3)

During the transition to the Late Woodland (which may have begun as early as 1400 BP), a shift in settlement patterns and economic strategies accompanied a shift from dentate-decorated to cord-marked pottery. Smaller campsites along the coast of Nova Scotia, New Brunswick, and Maine became much more common, each apparently housing a nuclear or extended family that exploited marine resources such as shellfish as well as terrestrial mammals such as beaver, moose, and deer. Territoriality may have increased, and these seemingly dispersed families may have seen themselves as part of larger groups that resembled the modern Mi'kmaq, Wolastoqiyik, and Peskotomuhkati (Passamaquoddy). After this period and when the transition to the Late Woodland was complete, around 1000 BP, ceramics began to decline in frequency in some other parts of the Maritime Provinces (e.g., Nash and Steward 1990:114; MacIntyre 1988:326; Blair 2009; Foulkes 1981). At the same time, trade appears to have increased at around 1000 BP or before, with evidence of lithic exchange extending as far away as Labrador and over into New England (Bourque 1994,

[57] Petersen (1996b:114) also calls this a technological population.

2001:93). Other items, such as shark's teeth, were also imported from as far away as Chesapeake Bay (Betts et al. 2012). The earlier Late Woodland is a transitory period into this time of increased social and economic interaction.

It is at this point in time that researchers usually propose a decrease in ceramic quality based on coarser pastes and more crumbly textures. These changes are generally associated with a switch from dentate decorations to cord marks. As previously noted, however, these attributes may have actually been improvements on the pastes, since they would have increased thermal shock resistance, even though they have subsequently fared worse than their Middle Woodland counterparts in the archaeological record. The decreasing number of pots noted at some sites from this period onward may have to do with this poorer resistance to freeze-thaw action.

The increased temper and coarser pastes during the Late Woodland would have required skill to handle. The less clay content in a paste, the less able are the plastic properties of clay to maintain a form under the paste's own weight. Paddling improves these properties by more closely pressing the platelets of clay together, but the two barriers to paddling are, first, the difficulty of making an initial form to be paddled (Herbert 2008), and second, the increased difficulty of paddling due to reduced plasticity and greater weight per clay content (Rice 2005). Therefore, the fact that vessels were made at all with greater than 30% grit temper is a sign of a skilled population of potters,[58] while a majority of vessels across the region with >30% temper and walls thinner than 1 cm indicates that this skill was widespread and stable.

At Gaspereau Lake, some earlier Late Woodland practices contradict the expectations set out by other researchers. One tradition during this period, the Red-Brown Cord-Marked Tradition, was finer tempered—mostly with a combination of organic material and grit temper—and higher fired, judging by the ubiquitous hard ceramic bodies. Later in time (after 1100 BP), heavily grit-tempered ceramics were manufactured, which conform much better to expectations set out by Petersen and Sanger and others, but the period of greatest ceramic manufacture appears to have been this moment during which grit decreased significantly and nearly disappeared altogether in favour of finer pastes. Ceramics fitting this description are not mentioned by Petersen and Sanger nor by other researchers in this region, meaning either that the tradition was specific to Gaspereau Lake and was not exported, or else researchers have seen this pottery as an anomaly and attempted to fit it into other categories. Another unusual attribute of the Gaspereau Lake assemblage is the near-complete lack of shell-tempered ceramics, which appear during this period in other parts of the Maine–Maritimes Region.

The replacement of dentates with cord marks is not a well-understood change, even though it occurred across a large portion of the Northeast. In the Maine–Maritimes Region, cord marks were usually the result of a stick, paddle edge, or flexible cord wrapped with another cord and impressed in a series of linear impressions (Bourque 2001:80; Godfrey-Smith et al. 1997; Petersen and Sanger 1991; Woolsey 2010). However, in other parts of the Northeast, cord marks also took the form of fabric paddling or impression (Krause 2016),

[58] So far, I am only able to make a pot with 1 ltr capacity using 20% temper. Attempts at larger amounts of temper have resulted in cracking of the rim during the paddling stage.

cord "roughening," rouletting or hopping by rolling a cord-wrapped stick (Leonard 1996:117; Strong 1930:133), or even lace impression (Drooker 1991). Where cord marks were not as common or did not appear, figurative decorations instead appeared, although these were largely associated with later Mississippian centres or complexes. As with the transition from Vinette 1 to PSS/dentate vessels, no transitional forms are known in this region (Bourque 2001:76), meaning that a break in manufacturing practices may be in evidence. However, unlike in the case of the Middle Woodland, less evidence exists for the introduction of new cultures or peoples from other regions. Because cord-marked pottery appears to have been a more gradual transition—some examples have appeared before the Middle Woodland (Godfrey-Smith et al. 1997:269)—the horizon style may represent a more general movement of people both to and from the Maine–Maritimes Region over several hundred years prior to cord marks becoming the dominant style. The early appearance in this region may also indicate that it originated here and spread westward and southward. Additionally, technological continuity exists between the earlier and later ceramics, both having been coiled and paddled, both having been tempered with crushed granite, and both having the same conoidal jar shapes, indicating use as cooking pots over open fires. Nevertheless, the cord mark horizon is recognized as a significant break not only here but across the Northeast generally.

At Gaspereau Lake, the earlier Late Woodland saw a gradual shift from the light, buff- or off-white paste with distinctive bluish-grey quartz particles toward finer-tempered pastes with increased iron oxide content and organic matter frequently included. During this period, interior channeling-and-burnishing appears to be the majority practice. Pronounced and prolific coil breaks characterize most vessel lots from this period, and they exhibit a smooth surface, flat shape, and a shallowly oblique directionality. This indicates that paddling was even less intensive than in the previous period. Despite this apparent decrease in structural integrity of vessels caused by increased joints of weakness, pastes are noticeably harder than before. This seems to indicate that firing regimes were hotter and, judging by the lack of carbon cores, longer. Also, the reddish colour of many vessels during this period suggests oxidizing conditions during firing.

Red-Brown Cord-Marked Tradition

The vessel lots in this tradition are tied together by a high degree of homogeneity in paste hardness and consistency, as well as a similar decorative strategy. This tradition is the largest in terms of number of vessels in a single tradition, and is distributed over both the Locus 1 and Locus 3 areas. It appears to have been characterized by relatively high firing temperatures, significant iron oxide content, low or no paddling, and channeled-then-burnished interior surfaces. The vessels are tempered with organic material, which promotes greater workability in vessel construction as well as faster drying (Skibo et al. 1989).[59] Specifically, organic temper allows the walls to hold together better and under more stress and the clay body to dry more evenly with less likelihood of cracking. Practically, it means

[59] In the words of an instructor at the New Brunswick College of Craft and Design, "You can get away with more bad behaviour."

that pots can be dried faster and harsher without having to be covered for such long periods. Such a technological strategy suggests that potters were looking for ways to insure greater success in the forming and drying processes as well as a faster way to turn out pots while being less concerned with the longevity of their pots, since little effort was made to join the coils securely. Perhaps higher firing temperatures and higher iron oxide content were intended to compensate for this lack of strength. The uniform difference in pastes from the previous period indicates a different manufacturing period, but the clear similarity in decoration and clay colour, as well as the predominant S-twist cord impressions, indicates continuity with the earlier Cord-Marked Buff Tradition.

This tradition is characterized by vessel lots that exhibit hard, high-fired pastes, reddish-brown to light red colouration, channeled-and-burnished interior surfaces, predominantly finely tempered paste textures, and plied cord, mostly S-twist. Tempers tend to include iron oxide, either as a fine particulate or as a granulate with particles visible in the paste. These vessels also tend to exhibit large or small vesicles where organic matter has burnt out. These vesicles often look like accidental inclusions, but they are so common in the locus 1 and Locus 3 samples that an intentional tempering material seems more likely.[60] Temper percentages range from 0–30%, with most under 20%, and include feldspar-poor granite and, in one case, sand. Decoration strategies range from alternating horizontal and vertical alignments to rocked-on curvilinear cord-wrapped edges creating a fan, as many pots from the earlier Cord-Marked Buff Tradition also were decorated. The cord-marked fan decorations in this tradition are usually S-twist while those in the earlier Cord-Marked Buff Tradition are usually unplied.

The tradition is chronologically contextualized by GLNS:93 from the secondary discard cluster surrounding the unit of 973N/983E and by GLNS:135 from a pottery storage feature located in unit 970N/979E, on the southern edge of Locus 3. GLNS:93 was dated to the range 1368–1175 Cal BP (2-Sigma range) with a likelihood of being at the earlier end of this range (see the previous discussion of unit 973N/983E in Chapter 4 and a more full discussion in Appendix 10). GLNS:93 is distinctive in its paste, apparently untempered with the possible exception of some large organic particles. Although the seemingly untempered paste is unique in the Locus 1 and Locus 3 assemblage, it is related to other vessel lots with organic and iron oxide temper. In particular, lamellar character is shallowly oblique and the paste gives the impression of a hard, fine, relatively high-fired fabric, particularly in places where the surface looks shiny and slightly melted. A high firing temperature was confirmed by SEM heating experiments, which suggest the vessel lot may have originally been fired to 1000°C. Although the colouration (buff-brown to sooty brown) is different on GLNS:93 from the light red or reddish-brown colour of most of the vessel lots in this tradition, areas of pink surface colour are visible in small sections of fresh breaks, indicating that the original colour was probably light pink or red and also that the paste or slip probably contains some iron oxide. Coil breaks are extremely prolific among the sherds, and the cross-sections of these breaks are unusually smooth, slightly oblique toward the exterior. This indicates that

[60] An alternative explanation is that these clays were acquired from one of the wetland areas around Gaspereau Lake that are underlain by the same residual clays weathered from feldspar in the area, causing poor drainage in basins and lower-elevation areas. These clays may have been selected precisely because of their organic content, which would accomplish the same goal as organic temper.

paddling and coil joining was even less intensive than for most vessel lots of the Late Woodland Period, but this is a common attribute for vessels of the Red-Brown Cord-Marked Tradition. Weakness in vessel structures may have been compensated for by higher firing temperatures and the addition of iron oxide to act as a flux. The manufacturing practice employed by the tradition therefore appears to have emphasized expediency in the forming and drying stages.

Another vessel lot that belongs to this tradition, GLNS:135, shows that a shift in pastes occurred later in Period 3 but many attributes (such as low intensity of paddling) remained the same. This vessel lot is dated to a distressingly long range of 1089–1287 Cal BP (2-Sigma range), but the most probable date occurs between 1173–1287 Cal BP (90.25% relative area under the distribution). This puts GLNS:135 at approximately the same time period at GLNS:93. GLNS:135 does not share so strongly the distinctive fine, buff-coloured paste and highly smoothed/burnished surfaces, but lamellar character and coil breaks are very similar. Coiling and paddling practices are more-or-less identical, indicating a single learning lineage.

The vessel lots made in the Red-Brown Cord-Marked tradition are mostly distributed around the secondary discard unit 973N/983E in a loose cluster. Those associated with layers in the extended hearth feature F27 tend to exhibit a sootier or browner colouration, as does GLNS:93, than their counterparts from the main occupation layer, although not in all cases. This colouration probably comes from subsequent hearths scorching the previously deposited sherds.

The tradition is probably an outgrowth of both the Cord-Marked Buff and the Complex CWS traditions of the previous period. Although the paste recipe is significantly different from the previous period's vessel lots, and paddling practices were clearly less intensive than in the previous period, continuity is apparent in the use of iron oxide, the continuation of the Cord Fan decorative practice that was characteristic of the Cord-Marked Buff Tradition, and the interior channeling that emerged in the previous period. S-twist indicates a learning lineage tied to the previous period. Additionally, when grit occurs in the Red-Brown tradition, it, too, is feldspar-poor and contains bluish-grey quartz particles that were so characteristic of the Cord-Marked Buff tradition.

Unlike in some other periods, paste varies somewhat while forming attributes are highly homogeneous. Differences in decorations and finishing techniques in this period may result from differential expediency requirements, or from neophytes or non-potters such as members of the potter's family having been recruited to help with decorating, but continuity of forming techniques was maintained throughout this period, as was a majority S-twist cord. One other noteworthy attribute of the Red-Brown Cord-Marked Tradition is that the largest number of vessel lots in the Locus 1 and Locus 3 samples belong to it, both explaining the paste variability somewhat and also suggesting increased production during this time. This period may have been longer than the first two AMS-defined periods, which might also explain the larger numbers somewhat.

Complex Cord Transitional

A group of vessel lots bears similarities to the Red-Brown Cord-Marked Tradition but shares too many attribute states with the earlier Complex Cord-Wrapped Stick Tradition to fit well in the former category. These include tightly plied Z-twist cord-wrapped stick, unusual zoning strategies that incorporate various orientations beyond the more common horizontal and vertical bands, and hard pastes that do not contain significant organic matter. They have distinctive even, red colouration throughout their pastes. Most of the vessel lots in this category come from Locus 1 around F44, a stone-lined hearth feature, indicating that the group who used the pots focussed on this other area and less on Locus 3. They have in common with the Red-Brown tradition a distinctive channeled-and-burnished interior treatment, pronounced coil breaks with smooth surfaces, and shallowly oblique lamellae. No date was acquired on any vessels from this tradition, but the apparent continuity from the previous period as well as the obvious blending of paste attributes into the Red-Brown tradition seems to indicate that this group is more transitional than it is a distinct manufacturing moment. Nevertheless, the number and similarity of pastes in this group suggests a fairly standardized paste preparation and firing practice that is not common in this region.

One Z-twist vessel lot, GLNS:29, exhibits the same paste texture and composition as the vessel lots in the Red-Brown Cord-Marked Tradition, but in addition to the decorative strategy being much more characteristic of the earlier Complex CWS vessel lots, the interior is fully channeled unlike the channeled-and-burnished interiors of the Red-Brown tradition. Also, the paste is similar to the Cord-Marked Buff vessel lots from the later Middle Woodland Period. GLNS:29 therefore represents a hybrid of a number of traditions.

Middle Late Woodland: Ca. 1100 BP (Period 4)

Not much can be said about this period because of a lack of contextual data. The one date delimiting this period comes from GLNS:143, a vessel lot with badly obscured surface decorations and a small number of constituent sherds that are, for the most part, too weathered to ascertain manufacturing attributes. The date range is 1176–988 Cal BP at the 2-Sigma range with the greatest probability that it falls between 1176–1045 Cal BP (75% relative area under the distribution at the 2-Sigma range). No coil breaks are apparent, but this is most likely the result of not being able to discern them. What can be ascertained about the rim sherd is that it has a somewhat unusual three-dimensional set of horizontal ridges running around the neck, and that the lip is rounded. There also appears to be a band of closely spaced punctates whose shapes are unknown. Channeling might be partially smoothed or burnished, which would fit with the previous period's channeling practices. However, the significantly later date suggests that close association with the previous period's manufacturing practices is unlikely. One important point about the date is that it was obtained on carbonized material on the exterior surface and the lip rather than the interior surface, so it is possible that it represents a post-breakage event. However, considering that no carbonized material occurs on any broken wall edge, a post-breakage event seems unlikely. Nevertheless, this date is considered the least secure as a result.

Later Late Woodland: Ca. 800 BP (Period 5)

This period is represented by a date range obtained on GLNS:28 of 905–702 Cal BP at the 2-Sigma range with the greatest probability that it falls between 803–702 Cal BP (73%

relative area under the distribution at the 2-Sigma range). This much later date range comes from Locus 1 near F44, indicating that this area has a significantly different chronology than Locus 3. However, some attributes suggest possible continuity with earlier traditions.

Temper is composed of both organic and grit particles such that it is reminiscent of the previous period, during which vessels were tempered heavily with organic material. The grit minerals are different from those in all previous traditions, except the Fineware tradition of 1500 BP and before, in that feldspar is evident while bluish-grey quartz is not. This means that, although organic temper may have continued from the previous period, the granite source being accessed had changed by the later Late Woodland.

The paste is also reminiscent of the previous period: it is buff-brown and appears to be a similar consistency and clay. However, its brownish colour and dark, extensive carbon core suggest that it was fired in a reducing atmosphere. It therefore appears more like the general conception of Late Woodland pottery in this region, with darker colour, slightly more crumbly appearance, and pronounced coil breaks.

Other attributes reminiscent of the previous period are the pronounced coil breaks, the cord marks (which are S-twist), and the channeled-and-burnished interior surface. While coil breaks are widely recognized during the Late Woodland, this particular surface treatment is not considered a Late Woodland attribute by Petersen and Sanger (1991:124–25), although Kristmanson (1992:78–79) found that channeling is somewhat prevalent during the Late Woodland. The distinctive look of the channeled-and-burnished interior seems the most likely evidence for continuity from the previous period and is supported by the organic temper and the S-twist cord marks.

The ceramics from this area are insufficiently understood at the time of this research to be able to delineate a manufacturing tradition represented by this date. Nevertheless, some interesting observations are possible. First, this vessel lot is very similar in form, paste, and decorative strategy to vessel lots from Locus 3 of the Periods 2 and 3, but the lip form is not found on Locus 3 at all. The potter has paid special attention to creating an evenly smooth squared lip with an additional smoothed facet on the exterior surface, creating a collar-like effect without an actual thickening of the lip. Four other vessel lots in the same unit have similar lip shapes, even though they differ significantly in decorations. This indicates continuity of morphological attributes not seen in the Locus 3 sample and only seen in this one case in the Locus 1 sample. Also, although the cord marks are different, they are all unusually small, GLNS:28 representing the largest. Therefore, these appear to be related, but further research will be needed to clarify how.

The fact that only one date was acquired so late in the Woodland Period suggests that pottery manufacture—or, at least, use—peaked during the Middle–Late Woodland transition and then declined. This must remain a tentative observation because only a portion of the ceramic assemblage was studied; however, it fits with observations elsewhere in the region that ceramics appear to have declined in numbers. One notable exception is the Skull Island Site, where pottery, dated to ca. 650 BP in a single-component burial site, numbers 1163 sherds, and 93 sherds in the adjacent shell midden (Leonard 1996). This context gives a number of clues about ceramic manufacture and use during the later Late Woodland Period. The much larger number of ceramics from the burial context suggests that artificial interment, such as in a burial, protects ceramics in the archaeological record.[61] Compounding this differential recovery may be the problem of shell temper, which fares poorly in the Maine–Maritimes archaeological record, to a greater extent even than grit-tempered ceramics. The leaching of shell and the resulting porous ceramic body leave these vessels extremely susceptible to freeze-thaw action.

Probably the most important clue, however, lies in the burial context itself. The vessels recovered and reconstructed by Leonard bear certain signatures in manufacture, morphology, and decoration that make the probability of a single potter higher than in most sites. First is the fact of the single deposition event, such that all the pots were deposited at the same time. While the decorations are not all identical, the same tool, a cluster of porcupine quills that make a star shape in the clay, is discernible on most of the vessels. The cord marks are also similar among vessels. The method of construction left many coil breaks, although not the smooth, well-developed coil breaks like those at Gaspereau Lake; the pots were clearly paddled to some extent. The morphology is not only similar amongst all the pots, but the same lip shape occurs on all the pots—an angled outward, squared-off lip that is quite uncommon in this region. Leonard himself mentioned the likelihood of two pots having been made by the same potter (Leonard 1996:120), and other researchers (Stapelfeldt 2014) have also noted the likelihood of a single potter. The significance of this possibility will be returned to below.

One of the first technological changes to occur during the Protohistoric Period was the acquisition and use of copper kettles by the Mi'kmaq and other groups from the French (Cottreau-Robins 2014; Hanley and Cottreau-Robins 2014). These kettles showed up in burials almost immediately, and were so ubiquitous that they earned the name "Copper Kettle burials" (Whitehead 1991). The importance of copper to Native peoples during the Precontact and Contact eras is well documented (Cottreau-Robins 2014; Leonard 1996; Whitehead 1991, 1993). Less well documented are the practices that occurred prior to this shift in burial practices, owing to the avoidance of Aboriginal graves in archaeological practice in this region. Skull Island is an exception; it was excavated at the request of the Fort Folly First Nation (Leonard 1996:15), who noticed that the nearby site was in danger from coastal erosion. In this site, human bones were placed inside ceramic vessels similar to the way they were placed in copper kettles in the following period, and copper nuggets were among the grave inclusions. This suggests that ceramics were important ceremonially, even though they were still tied to their utilitarian function as cooking pots, evidenced by conoidal bases and tempered pastes. It also suggests that copper was a valuable grave good.

If ceramics were moving toward a more ceremonial role, it seems possible that potters would also enjoy a more ceremonial status. There may no longer have been a need for every girl to learn pottery manufacture from her kin group in order to be marriageable, since pottery would not have been a only domestic tool, and other technologies, such as skin and birch bark containers and wooden vats, would have been used for the range of food

[61] An experiment conducted on British Neolithic ceramic reproductions yielded similar results (Millson 2011). Two cases of artificial deposition of ceramics were performed and returned to the following year. The first reproduction was left intact on the surface, while the second was buried. The first vessel was discovered as a small number of sherds similar to what is commonly found in the archaeological record in that region (and in this one), while the second was broken but more-or-less intact.

production needs of the group (Nash 1977; Rutherford 1991; Whitehead 1991, 1993). Ethnographic accounts of cooking mention that copper kettles were used in food preparation, but by no means did they replace all indigenous methods, since wooden tubs were reportedly used in rendering fat (Champlain and Biggar 1971:153, 155; Denys et al. 1908:402, 406, 419; Nash 1977) and baskets and birch bark containers continued to be made and used up to the present (Petersen 1996; Whitehead 1987). In contrast, only one case of pottery making was ethnographically reported in this region (Champlain and Biggar 1971), and no known examples of Contact-Period pottery are known to have existed (Petersen and Sanger 1991:151). It seems possible, in light of the evidence from Skull Island, that only one or two potters in each group would have made pottery, perhaps on commission for special occasions.

At the Skull Island site, all the ceramics—in the burial and the shell midden—were shell-tempered. It is possible that at other locations, grit was also no longer used. The complete lack of pottery in some sites during the later Late Woodland may be the result of 1) the greater susceptibility of shell-tempered ceramics to freeze-thaw action; 2) the smaller likelihood of preservation in features such as shell middens, hearths, and house floors; and 3) the increased usage of ceramics as burial inclusions, which have remained unexcavated for the most part.

SOCIAL DYNAMICS: EVIDENCE FROM CERAMICS

Ceramics have sometimes been thought of as one of the defining characteristics of the Woodland in the absence of horticulture that marks the shift in other areas (e.g., Keenlyside 1999:65; Leonard 1995). However, ceramics neither played a large part in the Early Woodland in the Maine–Maritimes Region, nor were they absent before this period, at least in other regions (Sassaman 1992; Taché and Hart 2008). The Early Woodland is characterized by a similar toolkit and set of cultural practices to the Late and Terminal Archaic periods, including atlatl weights, cache blades, groundstone tools and ornaments, shellfishing technology, mound-building, and ceramics, which had emerged late in the Archaic period in parts of the Southeast and Midwest (Claassen 2002; Sassaman 2010; Taché and Hart 2013). Ceramics only became well established in the Maine–Maritimes Region during the Middle Woodland Period, after which some other important transformations also occurred.

The transition from the Archaic to the Woodland Period holds some clues about why ceramics developed at all. Considering that ceramics break easily, that they take a long time to make and to learn how to make, and that other container technologies could be used for many of the same purposes (Arnold 1985:119; Keenlyside 1999; Rice 1999:7), the choice to include ceramics in the toolkit of mobile hunters, fishers, and gatherers does not seem immediately logical or necessary. The reason for the development of ceramics may have less to do with utilitarian necessity and more to do with changing roles of men and women during the Woodland Period. Where previously during the Archaic period, group solidarity was important to accomplishing goals, the Woodland Period emphasized individualistic endeavours and independence of group members. Important during the Archaic period were strictly adhered-to burial practices, which entailed large amounts of certain commodities such as red ochre, ground-stone tools and bayonets, and rich imported items such as copper and gemstones (e.g., Sanger 1973; Tuck 1975). Swordfish and sea mammal hunting were important group activities (Bourque 2012), for which dug-out canoes were necessary to protect against the dangerous attacks of swordfish, sharks, and killer whales (Keenlyside 1999:64; Whitehead 1991:227–29). These canoes did not facilitate shallow or rocky riverine travel, limiting the range to lower reaches of river systems, and Archaic peoples were heavily focussed on marine subsistence strategies (Black 2004; Bourque 2012). Pottery has been proposed as a risk mitigation strategy for women as a response to obligations during the Archaic (Claassen 2002; Sassaman 1992), which may be a response to rigid gender divisions that have sometimes been reported in cultures where dangerous hunting activities comprise a large part of the subsistence strategy.

During the Woodland Period, several developments changed this focus on group uniformity to more flexible group cohesion and roles. An examination of the technological developments of this period allow for some speculation about what the social conditions or consequences may have been. The invention of the birch bark canoe allowed travel along the extensive riverine and lake systems of the Northeast, in groups or individually. This was made possible by the ability to repair the canoes and by the remarkably light weight of the canoes; importantly, men, women, and children all could navigate and even carry these canoes, allowing much further individual ranging in search of resources or to visit other groups. Group members who might have been more dependent on others in the past were more able to contribute calories and gathered resources to the group and, possibly, to vote with their feet if interpersonal problems arose. Another development was the bow and arrow sometime during the Woodland Period. This tool was more portable, arrows were easier to replace than spears, and children could use bows effectively, so that contributions to the group could begin quite early in childhood. With these technologies in the toolkit, children would be seen as less of a burden and women would gain a measure of independence. Although this is speculative, it is based on the principals developed from other regions and in the ethnographic literature.

The Woodland Period shows signs of this more flexible structure in its material culture. Ceremonialism exhibits relative flexibility in the many kinds of burials: some are group, others single; some are very rich in grave goods, others are not; some are coated in red ochre while others are not; some are interred within mounds, others in pits, and still others in shell middens. Projectile points appear to have been more expediently made, with more use of retouched flakes (Blair 2004b). Cache blades were probably meant to be knapped into forms determined by immediate need and were distributed over a large geographical area (Taché 2011). Large ground-stone tools characteristic of the Archaic period, and presumably meant for large woodworking projects, were replaced by small scrapers that seem best suited to birch bark and fine carving projects (Blair 2009), as well as hide-working, ash basketry, and porcupine quillwork. This suggests more of an emphasis on container technologies such as woven bags and baskets (Whitehead 1987), skin bags (Keenlyside 1999:66), birch bark containers (Whitehead 1991), and wooden troughs (Ricker 1997). Resource bases expanded, and settlement patterns show more focus on the interior, especially at the confluence of two or more rivers (Clarke 1968).

Ceramics were an important part of this move toward more flexible group structure. Ceramics were made and used by women; they represent a risk mitigation strategy for a potentially vulnerable subgroup and their children. Ceramics allow increased caloric extraction over open-fire cooking because they allow a larger range of foodstuffs to be cooked and for some plants that would otherwise be poisonous, such as some groundnuts, to become edible (Taché 2008). Even-temperature simmering is not really possible using the stone-boiling technique, and it requires constant attention, whereas direct heat in a ceramic pot allows the cook to do other tasks at the same time. In addition to greater caloric contributions, ceramics constitute an economy made and controlled (to some extent, at least) by women. This means less reliance on hunters and male group members, and therefore, more status within the group. Ceramics emerged at the same time as shellfishing, another subsistence strategy carried out by women, and both would have granted women greater independence and possibly decision-making power within the group (Claassen 2002).

Early to Middle Woodland Ceramic Manufacture

Over time, ceramics in the Maine–Maritimes Region show some broad changes in their distribution and manufacturing attributes. These changes roughly correspond with other dynamics occurring in this region. During the Early Woodland, ceramics were probably not made to any great extent here, although they may have been imported along with other commodities such as pipe-stone and ground-slate artifacts (Allen 1980). This period saw an influx of ideas and goods as part of the Adena–Middlesex complexes that occurred on the Southwest Miramichi in New Brunswick (Turnbull 1976) and at the Boucher site in Nova Scotia (Heckenberger et al. 1990), but also a way of life somewhat unchanged from the earlier Terminal Archaic in many areas. Ceramics during this period exhibit the pattern of having been brought along with immigrants, possibly creating colonies or outposts, or possibly fleeing conflicts. These ceramics resemble ceramics from other parts of the Northeast in their fabric impression, their tendency to be asymmetrical, and their coarse grit temper.

At the dawn of the Middle Woodland, a remarkable transformation occurred in the ceramic manufacturing tradition. The thin-walled vessels decorated with PSS and dentate decorations have attributes that indicate they were meant as more than simply cooking pots. Fine grit temper and thin, harder-bodied walls reduced thermal shock resistance—a trade-off not made lightly. They were carefully paddled and smoothed, after which they were decorated with such care and consideration to zoning that a concern with expressing or signalling something to the viewer is a difficult conclusion to escape. As I remarked above, some of these vessels have such crisp impressions, made by such tiny tools, that they seem to be meant to be admired for their fine, delicate patterns. Everything about these pots encourages the viewer (or holder) to marvel at the skill of the potter and the effort put into the making of the pot. They are not standardized, and they show a mixture of learning lineages, but they clearly adhere to a certain style or aesthetic.

When such concern is placed on aesthetic properties, costly signalling can sometimes be inferred. Costly signalling occurs when people use their belongings or their labours to show allegiance to certain groups or ideals through the use of symbols. Considering that these pots probably—at least, in part—represent new ideas or people within the indigenous population, and that the pots are similar in many respects to those that had emerged to the south and west of the Maine–Maritimes Region, it seems likely that their communicative value is related to trade and communication between regions as well as a shifting lifeway toward increased settlement within a context of aggregation and dispersion as well as concentration on a broader range of resources. The makers and or/users of these pots were showing their connections to relatives or groups with whom valuable relationships had become important. The PSS decoration is most firmly associated with the Laurel tradition, or with the Great Lakes Region that would later be recognized as Iroquoian, while dentates are most closely linked to the Hopewell culture in the Midwest (Mason 1970). Were they women who had married into the exogamous peoples of the Atlantic Provinces, and their children and grandchildren? Were they emissaries or traders from other cultures? Did they maintain a symbolic link to other groups to remind their in-laws that they had powerful allies, should they be mistreated? These kinds of strategies are found in the ethnographic literature. In any case, ceramics at the beginning of this period mark an abrupt change, but go on to evolve more gradually during the remainder of the Woodland Period.

The Transition to the Late Woodland Period

There are indications that the Late Woodland Period was a time of increasing social complexity, of incipient chiefdoms in some areas (Leonard 1996), and of increasing territoriality. Trade increased significantly, evident in toolstone (Bourque 1994; J. Wright 1994), shark teeth (Betts et al. 2012), and probably a large range of both perishable and non-perishable goods as well as raw materials and crafted goods. This trend culminated in the Great Lakes Region in the emergence of the Iroquoians and in the Mississippian groups further to the south. Cord marks replaced PSS decorations, while dentate decorations became less common. Shell-tempered ceramics replaced grit-tempered ones in many regions; they were produced in large amounts and with increasingly figurative designs in a number of cultural contexts across eastern North America.

In the Maine–Maritimes Region, some of these trends are also apparent. According to Leonard (1996:ii), the Skull Island assemblage shows evidence of a possible "Big Man complex" in the amassing of wealth items that were ritually killed and placed in burials. Ethnographic accounts of the town Ouigoudi at the mouth of the St. John River (Ganong 1899:262) may indicate that similar phenomena occurred across the region. The GLR Site Complex adds another significant line of evidence to this picture of transformations and economic intensification. In the Skull Island site, ceramics play an important role, and—coupled with their apparent decline in secular sites—may indicate their association with sacred contexts.

Moving towards the Late Woodland, ceramics at Gaspereau Lake were made in increasingly large numbers, indicating that potters sought more expedient means of turning out pots. At ca. 1550 BP, this meant slightly less attention paid to paddling, slightly thicker walls, and less exciting and "show-off" decorations (Panter-Brick 2002:634); however, the manufacturing tradition was very similar to previous ones. Later, though, the paste was modified so that pots could be formed quickly and without the risky and time-consuming practice of paddling. Drying time was speeded up by including large amounts of grit temper, and pastes were hardened in firing by the addition of more iron oxide, which acts as a flux to facilitate melting of clay particles. Because aggrandizing events such as feasts, fairs, and political meetings would have required extra commodities to be manufactured, sometimes at short notice, strategies were adopted for turning out pots quickly on demand. These strategies included pastes with organic temper that would have made shaping easier and drying faster, and increased grit temper, which would have protected not-quite-dry pots during firing.

Demand for pottery, potentially as a result of aggrandizing events, looks different in the archaeological record than does demand based on markets or elite sponsorship. The most obvious difference is that there is not necessarily a constant demand, so learning lineages may show a tendency for punctuated, rather than gradual, evolution (Pool 2000). Accordingly, technologies that speed up production may come in and out of commission as necessary, such as kilns. As increased periodic demand becomes more regular, attached specialists may emerge (Costin 1991:5). This may have occurred during the later Late Woodland as evidence from some sites (e.g., Leonard 1996) indicates that pots were commissioned for events, possibly of one pottery specialist.

Why Gaspereau Lake?

The reason why Gaspereau Lake would have hosted such a large community over such a long time period is likely that abundant resources were available there. Lithics were clearly important for activities at Gaspereau Lake, evidenced by the large numbers of high-quality Minas Basin chert and White Rock quartzite, but they did not determine the choice of manufacturing locale. Rather, these materials were quarried from Scots Bay on the Bay of Fundy and from Gaspereau River in large numbers in a network of production and distribution at the centre of which was Gaspereau Lake (Deal 2005).[62] Additionally, although the abundance of several fish species were clearly important in maintaining the population at Gaspereau Lake, further downriver likely provided similar food resources with the additional advantage that human populations could spread out to a greater extent, which likely occurred at the Melanson Site. Other plant and animal resources available at Gaspereau Lake also probably played important roles in maintaining the population, but were not the determining factors for the choice of locales.

Gaspereau Lake is distinct in that it sits within a basin of granodiorite and pegmatitic leucograntite. These rocks weather to a number of possible alteration products, including clay, chlorite, hematite, and limonite (Hadril et al. 2003:224). The presence of white clay, hematite, and limonite was noted in drillhole samples into the Murphy Lake Leucogranite Unit from the southeastern side of Gaspereau Lake (Lowe 1977; Lowe and Farstad 1978; O'Reilly et al. 1982:64), a bedrock unit that also occurs in a few spots on the southern shore of the lake (MacDonald and Ham 1992). As a result of this particular geological setting and its weathering processes and "hematization" (MacDonald 2001:211), clay and tempering materials were probably abundant around the lake, and red ochre was also available. In

[62] Deal wrote that Minas Basin cherts show up in a variety of locations, but especially near their quarry site and along Gaspereau River: "The Scots Bay sources are most easily accessed by water from the Minas Basin area, and the most abundant use of these chalcedonies is along the Minas Basin and up the Gaspereau River to the Gaspereau Lakes. The southward distribution of Fundy shore chalcedony seems to follow well known historic portage routes to the Atlantic, namely, via the Shubenacadie and Musquodoboit rivers in central Nova Scotia and via the Laquille and Mersey rivers in southwestern Nova Scotia." Minas Basin chert also occurred in large numbers at the Goddard site in Maine, comprising 16% of the 4500 scrapers and making up a large percentage of other lithic materials as well (Steven Cox, pers. comm. August 3rd, 2017).

addition, desirable feldspar crystals and large mica sheets would likely have been plentiful (O'Reilly et al. 1982:66), and other alteration products may have included pyrite (MacDonald 2001; Appendix B) and semi-precious stones such as quartz crystals, topaz, chalcopyrite, autunite, torbernite, fluorite, azurite, and tourmaline (MacDonald 2001:200, Appendix B; O'Reilly et al. 1982:66). There is even the possibility of native copper and gold, considering how frequently these minerals are noted in geological reports on pegmatites and the South Mountain Batholith (e.g., MacDonald 2001:196–98, 208). In short, residents of Gaspereau Lake would have had rich resources to dispose of as well as a particular pottery-manufacturing situation that would have facilitated larger-scale manufacture and the building of a redistributive economy.

CONCLUSION: CONCEPTUALIZING IDENTITIES

The change in ceramic manufacturing practices from the Middle to the Late Woodland can be conceptualized not only in terms of changing priorities—moving from emblemically charged fineware to more standardized or "production" pottery—but also in terms of how potters used pottery to mediate between themselves and others. The intricately decorated, thin, hard-bodied pottery of the earlier Middle Woodland was at least partly intended to dazzle the viewer/holder/user, as the Melanesian canoes used in the Kula trade were meant to dazzle trading partners (Pfaffenberger 2001:83). Objects need not be as ostentatious as the Melanesian canoes in order to impress others with their beauty, or with the skill level of their makers (Gell 1992), or by the signification of their aesthetic interfaces (Allen 2008) that show membership in groups (Costin 2011; Gosselain 2008; Hosler 1996; Townsend-Gault 2004) or allegiance to powerful ideas (Pauketat 2001). Indeed, commonplace and un-ostentatious objects such as pottery can be the site of intensely personal genealogies of meaning (*sensu* Emerson and Pauketat 2008:172), spirituality and ritual enactment (G. Braun 2015; Levi-Stauss 1988), and cultural knowledge (Skibo and Schiffer 1999), and can signal allegiances and contestations of norms at various levels (Crown 2001:454; Dobres 2001).

In consideration of earlier Middle Woodland pots, the precise and time-consuming manner of the decorative strategies, the thinly paddled walls, the symmetrical shape, and the hard, reddish fabric indicate the loading up of labour not seen in later ceramics (Hayden 1995). The fact that two decorative tool types (PSS and dentate tools) dominate earlier Middle Woodland assemblages but are never seen together on the same vessel indicates a difference in intentionality between these two types. The care taken to show PSS and, to a lesser extent, dentate tool impressions clearly and precisely by closely spacing but not overlapping impressions on a majority of early Middle Woodland ceramics indicates that the tools were not simply a means of texturing the surfaces or creating zoned decorations. Rather, they were reproductions of widely recognized symbols that connected people across a broad geographical area, from at least the Great Lakes Region to the far Northeast and down into the Southeast and American Bottom (Mason 1970, 1991; Pauketat 2012:257–58; Reid and Rajnovich 1991; J. Wright 1967). The appearance of these decorations as majority styles rather suddenly at ca. 2200 BP across these various regions (Mason 1970; Pauketat 2012; Petersen 1988, 1997; Petersen and Sanger 1991) suggests that these symbols were connected by a historical event or series of events reaching across a significant portion of the continent.

Such a symbol, communicated through a widely made and used artifact class, on display for the entire group to see and judge (Dobres 2001), fits well with Wiessner's (1983) concept of an "emblemic" style. This kind of style communicates by having "a distinct referent and transmits a clear message to a defined target population . . . about conscious affiliation or identity" (Wiessner (1983:257, referencing Wobst 1977). Although she cites flags and emblems as examples, these classes of material culture go along with rather specific cultural concepts such as nations and institutions, whereas the broader concept works as well for an easily recognized graphical element such as a wavy line (PSS) or line of dots (dentate) in reference to more generalized concepts of super-group affiliation. By emplacing the recognizable graphical element on a pot, a potter may have been non-ostentatiously communicating something desirable about herself to others (Wiessner 1983).

Pottery during the earlier Middle Woodland was probably important as gifts in addition to pottery manufacture on a domestic, as-needed basis, and women with greater skill than others were probably respected as a distinct social category known as "potter" (Budden and Sofaer 2009:206) and asked to make pots for others. Daughters and possibly other girls or women who married into the group probably learned if they wanted to learn by watching and experimenting within informal learning frameworks. The impetus for learning probably came from a desire to be affiliated with the potter or her lineage (kinship or learning).

Identities would have changed with changing levels of production. As pots became more standardized around 1550, a single, more specialized potter may have been making pots at a greater rate than had her predecessors, and she may have been operating within a milieu of non-specialist potters who came to the specialist for better quality pots for gifts or personal use. Specialist potters probably still recruited close kin such as daughters according to their level of interest, but may have taken more of a directing approach to teaching pottery. Pottery may no longer have been about signifying the skill of the maker, or at least signifying skill in the abstract rather than through directly having made the pot.

The increased production evident later in time may mean that ceramics were still prestigious but were further removed from the significance of the earlier Middle Woodland as emblemic of specific affiliations and more generally meant to indicate wealth and status. Because pots would have been important components of aggregation and aggrandizing events, both in the preparation of food and as gifts, they would have been both important economically and devalued by the large number required to be reproduced. Potters would have had to respond to pressures from consumers, potentially including those with relatively more power or authority. Potters may have recruited learners for the express purpose of increasing productivity, which would have rigidified the learning framework somewhat. Learners may have been pressed into service on the basis of need rather than of potential or demonstrated talent. The homogeneous temper minerals show that potters needed to produce pots to particular standards on a regular basis, but decorations—which show no particularly emblemic character— may have been relatively unimportant and given to non-potters to do.

These conceptualizations are based on situations in the ethnographic literature. There are clearly not enough data to be able to reconstruct learning frameworks, but as Crown (2007) shows, learning frameworks should be possible to retro-engineer to some extent. It is hoped that further study of the phenomenon of knowledge transfer in ceramic manufacture, particularly in how it relates to economic and subsistence systems, could more fully answer these questions.

CHAPTER 6: CONCLUSION

The GLR Site Complex contains the first multi-line evidence for a ceramic manufacturing locale in Atlantic Canada. The GLR ceramic assemblage exhibits continuity through time in a manner that would be expected for an *in situ* manufacturing tradition. Temper and clay are both homogeneous, an attribute that likely indicates a nearby and repeatedly accessed source and which is not seen in other assemblages in this region. Fired clay scraps that match the fabric of many vessel lots in their clay colour and particle size probably indicate local manufacture and suggest the existence of a clay-covered structure that may have been used for firing ceramics (Balkansky et al. 1997:148). This *in situ* manufacturing tradition lasted from at least 1550 BP to 950 BP and may have begun as early as 3000 years ago and lasted to as late as European contact.

During the manufacturing tradition at Gaspereau Lake, which saw the greatest peak in production scale at the transition to the Late Woodland (1300–1200 BP), significant changes occurred in how ceramic manufacture was executed. These changes reflect changing needs and priorities of the potters who made these ceramics. Broadly speaking, there is a shift from finely made, elaborately and carefully decorated ceramics during the earlier Middle Woodland to more expediently produced and more standardized vessels during the earlier Late Woodland. While this is a broad generalization, and variation from this trajectory is in evidence, nevertheless, there is a quantifiable move from thinner to thicker walls, from a significant amount of paddling to no or minimal paddling, and from carefully applied fine decorations to faster and larger decorations that cover less of the surface. Temper also changed through time, with grit temper acquired from multiple geological sources changing to one main pegmatitic source, while organic temper was introduced alongside decreased paddling. Iron oxide, which was a ceramic constituent throughout the sequence, increased in percent of pastes later in time. Smoothed or anvil-marked interiors gave way to channeled interiors. All these changes indicate the goals of more expedient manufacture and larger production numbers.

WHY EXPEDIENCY? CERAMICS IN CONTEXT

At the close of the Early Woodland Period, about 2200 years ago, a shift occurred, marked by certain material culture. Among other things, a new kind of ceramic appeared in the Maine–Maritimes Region. This ceramic was symmetrical, thin-walled, and hard-bodied with fine temper and distinctive dentate and pseudo-scallop shell decorations. These ceramics were numerous and appear in many Middle Woodland sites in this region; they were clearly an important part of the toolkit at this time, in contrast to the Early Woodland, when they had not been as important. The knowledge of how to make these ceramics (and the impetus to make them) was brought to this region as part of a movement of people and ideas that saw Middle Woodland complexes such as the Hopewell Interaction Sphere and the Laurel tradition spreading outward and bringing with them rich commodities, new technologies, and probably new ideas and cultures. Whereas the Early Woodland looked a lot like the Terminal Archaic in its continuation of practices such as mound-building and a focus on marine resources, the Middle Woodland took on certain characteristics that indicate a new society was emerging, informed by the ceremonial chiefdoms and incipient states to the south and west of the Maine–Maritimes Region. Earlier Middle Woodland ceramics were an important part of this change as economically valuable objects, identity signals, and risk mitigation strategies.

Ceramic Manufacture at Gaspereau Lake: A Brief History

Ceramics were probably not manufactured in any significant quantity during the Early Woodland Period at Gaspereau Lake. Rather, the vanishingly small number of ceramics from this period probably indicates that women were travelling to Gaspereau Lake with their pots and their pottery-making knowledge, but they were probably not passing that knowledge on to others.

An influx of people from other regions beginning at ca. 2200 BP changed this trend, and both pottery and potters connected to other cultures and ideas flowed into the Maritime Peninsula. The pots that emerged during this time were quite different, characterized by hard, red ceramic bodies, fine textures, carefully applied PSS and dentate decorations, and thin walls. This pottery adhered to a set of ideas or rules about how to make and decorate a pot, including the importance of fine and intricate decorations with the distinctive PSS tool as well as the equally popular dentate tool. Within these rules, potters nevertheless found room for artistic freedom, expressing themselves using many inventive variations on the PSS and dentate themes and by subtly varying the shape of the pot. This was essentially a tradition of fineware, meant to be seen and to exhibit an individual woman's skill and possibly her affluence; it also probably signalled a woman's connection with other regions. At the same time, undecorated coarseware was also manufactured, probably in smaller quantities.

A more standardized and expedient pottery tradition, called Blended-Edge Dentate, emerged out of the Fineware tradition at approximately 1550 BP. For the first time, pots were made in larger batches using a pegmatitic granite temper source and a distinctive toothed tool applied horizontally in rows. This pottery was slightly thicker and coarser than the Fineware pots of the earlier Middle Woodland, and the pots tended to be less well paddled, evidenced by the emergence of poorly developed coil breaks.

Groups may have begun to be more focussed on commodities and trade partnerships as territories shifted and solidified. Aggrandizing events at Gaspereau Lake were probably a part of this increased focus on social and economic relationships, and may have played a role in increasing demand for pottery. Potters may have initiated or been encouraged to enact more structured learning lineages, in which particularly gifted neophytes were given additional instruction and then recruited to make pots part- or full-time in order to meet demands. However, despite the lower attention paid to paddling and the coarser pastes, walls were still moderately well smoothed and decorations were still carefully applied.

The standardized dentate-decorated pottery of the later Middle Woodland was gradually replaced with cord-marked pottery sometime after 1400 BP. Cord-Marked Buff pottery shows a similar concern with more expedient manufacture in its relative lack of paddling and less carefully applied cord decorations; it is also rougher overall. Pastes became very coarse with significant amounts of iron oxide included as a coarse particulate. Pastes appear to have been fairly standardized, even though decorations were not. This period is characterized by a wide assortment of decorative cord-mark strategies, with especially inventive use of the cord-marked fan decoration. There is a divide, however, between those ceramics whose pastes are very similar (Cord-Marked Buff) and those that used unstandardized temper and clay recipes (Complex Cord-Wrapped Stick). These last do not usually have the distinctive bluish-grey quartz particles found in the more standardized Cord-Marked Buff, and their pastes are often more brown or sooty coloured. These appear, then, to have been domestic or minority-style pots, possibly influenced by Iroquoian styles to the north and west, while the majority of pots were made within a distinct learning lineage using very similar pastes and firing practices to the Blended-Edge Dentate tradition from a century earlier.

The coarsely tempered paste of the Cord-Marked Buff pottery evolved into a faster-drying, easier-to-work paste at approximately 1300 BP. This new paste, tempered with even more iron oxide as well as organic material, was used to increase production numbers by allowing potters to skip the manufacturing steps of paddling and drying. These thicker-walled vessels, called Red-Brown Cord-Marked pottery, were fired hotter and harder than their predecessors, which probably helped to make up for their weak coil joins resulting from the complete lack of paddling. These pots show an unprecedented amount of standardization, exhibiting a range of paste compositions but a striking similarity of smooth and oblique coil breaks and the use of the cord-marked fan decoration nearly ubiquitously. When grit temper was used in these vessels, the particles exhibit the same bluish-grey colour and lack of feldspar that characterized both the earlier Cord-Marked Buff and Blended-Edge Dentate traditions. Apparently, the same pegmatitic granite was still being accessed for temper. This represents a continuation of knowledge from the earlier Cord-Marked Buff tradition. During this period, ceramic scale of production reached its peak.

One variation on this tradition has decorations that are reminiscent of the domestic or minority styles that occurred somewhat earlier, alongside the Cord-Marked Buff tradition beginning about 1400 BP. The variation uses paired oblique cord-mark decorations along the rim, similar to some earlier pots. This decoration sometimes occurs alongside the cord-marked fan decoration on pastes that are very red, high in iron oxide and organic material, and exhibiting the same clean coil breaks. Therefore, the Red-Brown Cord-Marked pottery appears to have descended both from the earlier, more standardized Cord-Marked Buff and from the minority styles that use the paired oblique cord-mark stamps in their decoration.

The red ceramic body was later dropped, possibly after 1100 BP, in favour of a very coarse grit paste, sometimes using grit temper in amounts over 50%. Organic temper was no longer used, and neither were the fan decorations that had characterized the Red-Brown Cord-Marked tradition and its predecessor, the Cord-Marked Buff tradition. Instead, cord marks tended to be simple or rocker-stamped obliquely or horizontally. Colours also became browner and sootier and pastes became softer. Firing regimes appear to have been overall cooler and atmospheres were reducing. Paddling was re-introduced, evidenced by the rougher appearance of the coil breaks in sherds of this pottery tradition and by slightly thinner walls. Scale of production may have decreased, and standardization is no longer in evidence. Too little evidence exists to clearly define the role of ceramics in this period, which extends to approximately 700 BP or beyond. However, based on evidence from other sites, it is possible that ceramics were increasingly taking on a ceremonial role and that their decreasing numbers at the End of Dyke Site might reflect their use in burials or other contexts.

OPPORTUNITIES FOR FUTURE STUDY

Only a fraction of the research potential in the GLR ceramic assemblage has been reported in this study. A larger sample would without doubt reveal more nuanced trends about the manufacturing tradition as well as the differential use of space through time. A more in-depth study of physicochemical analysis and sourcing would clarify the issue of local raw materials, the evidence for which is currently indirect. A study of firing temperatures that uses a larger sample would be valuable in understanding the differences in firing regimes between periods, which would greatly increase current understandings of firing technology. Refitting (conceptual is preferable to physical) and recording of more vessel lots would help in morphological studies, especially in how certain morphological attributes changed through time in relation to other attributes such as paste and decoration. Stable isotope analysis and lipid analysis would give valuable insight into diets at Gaspereau Lake. Finally, more radiocarbon dates would continue the important work of defining a more nuanced ceramic sequence.

In this thesis, I have proposed that temper and clay are mostly homogenous and therefore come from regularly accessed sources nearby. The next step in understanding raw materials procurement and processing behaviour is an in-depth look at the temper and clay minerals. Characterization of clay and temper minerals would be undertaken using laser ablation and X-Ray diffraction on a large sample to determine just how homogeneous these materials are and whether groups emerge. These characterizations would be compared to geological sources near Gaspereau Lake in order to find the clays and temper minerals accessed by Woodland potters. Such a research program would be long term, but graduate research could fractionally address it such that studies build on each other.

One area that I was unable to study to my satisfaction within time and budgetary constraints was firing regimes. I gathered data that suggest a great deal could be learned from the study of firing practices, but was unable to conclude anything based on the small sample size. XRF could indicate mineral phases, which in turn could indicate firing temperatures. This, coupled with recreative experiments, could be used to better understand how firing practices changed through time. As Pool (2000) has pointed out, firing practices can indicate production levels and, therefore, wider social dynamics that demand greater or lesser production. A study of firing practices would add evidence to or refute the arguments I have made in this research that ceramic production increased between the Middle and the Late Woodland at Gaspereau Lake.

Integrating Other Artifact Classes

Another problem I was not able to concentrate on in any depth is the relationship of ceramics to other artifact classes as they were distributed across the site. For instance, although ceramics are for the most part not related to either of the two large transgressive hearths in Locus 3, I was unable to determine if this was also the case for the many lithic flakes, faunal remains, and ochre fragments located there. Such a study would have most likely elucidated this part of the site.

Although it can be argued that the End of Dyke Site represents a domestic occupation layer upon which many people lived, there are two problems with such an interpretation. No direct evidence of house floors or architecture exists, and living floors have to be inferred only from the presence of hearths and faunal remains, which is not satisfactory. If the End of Dyke Site represents a work area that prepared food for large numbers of people periodically, hearths and faunal remains would be expected to appear on the site; therefore, such an observation cannot be said to indicate a domestic context without other lines of evidence. Additionally, many domestic contexts are identified in sites around the Maritimes, yet none, even the large ones such as the Oxbow Site, exhibit the large numbers of artifacts—especially flakes and ceramics—that were yielded by the End of Dyke excavation. Aside from the fact that this pattern does not exist elsewhere, such a large amount of debris would be uncomfortable or dangerous to occupants of the site (Costin 1991:26). Because many of the site's features have been preserved, the absence of post-moulds may mean that no domestic architecture to speak of was erected there.

Because the End of Dyke Site does not fit the pattern of either ritual or domestic sites, it represents an important development in current understandings of this region. Future studies should be directed towards better elucidating what mechanisms formed the GLR Site Complex as a whole. Without a clear idea of where domestic spaces occurred, little can be said about demographics and patterning, so this question should be at the fore in the methodologies of future excavations and artifact distribution studies. A better understanding of the economic focus of Gaspereau Lake could be achieved by a close study of other artifact classes, particularly lithics. If specialization is also revealed in this artifact class, as I have stated has been revealed in ceramics and as Nash and Stewart (1990) believe was revealed in lithics of the Melanson Site downriver, then lithic export could be shown to have been an important focus at Gaspereau Lake.

Another study that could clarify occupation patterning through time (e.g., aggrandizing events, domestic vs. workshop spaces, and subsistence strategies) would be an in-depth study of the faunal remains. Although, regrettably, degradation of the faunal assemblage prevents species-specific identification in most cases, the distributions of the faunal assemblage, particularly as it relates to features and other artifact classes, could be mined for significantly more information. In particular, associating some faunal remains with features (or, conversely, showing they are not associated) would help with identifying concentrations through time and activities related to certain features. The stone-lined hearths, which I have suggested were most likely earth ovens, might be particularly informative in this regard. Other studies in this vein would include an in-depth study of the copper assemblage, the ground-stone assemblage, or the pipe stems.

CONCLUDING THOUGHTS

The GLR ceramic assemblage shows that ceramic manufacture was more varied and complex than has previously been thought. It also shows that there is much more to learn about this class of artifacts. At the beginning of this research, I had hoped to articulate a manufacturing tradition that could represent Atlantic Canada, or at least the northwestern shore of central Nova Scotia. In this way, my aims were largely in line with Bourgeois, Kristmanson, and others who intended to refine the Petersen and Sanger sequence. It became apparent early on that the GLR ceramics could not be considered representative and that a great deal remains to be learned about ceramic manufacture across the region. One of the main questions I am left with is what were the forces—the on-the-ground factors—that induced potters to change their practices at different times.

As Gosselain (2008) emphasizes, pottery attributes only change if their makers want them to change. Although a great array of factors may impose constraints and pressures on potters, Gosselain believes that potters will generally try to maintain the stability of their traditions, in part due to an increasing association through time of traditions with particular identities, be they hereditary, status, income level, gender, or age identities (Budden and Sofaer 2009; Gosselain 2008; Michelaki 2008). If a pottery tradition registers change, then the motivation to change practices ultimately arose from the pottery makers—whether or not they changed willingly. In this region, the changes that can be seen in ceramics are widespread, indicating that pressures were regional in scale, but differences between the GLR assemblage and assemblages from other sites show that pressures were local as well. This remains an intriguing issue that can only be addressed with more fine-resolution studies that seek to see the actual artisans within the matrix of the archaeological record. It is my hope that I have shown that such a research aim is worthwhile.

FIGURES

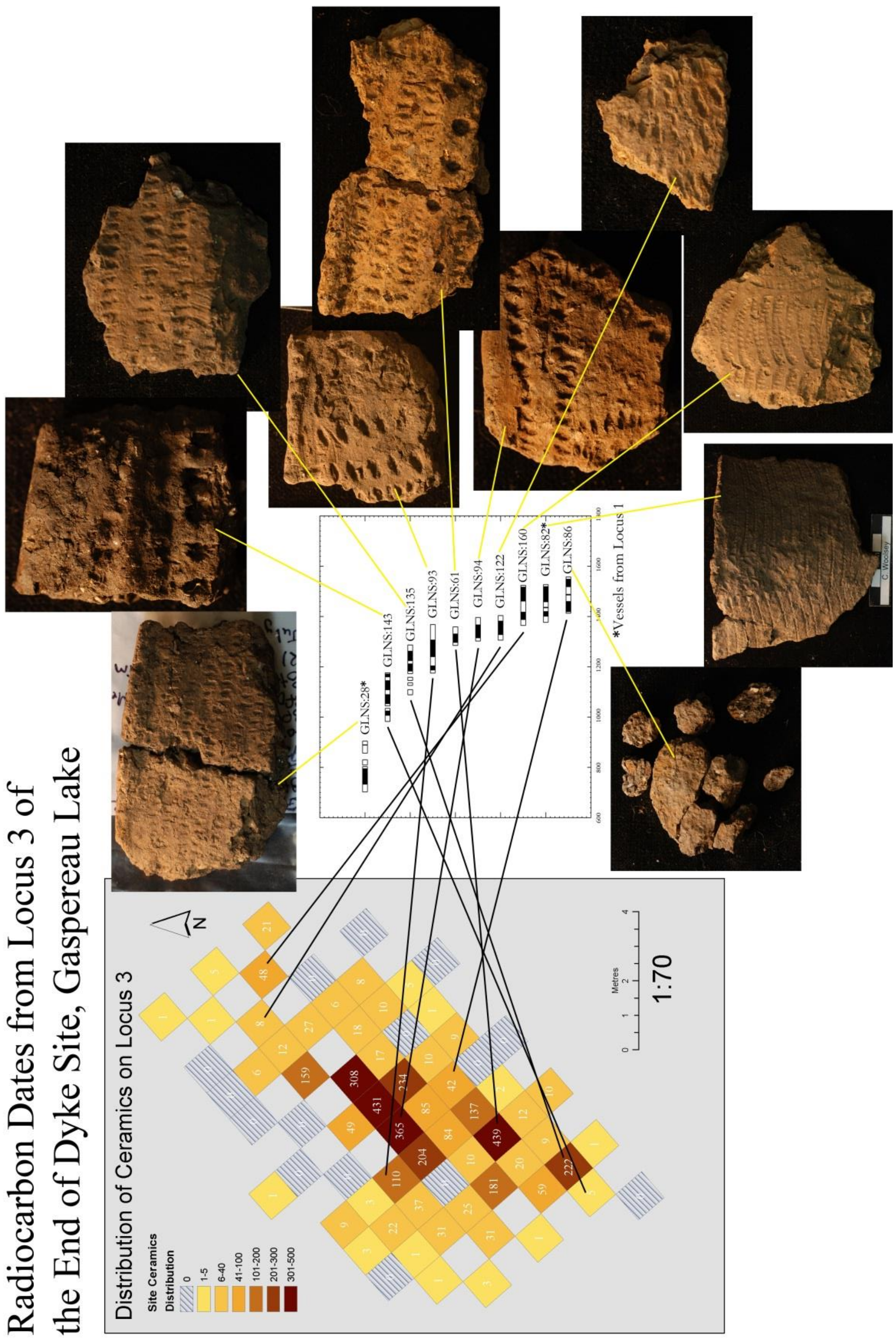
Radiocarbon Dates from Locus 3 of
the End of Dyke Site, Gaspereau Lake
Distribution of Ceramics on Locus 3
Site Ceramics
Distribution
0
1-5
6-40
41-100
101-200
201-300
301-500
Metres
0 1 2 4
1:70
GLNS:28*
GLNS:143
GLNS:135
GLNS:93
GLNS:61
GLNS:94
GLNS:122
GLNS:160
GLNS:82*
GLNS:86
*Vessels from Locus 1
600 800 1000 1200 1400 1600 1800
C. Woolsey

Figure 18: Location of the GLR Site Complex in Nova Scotia. (Toporama 2017)

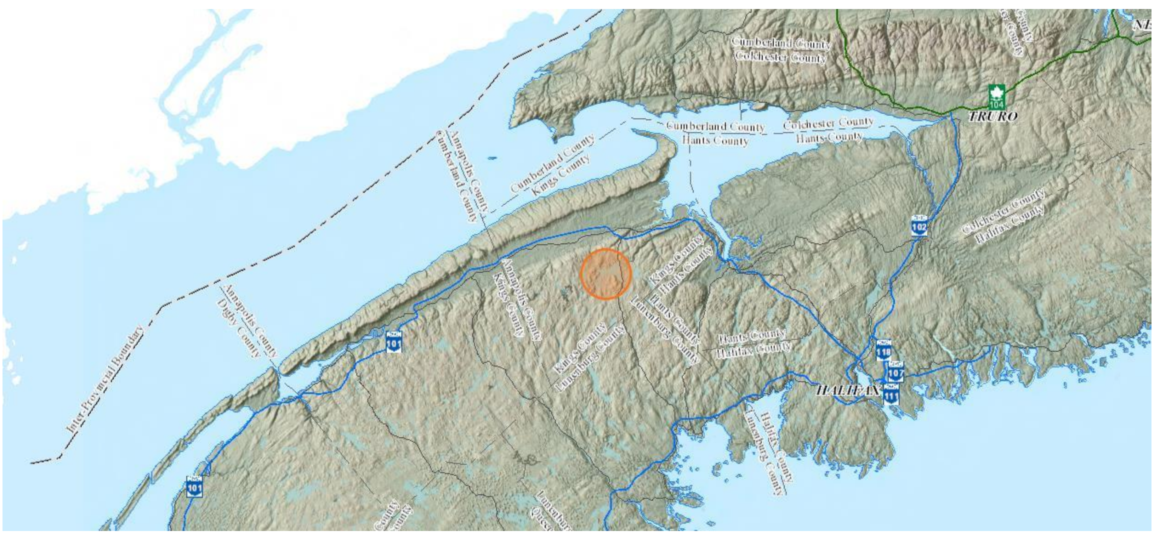

Figure 19: Map showing elevation surrounding Gaspereau Lake. (Novascan 2017)

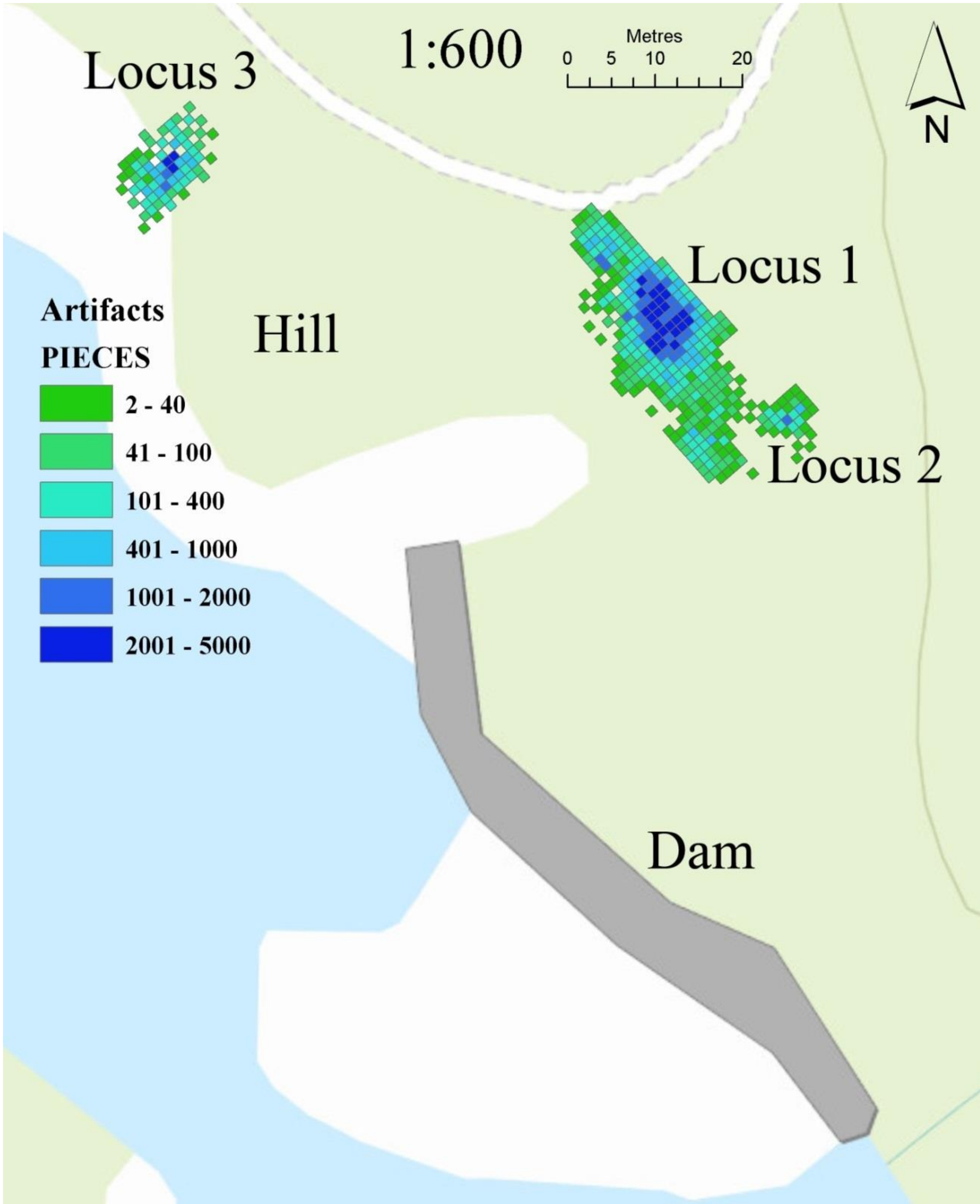

Figure 20: Map of the End of Dyke Site, showing the locations of Locus 1 and Locus 3, as well as artifact densities.

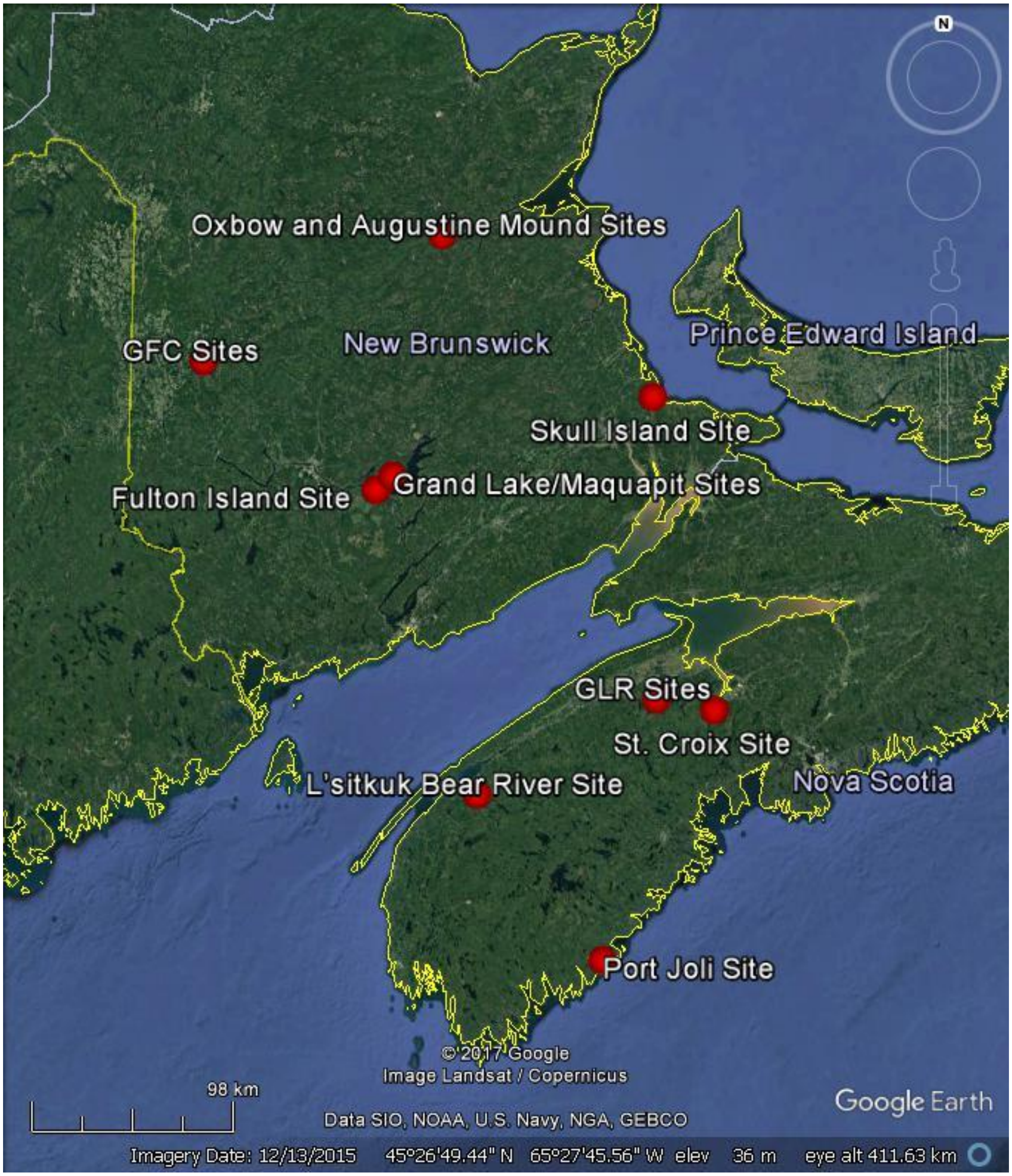

Figure 21: Map of all sites whose artifacts were used for comparison. (Google Earth 2017)

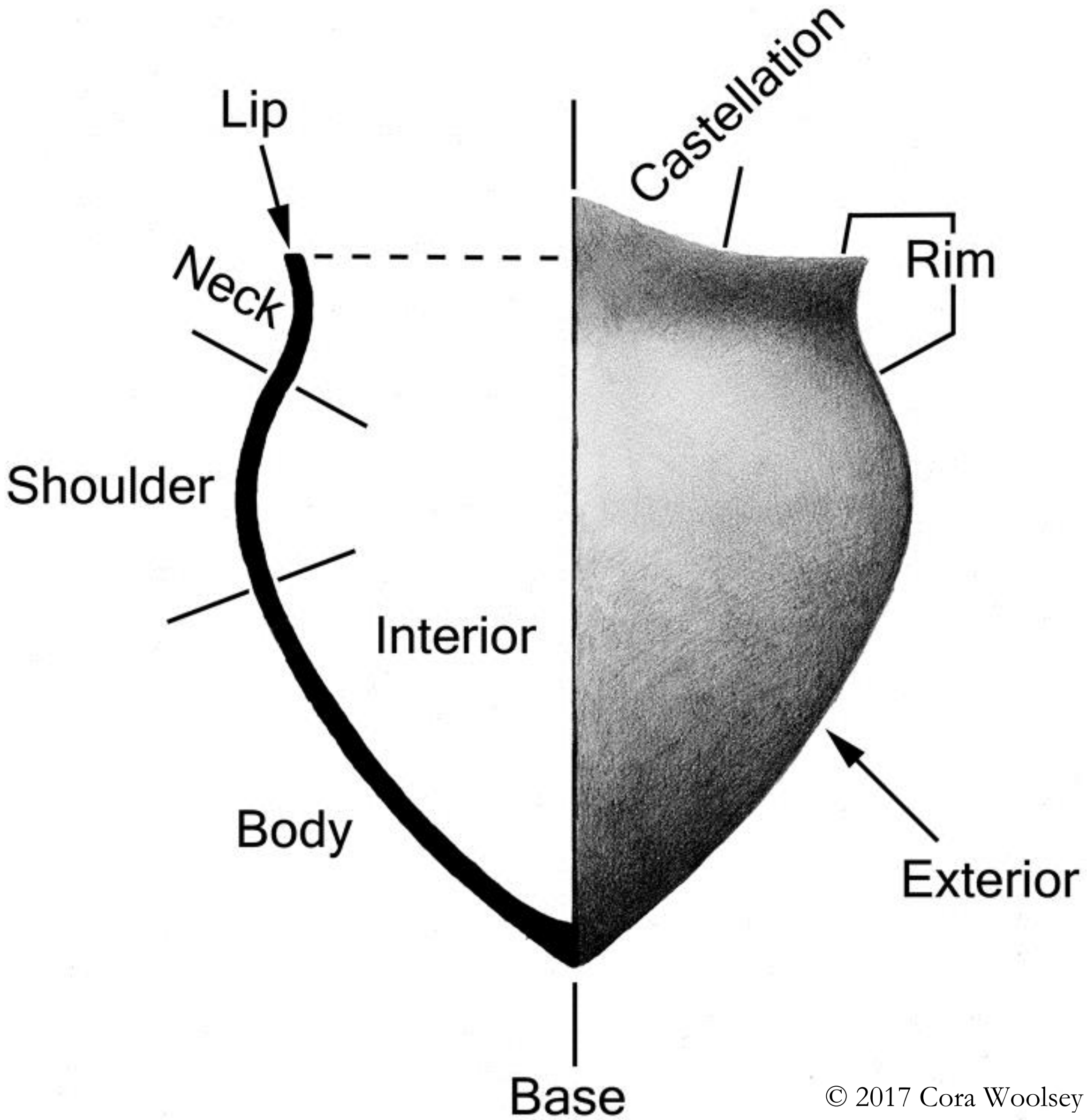

Figure 22: Regions of a typical ceramic vessel found in the Maine–Maritimes region.

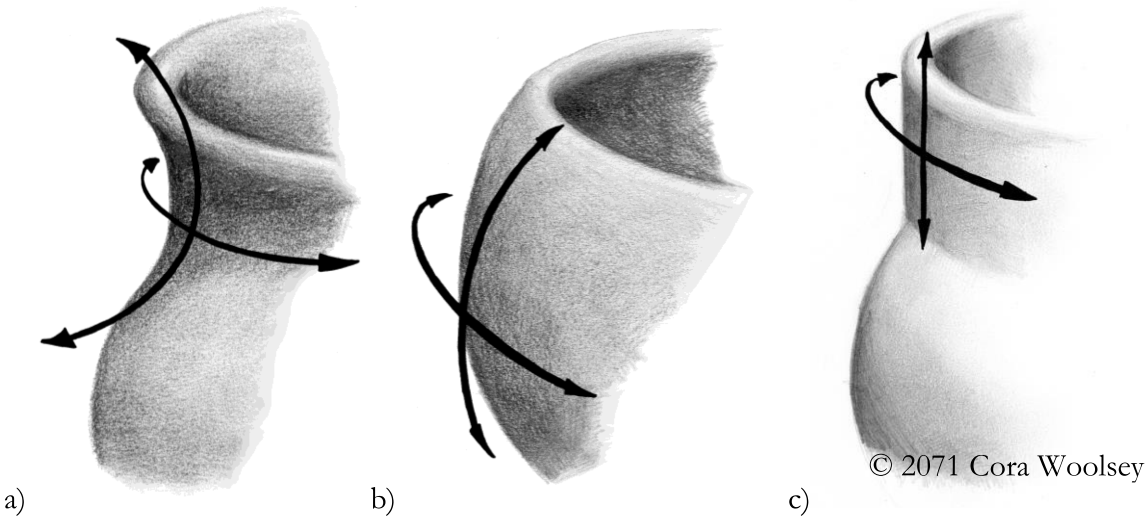

Figure 23: Three main attribute states are assumed to be possible in any given region of a vessel: *a)* excurvate, with the vertical axis curving in the opposite direction as the horizontal axis; *b)* incurvate, with the vertical axis curving in the same direction as the horizontal axis; and *c)* straight, with the horizontal axis curving while the vertical axis is straight.

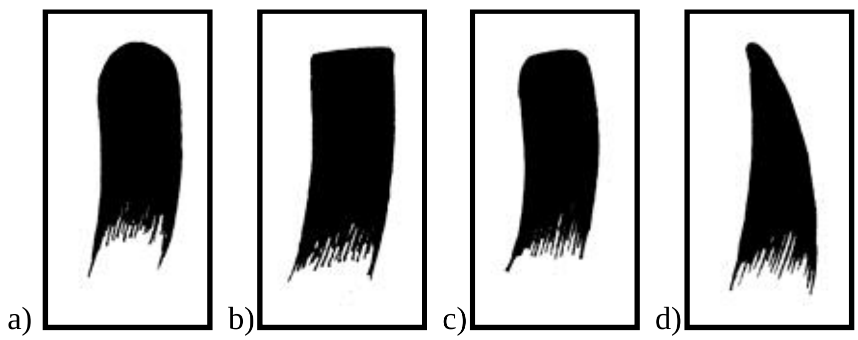

Figure 24: Types of rim shapes in profile. These are: a) round; b) square; c) semi-square; and d) thinned.

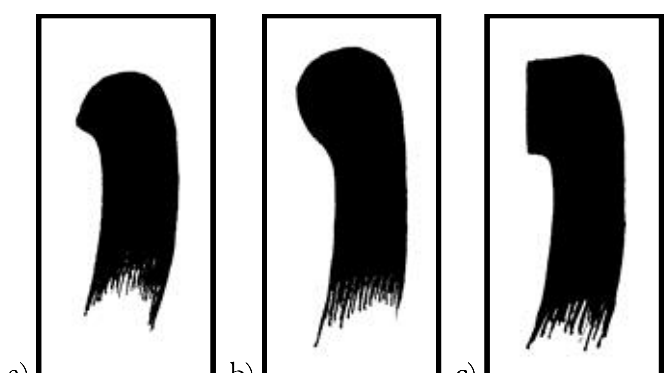

Figure 25: Types of collar shapes in profile. These are: a) lipped; b) round; and c) square.

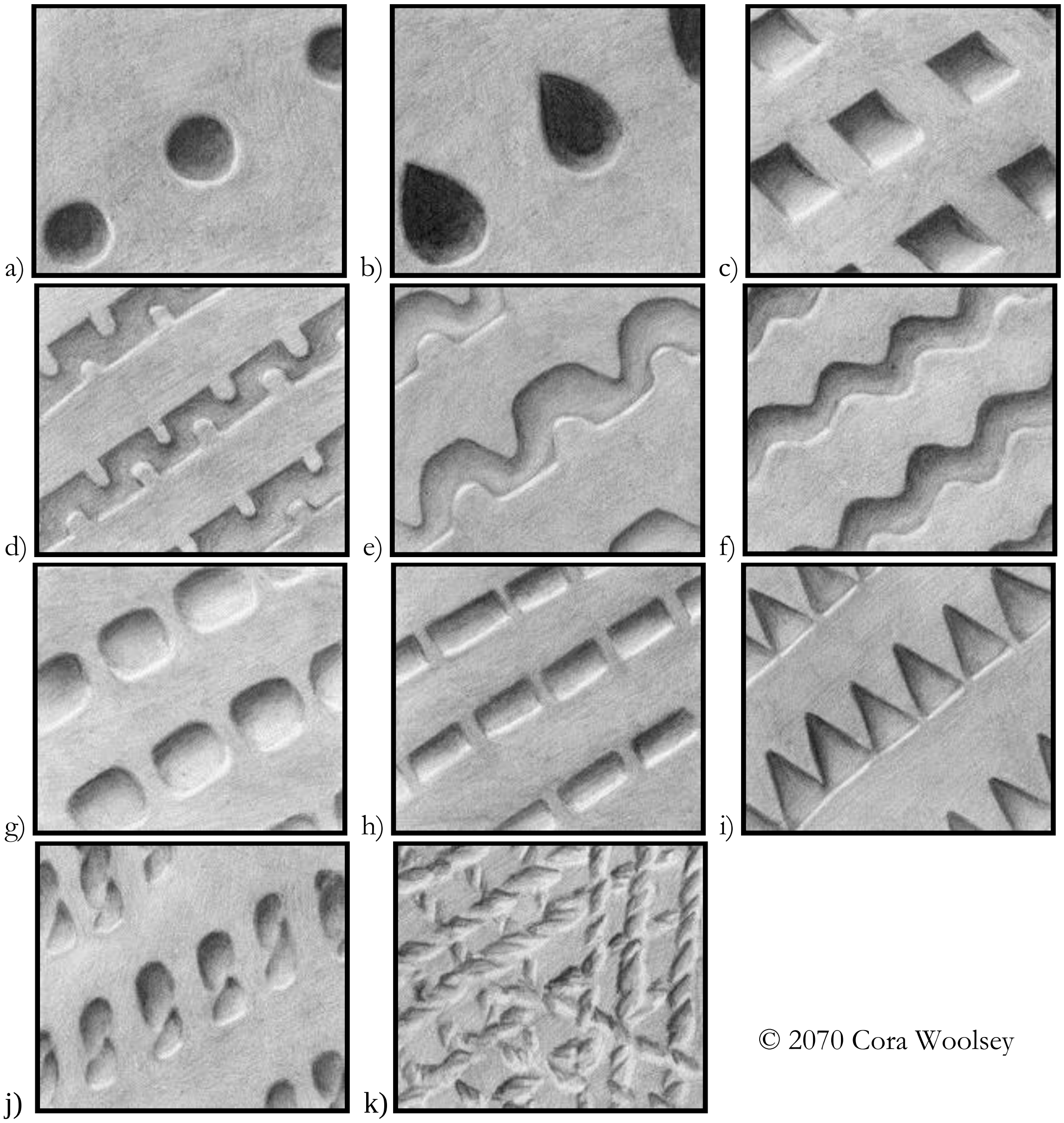

Figure 26: Variety of compacting tool types used on ceramics in the GFC Collection. These are: a) circular punctates; b) tear-shaped punctates; c) untwisted cord impression, possibly spruce root; d) square sinuous line; e) semi-square sinuous line; f) sinuous line; g) rounded dentate; h) rectangular dentate; i) triangular dentate; j) cord impression or cord-wrapped edge (S-twist—note that the positive cord twist is opposite from the impressed negative); and k) fabric impression (S-twist). Simple element tools are illustrated in a) and b); compound tools are illustrated in c) to j); and complex tools are illustrated by k).

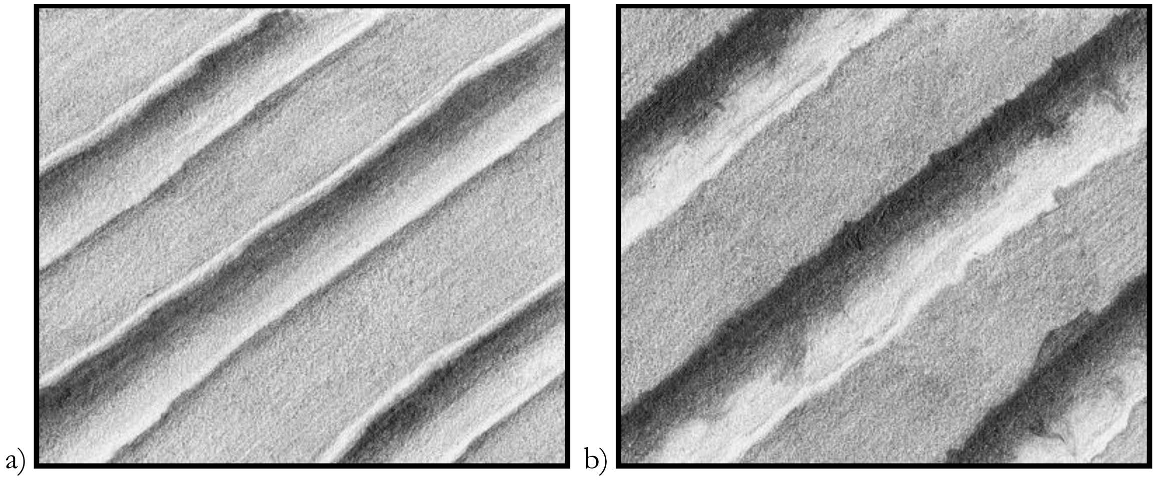

Figure 27: Variety of subtracting surface modifications used on ceramics in the GFC Collection. These are: *a)* trailing; and *b)* incision. The former results from a tool (in this case, pointed) being dragged through the wet clay surface, with characteristic overflow lines resulting on either side of the trough. The latter results from a tool (in this case, pointed) carving into the hardened clay or fired ceramic, with characteristic rough or broken edges resulting within and on either side of the trough.

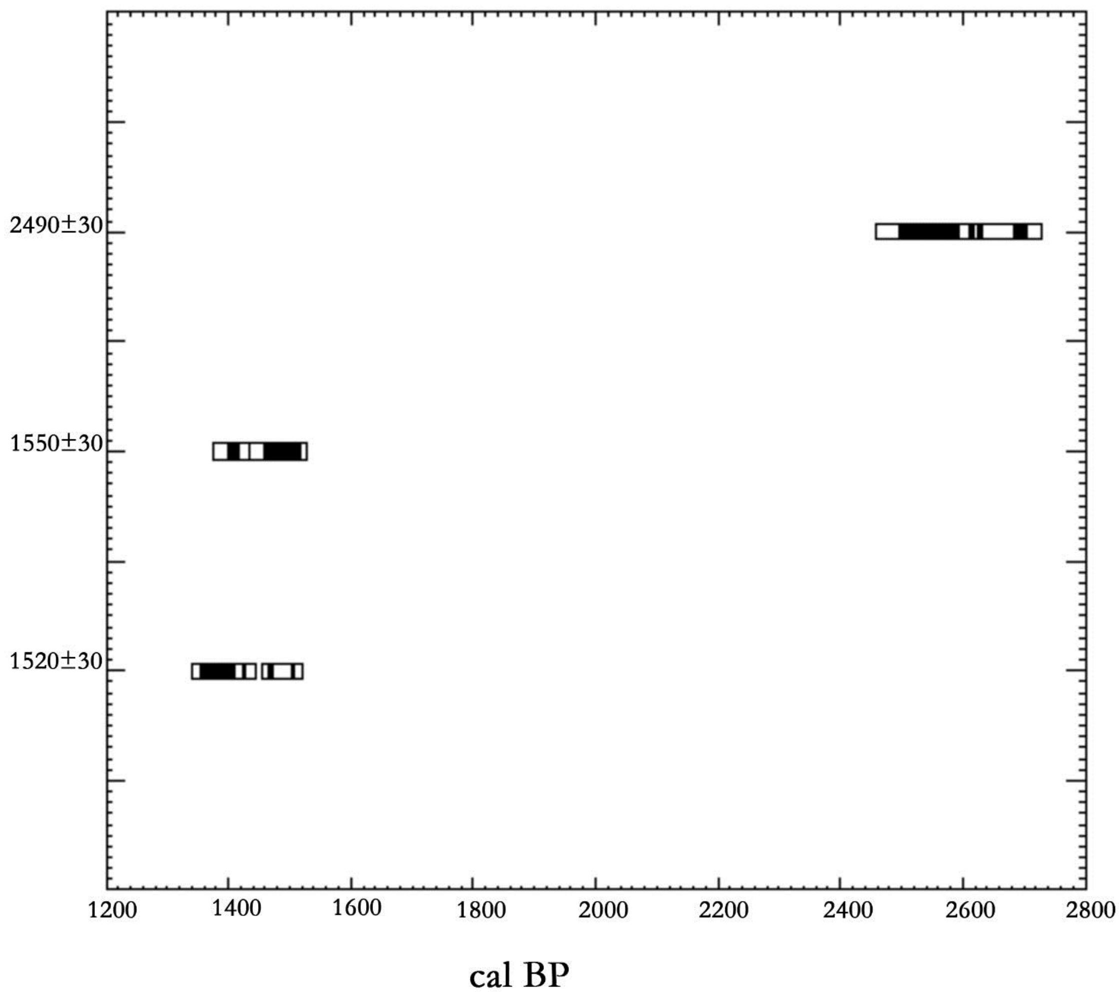

Figure 28: Calibrated age ranges for AMS dates taken from F44, the stone-lined hearth in Locus 1. All dates come from Sanders et al. (2014:346).

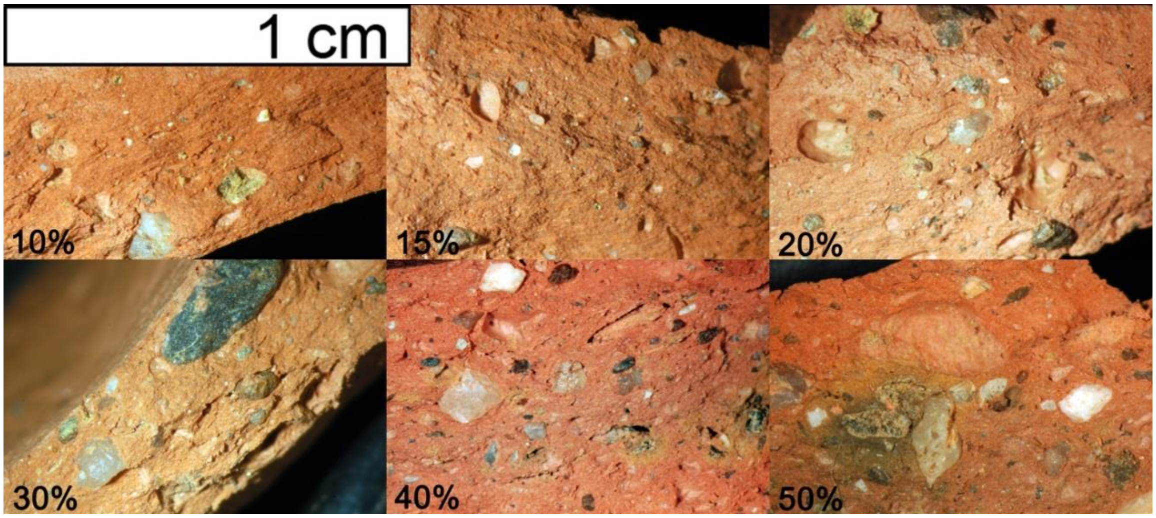

Figure 29: Temper percentages in test tiles. Seen here are the broken wall edges of test tiles made using commercial earthenware clay and sand from a gravel quarry, and fired to 800°C. Note the residual carbon staining in the 50%-tempered test tile, a result of incomplete combustion of organic material included in the sand.

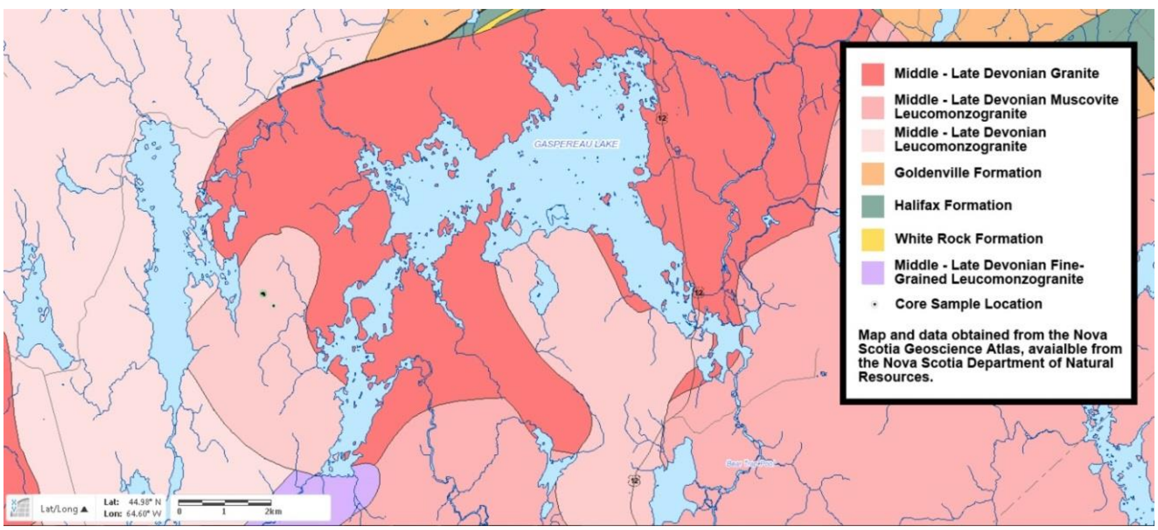

Figure 30: Bedrock geology of the area around Gaspereau Lake. The lake basin is underlain by granites, granodiorites, and fine- to coarse-grained leucomonzogranites associated with the South Mountain Batholith. Other formations to the north and east include schists and sandstones (Goldenville and Halifax formations) as well as marine quartzite (White Rock formation). The map is generated from the Nova Scotia Geospatial Atlas.

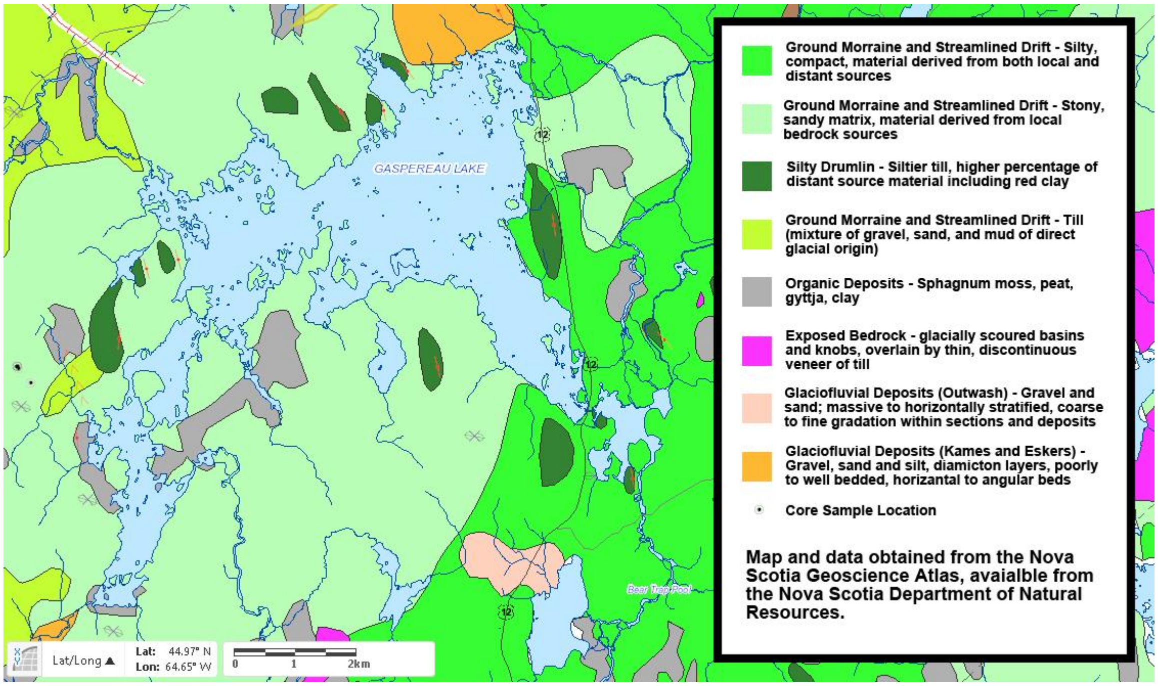

Figure 31: Surficial geology of the area around Gaspereau Lake. The lake basin is dominated by glacial till and glaciofluvial deposits and contains several features that resulted from a glacial lake overlying the area. Clay has been observed as an alteration product of granitoid bedrock within the areas overlain by ground moraines and streamlined drift and as a non-locally-derived glacial deposit within silty drumlins. It also occurs along with organic deposits. The map is generated from the Nova Scotia Geospatial Atlas.

Figure 32: Microscope photo of a paste containing Bluish-Grey Quartz temper. The bluish-grey particles are abundant in this sample. Note also the presence of an iron oxide particle and a lack of obvious feldspar.

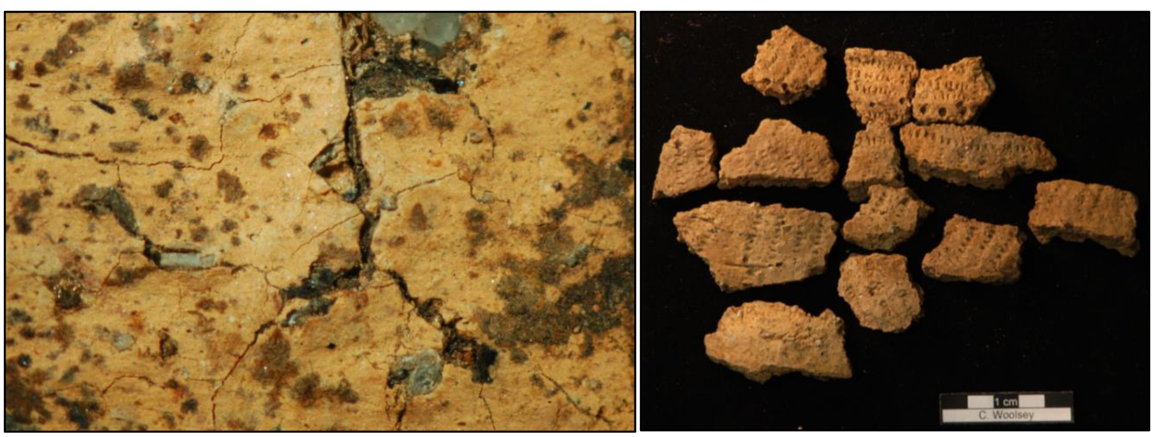

Figure 33: Close-up of ceramic fabric of GLNS:61, a cord-marked vessel lot with coarse grit and iron oxide temper and buff-coloured clay. Note the bluish-grey quartz particles and the lack of feldspar, indicating a pegmatitic granite source. Also note the hexagonal cracking pattern, indicating large, inflexible clay particles characteristic of kaolinite.

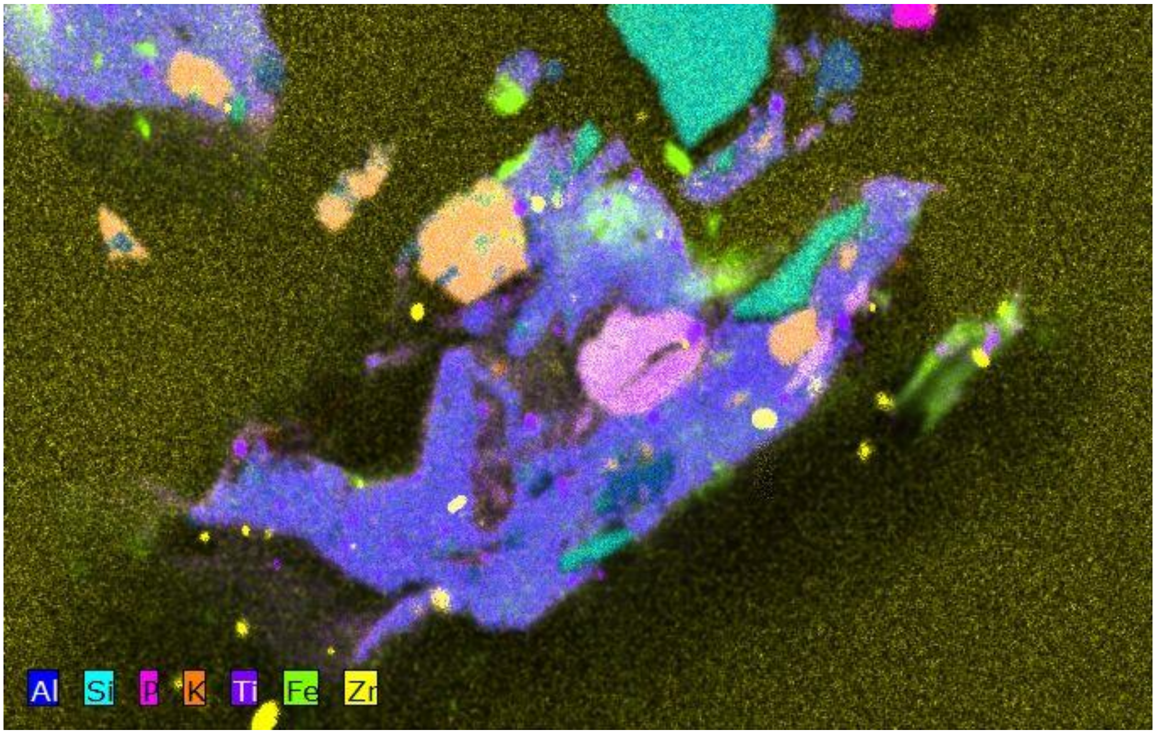

Figure 34: XRF image of a particle from GLNS:61.

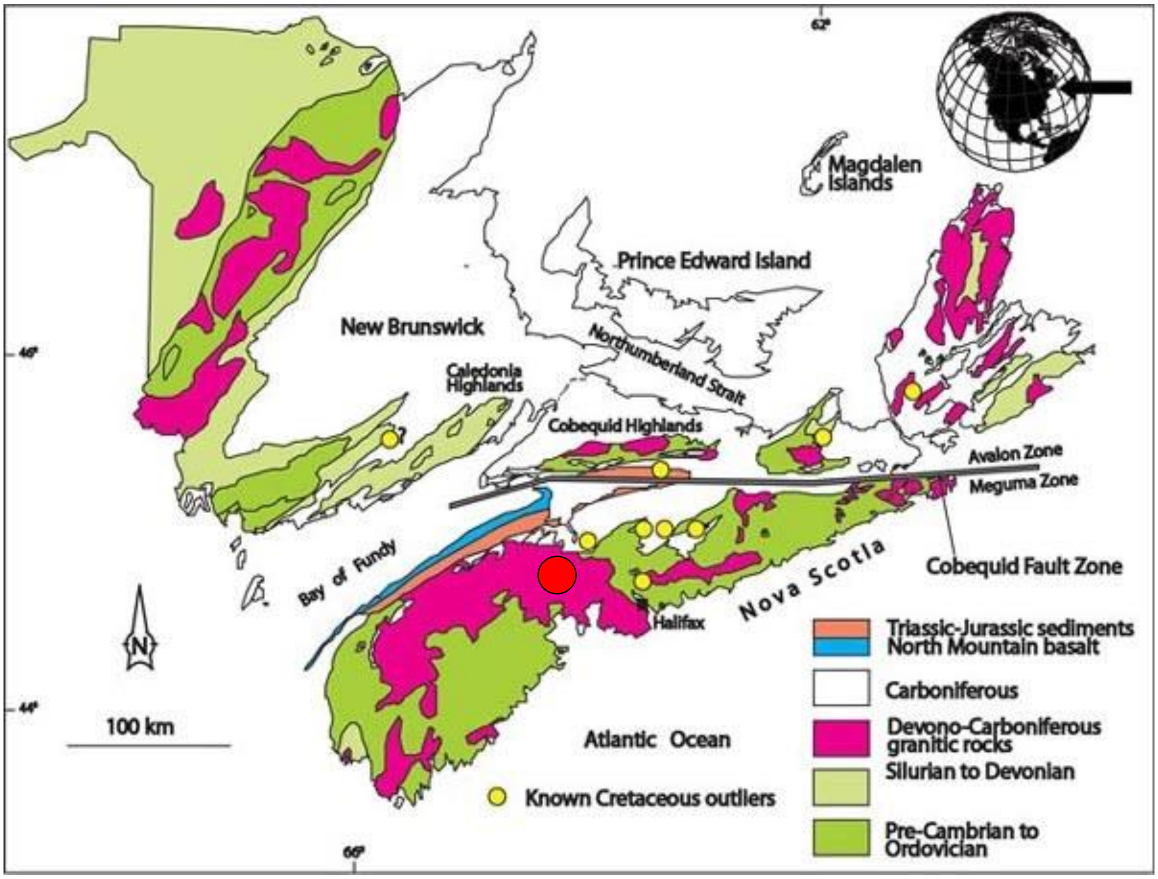

Figure 35: Bedrock Geology of the Maritime Provinces showing the deposits of kaolin clay and silica sand (Cretaceous outliers). Gaspereau Lake is indicated by the red dot. This map is reproduced with permission from Ralph Stea, http://www.steasurficial.ca/kaolin.html.

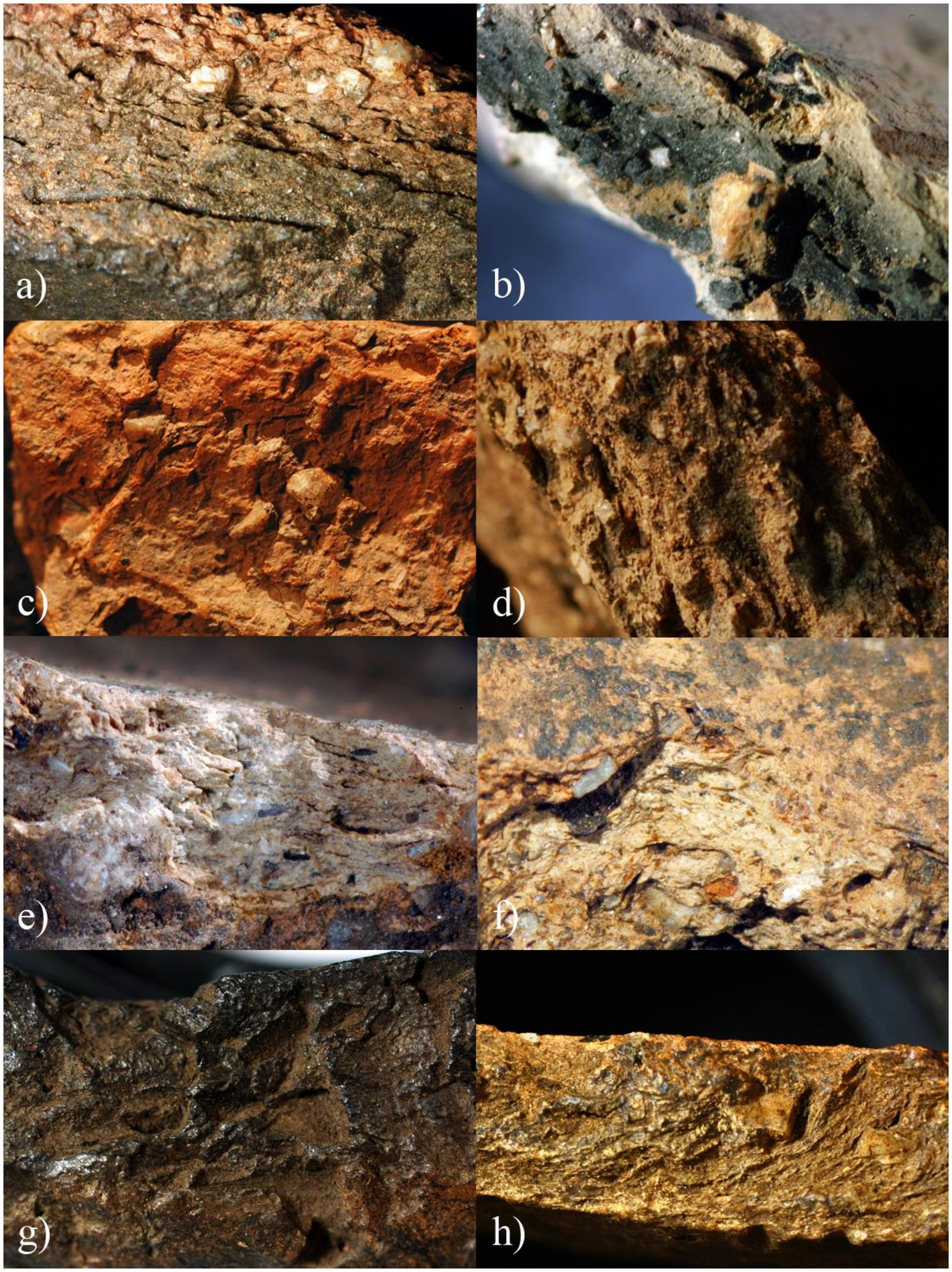

Figure 36: Comparison of ceramic fabrics from some sites in New Brunswick and Nova Scotia. A) and b) show typical fabrics in the GFC assemblage; c0 comes from the Bliss Islands in the Quoddy Region; d) comes from a private collection from central New Brunswick; e) to h) are from the GLR assemblage. Note that iron oxidation (reddish colour) has not occurred to any extent in the clays of the GLR fabrics, despite the red particles that have clearly oxidized. This indicates a lack of iron in the clay particles themselves compared with the other fabrics.

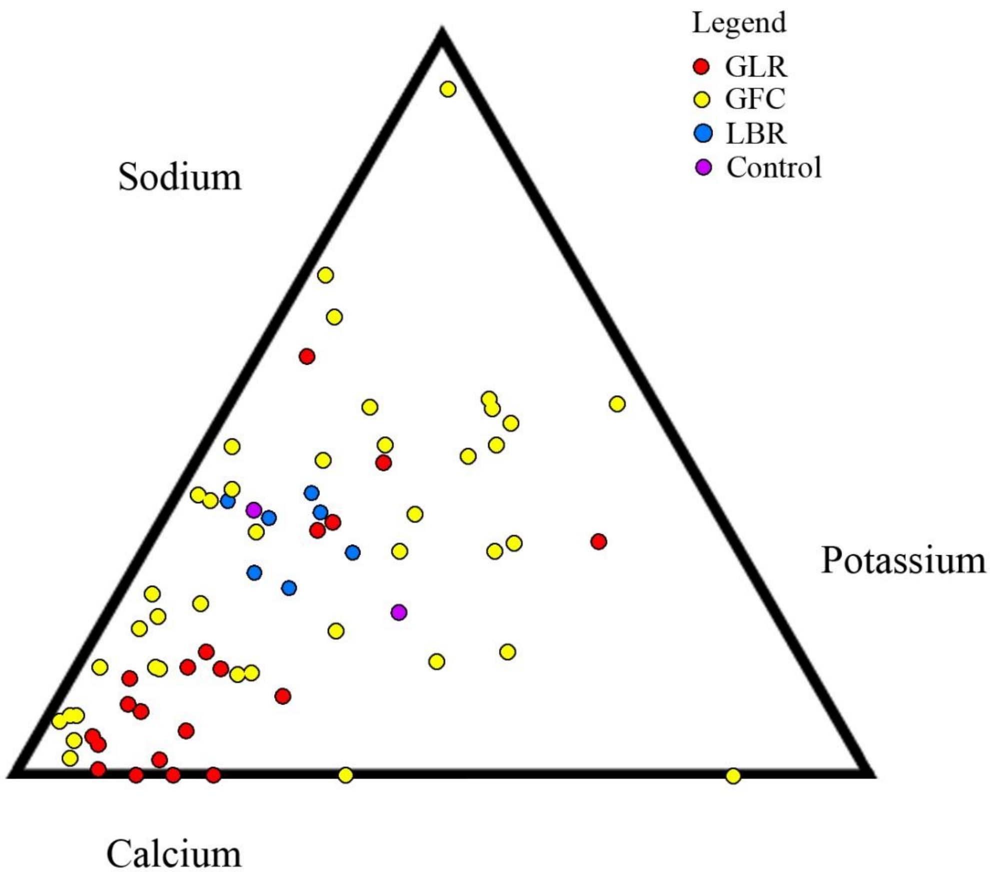

Figure 37: Tri-plot of Na-Ca-K in clays from the GLR, GFC, and LBR assemblages investigated using SEM-ED spectra. Amounts are reported in atomic weight percent. The GLR ceramics cluster, tending to exhibit less calcium and more potassium on average than the GFC ceramics from New Brunswick. LBR ceramics also cluster, showing difference from both the GLR and the GFC ceramics. The two samples made with clay from Parsboro are not particularly associated with any of the groups.

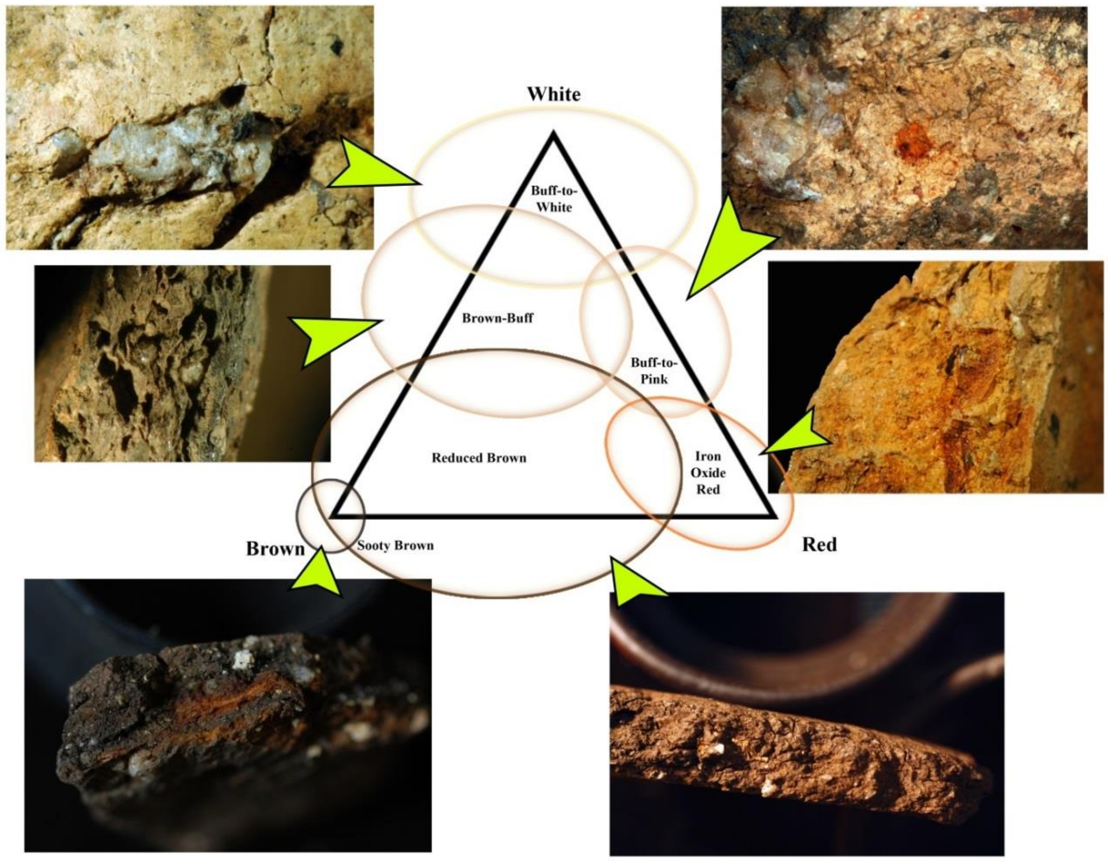

Figure 38: Paste groups in the GLR assemblage.

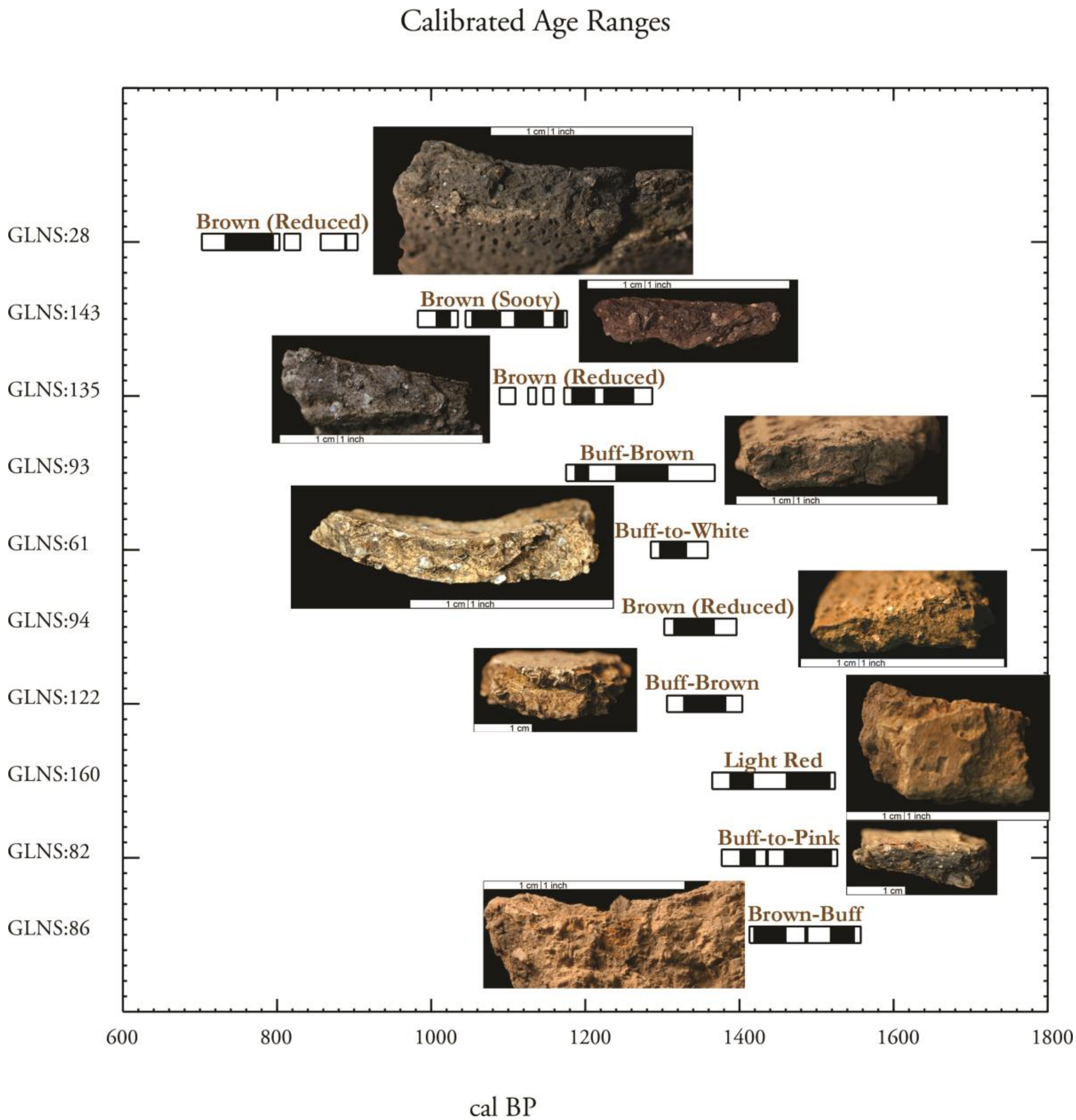

Figure 39: Chronological arrangement of paste colours, showing a broad trend from lighter to darker. Earlier ceramics also tend to be redder, while later ceramics tend to be buff or neutral brown.

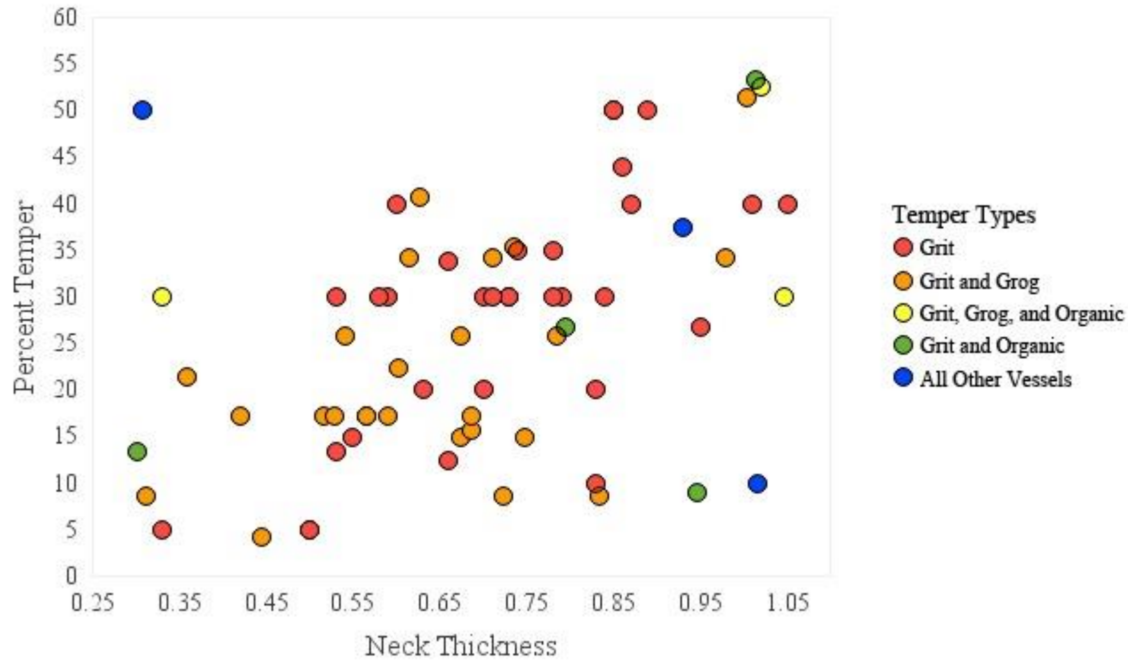

Figure 40: Plot of neck thickness by temper percentage from the Locus 3 sample (*n*=67) with temper types distinguished by colour.

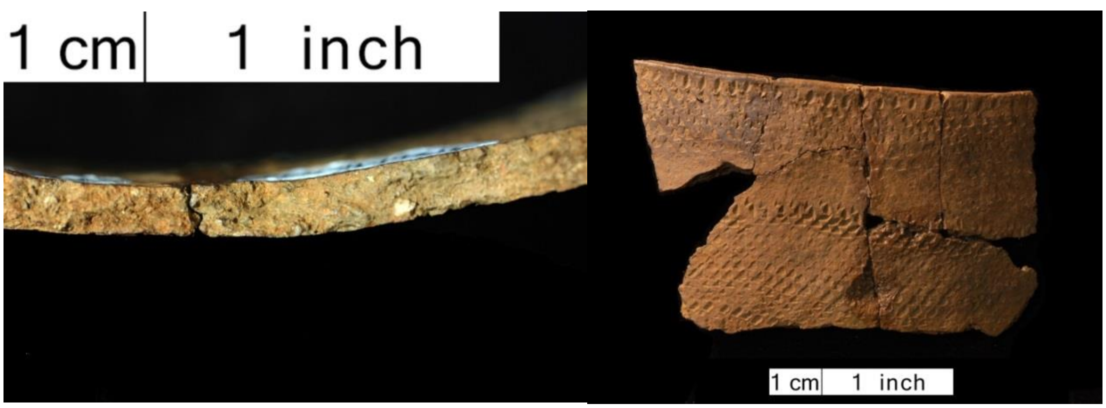

Figure 41: GLNS:150. Note the fine paste evident in the broken wall cross-section (left). The largest fragments have been physically reconstructed (right).

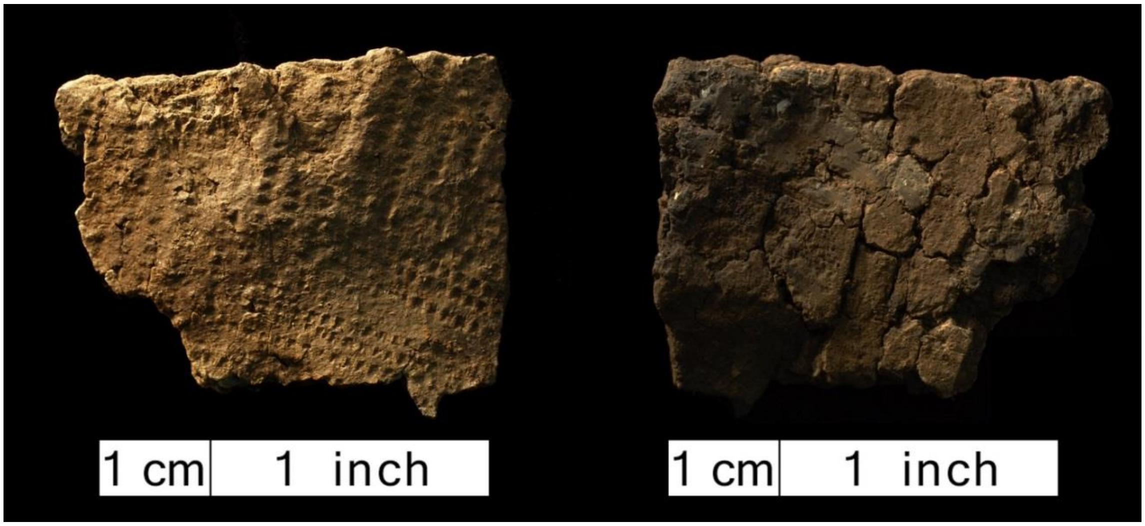

Figure 42: GLNS:79, exterior (left) and interior (right) surfaces. Note the spalling and degradation on the exterior and the sever cracking on the interior surface indicating direct heat. Because the worst degradation occurs on the interior surface, this side faced the heat source, indicating that the heating event or events occurred post-breakage and probably post-depositionally.

Figure 43: Coil breaks showing smoothed surfaces, a lack of lamellar character, and flanges on the edges. Shown are two opposite edges of the same sherd, BfDd-24:5137, from GLNS:20, one edge convex (top) and the other concave (bottom). This results when both interior and exterior surfaces of the coil are smoothed down equally into the previous coil during attaching.

Figure 44: Non-coil break edge exhibiting jagged and uneven edges and lamellar character. Shown here is BfDd-24:14000 from GLNS:109.

Figure 45: Lamellar character in two sherds. On the left is a dentate-decorated sherd with vertical lamellae (parallel to the wall axis). On the right is a cord-marked sherd with oblique lamellae (diagonal across the axis of the wall).

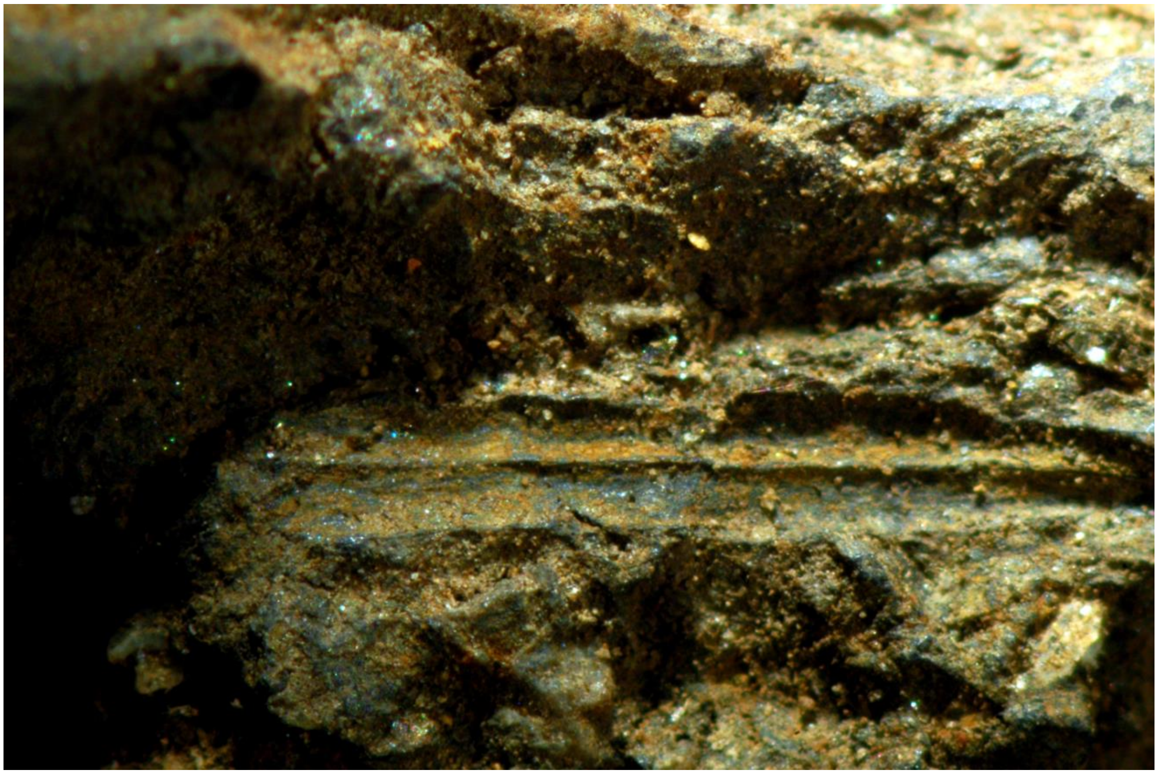
Figure 46: Coil break exhibiting score marks, a technique for increasing cohesion between coils.

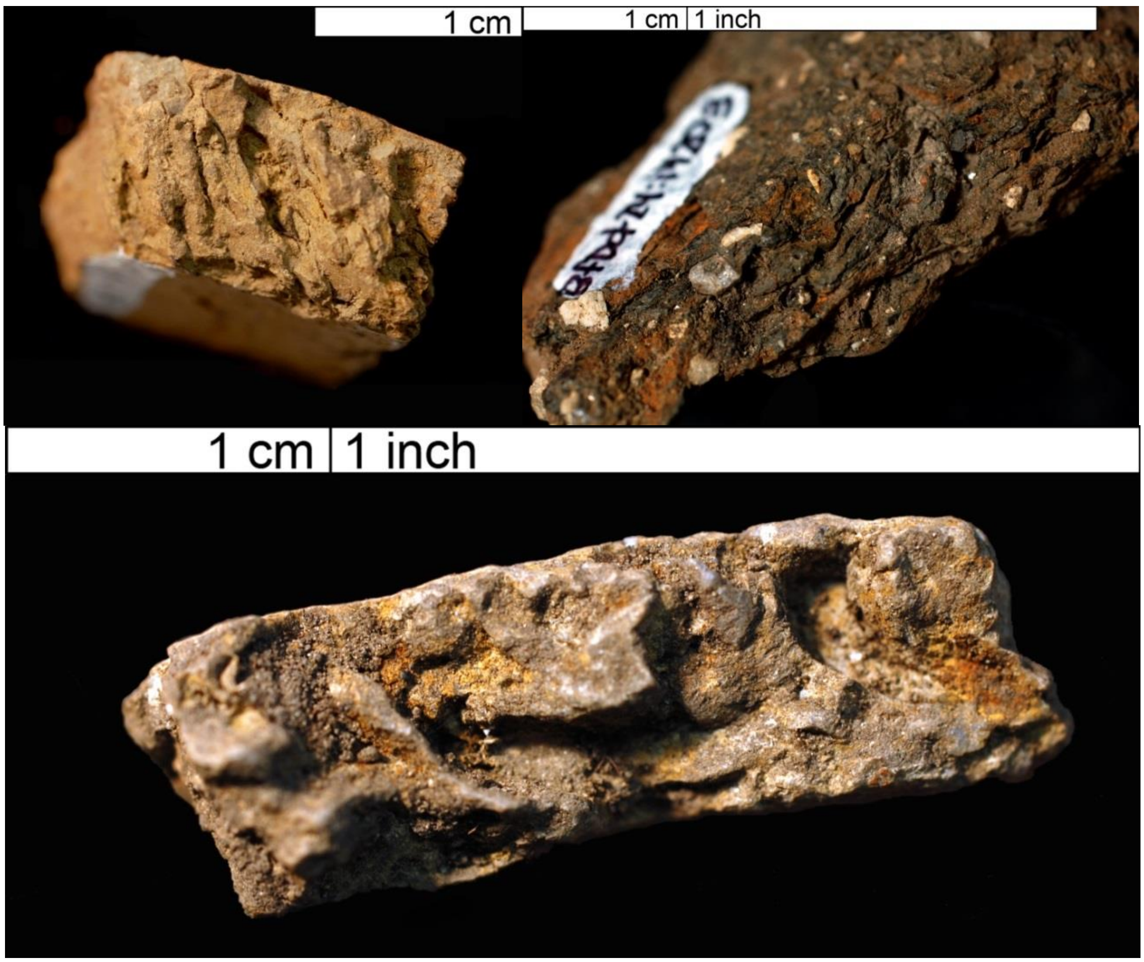

Figure 47: Examples of lamellar directions occurring in the Locus 1 and Locus 3 samples. Top left: oblique lamellae; shown is BfDd-24:6784 of GLNS:69. Top right: vertical lamellae; shown is BfDd-24:14204 of GLNS:148. Bottom: U-shaped lamellae; shown is BfDd-24:67.

Figure 48: Curvilinear rocked-on impressions. On the left, the tool's rocking motion moved in a horizontal direction with the tool oriented vertically, creating a horizontal band. In the centre, the rocking motion moved vertically with the tool oriented horizontally, creating vertical columns. On the right is a sherd from the Port Joli site on the south shore of Nova Scotia with rocked-on dentates or PSS decorations.

Figure 49: Two sides of a piece of clay that appears to be waste or an unknown class of ceramic artifact. It appears not to be part of a vessel lot because it violates several assumptions about a conoidal ceramic vessel. First, it exhibits no curvature; second, there is no evidence of an interior or exterior surface; third, the clay is untempered.

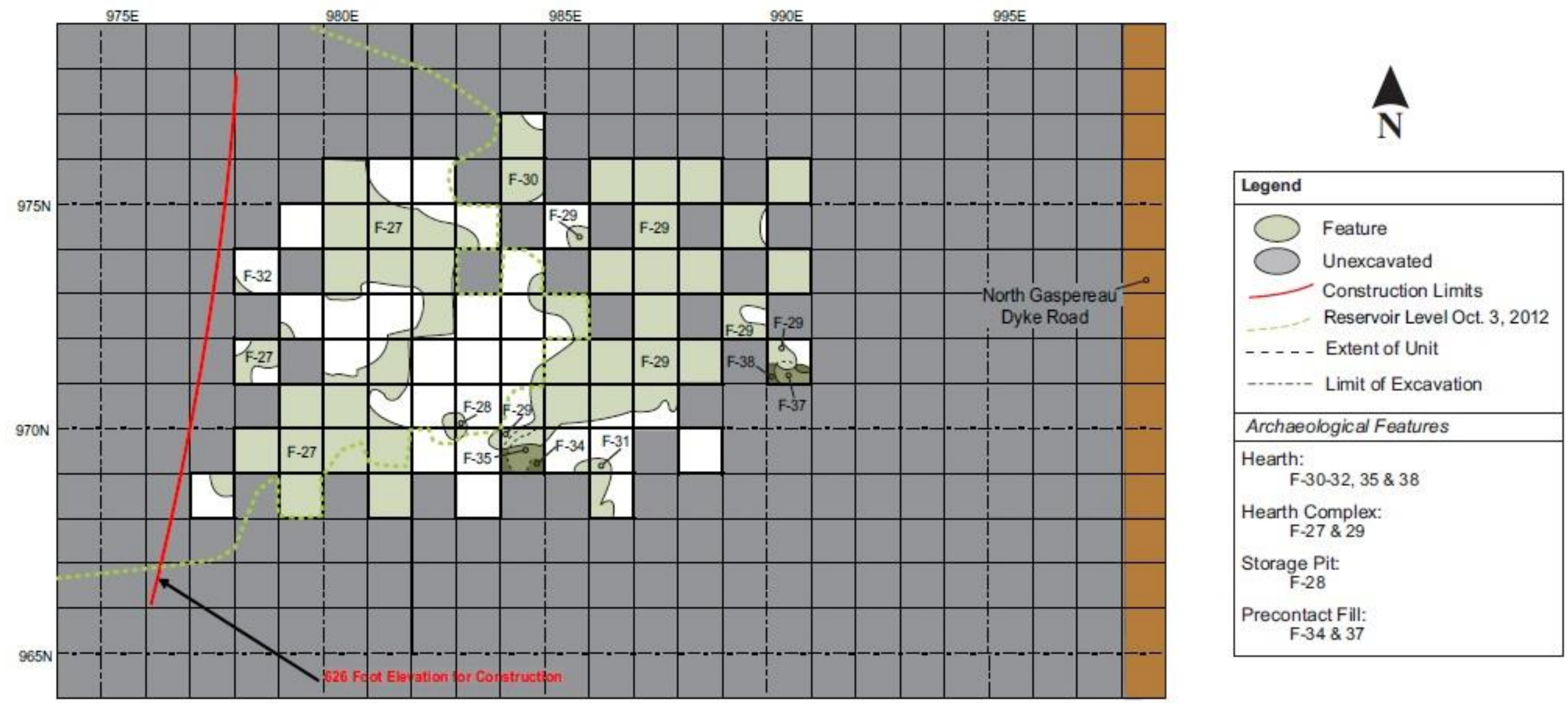

Figure 50: Map of Locus 3 from Sanders et al. (2014:Figure 12), courtesy of Mike Sanders and Cultural Resource Management Group Ltd.

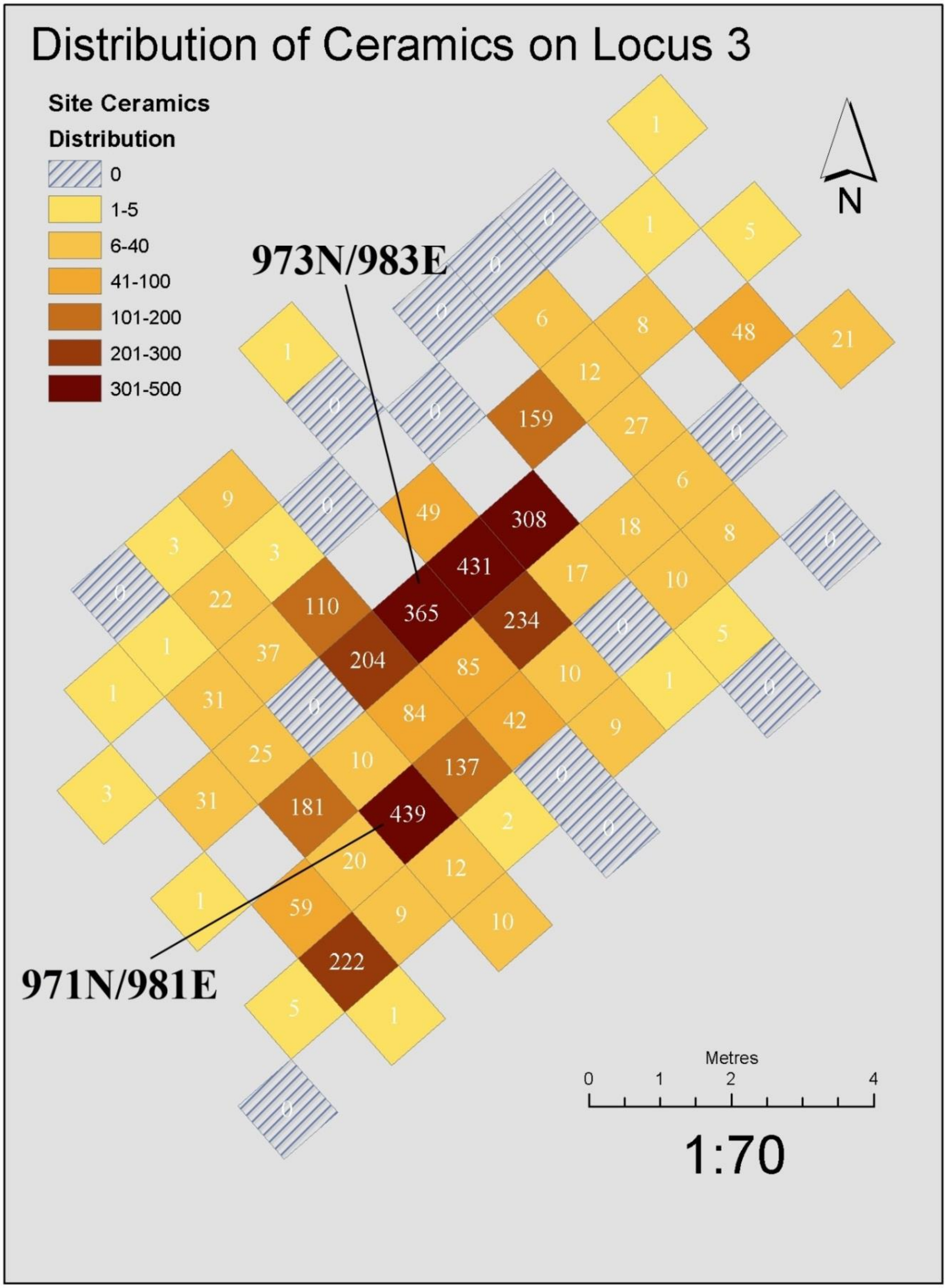

Figure 51: Spatial distribution of ceramic sherds on Locus 3 of the End of Dyke site.

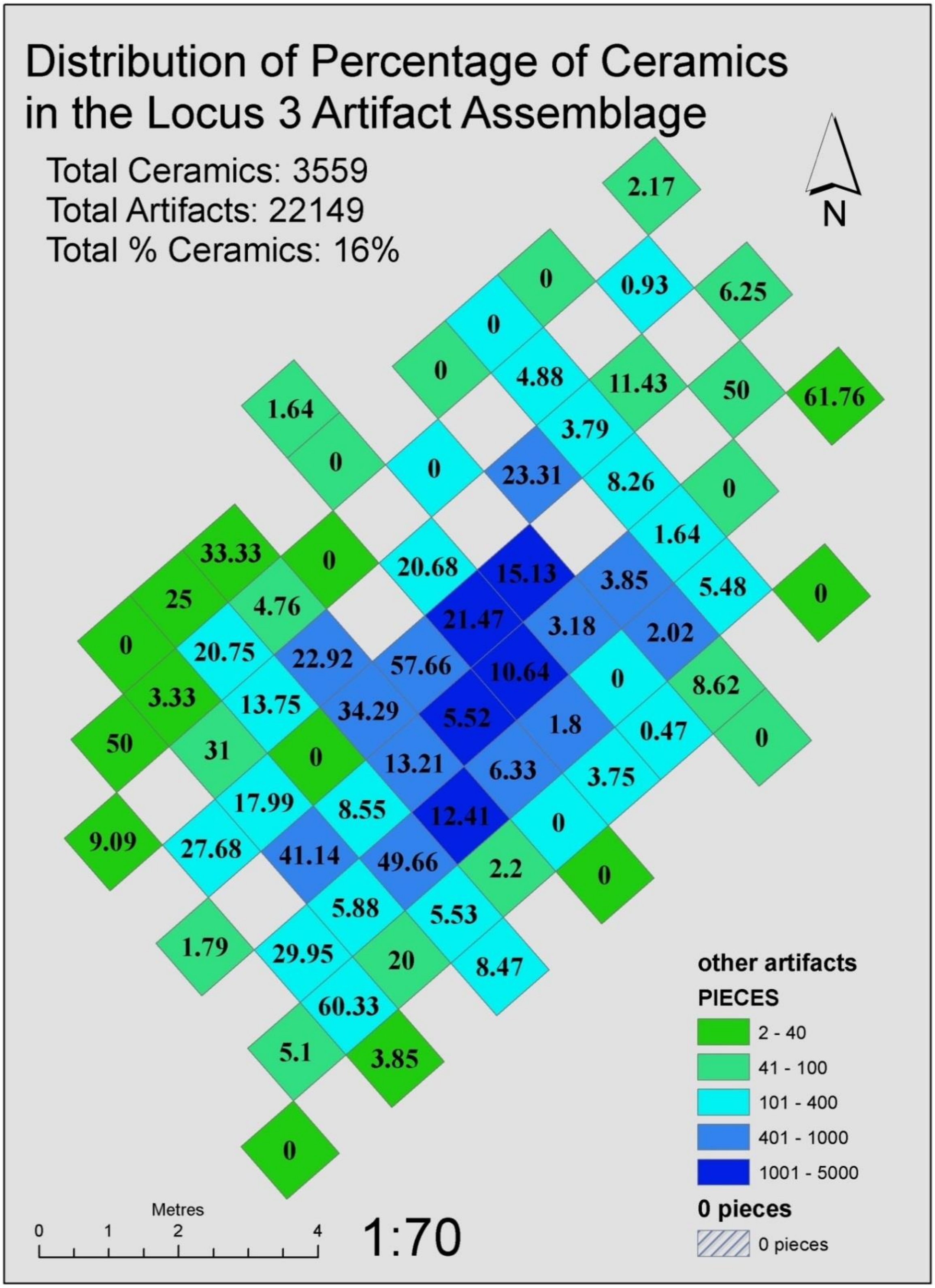

Figure 52: Ratios of ceramics to other artifacts in all units on Locus 3 of the End of Dyke site

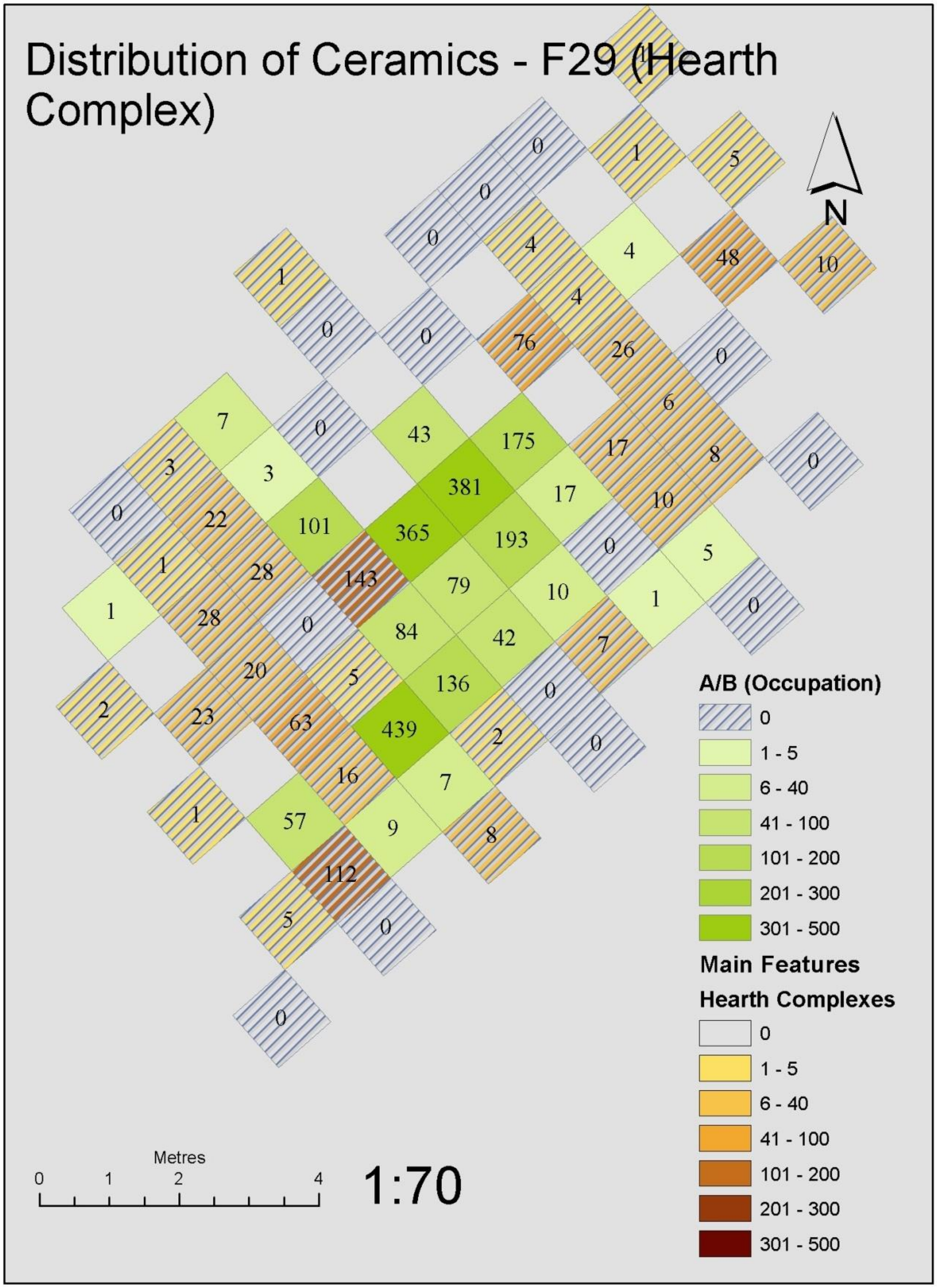

Figure 53: Spatial distribution of ceramics showing differences in association versus non-association with features F-27 and F-29.

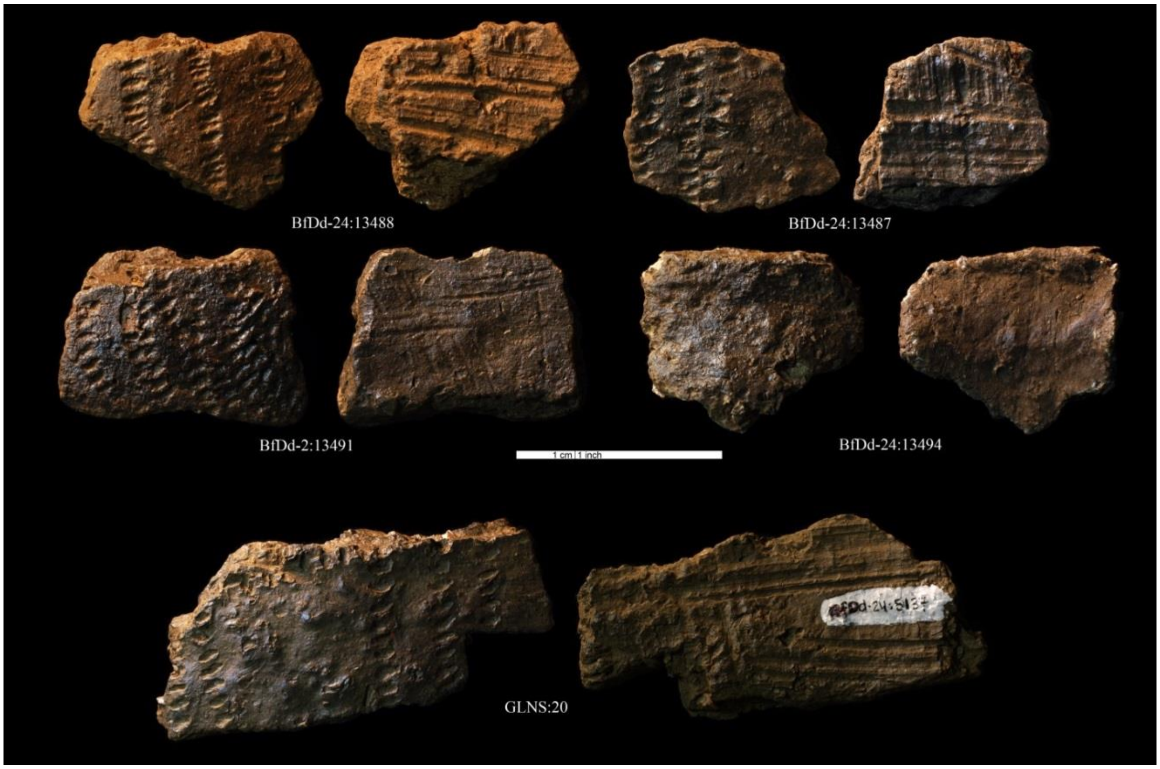

Figure 54: Five sherds associated with F44, a stone-lined hearth on Locus 1. The sherds show signs of having been over-fired. GLNS:20 appears to have been vitrified or partially vitrified throughout the wall, while the other sherds exhibit possible melted surfaces (evidenced by shiny surfaces and dark colouration) but softer wall interiors.

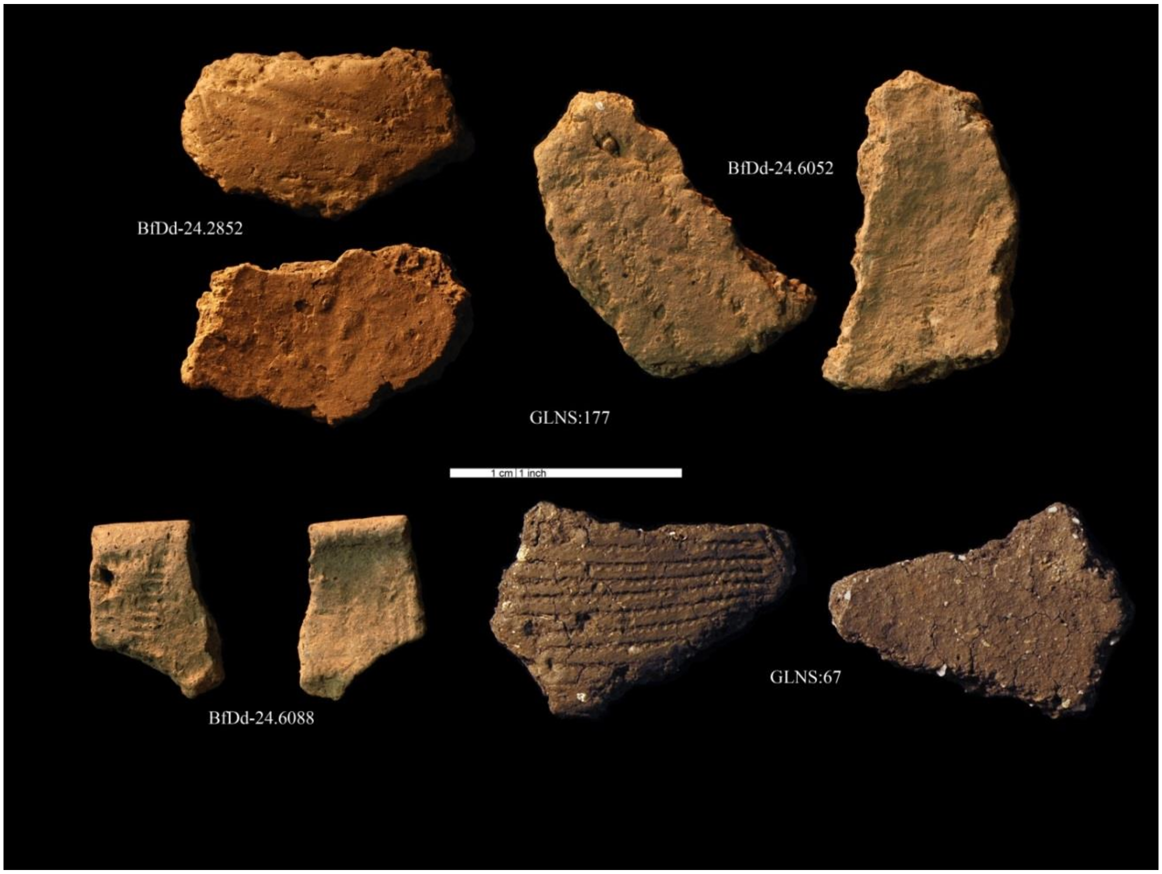

Figure 55: Several sherds that may have been used as pottery manufacturing tools. Attributes that may indicate this kind of reuse of sherds are rounding and polishing along several edges, striations that run over the edges, and roughly pentagonal or triangular shapes.


Figure 56: Striations visible along edges and through surface decorations, indicating that they were acquired after breakage in the first case and after decorations were applied in the second case.

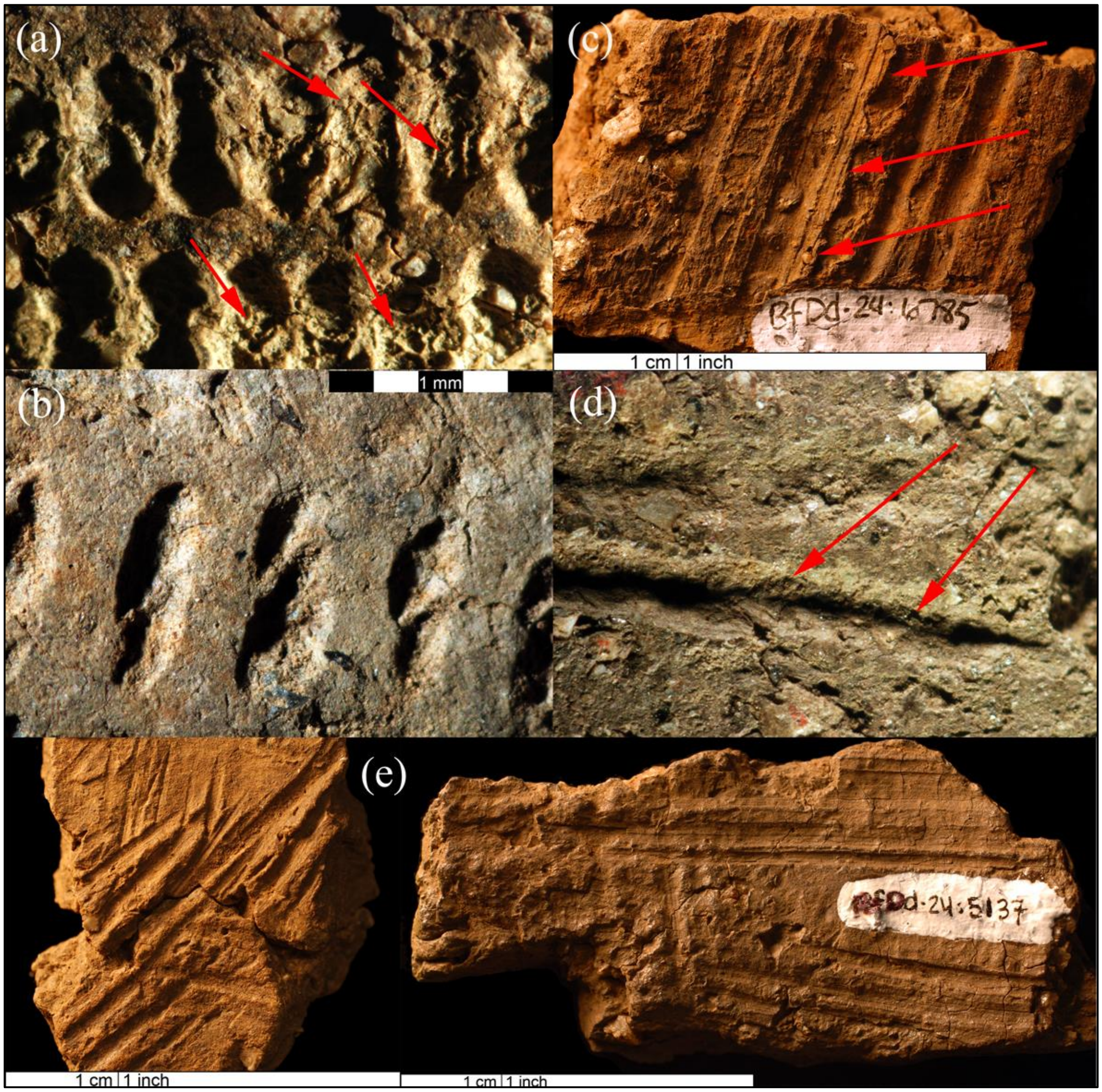

Figure 57: Surface modifications showing that their application was poorly timed, either applied when the clay was too wet or too dry. Shown are a) suction marks created by impressing cord into too-wet clay (G19-3 of GFC:6); (b) cord impressions with an absence of suction marks, showing that the clay was the right dryness (BfDd-24:6710 of GLS:60); (c) spillage of excess clay outside the channeling marks because clay was too wet (BfDd-24:6765 of GLNS:55); (d) incised design after clay was allowed to dry too much, resulting in broken edges along the incision trough (G145-35bb, no vessel lot); and (e) channeling marks showing ideal dryness at the time of surface treatment (BfDd-24:). Note the clean appearance of the channeling marks and the cord marks applied at the right stage, compared with the rough appearance of the too-dry clay and the messy appearance of the too-wet clay.

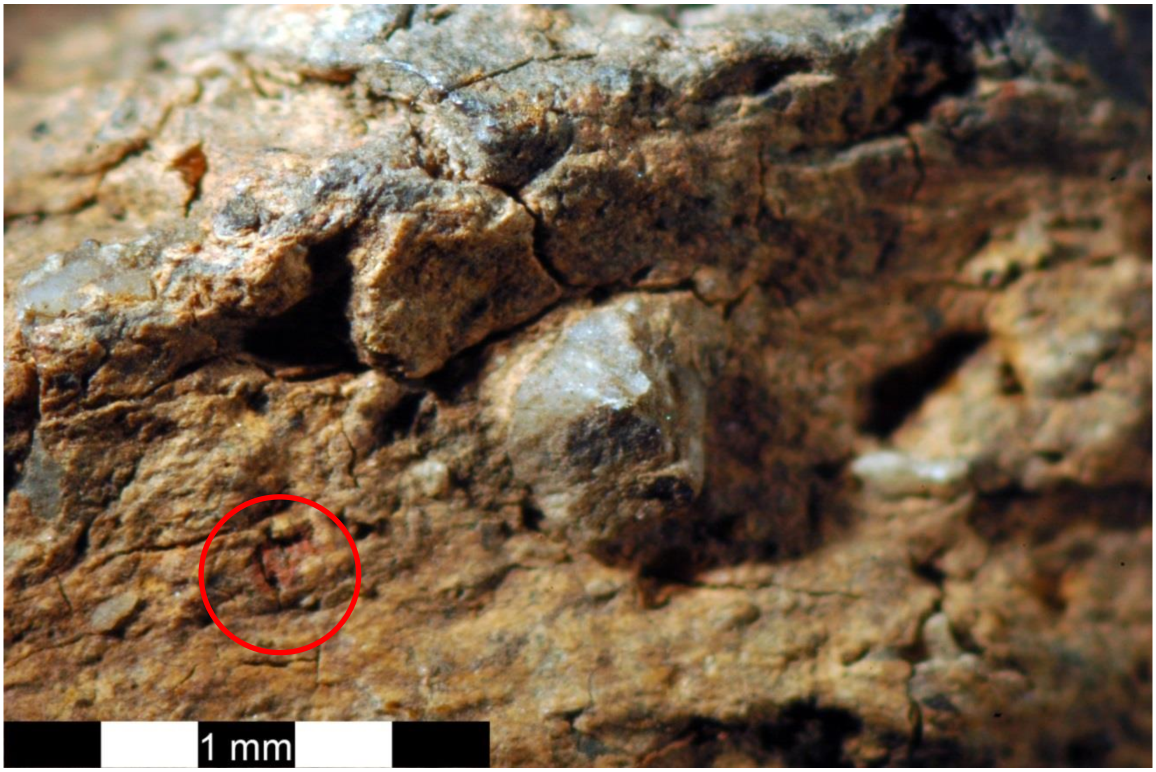

Figure 58: Possible grog particle in GLNS:62.

Figure 59: An example of a fabric-impressed vessel lot.

Figure 60: Some examples of the PSS Fineware Tradition. Note the careful application of tools, the hard, highly smoothed surfaces, the relatively bright red surface colour, and the fine pastes.

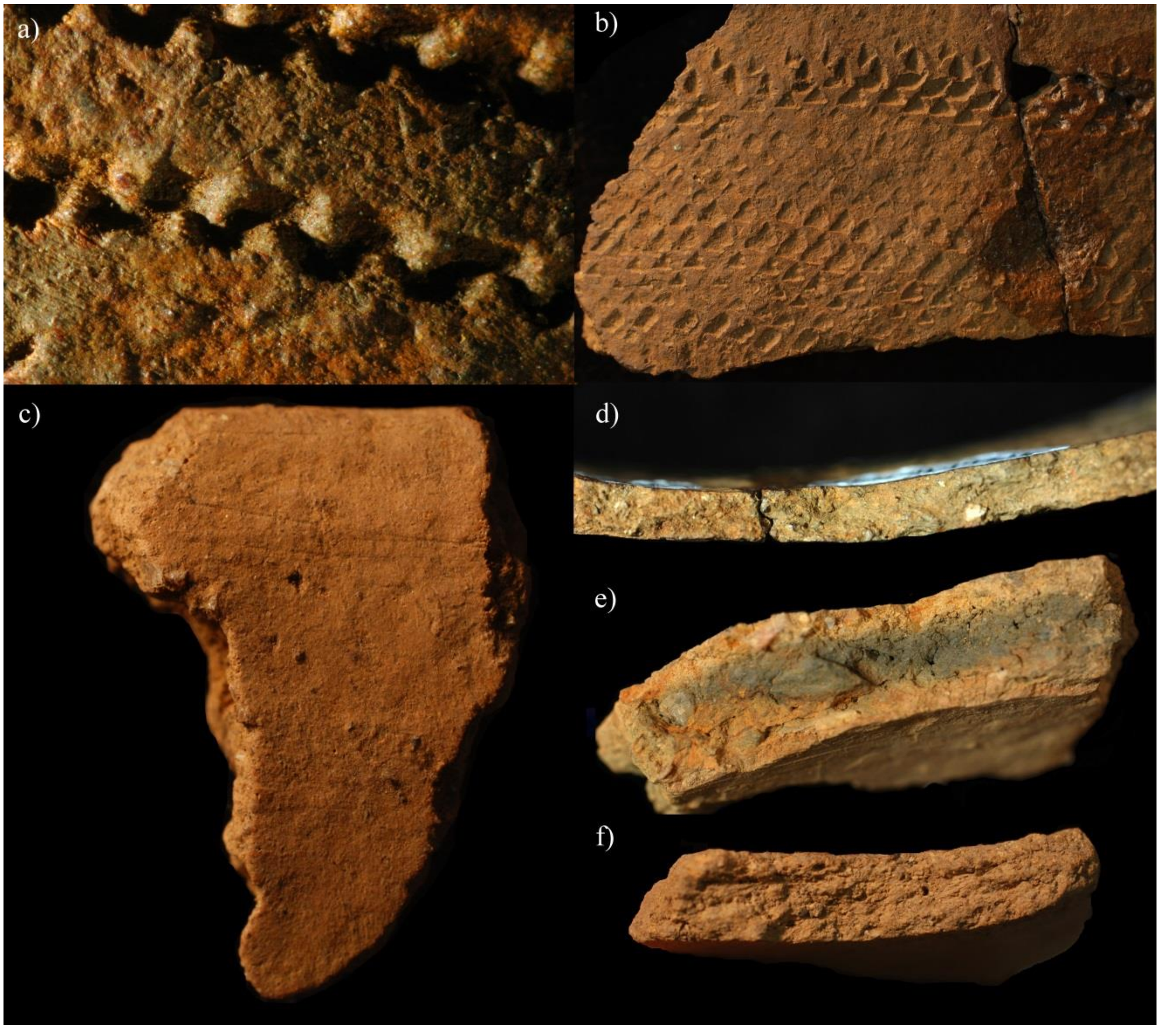

Figure 61: Attributes of Fineware: a) carefully applied and delicate impressions of dentate or PSS; b)closely spaced or articulated impressions that are evenly distributed in oblique, horizontal, or vertical zones; c) smoothed or burnished interior surfaces; d) usually finely tempered pastes (0–10% temper) with a variety of minerals and thin walls; e) commonly characterized by carbon cores and reddish surfaces; lamellar character that is strongly vertically oriented or oblique tending towards vertical.

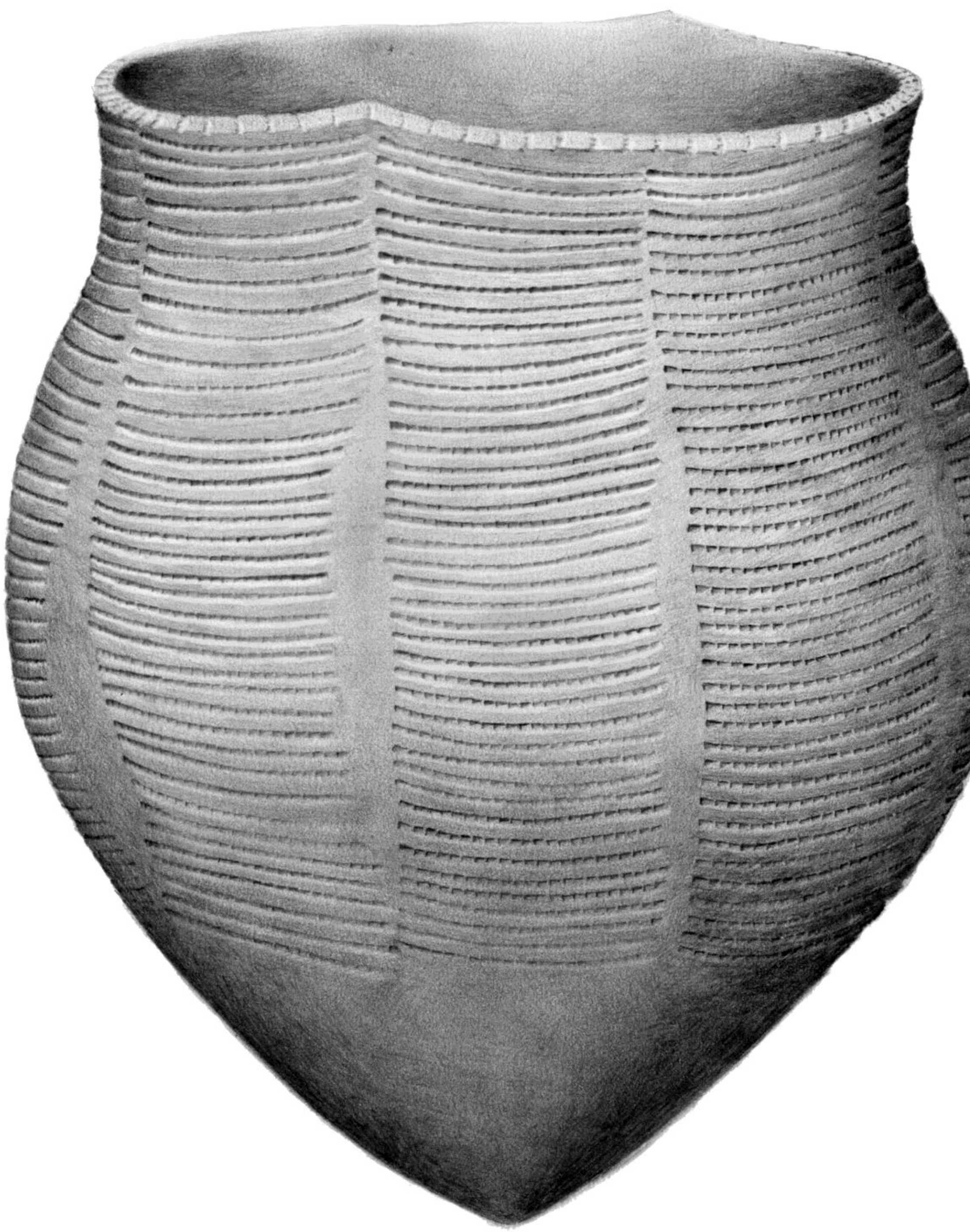

Figure 62: Rendering of what a Blended-Edge Dentate I pot would have looked like before having been used and broken.

Figure 63: An example of the Blended-Edge Dentate I tradition. Note the highly regular spacing of the dentate tool.

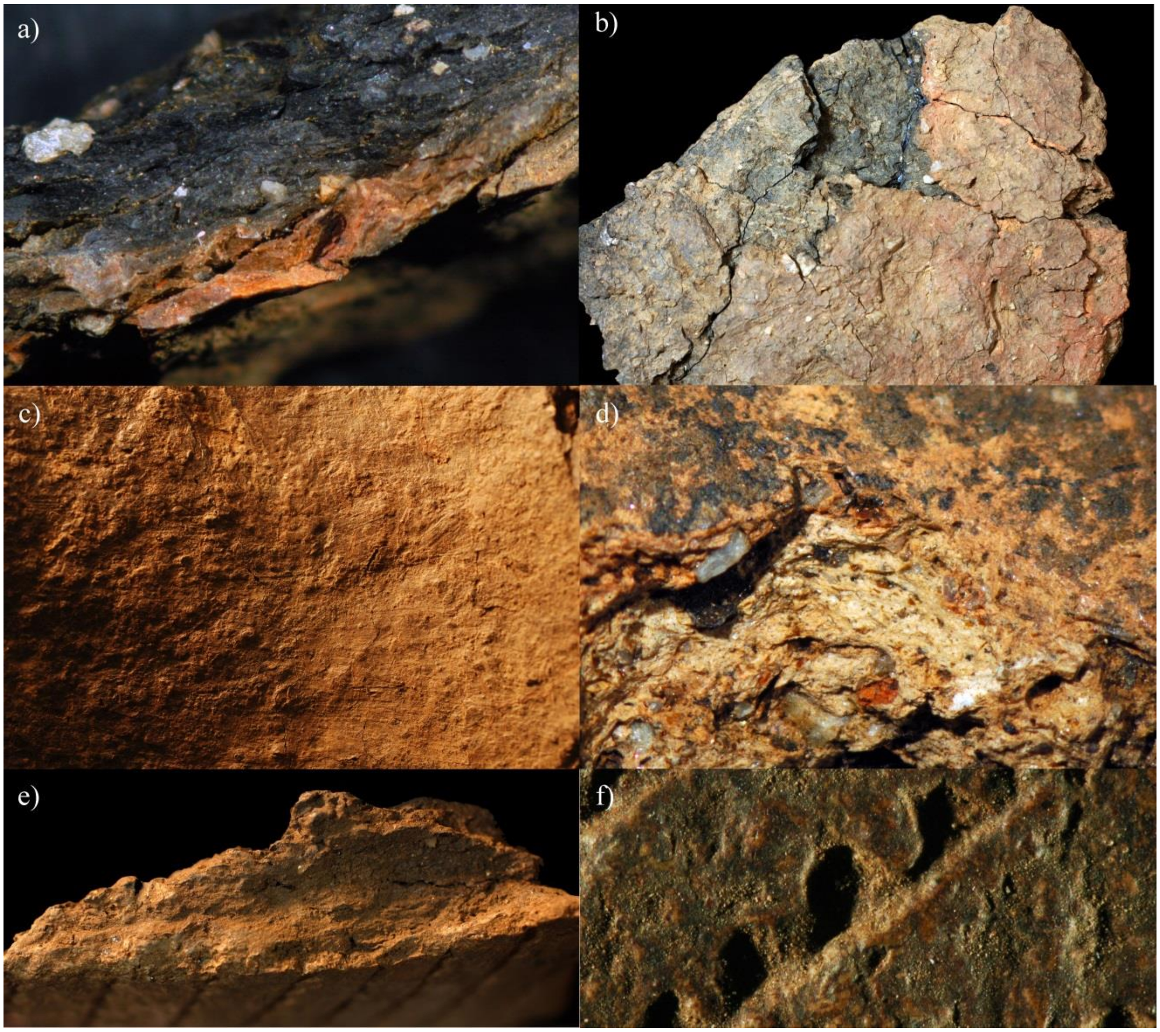

Figure 64: Attributes of Blended-Edge Dentate I: a) dark carbon core and medium to bright red exterior colouration; b) exfoliation as a result of intensive paddling and medium paste texture (10–30% temper); c) interior smoothing (finger or anvil); d) temper comprised of bluish-grey quartz, mica, and iron oxide particles and buff to pink coarse-particled clay; e) poorly developed to well-developed coil breaks; f) blended-element dentates with trapezoidally shaped elements.

Figure 65: An example of the Blended-Edge Dentate II tradition. Note the coarse paste texture and the variable paste colour as well as the oblique tool application, all in contrast to the earlier Blended Dentate I pottery.

Figure 66: Attributes of Bleded-Edge Dentate II: a) coarser temper; b) variable orientations of dentate impressions.

Figure 67: An example of the Cord-Marked Buff Tradition. Note the coarse and buff-coloured paste, the variable orientations of the decorations, and the S-twist cord.

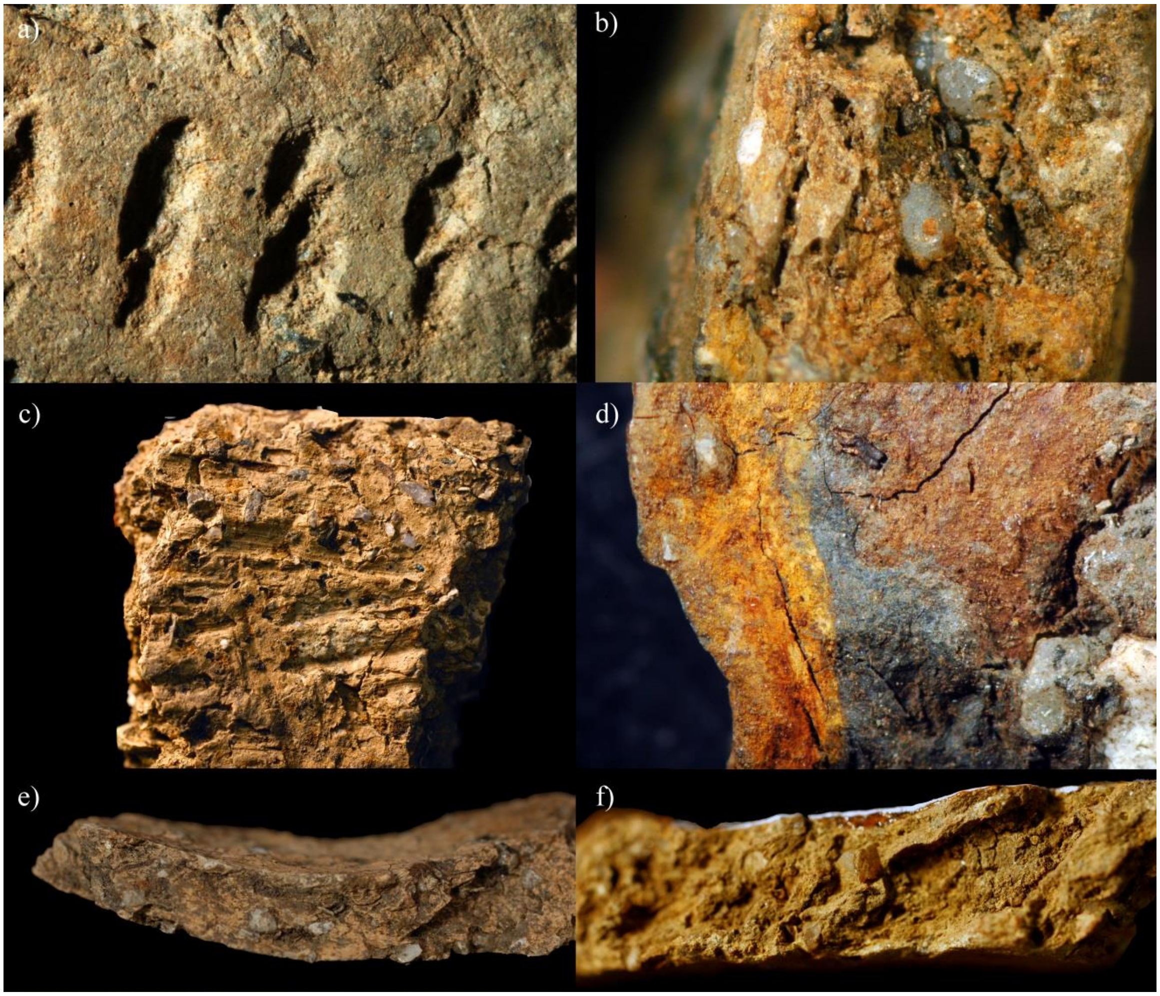

Figure 68: Attributes of Cord-Marked Buff: a) impressions tend to result from S-twist, loosely plied cord or (not shown) unplied cord; b) paste is medium to medium-coarse (20%–40% temper) with bluish-grey quartz, mica, and iron oxide particles; c) interior is typically aggressively channeled; d) colouration ranges from dark grey (carbon core) to bright orange with typical exterior surface colouration of buff-to-pink; e) coil breaks are well-developed; f) lamellae are typically oblique.

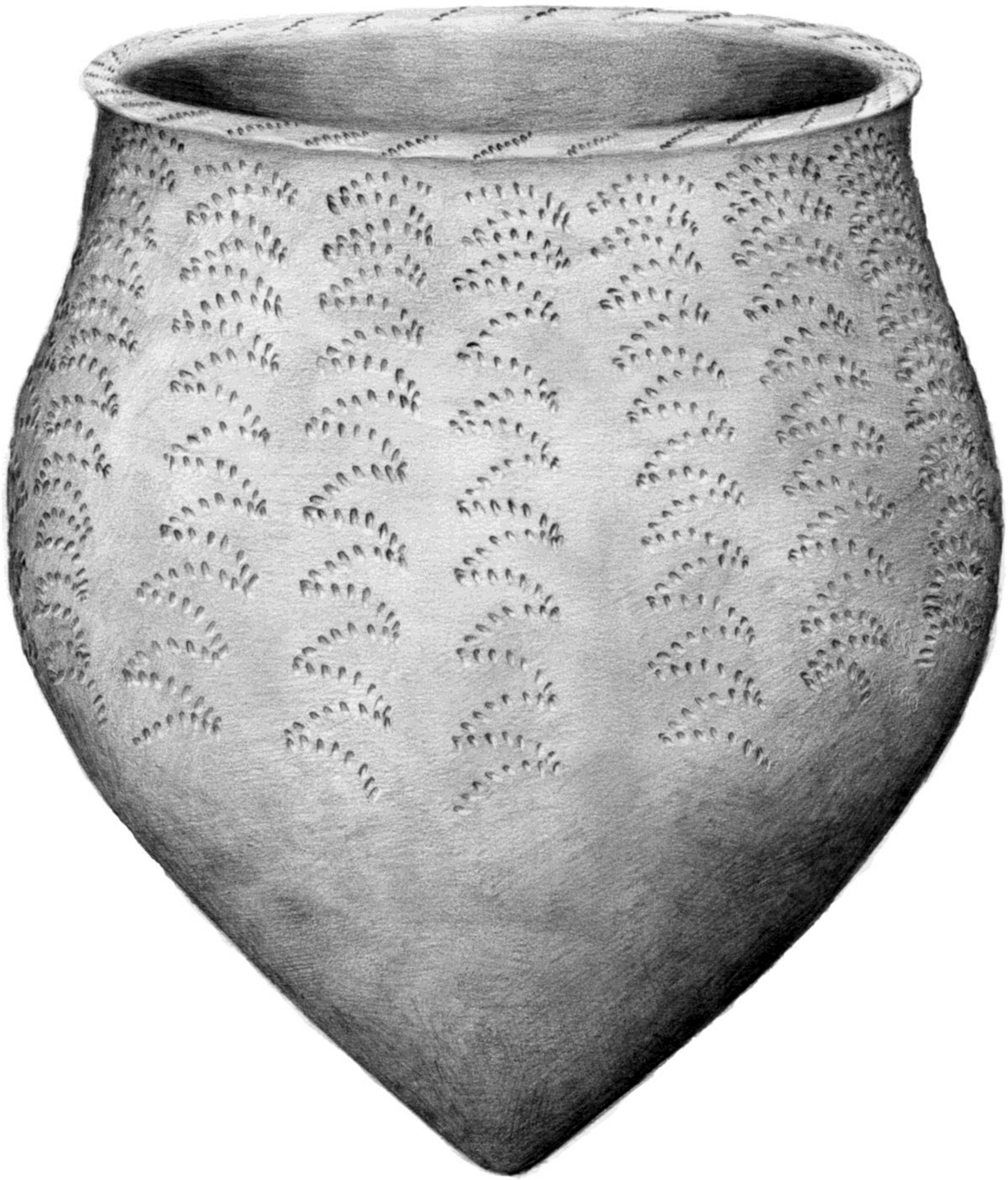

Figure 69: Rendering of what a Cord-Marked Buff pot (with a Cord Fan decoration) would have looked like before having been used and broken.

Figure 70: An example of the Cord-Marked Buff tradition with a Cord Fan decoration. Note the regular widths of the cord elements, the rocked-on curvilinear tool impressions creating vertical columns, and the even, reddish colouration of the body.

Figure 71: An example of the Red-Brown Cord-Marked Tradition. Note the evenly pink paste colour, the rocked-on, unplied cord decoration tool, and the lack of discernible temper particles.

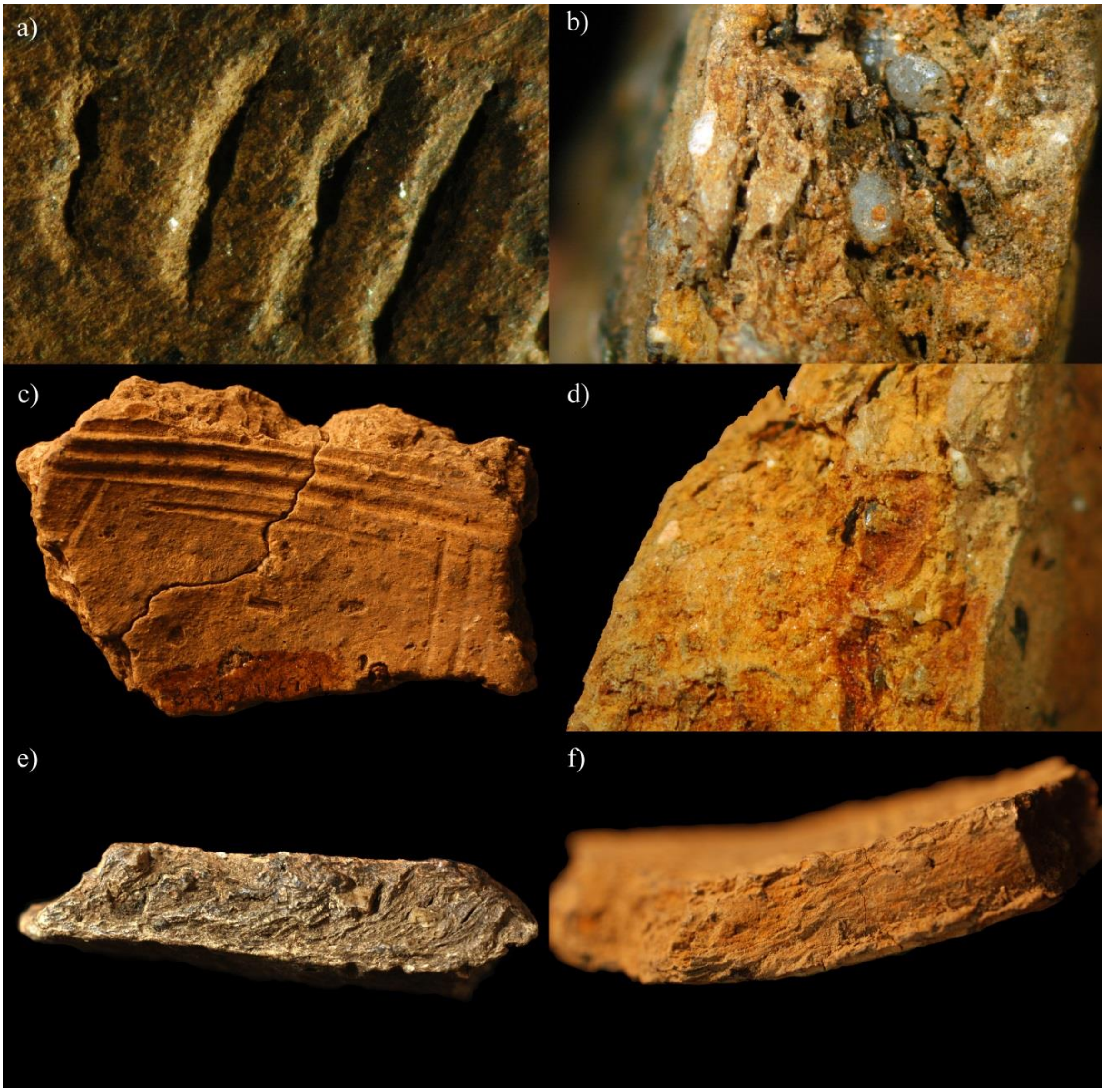

Figure 72: Attributes of Red-Brown Cord-Marked: a) unplied or loosely plied cord-marks that are frequently rocked on (Cord Fan decoration); b) many different combinations of bluish-grey quartz, mica, iron oxide, and organic particles, and temper percentages range from fine (0–10% temper) to coarse (40–50% temper); c) channeled-and-burnished interiors; d) clay is often finer-particled and iron oxide is often a significant constituent; e) lamellae are oblique or U-shaped; f) coil breaks tend to be well-developed.

Figure 73: An example of the Complex Cord Transitional Tradition. Note the Z-twist cord marks, the variable orientations of the decorations, the evenly pinkish red paste, and the small amount of discernible temper particles.

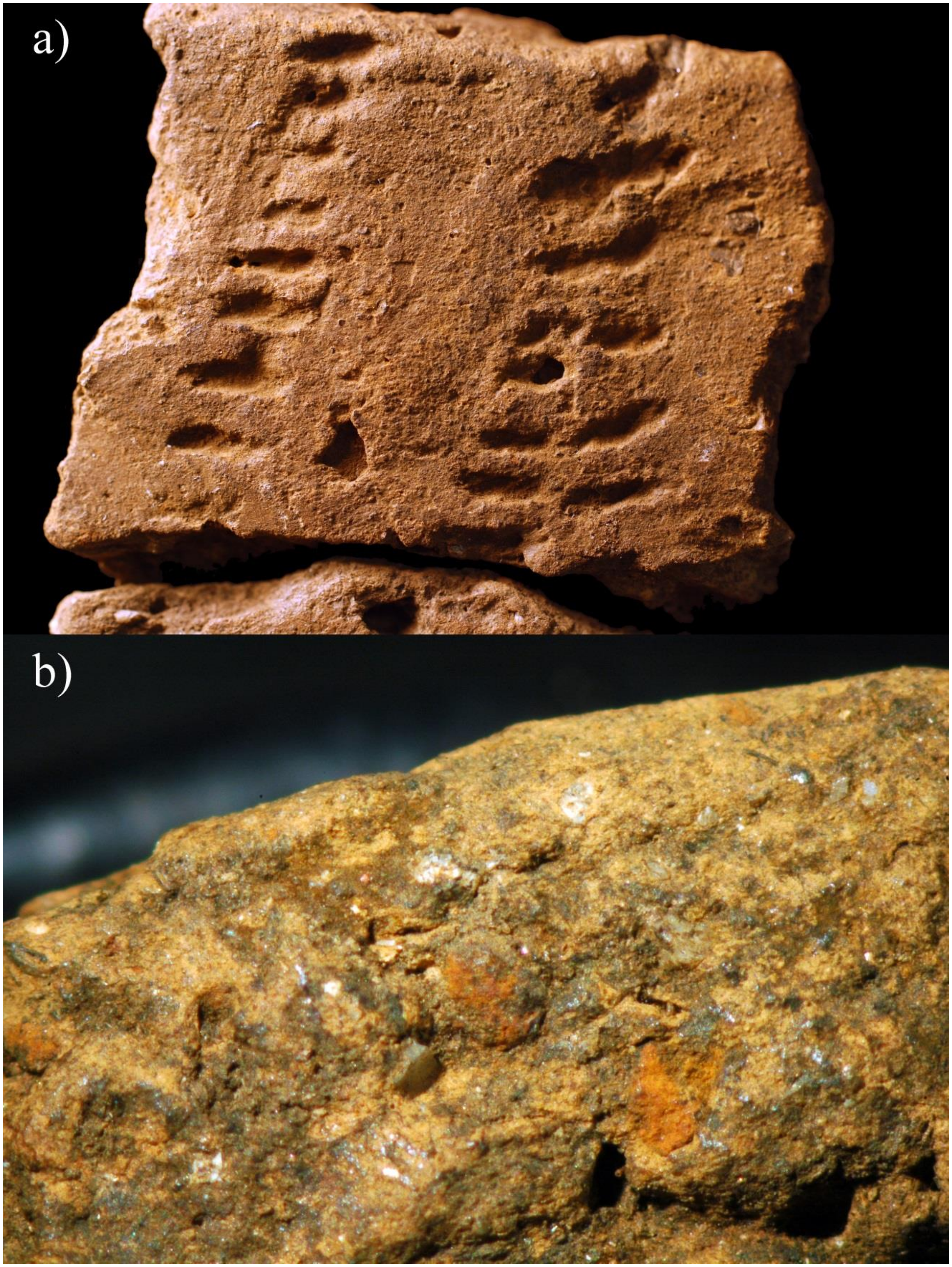

Figure 74: Attributes of Complex Cord Transitional: a) tightly plight Z-twist cord in highly variable orientations (no Cord Fan decoration); b) predominantly fine paste composed of bluish-grey quartz, mica, iron oxide, and organic particles and coarse-particle buff-to-pink clay.

Figure 75: A vessel lot from the later Late Woodland period (after 900 Cal BP). No tradition is proposed for this time period at the time of this research. Note the horizontal cord mark decorations, the moderately coarse paste, the brownish colouration, and the thickened rim.

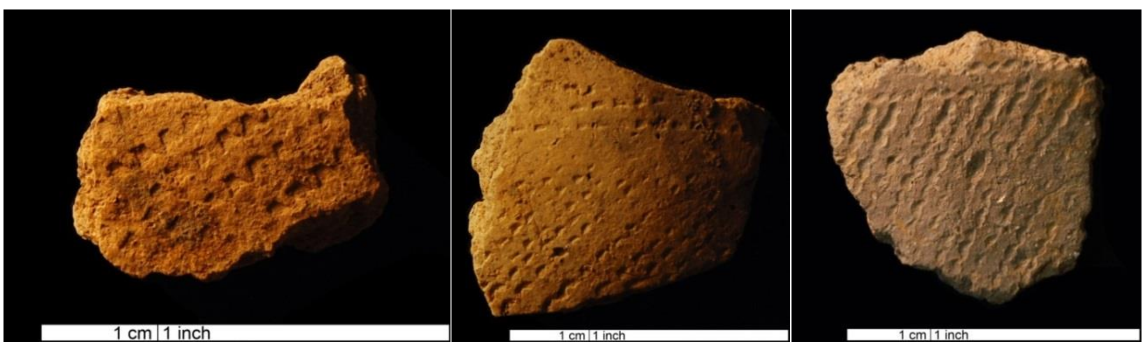

Figure 76: Three PSS/dentate-decorated sherds from the unit 971N/981E. Shown, from left to right, are BfDd-24:6756 of GLNS:70, BfDd-24:6757 of GLNS:156, and BfDd-24:5618 of GLNS:52. The leftmost and centre sherds have been classed as Trapezoidal Continuous-Element PSS while the furthest right has been classed as Precisely Impressed PSS. The centre sherd may represent a transitional decoration between these groups, exhibiting both discrete, squared elements and continuous, 'wavy lines.'

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GLOSSARY

Base The bottom-most portion of a vessel.

Biotite A sheet silicate belonging to the phyllosilicate family, specifically the mica group. Biotite is usually dark in colour and is often found in granites.

Body The region below the shoulder, at the point where the profile shape begins to contract, but above the base.

Calcination The process of burning shell before adding it to clay as shell temper.

Carbon Coring The darker layer of ceramic running parallel to the axis of the wall that results from volatiles in the clay body having been insufficiently burned out during firing. Carbon coring ranges from just slightly darker than the surrounding clay to dark sooty grey to black, and can occur in variable pockets, in a distinct, even layer within the wall, or through the entire thickness of the wall.

Castellation The region of the rim, occurring on some vessels, where the lip slants upward to a point, from which it slants down again.

Channeling The practice of texturing a clay surface with a corrugated texture by dragging a toothed or serrated-edge tool over the surface. The result is a series of parallel striations.

Ceramic Clay that has been treated with heat to the extent that it is no longer soluble in water. Usually, ceramic refers to the deliberate action of creating a shaped object out of clay and subsequently firing it to a fairly high temperature.

Ceramic Matrix The component of a ceramic that was clay before having being fired, and that has subsequently become indurated through the action of heat. This component is different from a purely clay material that has been fired because the molecular structure will have incorporated tempering material to some extent, depending on the amount and length of heat applied to the ceramic.

Chemically-Combined Water The hydrogen and oxygen atoms that are fixed within a crystal lattice, which combine when heat is applied above ca. 400°C and leave the structure in the form of steam.

Chlorite A group of the phyllosilicate family with a 2:1 interlayer structure similar to smectites, and with four endmembers defined by the amounts the elements Mg, Fe, Ni, and Mn. Chlorites often weather to smectites, and are frequently found as incidental minerals in clay deposits.

Clay A plastic, sedimentary material, composed of fine, plate-shaped particles called platelets, that hardens upon drying, and that becomes increasingly insoluble as increasing heat is applied. Clay is typically deposited in large lenses or beds by the action of water, and as such, is often found along river banks. It is also found well below ground and, in this case, needs more complicated mining techniques in order to extract it.

Clay Body The clay in a ceramic as well as all other components added to it in order to modify its properties.

Coil The structural building blocks of a ceramic vessel that has been built by means of the coil-building technique.

Coil Break A clean split apparent along the horizontal axis of some sherds that results from two coils having not become sufficiently connected during the coil-building process.

Coil-Building A technique for building ceramic vessels involving the forming of a coil by rolling the clay between the hands or between a hand and another surface, placing the coil along the top-most wall of the vessel, pinching the coil to the lower section of the wall with the thumb and index finger while rotating the vessel, and thinning the coil while shaping it upward at the same time.

Collar An attribute that occurs on some pre-contact vessels from New Brunswick, it is the portion of the rim that is thicker than the neck, and that occurs at the junction between the lip and the neck.

Compacting Tool A type of surface modification tool. Tools in this category have the common feature of compacting the clay as they modify its surface. Included in this group are simple, compound, and complex tools.

Complex Tool A surface modifying tool, belonging to the compacting group, that has elements that are repeating as a result of the process that created them, but that are each slightly different from the others; in other words, they form a pattern that stretches along a 'plane.' When impressed, element types can be observed to repeat, even though individual elements are non-repeating. An example of a complex tool surface modification is a fabric or net impression, in which elements are created by cord structured non-randomly by means of weaving, plaiting, or knot-tying.

Compound Tool A surface modifying tool, belonging to the compacting group, that has multiple elements all made in the same way, though each is slightly different from the others. When impressed or stamped repeatedly over an area, individual elements can be recognized as repeating. Compound tools are theoretically a shape-producing mechanism, but in practice on pre-contact ceramics in New Brunswick, they are 'line' tools, and generally straight. An example of a compound tool surface modification is a cord-wrapped edge or dentate impression, in which the elements are created by wrapping cord repeatedly around a stick or carving incisions repeatedly into a thin edge.

Conoidal A vessel shape that tapers to a pointed or semi-pointed base.

Dehydroxylation The state of clay after oxygen and hydrogen atoms, called chemically-combined water, have been driven out of a clay structure in the form of steam. This usually occurs above 900-1000°C. When dehydroxylation has occurred, the clay has been altered into ceramic, and is no longer soluble.

Detritus The material shed by an archaeological ceramic over time, which, during this research, was collected from the bag in which each sherd is kept. This material can be employed in chemical characterization techniques, especially destructive techniques that would not otherwise be possible.

Equilibrium The state in which a crystal structure registers no net change over time, having changed to the extent that it can change at a given temperature.

Excurvate A vessel wall shape with the vertical axis curving in the opposite direction from the horizontal axis.

Fabric 1) The ceramic body, including ceramic matrix and additives, after firing. 2) The woven fibre perishable used to impress ceramic surfaces, or the material stretched over a paddle that is used in the paddle-and-anvil technique.

Fabric Paddling The process of slapping or spanking the ceramic surface after the vessel has been coil-built. Fabric paddling straightens up the vessel shape and compacts the clay wall. It can be employed with one hand while the vessel is held in the other hand, or it can be used for the paddle-and-anvil technique, where either the hand or another surface is placed behind the wall to support it.

Fabric Impression A surface treatment used on ceramics from New Brunswick, especially during the Early Woodland period, where the wet surface of a ceramic vessel has been pressed with fabric, either by a fabric paddle or by cloth wrapped around the vessel.

Finishing Tool A type of surface modification tool. Tools in this category have the common feature of efficiently obscuring and smoothing out the texture that results from the coil-building or hammer-and-anvil process. Elements are less discernible in finished surface modifications because the intention is to smooth out texture, often as a preparation for further surface modification by compaction or subtraction. Included in this group are finger-smoothing, smoothing with a stone, scraping with a compound tool, slip-brushing, and wiping with a piece of leather or cloth.

Flux A component of a clay body that lowers the melting temperature of silica. Fluxes are often added by potters to cause a clay body to become indurated to a greater extent. The term is used in two ways in reference to archaeological ceramics. First, "flux" refers to a deliberately added substance such as iron oxide or lead sulphide; this deliberately added component is also referred to as a fluxing agent. Second, "flux" refers to any substance that is added by the potter or is incidental to the clay body or tempering agents that bring the melting temperature of silica down. The reason for this distinction is that many substances act as fluxes, but cannot be determined to have been deliberately employed by a potter as a fluxing agent. Below is a list of commonly used fluxes:

Alkalines	***Oxide***	***Alkaline Earths***	***Oxide***	***Other Fluxes***	***Oxide***

Sodium	Na_2O	Magnesium	MgO	Lead	Pb0
Lithium	Li_2O	Calcium	CaO	Zinc	ZnO
Potassium	K_2O	Strontium	SrO	Boron	B_2O_3
		Barium	BaO	Iron	FeO or Fe_2O_3

Green Strength The strength of dried clay before it is fired

Greenware Pottery that is fully manufactured but unfired.

Grit Temper A tempering agent composed of a crushed rock, typically granite.

Grog Temper A tempering agent composed of ground-up, already fired pottery.

Heat Work The sum effect of heat and time at various temperatures on a ceramic. Heat work is used as a measure of firing. For instance, a vessel that has been heated to 1200°C over a total period of four hours is considered to have received less heat work than a ceramic that has been heated to 1000° over a period of fifteen hours.

Hydroxylation The state of clay prior to the application of heat whereby the crystal lattice contains a certain amount of hydrogen and oxygen atoms, called chemically-combined water. These atoms can be driven off starting at temperatures above ca. 400°C.

Illite A species of clay with a chemical formula of $(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$ and a 1:1 structure (one octahedral layer and one tetrahedral layer) with moderately-sized platelets and a small amount of water absorption and shrinkage and moderate plasticity. Illite is usually available in secondary deposits, forming from the weathering of granites and muscovites. Illite clay is well-suited to pottery manufacture because of its low shrinkage rate, but can be made more plastic by adding smaller-grained clays such as montmorillonites.

Incurvate A vessel rim shape with the vertical axis curving in the same direction as the horizontal axis.

Indurate To make a substance hard by interlocking the crystal lattice through the application of some action, such as heat, pressure, or cementation.

Kaolinite A species of clay with the chemical structure $Al_2Si_2O_5(OH)_4$ and a 1:1 structure (one octahedral layer and one tetrahedral layer) with large-sized platelets (ca. 2 μm in diameter) and a small amount of water absorption and shrinkage and low plasticity. Kaolinite is not usually available in deposits at the surface, instead usually occurring in large deposits below ground that require sophisticated mining techniques to extract. Kaolinite weathers from feldspars, and in turn, often is weathered to illites; therefore, illite deposits will often be mixed with kaolinite. Kaolinite is difficult to use as a clay body in pottery manufacture because of its low plasticity, high silica content requiring a high firing temperature, high temperature at which dehydroxylation is complete, and low thermal shock resistance, but these characteristics can be mitigated by adding smaller-grained clays such as smectites or illites. Even though Kaolinite is a difficult clay to work with, it has been prized in many parts of the world, as it is in modern pottery manufacture, because of its white colour, its glass-like structure upon vitrification, and its unique translucency.

Lamellae Layers of ceramic matrix within the wall of a ceramic sherd, usually running roughly parallel to the axis of the wall, developed during the process of paddling the vessel after the vessel shape has been formed by means of coil-building.

Lip The uppermost portion of the vessel, and the surface between the interior and exterior surface.

Montmorillonite A species of clay, derived from smectite clay, with a chemical structure of $(Na,Ca)_{0.33}(Al,Mg)_2(Si_4O_{10})(OH)_2 \cdot nH_2O$ and a 2:1 structure (one octahedral layer sandwiched by two tetrahedral layers) that absorbs a high amount of water and typically is comprised of smaller-than-average platelets (ca. 1 μm in diameter). The high water absorption and small platelet size make montmorillonites unsuitable for pottery manufacture by themselves, but, when mixed with other, larger-platelet clays, they can add great strength because of their ability to pack closely into the crystal structure of larger clays. They also reduce shrinkage of other clays when mixed in certain proportions. Montmorillonites usually occur in primary deposits or in close proximity to other primary deposits.

Morphology *In chemical characterization of ceramics:* the extent of the state change of clay as heat or other action is applied. Morphology is used to infer the extent to which a ceramic has been sintered or vitrified. *In vessel shape:* the range of variation of ceramics, especially across time, used to infer stylistic or functional change through time variability across space.

Muscovite A sheet silicate belonging to the phyllosilicate family, specifically the mica group. Muscovite is usually light or golden in colour and is often found in granites.

Neck The region below the lip and above the shoulder.

Non-Plastic A property of material that often co-occurs with clay or is added to clay. Non-plastic materials are often desirable in working with clay because they create pockets of non-sliding material in a matrix of sliding, material, causing the clay body to become more stable. Non-plastic materials also decrease the amount of shrinkage that occurs when the clay body dries or is fired, reducing the risk of cracking.

Oblique Left Angled from the upper left-hand corner to the lower right-hand corner.

Oblique Right Angled from the upper right-hand corner to the lower left-hand corner.

Organic Temper A tempering agent composed of organic substances, such as paper, grass, or dung.

Orthoclase A feldspar commonly found in granites, with a high potassium content. Particles are usually blocky, exhibiting right angle cleavage planes. Orthoclase is often found in pre-contact ceramics as temper.

Oxidation A firing atmosphere in which oxygen is freely accessible to bond with particles in a ceramic. Oxidized ceramics frequently exhibit a reddish colour as a result of iron oxide formation.

Paddle-and-Anvil Technique A fabric-paddling technique where either the hand or another surface is placed behind the wall to support it while the exterior surface is paddled.

Parent Material The rock or sediment from which clay is weathered. A typical parent material is feldspar, which provides all the constituents necessary for the formation of clay crystals.

Paste The clay body prior and all its constituents prior to firing, or the material that was previously clay but has become indurated after firing.

Phlogopite A magnesium endmember of the mica group belonging to the phyllosilicate family, with a chemical formula of $KMg_3AlSi_3O_{10}(F,OH)_2$. Phlogopite is usually reddish, greenish, or yellowish in colour and is often found in granites.

Plagioclase A sodium of calcium feldspar with the chemical formula of $CaAl_2Si2O_8$ (anorthite) or $CaAl_2Si2O_8$ (albite), commonly found in granites. Particles are usually blocky, exhibiting oblique-angle cleavage planes and striations on one plane. Plagioclase is often found in pre-contact ceramics as temper.

Plastic A property of clay that allows it to be easily shaped.

Plasticity A measure of how plastic a clay body is. Tests for plasticity include bending a coil until cracks appear. Plasticity is increased with the addition of water, and of temper in particular amounts.

Platelet A clay particle, so-named for its flat, plate-like shape. It is this shape that allows water to create strong suction between the flat planes of platelets, thereby giving clay its unique plasticity when wet, and its strength when dry and fired.

Ply Plying is the action of twisting two spun threads together. Fibre can be plied in either a counter-clockwise (S-twist) or clockwise (Z-twist) direction; usually it is plied in the opposite direction from the initial spin direction in order to keep the spun thread from untwisting. However, some thread is plied in the same direction as it is spun, creating a rather different effect, and a less stable cord that will have a tendency to untwist if not kept taut.

Primary Clays A category of clays that have weathered and been deposited *in situ*, or next to the parent material. Kaolinites and chlorites are usually primary clays, because the relatively simple structure of kaolinites is easily modified during weathering and subsequent transport, resulting in a new clay species such as smectite. Primary clays usually have few impurities such as iron; as a result, they are often white or very light upon having been fired. Primary clays are also often composed of relatively large and poorly sorted grain sizes, imbuing them with relatively low plasticity and low water absorption. Primary clays usually occur at some depth below ground, making their location and extraction difficult without sophisticated mining techniques.

Ramp The rate of temperature increase during firing. A fast ramp would increase from 200°C to 500°C in under an hour, while a slow ramp would increase that interval in four or more hours.

Reduction A firing atmosphere in which oxygen is not available or is only partly available to bond with particles in a ceramic. Reduced ceramics can exhibit a range of colours as a result of the materials used to reduce the atmosphere, which are bonded with the particles in ceramics in place of oxygen. An example of a ceramic fired this way is the black pottery produced by Maria Martinez, who achieves her famous black slip-glaze ware by applying high-iron slip to the vessel surface and then smothering the firing with dung and other carbon-rich material.

Rim The region encompassing the lip and the neck, including both interior and exterior surfaces.

Scanning Electron Microscopy (SEM) A chemical characterization technique that uses an electron beam to collect semi-quantitative data about the molecular structure of a material, and also to produce high-magnification topographic images of that material.

Secondary Clays A category of clays that have been weathered and transported away from the parent material. Illites are common secondary clays because they usually have resulted from the alteration and transport of smectites. Secondary clays usually have many impurities as a result of weathering and transport over long distances, and iron is much more common in secondary clays than in primary clays, giving secondary clays a red, yellow, or brown appearance upon having been fired. Secondary clays are usually composed of relatively small and well-sorted grain sizes, imbuing them with high plasticity and moderate to high water absorption. Secondary clays are often available at or near the surface, especially along riverbeds, making their location and extraction relatively easy; usually, secondary clays are the clay types found in pre-industrial pottery, for this reason.

Shell Temper A tempering agent used during the Late Woodland ceramics, composed of crushed shell, possibly calcined prior to inclusion in a clay body.

Shoulder The bulbous shape below the neck, which occurs at the widest part of the vessel.

Simple Element Tool A surface modifying tool, belonging to the compacting group, that is single-element, and that is usually used to repeat a standard pattern. Essentially, they are 'point' tools; an example of a simple tool surface modification is a punctate.

Sintering The process whereby powder material becomes fused as the crystal structure interlocks, caused by the application of heat or pressure. This state change occurs because chemically-combined water is expelled from the crystal lattice and the resulting spaces are filled by neighbouring anions and cations. Complete sintering, or dehydroxylation, usually occurs by 900–1000°C.

Slip A clay body with enough water added to turn it into a liquid, which is subsequently applied to the wet surface of a vessel.

Smectite A species of clay with a chemical formula of $A_{0.3}D_{2-3}[T_4O_{10}]Z_2 \cdot nH_2O$ and a 2:1 structure (one octahedral layer sandwiched by two tetrahedral layers) that absorbs a high amount of water and typically is comprised of smaller-than-average platelets. The high water absorption and small platelet size make montmorillonites unsuitable for pottery manufacture by themselves, but, when mixed with other, larger-platelet clays, they can add great strength because of their ability to pack closely into the crystal structure of larger clays. They also reduce shrinkage of other clays when mixed in certain proportions.

Soak A time period during which a firing temperature is kept steady, usually at the peak temperature in a firing cycle.

Spin The action of twisting a bundle of fibre together to make it into cord. Fibre can be spun in either a clockwise (S-twist) or counter-clockwise (Z-twist) direction. Spinning gives fibre much greater strength than it would have without any twist, even though spun fibre has the tendency to untwist if it is not plied with at least one other cord.

S-Twist Cord twisted in a counter-clockwise direction, resulting in threads aligning in a left oblique angle (from the upper left-hand corner to the lower right-hand corner) if the taut cord is looked at from above.

Stable Isotope Analysis (SIA) A chemical characterization technique that vaporizes organic material in a plasma in order to analyze the ratio of nitrogen (^{15}N) and carbon (^{13}C) isotopes. These ratios indicate trophic level and marine/terrestrial signature of the organism(s) being sampled, and, when plotted on a horizontal and vertical axis, can be assigned to groups or organisms known to produce particular levels of ^{13}C and ^{15}N.

Subtracting Tools A type of surface modification tool. Tools in this category have the common feature of subtracting clay from the surface they modify. Tools included in this category are any object dragged over the wet or dry surface, or carved into the fired surface.

Surface Decoration The modification of a vessel's surface, before or after firing, with the intention of creating an ornamentation that functions aesthetically, regardless of the other functions (technological or otherwise) it may also serve. Practically speaking, in the case of New Brunswick pre-contact ceramics, surface decoration is distinguished from other surface modifications when it has been organized into zoned, or discrete, regions of the vessel.

Surface Modification The modification of a vessel's surface before or after firing. The term implies no intention on the part of the potter.

Surface Treatment The modification of a vessel's surface, before or after firing, with the intention of creating an all-over pattern, and whose aesthetic function is not necessarily a primary function of that modification. Practically speaking, in the case of New Brunswick pre-contact ceramics, surface treatment is distinguished from surface decoration in that it is not zoned, or organized into discrete regions of the vessel, but rather covers the entire surface or the majority of it. The effect is less visually striking than in the case of surface decoration, and most likely was intended by the potter to function in a different way than ornamentally, even though its tactile function may be significant.

Temper Strictly speaking, temper is any addition to clay that modifies its properties, and therefore includes water as well as other components (Rice 1987). More practically, temper is a non-plastic additive to a clay body that acts to open up the structure of the clay. This serves a number of purposes. First, temper causes a decrease in shrinkage of the clay body both during drying and during firing. Second, as a result of decreased shrinking, temper partially protects the clay body from cracking during firing. Third, temper increases thermal shock resistance after having been fired. Fourth, temper causes clay to become more workable in certain ratios to the clay body, depending on the clay type and the temper type. Typical temper types are grog, sand, crushed rock such as granite, grass, shell, dung, and paper.

Thermoluminescence (TL) Dating A technique of dating materials by measuring the time since a mineral, usually quartz or feldspar, was last exposed to a "clock-resetting" event. In classic TL, the clock-resetting event is heating to a temperature of about 500°C. The measuring of time works by analyzing the radiation absorbed by a crystal lattice at the time of the clock-resetting event, such as firing. This radiation is measured by exposing the sample to gamma radiation, which causes the crystal lattice to release stored energy in the form of light (called "thermoluminescence"). The amount of emitted light is plotted against temperature applied to give the time since the clock-resetting event.

Thin-Sectioning A geological method of analyzing soil samples or rocks by means of cutting a hard or artificially-hardened material with a diamond saw into thin slices, mounting the slices on glass or epoxy, and polishing the surface. This enables the examination of the material contained in the slice by SEM, backscatter, and other high-powered magnification techniques.

Titanite A calcium titanium nesosilicate mineral whose crystal shape is characteristically wedge-shaped and whose chemical formula is $CaTiSiO_5$.

Total Digest (TD) Also called LA-ICP-ES (laser ablation inductively-coupled plasma emission spectrometry) a process whereby a sample of material is dissolved in nitric and hydrofluoric acid. The resulting solution is analyzed using an emitted light detector. Total Digest is able to detect 24 elements (not including silica) to an accuracy of approximately 5 parts per million.

Twist The action of twisting fibre, either counter-clockwise (S-twist) or clockwise (Z-twist). Twist always refers to the final direction that is discernible, whether this is the spin direction or the ply direction.

Vitrification The state change that occurs when the silica content in clay melts into an microcrystalline, glassy material, bonding the molecular structure extremely. Typically, this occurs at temperatures upwards of 1100°C, but the process can begin at lower temperatures if strong fluxes are present.

X-Ray Diffraction (XRD) A chemical characterization technique that projects X-rays at a material and registers the angle at which X-rays are diffracted, indicating atomic structure.

Yield Point The point at which a coil of clay will develop cracks when it is progressively bent in one direction. It is used as a measure of a clay body's plasticity.

Yield Value A measure of workability that ascertains the yield point for a given clay body, particularly one with a given amount and type of temper. Shell temper provides clay with a higher yield value than grit.

Z-Twist Cord twisted in a clockwise direction, resulting in threads aligning in a right oblique angle (from the upper right-hand corner to the lower left-hand corner) if the taut cord is looked at from above.

APPENDIX 1: ATTRIBUTES

In this appendix I discuss my use of attribute analysis to build categories. The explanation for methods is best understood alongside the database used in analysis. This database can be accessed by contacting the author or the archaeological division of the Nova Scotia Museum of Natural History. The database is treated in Appendix 4.

A large number of sherd attributes were recorded in the analysis, but some attributes constituted the basis of the research while others were recorded if they were easily apprehensible or were part of a vessel lot of particular interest, but otherwise were left unrecorded. Attributes fall into seven main categories: 1) provenance and site data; 2) numeric (physical) measurements; 3) surface modifications (decorations, treatment, and finishing); 4) temper and paste attributes; 5) morphology and vessel lot attributes; 6) use-wear attributes; and 7) archaeometric data. Some attributes were recorded exhaustively (*exhaustive* attributes), such that any sherds included in any sample had these attributes recorded. Other attributes were recorded on only one sherd in a vessel lot (*representative* attributes) as a means of cutting down the time spent on analysis. This decision was made while acknowledging that more robust data for vessel lots could have been achieved had each sherd received the same scrutiny, but that developing a large sample size took priority in the pursuit of understanding the assemblage. Finally, a number of attributes were recorded on only a few sherds (*selective* attributes) with the hope that they would constitute a smaller sample that could provide insight into some specialized areas of research—such as surface cracking or finishing techniques—but that were peripheral to the main goals as outlined in Chapters 1 and 2.

Attribute recording focussed on paste recipes, forming and firing practices, temporal significance, thicknesses, and decorative techniques. Paste recipes were only somewhat apprehensible because the analysis was limited to using a low-powered microscope to examine broken wall edges. A significantly clearer picture of temper types and minerals would have been possible using petrography, but for the following reasons, this was not possible. First, time did not allow the examination of thin-sections in the numbers that would have been required to provide comparative data across the vessel lots. Second, sherd destruction was not optional. Permission was given by the Nova Scotia Museum for destructive analysis of detritus particles from sherds, but these were generally not large enough for a thin-section to be made from them. Third, significant gains in understanding the assemblage by petrographic analysis was by no means guaranteed; the returns did not seem worth the investment of time, labour, and money at the time this research was conducted. Further compositional and petrographic research is planned in the future to build on the research detailed in this dissertation.

Attributes were recorded as nominal, ordinal, numeric (both ratio and interval), and descriptions. The range of attributes was meant to provide ample material for numerous analytical approaches. Mostly, the attributes are qualitative or semi-quantitative, despite efforts to include as much quantitative data as possible. Although several attributes are numeric measurements, they are not necessarily quantitative; this distinction only applies where attributes can be used in quantitative approaches such as correlations and regression models. In archaeology, this kind of data is not as accessible as in other fields because of a number of factors including low variability in numeric measured attributes, imprecision of measurements, and small sample sizes. It also bears consideration whether the quantitative data archaeologists *can* access is as meaningful as would be ideal in statistical analyses. For these reasons, the attributes chosen in this research are, for the most part, qualitative or semi-quantitative. However, transformation of the data during research allowed for strong statistical analysis on categories such as Chi-square tests and T tests on means. Other uses for the attributes included plotting distributions in bar graphs and in spatial representations (maps). Descriptions were included wherever possible as a means of clarifying details that seemed important during recording, especially in order to clarify observations for future researchers who may not understand how seemingly contradictory attribute states might have been recorded together.

Some attributes were chosen because they led to a well-developed method for understanding some part of ceramic manufacture and use. For instance, neck thickness was measured wherever possible because it can serve as a good indication of overall thickness of vessels, thus providing one measure of morphology and capacity. Other attributes were chosen because, though their significance was not well understood at the beginning of the research, I felt they were important and that their significance would become apparent during the course of attribute recording. One example was wall lamellar direction and size, which I knew were related to the actions of building and paddling vessels, but I did not know specifically how. Some attributes were added as recording progressed and their importance gradually became apparent for some reason. Late in the research, coil break shapes or profiles became important as a means of further distinguishing vessel lots and categories of vessel lots. Finally, some attributes that originally seemed significant were abandoned. Carbon core was one such attribute, originally intended to give insight about firing practices, but eventually observed to be often associated with carbonized food on the interior surfaces.

TEMPER

Research on temper usually occurs along any of five dimensions: 1) minerals present; 2) particle size (mesh); 3) particle shape (angularity); 4) temper percent (paste texture); and 5) homogeneity or heterogeneity of the minerals. These dimensions indicate from where (generally) temper was procured, what kind of actions were involved in temper procurement, for what uses the vessel was intended, and how vessels differed from each other. I reconfigured these five dimensions into a measure of heterogeneity across the assemblage, which can help in understanding where the pottery came from and how it accrued at the site. In this research, only limited investigation was possible, but some measures of colour, minerals, shapes, and sizes were taken such that heterogeneity and homogeneity could be assessed.

Mineral Types

Minerals indicate the basic rock types being used as temper. In the Maine–Maritimes Region, grit temper is by far the most common temper type, and granite minerals are by far the most common rock type used in grit temper (e.g., Allen 1981; Foulkes 1981; Deal 1986;

Wills 2012). Granite is composed of three main minerals: quartz, feldspar, and mica. This distinctive mix is discernible from black or gold mica sheets embedded in the interior and exterior surfaces, angular particles of white or clear quartz that show up mostly in broken wall cross-sections, and off-white or pink feldspar particles that often have exposed planes of cleavage with some iridescence, also usually discernible in broken wall edges. Researchers (e.g., Deal 1986; Nash and Stewart 1990, 1991; Petersen and Sanger 1991) have generally agreed that granite was crushed into a particulate and added to the paste in amounts between 10% and 50% of the overall fabric. Although exceptions exist, grit temper (as opposed to sand, which is not crushed) has usually been synonymous with crushed granite in the Maine–Maritimes region.

Although grit temper often cannot be sourced to a physical location, one example of grit will usually have enough distinctive attributes that it can be distinguished from or lumped in with another example, so that *ad hoc*, abstract sources can be assigned. These abstract temper sources help in answering questions of locally manufactured versus imported pottery.

Minerals can be investigated at various levels of precision. At a coarse level, grit, organic, and shell temper can usually be identified without magnification. With magnification, mineral types can often be identified in the broken cross-section of walls, such as individual feldspar particles, calcareous granules, or grog particles. Thin-sectioned ceramic pieces give more precise mineralogical information, such as whether feldspar particles are calcium-, sodium-, or potassium-rich, and whether minerals are high- or low-temperature phase minerals. Additionally, minerals with distinctive decay patterns or inclusions can be recognized, and possibly assigned to a group (Owen et al. 2014). SEM can be used on thin-sectioned or loose particles to analyze coarse-resolution elemental composition (usually on the scale of parts per 10,000) and to see mineral microstructure, the latter of which can be useful in analyzing the species of shell particles. For high-resolution elemental composition (parts per million or billion), neutron activation analysis (NAA) or LA-ICP-MS is required; fingerprinting temper sources requires this level of precision. Temper was investigated using SEM and LA-ICP-MS both to confirm mineral assemblages (granite) and to assess degree of compositional homogeneity. The former was not a key component of the research, and so the sample size is small (n=25). The latter was used in a preliminary study and included six samples.

Particle Size

Temper particles can range in size from invisible (even with magnification) to equal in diameter to the thickness of the vessel wall. Particle size is a function of both the processing mechanism and the sorting mechanism (if any).

All temper requires that some action, whether human or otherwise, break down the material to be used. In the case of grit and grog temper, that action is usually a combination of weathering to decompose the structure (ancient potters probably looked for "rotten" granite or encouraged granite breakdown by placing cobbles in fires), and then grinding using harder stones. In the case of shell, the breaking-down action may be burning—or calcining—the whole shells prior to grinding them up. In the case of sand, rock material is broken down entirely through erosion caused by wind, water, ice, or biological forces; no human action is required, although additional sorting may be accomplished by winnowing or sieving. Each kind of processing leaves distinctive traces.

The variance of particle sizes within a paste is also significant. If large variance exists, such that some particles are over 3mm in diameter, while others are smaller than 1mm, and still others are less than 0.1mm, the particulate can be considered poorly sorted and "young," probably indicating that it was processed by the potter and not by geological processes. When particles exhibit low variance, either consistently very fine or somewhat coarse, the particulate can be considered well sorted. Sorting can occur through human action such as sieving, but especially if particles exhibit rounding, Aeolian or hydrological mechanisms should be considered, meaning that no human processing occurred. Sand is the usual temper type gathered this way, but weathered granite can also be found in this state, so careful examination of the individual particles for signs of weathering are important in distinguishing gathered from processed particles.

Colour

Minerals can often be identified by their colour, or at least distinguished one from another this way. Granite is generally speckled in appearance owing to its tri-mineral composition, and ranges in colour from black and white to black, white, and pink, to black, white, and red-brown. The variation of the feldspar colour (white to pink to red and brown) is often a good way to tell vessels apart. Quartz can also range in colour because of impurities like iron and titanium, causing a range of colours from pink to brown to grey and blue, and can also range in transparency. Mica is usually black or gold or a mixture.

One way of distinguishing grit from other temper types is the uniformity of the particle colours. When sand is used as temper, typically the particles exhibit a range of colours instead of categories of colours. Shell temper generally appears white where particles are still present and visible. Grog is usually reddish. Iron oxide is bright red-orange or rich red-brown.

Particle Shape

The degree of rounding is an important indicator of how the temper was procured and processed. Rounded edges on rocks and minerals generally indicate a lengthy history of transport, and therefore, sand is inferred. However, in the case of grog, rounding can occur for other reasons, namely, that grog (in this region, at any rate) is comparatively very soft and tends to crumble in a pre-rounded shape that gets more rounded through working into the clay. When particles are angular, it can be inferred that they were crushed by the potter. Granite crystals often exhibit both rounded and angular particles, so the identification of crushed granite requires careful comparison with experimentally crushed granite. Shells are usually angular after having been crushed, and so even if the individual particles have leached out, they can be identified by the angular pore spaces left behind. This is in contrast to plant fibres used as temper, which often leave more rounded pore spaces after being burnt out.

Homogeneity/Heterogeneity

In assessing degree of heterogeneity of minerals in ceramics and the behaviour that can be inferred, the first question is how much heterogeneity can be observed in a given space (say, one broken wall edge), and the second question is whether the heterogeneity is caused by adding different kinds of temper or a single, heterogeneous source of temper. In the case of granite, heterogeneity exists because three minerals are typically present in granite rocks, but the source is singular. However, granite particles frequently co-occur with grog or iron oxide particles, so that two different temper sources are represented. In the case of sand, high heterogeneity is likely to be in evidence, but after assessing the particles for rounding and sorting, it may be determined that only one source is in evidence. There have also been cases recorded of shell- and grit-tempered ceramics. The addition of two or more sources of temper is noteworthy, particularly if it occurs with some regularity because, theoretically, only one is needed to accomplish the job of increasing thermal shock resistance. Heterogeneity can thus be assessed in terms of how many sources of temper were used, how many minerals were used, and how much variability exists within particles of a single temper source or mineral type. This allows an assessment of behaviour during the making of a single pot. Heterogeneity can also subsequently be assessed in terms of how many different minerals were used across an assemblage, how many different sources, and whether particle heterogeneity differs across vessel lots. This allows an assessment of differential or changing behaviour in temper procurement and processing.

CLAY

Theoretically, clay used in archaeological ceramics from this region could be traced to existing sources if researchers were willing to do the analysis using any of a number of characterization techniques. Typically, this is not done, however, because clay is not easy to differentiate in archaeological ceramics, and other indications seem to point to the movement of ceramics across the Maine–Maritimes landscape, making provenance studies untenable or else long term. Such a study would be well worth the investment, however, in the case of sites with large ceramic assemblages that exhibit homogeneity of clay sources and that evince long-term occupation and/or year-round occupation. In these situations, clay in archaeological ceramics could be matched with existing clay sources, which could in turn provide information about how intensively a source was accessed, through which temporal spans it was accessed, and whether it was the only source accessed.

In this research, I restricted clay analysis to noting colour and fracture patterns where these were evident in the sherds. This restriction was intentional as I assessed the assemblage for the likelihood of *in situ* manufacture. One obscuring factor is that ceramics, as a rule, are subjected to frequent carbonizing events (fires) which leave soot and dark stains on both the interior and exterior surfaces of pots. Later, when ceramics are deposited in the archaeological record, they are again subjected to staining from soil and organic decomposition. The result is that the original colour of the clay as it would have looked directly after firing is difficult to apprehend, but fresh breaks on wall edges will sometimes reveal a patch of bright red or creamy buff. Within an assemblage, an idea of original colour can often accrue from these fleeting glimpses matched up with how the sherds look where they have not been exposed. In this way, a sharp-eyed ceramic analyst can come to distinguish rich and meaningful colour variations where others may perceive only an unbroken sea of medium brown sherds.

The "eyeballing" method of assessing clay sources is fraught with difficulties, however, and any attributes recorded in this manner are not trustworthy. Assemblage-wide impressions are probably the most that can be hoped for. Yet the practice of trying to record clay attributes is not futile, as it can inspire insights and hypotheses about manufacturing practices that can later comprise the basis for more in-depth research projects. An attempt at sourcing clay using high-powered characterization techniques should never be undertaken until the researcher has gained some concept of the variability and character of the clay in an archaeological assemblage.

In this research, an attempt was made to differentiate different colours of clay without necessarily identifying the reasons for those differences. In other words, I looked at possible classes of colours and tried to sort out after I had classed sherds by colour whether the classes were significant of simply variations of one colour. The insights gained from this method are tenuous but important in the overall assessment of the manufacturing context of the assemblage. Only a small number of sherds were subjected to SEM analysis to compare compositionally with each other and with ceramics from other sites. The results are reported in Chapters 3 and 4.

FORMING

Pottery in the Maine–Maritimes Region is generally assumed to have been coil-built and paddled using an anvil technique. This technique involves first building a container shape up by stacking coils and smoothing them one into the next, and then paddling them with a broad, flat or slightly concave paddle and bracing the other side with an anvil (a stone or a hand). Another possibility is that flattened clay was pressed into a textile mould. There is no reported evidence of rotative action (fast or slow) (Roux and Courty 1998), although further experimental work may reveal slow rotative action, possibly from a rotating plate or base.

The coiling technique is evident where sherds exhibit coil breaks, often occurring as relatively less jagged broken wall edges with concave, convex, or oblique profiles. Paddling is evident when broken wall edges exhibit lamellae, or layers, often (but not always) parallel to the wall axis. The paddle-and-anvil technique is also evident when the interior surface has not received extra smoothing or finishing, and anvil marks—small articulating facets—cover the surface and clay appears smoothed without any striations from a finger or a brush.

Although the coiling technique and the paddle-and-anvil technique may seem straightforward, Gosselain (1992, 2001) and others (e.g., Roux and Courty 1998) have demonstrated that a myriad of variations exist in how potters perform these techniques. Variations in the potter's position include standing, sitting on the ground, sitting at a table, or kneeling while coiling. Variations in rotational technique include rotating pots with one hand while shaping with the other, using feet to rotate the pot while shaping with hands, rotating with two hands and pausing to shape the pot, or moving around the pot and shaping with hands. Variations in anvil technique include paddling the pot with no support, paddling while supporting with a smooth rock or a hand, or paddling while supporting the other side of the pot with the legs of a concave form. Variations in the paddling include paddling up to four separate times, paddling with up to four different kinds of paddles, using smooth paddles, using carved paddles, and using fabric- or cord-wrapped paddles. Re-creative efforts at understanding the range of forming variability in the Maine–Maritimes Region have only just begun (e.g., Stapelfeldt 2009).

In order to understand forming techniques, I recorded lamellar character, size, and direction, coil sizes (where possible), the presence of coil breaks and their profile shapes, and the presence of scoring marks on coil surfaces. Although relatively little is known about the possible variability in this region, changes in forming practices should be apprehensible by changes in these attributes, even if the respective techniques are unknown. Future re-creative work may be able to shed light on the techniques that create the attribute states observed in the archaeological record, such as the study by Roux and Courty (1998) that found distinguishing traces of different combinations of coiling and rotational action.

MORPHOLOGY

One of the more challenging attributes to record in the Maine–Maritimes Region is morphology, owing to the incompleteness of the vast majority of ceramic vessels. Ceramics are usually encountered as tens or hundreds of sherds no larger than 5 cm at maximum length. It is therefore difficult to piece together (conceptually or physically) the evidence for profile shapes.

The draw to physically reconstruct vessels is powerful. This is partly because morphology is such an intriguing part of ceramic analysis, but also because holding and seeing a reconstructed pot is so much more satisfying than a box or tray holding a number of sherds. This is particularly true in the case of museums catering to laypeople and the public at large who may have little understanding of how to conceptualize a whole vessel from a few sherds. Nevertheless, physically reconstructing vessels has a number of drawbacks. First, if refits are possible, then it is most likely that they represent fresh breaks, meaning that they probably can reveal a great deal of information about paste, temper, lamellar character, and so on, of the vessel. All this becomes inaccessible if permanently refitted. Second, the archaeological ceramic pieces are likely to be more delicate than the glue holding them together, so they are in greater danger of breakage when glued into a three-dimensional shape. (I have seen this happen in a number of collections so far.) Third is the problem that measuring and examination generally becomes harder on reconstructed pots than on sherds. Thickness of some regions, like the body and base, becomes inaccessible with calipers depending on the size of the reconstructed vessel. Most spreading caliper sets will not reach past a ca. 10 cm depth. Additionally, placing the pot under a microscope or in an SEM machine is not an option. Fourth, storage options increase in difficulty depending on the size of the reconstruction. Fifth, morphological studies in this region have so far found that vessels consistently followed the conoidal jar template, with variations occurring in the rim rather than the body and base. Rim forms are easily studied without any need to glue them together. Thus, unless an in-depth comparative analysis of the morphological attributes of a vessel are the subject of study (e.g., Stapelfeldt 2010), there is little research or educational reason to reconstruct a vessel.

Given these drawbacks, it seems that physical reconstruction ought to be discouraged except in cases where a ceramic has received extensive analysis, is representative of a large assemblage in which other vessel lots can give similar data, and would bestow measurable benefits on an institution such as a museum. This seems particularly self-evident given the fact that morphology can be conceptually reconstructed through technical drawings and computer 3-D scans, and the likelihood that present analysis will not address the needs of future researchers, who may need access to attributes made inaccessible through physical reconstruction.

In the present research, no physical reconstructions were undertaken, although a number of vessels had been partially reconstructed during the initial cataloguing and sorting phase by Cultural Resource Management Group Ltd. I did not anticipate that morphology would constitute a major component in the research because of the stability of the conoidal form through time, but I recorded basic attributes of each region of the vessel (lip, collar, neck, shoulder, body, and base, with an extra category for region unknown), including shape, thickness, and whether decoration was present on either surface. Profile shape and vessel capacity were not calculated for most vessels unless sufficient data existed and there was something extraordinary about the vessel. This decision was made based on previous experience with fragmentary collections from New Brunswick, in which sufficient data generally did not exist for most vessel lots; additionally, previous experience has indicated that variability in rim profiles seems to occur at the level of the individual potter rather than of the time period, style, tradition, or learning lineage. Thus, only coarse attributes were recorded for correlation purposes but not for close comparison among vessel lots.

For every thickness measured, up to five measurements were taken in one region of the vessel and averaged. An effort was made to take measurements greater than 1 cm away from each other, and to try to capture the range of thicknesses within the sherd. If three thicknesses were taken that resulted in the same number, only the first two were used, in order not to over-represent a measurement in standard deviation calculations.

Neck Thickness

One morphological attribute that was recorded for each vessel lot (where possible), and made up a significant part of the comparative strategy, was neck thickness. The attribute has the benefit of being both meaningful and quantitative, one of the few such attributes possible in ceramic analysis in the Northeast. It is an important measurement for two reasons. First is that neck thickness is usually at least somewhat indicative of both overall thickness and vessel capacity. The second reason is that neck thickness probably represents a focus for the potter's skill and expression by being the most visible part of the pot and also by requiring the most skill to maintain during manufacture without inducing cracking. Because of technological constraints on the potter owing to the size of the vessel and its ability to support the neck walls during construction (van der Leeuw 1991, 1993), neck thickness is considered here as a good measure of the skill and intentionality of the potter. If vessel walls are unusually thin, it may be inferred that the potter worked to achieve such a thin wall, because thicker walls are easier to achieve and require less time and effort. Neck walls are easy to evaluate by both knowledgeable buyers and colleagues and unknowledgeable onlookers, such that the reputation of potters may be constructed partly by the thickness of their vessels' necks. Similarly, thicker necks may construct the reputation of a potter as efficient or maybe as an understudy to a more experienced potter.

Standard deviations of thicknesses (within vessel regions and across whole vessel lots) are also important attributes because they give a measure of how consistently a thickness was maintained.

SURFACE MODIFICATIONS

The method of identifying surface decorations by their shapes (i.e., PSS, dentate, and cord-wrapped stick) has promoted a non-technological perspective on ceramics from eastern North America and the Northeast. Yet there is evidence that surface modifications—decorations, treatments, and finishing—do have technological import (Schiffer et al. 1994). Additionally, the choice to decorate, treat, or finish a surface has implications for amount of time, effort, and skill required to make a ceramic vessel. In order to understand why different kinds of surface modifications were used, it is preferable to classify them by the kind of effect they have on the ceramic or on the process of ceramic manufacture. The difference between a dentate tool impression and a series of cord impressions is not striking visually, but the differences to the potter are significant. The dentate tool must be applied painstakingly in individual movements, while a cord-wrapped dowel can be rolled or rouletted across the surface of a pot making decoration much less time-consuming (Leonard 1996).

For purposes of analyzing technological function of surface modifications on Woodland ceramics, I divide surface marks into compacting, subtracting, and finishing techniques (Woolsey 2010). Each has a different effect on the surface of the finished vessel, which can enhance thermal shock resistance or reduce it (Schiffer et al. 1994). *Compacting* modifications are the marks left by stamping or compressing tools on ceramics, including PSS tool, dentate tool, cord-wrapped edge, and fabric impressions. Compacting modifications align particles at the surface and compress them, contributing to strength and impermeability of the ceramic. *Subtracting* modifications, conversely, remove or displace clay when they are applied to the surface of a ceramic, and these include incision, trailing, and channeling. This kind of modification serves to create a more ragged, porous surface composed of misaligned particles. *Finishing* modifications smooth a surface either prior to decoration or—in some cases—after decoration has been applied. These last include slip-brushing, finger smoothing, wiping, and burnishing, and they are important because they seal the surface to some degree, but depending on the technique, leave it porous to varying degrees.

In the Maine–Maritimes Region, a somewhat limited range of surface modifications can be found. No pictorial or geometric imagery is found on ceramics, and the majority of vessel augmentations range from all-over textures (surface treatments) to banding with decorative elements (surface decorations). Some vessels are left smooth, allowing the finishing technique to be identified. Decoration tools are usually linear edges or dowels stamped into the surfaces of pots. Sometimes styluses are dragged across the surface to create single lines, hatching, or cross-hatching.

The tools used to decorate ceramics have been recognized as distinct classes and as chronologically sensitive across a large area ranging from the Far Northeast to west of Ontario (Weirsum 1973) into northern Ontario and Quebec (Dawson 1980; Noble 1975; Pollock 1975; Ritchie and MacNeish 1949) and down into New England (Martin 2008; Ritchie and MacNeish 1949) and the American Bottom (Mason 1970). Understanding them is imperative to classifying ceramics in this region. In the next section I give a synopsis of tool types, the impressions they make, and their chronological significance. Because the range of decorations has been so thoroughly studied by Petersen and Sanger (1991), and has been expanded on by Kristmanson and Deal (1993), I use their terminology here.

In order to better delineate classes of tools, I recorded a large number of attributes beyond their conventional categorizations. These include tool length, element width and shape, tool orientation, decorative strategy (number of bands or columns, impression spacing, and so on), and impression depth. These attributes were used to identify clustering to ultimately form classes of decorations.

Fabric Impression

Used only as a treatment, fabric impression most likely results either from building a pot using a textile mould or from paddling with a cord- or fabric-wrapped paddle. The impression left in the wet clay is the negative of the fabric or cord, and as such, examples of fabric impression have been doubly important for analyzing textiles and cordage twist (Adovasio 2010; Petersen 1996). Fabric impression is identified as a hallmark of Vinette 1 pottery, an Early Woodland type that can be found across much of the Northeast (Petersen and Sanger 1991; Taché and Hart 2013; Taché et al. 2008). Although impressing pots with fabric or cord as a treatment did appear again (or maybe never entirely ceased), special care appears to have been taken during the Early Woodland to preserve the impressed cord marks. Because fibre perishables such as basketry presumably were important well before the advent of pottery in the far Northeast, some (e.g., Speck 1930) have suggested that pots were figured after the more valued or aesthetically pleasing basketry. Another possibility (discussed further in Chapter 5) is that, during the Early Woodland, a fabric-lined hole or a basket were used as a mould for patting clay into the form of a jar (Keslin 1964:50, qtd. in Kutruff and Kutruff 1996:164). Fabric impression, whether achieved through a mould or through fabric paddling, is a compacting process.

Pseudo Scallop Shell

Pseudo scallop shell (PSS) is a straight, linear-edge tool with alternate notches carved along each edge, such that the elements are connected and the stamp looks like a wavy line. Elements can vary from rounded (making a classic wavy line) to squared, which looks like the cross-section of steel decking, to triangular, making a line of triangles connected by their bases. The edge along which notches alternately occur can be straight, slightly bowed, or curved. As discussed previously, the PSS "horizon" is usually thought of as a constrained date range, although evidence continues to accrue that this horizon is not as temporally constrained as previously thought. It is intriguing, however, that the tool type has such a broad spatial range and peaks within similar time frames in various regions of North America (Mason 1969, 1970; Pollock 1975; Ritchie and MacNeish 1949).

The PSS tool is variously used as a discrete stamp repeated in some pattern (usually, but not always, in a horizontal band); as a rocked-on stamp creating columns vertically down the pot or bands horizontally around the pot; as a dragged tool, creating ridges or wider linear impressions; and as a surface treatment in which stamps are closely spaced (usually rocked on) such that individual elements are obscured but an overall texture is created. In all cases except drag-stamping, PSS tools compress the clay, and in ceramic assemblages from New Brunswick, I have previously observed that this decoration tool seems to be one of the most effective in halting surface cracks (Woolsey n.d.).

Dentate

Dentate tools are also linear, but are distinguished from PSS tools by having discrete elements that, when impressed into the clay, look like they were made by a row of teeth—hence, "dentate," as from the Greek architectural element that looks like a row of teeth. Dentates are a problem for decoration classification because they exhibit such a range of variation. Dentate elements can be round, square, rectangular, triangular, or something between all of these; they can be very fine (<0.1 cm) to very large (>0.5 cm), they can have completely discrete elements or the elements can be blended or joined. Although it might seem like an easy distinction to simply label a tool as PSS when elements begin to blend, in reality, it can be difficult to decide the degree of articulation of elements at which the tool can no longer be considered a dentate tool. This is particularly true if the elements are somewhat triangular in shape, making them appear to be wavy lines.

The difficulty of classifying tools as either dentate or PSS is not infrequently noted in the literature on ceramic of the Northeast. Dawson (1980:49) notes that the ceramics from the MacGillivray Site in Ontario seem to exhibit a blending from PSS into dentates, and only certain ceramics can be classified as "true dentates." Foulkes (1981) worked to define a conceptual distinction between the tool and the impression made in order to better understand the dentate impressions she was observing. J. Wright (1967) posited that the reason for this problematic distinction lies in the actuality that both marks are made with the same tool, the angle at which it is held while stamping being the distinguishing factor. If it is held perpendicular to the surface being impressed, a dentate will result, but if it is held at an angle, only the corners of the dentates will be impressed and a PSS will result. While such a phenomenon is not difficult to imagine, and does seem to fit the evidence from some impressions, the perfectly defined wavy lines on the surfaces of many pots—as evenly deep and wide as though they had been drawn with a pen—make this proposition as a general occurrence difficult to believe.

It seems likely that part of the problem lies in a seemingly ubiquitous attempt to define both PSS and dentate tools too broadly, and that in fact, a number of variations exist within both categories and also between categories. For instance, the problem of where to cut off a dentate from a PSS can be solved if the researcher is willing to classify a tool as a blended-element dentate, essentially creating an in-between category. Further clarity can be achieved by naming the shape of the elements; for instance, if they are predominantly triangle-shaped, with bases touching, a logical classification would be a triangular, blended-element dentate. Of course, "dentate" and "pseudo scallop shell" are monikers that could be done away with altogether in favour of more descriptively selected categories. The benefits of such a strategy would be that reports on ceramic assemblages would become more comparable to each other, particularly if elements were measured. Currently, ambiguity about what a researcher feels constitutes a dentate or a PSS tool creates real problems for comparing results. The problem has been compounded by the lack of illustrations such as photographs and renderings of artifacts, often a symptom of printing constraints.

I have opted to keep the general label of PSS and dentate as broad categories, while acknowledging that what I consider a dentate may seem to be a PSS to another researcher. I have also classified tools by the shape of their elements (squared, rounded, triangular, trapezoidal, parallelogram, and elongate) and by the shape of the edge along which they occur (straight or curved). I have further classified tools by whether elements are discrete ("true" dentate), blended (in between a PSS and a dentate), and continuous (an unbroken wavy line, generally called PSS). I have observed all these variations in ceramics from the Maine–Maritimes Region.

The dentate tool appears to have enjoyed a lengthy popularity in this region. Possibly occurring as early as the late Early Woodland (Petersen and Sanger 1991), fine dentate-decorated ceramics co-occurred with PSS-decorated ceramics, with the size of the dentates increasing through time. According to Petersen and Sanger (1991), dentates were replaced by cord marks some time during the Late Woodland. Dentates may have been connected in some fashion with Hopewell cultures to the south and west (Mason 1970), a not-improbable supposition considering that Adena, Meadowood, and Middlesex influences are apparent in the Maine–Maritimes Region (Heckenberger et al. 1990) and that the Hopewell manifestation appears to have been the cultural inheritors of the Adena/Meadowood cultures (Charles and Buikstra 2006). PSS, on the other hand, appears to have been a shared style with Laurel material culture (Mason 1970), and seems to have lost ground to dentates as the dominant decoration sometime during the Middle Woodland Period.

Dentates were applied to ceramic surfaces basically the same as PSS: in discrete, simple stamps, rocked on, or drag-stamped. They are less often used to treat a surface (all-over texture); also, particularly toward the latter part of the Middle Woodland, they exhibit somewhat more sloppy application, many examples impressed unevenly and with little regard for the straight, neat rows and bands so important to the potters using PSS tools. Dentates occur on both straight and curved edges and they create a fan-like pattern when rocked on. Dentates, like other stamping tools, compress the clay surface.

Cord Marks and Cord-Wrapped Stick

Sometime during the transition from the Middle to the Late Woodland Periods, the predominant method for decorating pottery across the Northeast turned to cord marks. Usually, these marks have been termed "cord-wrapped stick" (CWS) denoting cord wrapped around a dowel such that cordage twist and ply are often evident, but the marks left by cords are far more varied in their tool form than this simple moniker would suggest. Probably what many have called CWS were actually the edges of cord-wrapped paddles used to shape the vessel during forming. As previously noted, "fabric impression" seems to occur in all parts of the Woodland Period, but after the Vinette 1 style of the Early Woodland, fabric appears to have been "partially smoothed." These marks are probably in fact the result of cord wrapped on the shaping paddle, evidenced by well-defined "warp" elements but no discernible "weft" elements. One way that a cord-wrapped edge is evident is if the decoration exhibits elements of negative cord impressions occurring along a straight edge and if the same pattern of elements repeats in each separate impression. In the case of a

CWS, there would be no reason for such tight repetition because the stick can be rolled and repositioned such that the positioning of each element changes somewhat from impression to impression.

Another cord mark that can occur in this region results from "rouletting" or rolling a dowel with a number of cords attached to it across a surface. When the cords are wrapped up around the dowel, it is placed on the wet clay and rolled, so that the cords unwrap. The tool is picked up, wrapped again, replaced where the last impressions left off, and unrolled in the same way. This continues across the pot until the space is filled with cord marks. Cord is also sometime wrapped around a flexible material, such as another piece of cord. Another complicating factor is that sometimes grass is wrapped around a dowel rather than cord. In this case, the elements may appear to exhibit a twist, but in reality, the grass is twisted through the action of wrapping and is not a true spun cord, probably representing handedness rather than muscle memory.

Incision and Trailing

Incision results from drawing directly on the ceramic surface with a stylus after the clay has dried. Trailing is the same technique, but performed while the clay is still wet or leather-hard. Incision and trailing are subtracting techniques and they result in a broken ceramic surface, more so in the case of incision. Often, incision or trailing is used in hatching (parallel lines) or cross-hatching (checkerboard pattern) to fill in an area of the vessel. Incision and trailing are not as common in the Maine–Maritimes region as in other parts of North America. They are not particularly chronologically sensitive, occurring throughout the Woodland Period, but they seem to have increased later in time and are particularly associated with the more "Iroquoian" influences that show up during the Late Woodland Period.

Punctates

Punctates are single- or clustered-element stamps (usually in a dowel shape) that are usually applied in a single or double row around the neck below the lip edge. They are generally straight and are usually applied over top of other decoration. Often, punctates punched from the exterior are accompanied by interior bosses, or bumps on the interior, where the tool was pushed almost through the clay and braced from the other side with a thumb or part of the hand. Thumb prints can often be observed on these interior bosses.

Punctates come in a variety of shapes, including circular, square, clustered porcupine or bird quills, crescent-shaped (possibly made by a fingernail), and irregular-shaped.

Channeling

Channeling is the practice of using a toothed tool, such as a dentate tool, to scrape the wet surface of a vessel. It leaves behind a series of deep, parallel grooves that often criss-cross each other. This treatment is usually reserved for pottery interiors, an interesting choice for vessels intended for cooking. Presumably, such a treatment would make cleaning out foodstuffs difficult. One possibility for why the treatment was used on interiors is that it likely improves thermal shock resistance and mitigates cracking, while lining the pot with leaves during cooking would make cleaning of the interior unnecessary. Such a practice was observed by Skibo (1992) in the Kalinga village of Dangtalan in the Philippines. Like trailing, it is a subtractive technique.

Petersen and Sanger claim a fairly limited temporal range for interior channeling, noting that it only seems to occur alongside PSS decorations. This has been corroborated by other researchers (e.g., Kristmanson 1992).

Scraping

A surface is sometimes scraped with a flat edge, such that the surface is smoothed by excess clay being removed. It leaves a similar porous surface to wiping because many particles are ripped out, leaving a jagged and broken micro-surface behind. Scraping is evident from barely discernible parallel striations and mark edges perpendicular to these fine striations. The edge marks occur when the scraper is set down on the surface and begins to scrape. These edges are often close together, their angles to each other differing slightly. This is because scraping often involves going over an area repeatedly to smooth out a lumpy or rough section, so that marks are short and sharp.

Slip-Brushing

Interior and exterior surfaces are often slip-brushed prior to, or instead of, stamp decoration or treatment. Slip-brushing consists of mixing water with clay to make a slurry, or slip, and brushing this mixture onto the clay surface. I found evidence for slip-brushing on the George Frederick Clarke ceramic assemblage (Woolsey 2010), and noted that the slip appears to be made out of the clay body after it had been tempered, such that small particles of mica, quartz, and feldspar were included in the slip layer. This finishing technique would tend to seal the surface, particularly if the clay is composed of fine particles, but temper probably serves to keep the surface somewhat porous, a necessary condition for heat to circulate properly through the vessel (Schiffer et al. 1994; Skibo 1992). Slip-brushing is evident by the brush marks that exhibit smooth, parallel striations, edges where the brush is first laid onto the surface, and overlapping sets of marks whose angles to each other typically range from near 0° to 45°. Marks are often relatively short and usually the same length owing to the tendency of the brush to run out of slip at about the same point during each brush action.

Wiping

Surfaces are often finished by wiping them with a piece of wet leather or cloth. This finishing technique tends to leave the surface somewhat porous as smaller particles are wiped away leaving only the large particles at the surface. The technique is evident from parallel striations and exposed temper particles. Marks are usually parallel to each other and tend to be long.

Finger-Smoothing

Finger-smoothing is the easiest technique and most pots have had at least one round of finger-smoothing. The technique simply involves running the finger (wet or dry) over the surface of the clay to smooth out unevenness and lumpiness. Marks consist of parallel striations that mostly occur in one direction but occasionally orient in a totally different direction. This is because a potter will usually try to keep all marks uniform, but occasionally is tempted to fix a slight problem (surface cracking or exposed temper article, for instance) by shifting the direction and pressure of the smoothing gesture. Finger-smoothing can also sometimes be picked out by the association of finger marks with pressure on the clay, such that striations occur within a shallow trough. A further clue is the occasional fingerprint left on a surface, although fingerprints are always a possibility regardless of finishing technique.

Burnishing

Burnishing occurs when a smooth stone is rubbed intensively over a pottery surface to flatten all the particles, thus creating a shiny, hard surface. Burnishing is not a common finishing technique in this region and is more characteristic of pottery in the Midwest, the Southeast, and the Southwest. Nevertheless, it does occur in this region. Usually, burnishing is performed over an imperfectly smoothed surface, such that the flattest parts receive a shiny polish while the more uneven or rough parts remain unreached by the smoothing stone. My best guess for why surfaces would have been imperfectly burnished is that a well-burnished surface would seal the vessel too much to make it a good cooking pot. This remains speculation, however.

USE WEAR

Use wear can potentially reveal significant information about pots and their life histories, and about the pottery assemblage as a whole. The ways pots were used can indicate subsistence practices, and the ways they were re-used can indicate a range of things such as length of residency in an area, food processing practices, population densities, and ceramic production levels, among others. Archaeologists have long known that use wear leaves traces on pottery, but sorting out those traces one from anther has sometimes seemed impossible.

The main contribution to the study of use wear on pottery came from Skibo (1992, 2013) and Hally (1983). Skibo linked specific use-related activities of pottery to traces of abrasion on pots in an ethnographic context. By watching the specific uses to which pots were put by members of a Kalinga village, and examining the various surfaces and materials with which pots came in contact, Skibo was able to distinguish marks by abrasion type, direction of striations, and the region of the vessel on which they occurred. For instance, he found that circular striations and patches of missing surface that occurred on pot exteriors indicated a scrubbing action, further indicating that the pot had rested in the fire rather than beside the fire, and hence requiring the removal of soot. He also found that horizontal striations around the area of greatest neck constriction were caused by stirring with a spoon, and the depth of the striations indicated how hard the material was, ranging from wood to ceramic to stone. Microchipping on the exterior lip usually indicated scrubbing and also storage upside down, while microchipping on the interior edge usually indicated stacking of pots and also cooking-related damage over time. Hally also observed that certain cooking related practices caused distinct sooting and oxidation patterns on the exterior and interior surfaces. He found that the area of greatest heat (as from a fire) would leave the brightest spot of oxidation on a pot, with less bright colours radiation out from the brightest colour. Oxidation colours were pinks, reds, oranges, and yellows, depending on the clay body. Furthermore, he found that, over time, clay loses its ability to oxidize, resulting in lighter colours until finally, after many heating events, a clay pot is left greyish-white. He also found that sooting occurs in a halo around, but not actually on, the part of the pot exposed to the fire. Both researchers also found that cooking causes carbonized residues to adhere to the interiors of pots, usually on the upper regions of the neck and lip.

In this research, I noted the presence of use-related abrasion, the surface and region of the vessel on which it occurred, the type of abrasion (whether striations, patches, polish, or missing surface), and whether it indicated a particular activity. I also noted carbonized material on the interiors and sooting and oxidation patterns on the exteriors.

ATTRIBUTE LIST

A full list of attributes can be found on the DVD accompanying this dissertation. Also included on the disc are an Excel spreadsheet of the main table and the vessel lot table. Some data are missing since container fields (images) and repeating fields cannot be exported from Filemaker Pro. Additional tables or other data are available by contacting me. The database itself is available from me or from the Nova Scotia Museum.

APPENDIX 2: THE ANALYTICAL STRATEGY

The overall analytical strategy depended on several subsidiary strategies. The first was building a sample at the level of vessel lots by assigning sherds to vessel lots. Multiple sherds with similar or identical attributes were counted as only one, according to rationales outlined below. Vessel lots were then assigned to traditions, which entailed identifying vessel lots that all exhibited a (fuzzy) cluster of attributes. Not all vessel lots are assigned to traditions. The manufacturing tradition of Gaspereau Lake was built out of comparing data at these three unit levels: sherds; vessel lots; and traditions.

Sherds

All sherds were assigned to a region of the vessel, their height, width, and thickness measured, shape(s) noted, temper type recorded, decorative tool (if any) assigned, and any other distinguishing attributes recorded, such as iron oxide coating, shiny residue, or carbonized encrustation. Each sherd was photographed twice for identification (both exterior and interior surfaces). Vessel lots were assigned where possible (see below), and one piece from each vessel lot received the following treatment. Surface decoration, treatment, and finishing were recorded by creating a Surface Modification record related to the vessel lot to which the sherd was assigned. Surface modification type, tool type, element type, impression spacing, and zoning were among the attributes recorded for each surface modification. Temper type was expanded on by noting specific minerals using a microscope, as well as noting sizes of the three largest particles of each mineral and their shapes. Temper percentages were estimated by comparing broken wall edges with reference samples created with known temper percentages (10%, 20%, 30%, 40%, and 50%). Paste characteristics such as lamellar character, coarseness, and direction, paste hardness, and coil break shapes were recorded. Diameter of the lip, neck, and shoulder were measured where possible. Carbon coring was measured. Carbonized encrustations and use wear were noted and described.

All special analyses (e.g., radiocarbon dating or SEM) were recorded in the record of the sherd used for the analysis. These were included in the summary of the vessel lot to which the sherd belonged.

Vessel Lots

Vessel lots are groups of sherds thought to come from the same original vessel. Sherds do not make good base units for most analysis, particularly many statistical methods (although some statistical methods do work well at this level, as will be shown). In ceramic assemblages with many sherds that can be matched and placed in vessel lots, the statistical problems become obvious immediately. If, in a collection of one thousand sherds, ca. 200 can be assigned to vessel lots, ca. 200 are parts of vessel lots that escaped the notice of the analyst, and ca. 600 are orphaned sherds, then the statistical skewness created by re-counting sherds that should be cancelled by their inclusion in a vessel lot is not severe. In archaeology, imprecision of measurement is likely to be a worse problem for statistical and spatial analysis than is skewness from this kind of sample. However, in a population of ca. 18,000 sherds, where most are from the same vessel as some other sherds, over-representation of some attribute states becomes a real problem. For instance, if the majority of PSS-decorated vessel lots have no more than ten sherds, while the majority of dentate-decorated vessel lots have over ten sherds and up to 150 sherds, then counting PSS versus dentate decorations at the sherd level will give a dramatically different idea of manufacturing scale for these two decoration types than it will at the vessel lot level. The solution is to switch the base analytical unit to the vessel lot and to perform statistical and spatial analysis at this level.

The means for doing this is not necessarily straight-forward. The method used in this research consists of analyzing representative sherds thoroughly such that the majority of attributes recorded for the vessel lot come from these lone sherds, while quantitative data and other exhaustive attributes are recorded for all sherds in order to obtain accurate measurements for distributional analysis. Before attribute recording begins, each sherd has certain data attached to it including unit and level. The first step is that each sherd assigned to the vessel lot is weighed, assigned to a region of the vessel, and temper type, thickness, shape, surface colour, and decoration as classified by Petersen and Sanger (1991) are recorded. Also, any carbonized encrustations or detritus are noted for future analysis. During this stage, vessel lots begin to cohere as sherds that obviously bear the same surface modifications and are made from the same paste are grouped and given a vessel lot number or placed with previously defined vessel lots. Next, one sherd (or a few sherds, if the vessel lot contains many different pieces) is thoroughly analyzed: temper minerals are recorded, their shapes and sizes, the amount of temper estimated, various attributes concerning the paste and lamellar character measured and noted, surface finishing is ascertained and noted, use-wear is summarized, sooting noted, and degradation noted. This provides the basis for classifying the vessel lot by tradition and for later analysis. Next, the vessel lot is summarized using the data gathered on all sherds. An average and a standard deviation of the following measurements (taken from sherds) is recorded: diameter (for all vessel regions), thickness (for all vessel regions), and temper particle size. The weight of all sherds in the vessel lot is summed.

Vessel Lots as Theoretical Categories

A vessel lot is a theoretical category because the evidence for assigning sherds to vessel lots is not always as strong as it ideally would be. For instance, if two sherds fit together along a broken wall edge, they obviously came from the same original vessel lot. However, the more common case is that sherds appear to come from the same vessel because of matching surface modifications, temper types, and other visually identifiable attribute states, but there is no way to know for certain that they in fact did come from the same vessel. More than one vessel may have been made by the same person at the same time in exactly the same fashion, such that, without a direct refit, there is always the possibility that more than one vessel is represented. There is also the possibility that the researcher is not able to distinguish differences in attributes that indicate different vessels for a myriad of reasons, including inadequate observational equipment, poor eyesight, not enough knowledge of the ceramic tradition, not enough time, and so on, and this is simply a reality of analysis. Evidence for vessel lots becomes less certain the fewer attributes can be matched (and also the smaller the ceramic pieces tend to be). Some researchers may shy away from such uncertain assignations, but the alternative to assigning sherds tentatively to vessel lots is to leave large numbers of sherds unassigned, under-representing some vessels, or, worse, to define too many vessel lots, over-representing some vessels. It is up to the individual researcher whether to err on the side of over-representation or under-representation, but in either case, the erring tendency must be kept in mind during data analysis and synthesis.

Reasons for including a sherd in a vessel lot can be placed on a hierarchical scale of evidence from strongest to weakest. The strongest evidence for inclusion in a vessel lot with another sherd is refitting. If two sherds fit together seamlessly, they are definitely from the same vessel lot. The next strongest evidence comes from being able to match a sherd spatially with the other sherds in the vessel lot, such that even if no refit is possible, the pieces can be lined up with other sherds. Decoration is the easiest way to do this, but coil breaks and morphology also contribute to placing sherds spatially within a vessel lot. Next strongest is the same attribute states across multiple sherds, particularly if they came from the same unit and level or articulating units and/or levels. In this case, the more attribute states that are the same, the stronger is the inference that they belong to the same vessel lot. Decoration and treatment tools help a lot with this inference because tools are often distinctive and their impressions can be matched up to show that the same tool was used on both sherds. Other attributes are temper minerals and sizes, lamellar character, surface colours and patinas, adhering residues common to both sherds, similar rim shape, similar thickness—basically, if there is a reason to believe a match is significant, then it should be assigned the same vessel lot. The strength of the inference also depends on how distinctive the attributes are. For instance, some sherds can be designated part of the same vessel lot only by paste characteristics, but if one temper mineral is unusual but is common to multiple sherds, the inference that they came from the same vessel lot is somewhat strong. The weakest evidence is a case when only one attribute is used to link two or more sherds, but because they do not match any other vessel lots, they occur in the same unit, and they have no attributes that suggest a non-match, they can be assigned to the same vessel lot. This last kind of evidence must be treated with great caution, but it is better that they be assigned a vessel lot and be analyzed than to escape analysis. This is because to omit vessel lots without diagnostic attributes is to skew the sample; if there is some reason to believe the sherds represent a vessel lot, they should be included.

In the case of many sherds, vessel lot definition is relatively straightforward and easy, even in the absence of direct refits. However, some vessel lots have fewer distinguishing characteristics and so definition relies entirely on paste attributes or surface finishing techniques, which require more time and effort to match. These vessel lots must often be designated as tentative and treated cautiously in analysis. This is particularly true in the case of vessels with no decoration or which had no rim pieces. It can probably be assumed, however, that for every tentative vessel lot, there is a vessel lot that could have been defined and was not. The hope is that the sample is large enough, and the methods rigorous enough, that these possible misidentifications even out.

Type Pieces for Vessel Lots

For every vessel lot, I define a "type piece" that stands for the vessel lot as a whole. Typically, type pieces provide the most data about the vessel lot, and so often they are the largest and are rim pieces, although neither of these conditions is always the case. Type pieces are so-called because vessel lots are a special kind of category similar in a sense to a type: there is a real-world, though not present, object (the vessel) from which real-world objects (sherds) came, such that there should be ontologically matched attributes shared across many sherds. A type piece is meant to be that specimen against which other sherds can be compared to determine whether their attributes match. Type pieces are generally the sherds that have been thoroughly measured and recorded, though, again, this is not always the case.

Traditions

Defining traditions is a similar process to defining vessel lots, except that the groups constructed have more ideological import and no real-world entity (e.g., a broken pot) tying the members together. There is also the time-consuming problem of evaluating similarities at various levels and considering whether they add up to a group. Because traditions are based on stylistic similarity, the categories are more loosely defined, and the constant concern of the researcher must be whether the group members (vessel lots) were responses to each other or, instead, whether similarity might be coincidental or else constrained in some way (e.g., available resources or practices unrelated to ceramic manufacture). These questions are not easy to answer, and the constructed groups are tenuous and constantly shifting as more information is added.

This is not to say that there are no concrete reasons for making groups or that all inferences about groups are somewhat tenuous. Pots are bound to share the same paste if they were made at the same location; therefore, matching clays and temper minerals may be good grounds for positing a tradition. Clays are not easy to describe without physicochemical characterization, but they sometimes can be distinguished from each other on the basis of colour or texture. Also, temper types can be fairly distinctive even within an overarching category of granite. When a group of sherds exhibits the same clay or the same temper, there is good reason to suspect they belong to a similar time period, pottery-making faction, and/or functional category—in short, they are good candidates for members of a single tradition.

The hard-work component is not in recognizing or forming such a group, but in deciding whether the common paste attribute indeed represents a rationalised human behaviour or whether some other, non-human mechanism is at work. Potentially, *all* clay within a 50km radius of the site looks exactly the same. Or, there may have been only one possible source to access, so unrelated people may have made pots with the same clay. The decision to designate a group based on a matching attribute is dependent on the relationship of other attributes: whether multiple matches can be found, or whether vessels with the same paste seem to concentrate spatially or in one level, for example.

Because of the importance of matching attributes, I found that one way to justify a group was by creating mini-groupings based on attribute clusters like overall paste (temper minerals, temper percent, and clay type), surface modifications (decorative tool and surface finishing), rim profile (neck and lip shape, and neck thickness), forming techniques (size of lamellae, lamellar direction, presence and shape of coil breaks, and coil sizes), and firing attributes (carbon core type and size, paste hardness, presence of shiny surfaces, and oxidation patters). When I could assign a vessel lot to one of these mini-groupings, I could then check to see if that vessel lot also conformed to other mini-groupings. If this was the case, membership in a tradition was considered to have been assigned. If this was not the case, the vessel lot was provisionally placed in relation to other sherds also belonging to the mini-group, but not necessarily the same as them. As more of this kind of relationship were discovered and built up, patterns emerged in how the vessel lots grouped and related to each other. Radiocarbon dates were used to situate some vessel lots, which helped in resolving (although never irrefutably) temporal aspects of relationships. Further information about mini-groupings came from SEM work showing firing temperature and mineralogical composition.

As in the case of vessel lots, traditions are constructed around one or two "type pieces" that contain a large amount of information against which other units can be compared. "Type" is a misnomer, since the traditions are not types (see above discussion). A better moniker might be "exemplars," but this places too much emphasis on the idea of a standard with which the potter works, something I do not see any evidence for, either in archaeological material or in modern craft and art. I therefore decided to stick with "type piece." These tend to be the vessel lots containing the largest number of sherds, and they tend to be the best preserved. Traditions are reported in Chapter 3.

One concern during the construction of traditions and relationships is the likelihood that vessel lots resembling each other were made by the same person. This possibility can never be ruled out. However, there are ways to narrow down the likelihood that this happened. Tools used to decorate a vessel lot can be a clear indication that a potter made more than one vessel, particularly in the case of linear tools with multiple distinctive elements. These tools can be "fingerprinted" by drawing their outlines with imaging software and then superimposing the drawing over another decoration image at the same magnification. This method is, in fact, useful in placing ambiguous sherds in vessel lots if diagnostic elements of the decorative tool can be identified. It is true that a tool may have been passed on from generation to generation, and so different potters may be using the same tool. This question might be resolvable by looking at other attributes, particularly for gesture and attributes determined by muscle memory that might indicate different individuals. Obviously, this is not always possible, and most always will lead to tenuous conclusions at best. On the other hand, a case can be made against only one potter by showing that mini-groupings are the same, but very slight variation exists in comparing attribute states. Presumably, conformity to a tradition or style is in evidence here rather than muscle memory, whereas muscle memory will determine the look and feel of some attributes while others need not remain the same, such as morphology. This latter scenario assumes that people were allowed and/or encouraged to vary their pots, a situation I have observed both in the George Frederick Artifact Collection (Woolsey 2010) and in ceramics from Skull Island. However, if many attributes are more-or-less the same, gestural attributes look or feel similar, and there are multiple pots belonging to this group, a single potter making standardized pots might begin to be suspected.

APPENDIX 3: THE SAMPLING STRATEGY

The main sample analyzed in this research is a bulk, or cluster (Orton 2000) sample from one area of the End of Dyke Site. Although ideally the entire assemblage would have received at least rudimentary analysis, the large number of specimens made this goal impossible for the present research. Ideally, simple random sampling should be performed where possible, but it was not a viable option for the End of Dyke ceramic assemblage, as I will discuss. Stratified sampling was also not a good strategy. A judgemental sample was also ruled out on the grounds that such an analytical strategy would most likely serve to reinforce my own ideas about Aboriginal ceramic manufacture rather than bringing to light the details of the manufacturing practices through time at Gaspereau Lake. A bulk sample was therefore chosen as a means of minimizing researcher-induced bias and generating the greatest amount of information within a ca. 3000-specimen sample.

Simple random sampling from the assemblage was found to be unhelpful because the basic analytical unit is vessels, not sherds. Thus, sherds would have needed to be analyzed into vessel lots before sampling occurred. Much of the information about the ceramics exists in, first, the sometimes extensive vessel lots and, second, the relatedness of sherds occurring in the same unit or the same level. Vessel lots can only be apprehended after analyzing *all* sherds in a given set (a unit, a level, or a sample chosen in some other way), while spatial and formal relationships among sherds, is only meaningful in the context of vessel lots. This means that simple random sampling across the site would have failed to capture a large amount of data required for a good sample. This is particularly true in cases where the majority of sherds are not orphaned pieces but rather can be linked with other pieces, if not physically, then by matching attributes. It makes no sense, therefore, to choose a sample that includes an undecorated body sherd when the decorated rim portion from the same vessel is right next to it in the same unit and level, and the sample's validity will be destroyed when more than one sherd from the same vessel lot is included but counted as separate specimens. Similarly, random-sampling the units would have been problematic. The first consideration here is that an understanding of the site would only be possible by looking, in some form, at the assemblage from all the units. Breaking up the units randomly would have made examination of the ceramics around features and concentrations impossible.

While stratified sampling has worked in some archaeological studies, in this case, such a strategy would not have worked. The same barriers to simple random sampling also exist for stratified sampling, but additional problems include the lack of good criteria along which to divide the population and the lack of information about specimens that could be used to classify the assemblage. Stratified sampling requires that the categories be mutually exclusive or equal to each other in some way; ceramics from the Maine−Maritimes Region do not have attributes that can be so easily separated or shown to be meaningfully attached to a hierarchical arrangement such as time period. It has been argued that decoration types (fabric-impression, PSS impressions, dentates, and cord-wrapped stick) are essentially chronological markers (Allen 1981; Petersen and Sanger 1991), but as discussed earlier, there are a number of problems with this assessment.

A bulk, or cluster, sample consists of every piece in the units within an area and imparts several advantages during analysis. Because the sample includes every piece in a continuous set (basically, the population is the same as the sample, but the population is artificially cut down to a subset of its original number), the researcher gains a high degree of control over spatial and formal distributions within a limited section of the site. This control is important in a context where variability is not known and cannot reasonably be predicted. While considering this subset of the total population as a sample presents some problems, it accomplishes the goal of understanding and organizing a population sufficiently that simple random sampling or stratified sampling can now be meaningfully employed. Thus, the range of variability is captured as well as the means to statistically analyze the significance of that variability relative to time period, attribute clustering, and so on. Number of pieces in vessel lots can be compared, for instance, with attributes such as thickness or temper percentage of paste, in order to understand how positioning and preservation may be related to time period, manufacturing method, or pottery function, and this can be done at the level of population or a smaller subset. In a case where only diagnostic sherds are examined, the same control cannot be achieved, and statistical analysis is probably close to meaningless. Another advantage is that each piece is examined and given a certain amount of attention. This leads to the researcher becoming well-acquainted with the assemblage, particularly with attributes such as paste and use wear, because so many sherds cannot be categorized based on decoration that they then become the focus of other observations that might not otherwise come to light. It also bears mentioning that a major source of bias enters the sample if criteria include (implicitly or explicitly) nicer or more recognizable decorations; this method eliminates that bias.

The drawbacks of a bulk sample are that only a portion of the site can be evaluated. Though it may be tempting to use the bulk sample to represent the entire site, such an inference cannot be justified without more bulk samples or analysis of the entire collection, the latter of which may be the researcher's long-term goal. It is reasonable to assume that different parts of the site will represent different activity areas and different time periods, so a bulk sample is not likely to capture the whole range of variability, or even a large portion of variability. Assessment of this problem must occur as analysis progresses. A second bulk sample is preferable in order to assess whether the first sample is similar or completely different; after looking at the second bulk sample, the researcher will be in a better position to decide whether the first sample is representative.

Samples

The research was conducted on three samples. The first was a preliminary sample of 50 vessel lots chosen judgementally as a first step to getting to know the assemblage. The second, and main, sample was a bulk sample of ca. 3500 sherds that represented the entire assemblage from Locus 3, the northernmost portion of the End of Dyke Site that is more-or-less discrete and separated from the rest of the site by a knoll overlooking the Gaspereau Lake edge (however, future excavations of the knoll and surrounding areas may show that, in fact, there is a continuous stretch connecting the two seemingly discrete areas). The third sample was less formally examined than the second, and was mainly examined for the purposes of determining whether the patterns observed in the second sample were reflected across the site; it included ceramics from the units with greater than 50 sherds clustered around Feature F44, which originally had been suspected of being a kiln (Mike Sanders pers. comm. 2013).

Preliminary Sample

Fifty vessel lots were defined by looking through the assemblage, finding units or areas with a large number of sherds, and picking sherds that looked interesting. In most cases, vessel lots consist of one or two sherds even though other sherds almost certainly had come from the same vessel. Time was not devoted to assembling these vessel lots to any degree, but rather, to building a sample that could be assessed for degree of variability and homogeneity. Rudimentary attribute recording was performed using the exhaustive attributes of thickness, decoration, rim shape, temper type, and surface colour, as well as some other attributes less uniformly gathered, such as use-wear, carbon coring, oxidation patterns, and paste texture. The vessel lot data were assessed to determine degree of variability.

The Main Sample: Ceramics from Locus 3

Within Locus 3, 3559 sherds were retrieved from 76 units. The units encompass the features F27 and F29, two large hearth complexes with multiple foci, as well as a number of smaller features summarized in Table 4. Density of ceramics by unit is high in this area, with the largest average number of ceramics per unit of all the sites in the GLR Site Complex. Sanders (2014:232) writes that this area appears to have been a dwelling site with many associated activities including flint-napping, painting, abrading, and food preparation and disposal. However, no post-molds were found, and the transgressive hearths and large artifact counts (especially pottery) suggest a more dedicated activity area with large intervals between uses rather than a continuous- or seasonal-use area. Sanders sums the area thus:

> Its full extent will not be known until mitigation of the area is complete, but it appears that Locus 3 is roughly oval in shape and measures at least 15 metres long (northeast/southwest) and 8 metres wide (northwest/southeast). Compared to Locus 1 and Locus 2, it is intermediate in size and represents a moderate artifact concentration. The centre of Locus 3 currently consists of five contiguous units that each yielded more than 1,000 artifacts. Since several of the surrounding units are unfinished or completely unexcavated, the number of unit counts exceeding 1,000 could rise during continued excavation. At present, the highest individual count is 2,036 artifacts (Unit 973N/985E). Units with counts in the hundreds, rather than the thousands, exist all around the centre of Locus 3. (Sanders 2014:17)

The ceramics from Locus 3 were originally assigned specimen names if they had a diagnostic decorative or morphological attribute. Otherwise, they were grouped by lot (level) number and assigned a group specimen name. Analyzing the bulk sample included dividing these grouped specimens into individual specimens, each in their own bags, so that they could be assigned to vessel lots.

Table 27: Features in Locus 3, including pottery distributions. This table does not include modern features. Note that pottery associated with F28 does not have a weight measurement. It was not available during the research.

Feature Name	Feature Type	Description from Sanders (2014)	Sherd Count	Sherd Weight
F27	Hearth complex	"Multiple depressions in the subsoil connected by scorching and hearth accumulation"	711	1508
F28	Pottery accumulation	"Depression in subsoil containing a concentration of pottery"	2	N/A
F29	Hearth complex	"Multiple depressions in the subsoil connected by scorching and hearth accumulation"	422	1870
F30	Hearth	"Depression in subsoil with evidence of *in situ* burning"	1	5
F31	Hearth	"Depression in subsoil with evidence of *in situ* burning"	0	0
F32	Hearth	"Depression in subsoil with evidence of *in situ* burning"	2	22
F33	Hearth	"Depression in subsoil with evidence of *in situ* burning"	0	0
F34	Precontact fill	"Deposit of mixed topsoil and subsoil"	0	0
F35	Disturbed hearth	"Mottled hearth material"	7	37.9
F36	Hearth	"Depression in subsoil with evidence of *in situ* burning"	12	102.6
F37	Precontact fill	"Deposit of mixed topsoil and subsoil"	0	0
F38	Disturbed hearth	"Mixed hearth material"	0	0

The Supplemental Sample from Locus 1

The third sample, studied to supplement the main bulk sample, was taken from Locus 1, the area of the greatest artifact density and the location of some of the most interesting features on the End of Dyke Site. The centre of Locus 1 is described by Sanders as:

> a 10 metre long (north/south) and six metre wide (east/west) area of contiguous units with artifact counts exceeding 1,000 per square metre. Registering a maximum count of 4,670 artifacts per square metre (Unit 924N/1017E), this likely represents the greatest artifact density ever recorded for a Precontact habitation site in Nova Scotia. Outward from this locus

> centre, contiguous units with counts in the hundreds generally extended a distance of at least two to four metres within the mitigation area. Elements of Locus 1 extended outward to the north and southwest, with contiguous unit counts in the hundreds and occasionally a thousand plus. (Sanders 2014:17)

The supplemental sample came from north of the area of greatest density, in the area of the feature F44. Ceramics were analyzed from units around F44 in which more than 100 ceramics were retrieved, ensuring that numerous vessel lots composed of multiple sherds would be constructed. Because time was a factor, I chose a more adaptive strategy with the goal of defining a large number of vessel lots for comparison with the main sample. For rigorous statistical analysis, the same methodology would have to be applied to the supplemental sample as to the main sample, but in the interest of time, and also because great rigour is not necessary to evaluate whether some patterns differ between the two samples, the supplemental sample did not include all ceramics from all units.

The same treatment of specimens (group and individual) was applied to this sample and vessel lots were defined in the same way. Some vessel lots that had previously been defined during the preliminary analysis were added to and incorporated into the set of better-defined units (vessel lots) that were used to compare the main and supplemental samples.

Statistical Methods

The two bulk samples were used in statistical analysis to describe the range of variability, test hypotheses, and discover patterns. Distributions of attributes across both samples were examined, and T-tests on means were employed for understanding differences between types of vessels and between the samples. Chi-square tests were used to identify relationships among attributes. Paired mean tests were used to identify patterns in the spatial distribution of ceramics compared with other artifact classes. Correlations and regressions were used where quantitative data would allow.

Statistics have not traditionally been used extensively in archaeological studies in the region (but see Nash and Stewart 1986). This is partly the result of the relative dearth of synthesizing studies, but also, statistics are not commonly part of an archaeologist's toolkit (Cowgill 2015; Orton 2000). Additionally, it is a valid concern whether statistics, predicated on the axiom of representativeness through random sampling, can be employed meaningfully on material that is preselected by unknown criteria (uneven decomposition and recovery rates) before ever reaching the archaeologist (Drennan 2010). Despite these hurdles, statistics can be fairly simply employed on an assemblage if the basic principles are understood. Even a simple standard deviation applied to measurements and ratios can be revealing about how categories cluster; by sorting specimens by standard deviation, other rankings can become visually apparent.

Justifying the Use of Statistics

In this research, I used descriptive statistics (summaries, dependence tests, and graphical representations) to uncover patterns, group specimens, understand spatial distribution patterns, and as an aid in describing phenomena. I also relied on statistics to help disprove hypotheses I developed during analysis and to test theories others have proposed.

Because my samples are at least two degrees of separation removed from a simple random sample, great care is required in using and interpreting statistical results. There are times when it is simply not justified to treat a sample as a simple random sample, but at other times, the argument may be made that the sample is likely to yield similar results to a simple random sample (Drennan 2010). It would not be justified, for instance, to attempt to correlate significant use wear on ceramics with the likelihood that they are found in or near a hearth feature. There are many factors that could affect how a well-used pot might be preserved in the archaeological record, including artificial deposition (say, in a midden), likelihood of significant pre-deposition decay depending on length of use-life, and the probability of increased exposure to fire if left in a hearth after breaking. What comes down to the archaeologist is nothing like a random sample of use wear. On the other hand, a correlation of lamellar size with temper particles is well suited to an archaeological assemblage because few pre-deposition processes are likely to select one kind over another. Although it cannot be assumed that a sample will be random, the argument is much better for treating a selection from an assemblage as a random sample and performing correlation tests.

Another consideration is the meaningfulness of attributes and measurements. Particularly where the sample is problematic, great care must be taken to select attributes that have *real*, *established*, and *interlinked* meaning to the problem at hand. "Reality" is a difficult but necessary concept in archaeological statistics: the reality of an attribute (at least for statistics) is its ability to show something about the artifact, feature, or site. Reality is not the same as empirical. It is a testable proposition about a low-range phenomenon. The fact that the introduction of maize horticulture is linked to increased dental caries in burials (Stewart 1999) means that the number of dental caries is real, and can be measured and used statistically. Establishing this reality is a matter of justification. The importance of an attribute may have received a long treatment in the literature, establishing it as an index of something else or important in its own right. Establishing an attribute's reality may also be a matter of forming a new justification where previously it had gone unrecognized. Establishing the reality of an attribute is necessary for constructing the argument to which statistics will constitute a premise, and the strength of the argument is the degree to which the attribute's meaning is interlinked. Measuring the base of a pot may have a real meaning for how well it sits in the sand or between rocks. But if the argument for measuring thickness is to judge approximate capacity, base thickness is probably not the best measurement because it can vary independent of capacity. In this case, the base thickness's meaning is not sufficiently interlinked, whereas neck thickness is likely much more related to overall capacity. Therefore, the argument for measuring neck thickness is sound and the measurement is a much better choice for statistical methods. This example also shows how statistical methods may show that an attribute is not as real, established, or interlinked as the researcher may have thought, and can help disprove hypotheses or adjust measurements to be more meaningful.

Traditions and Statistical Groups

In the process of building traditions, I sought opportunities to test associations. The process generally moved from pattern recognition during analysis to testing a low-level hypothesis in order to confirm or disprove an association, back to considering groups more holistically and developing new hypotheses, and back to testing statistically. I moved from low-level associations up to more complex inferences about groups and about the population as a whole. While statistical techniques were important in developing hypotheses about traditions, they were not the determining factor in whether a tradition was accepted or rejected. This is because statistics cannot disprove something like a group, but can only show a lack of evidence for a group. There are other ways of defining a group than by statistics. A type classification would be more appropriate for statistical analysis than traditions. Instead, statistics were used to build up arguments for traditions, with ultimate justification coming from logical inferences.

Geographic Distributions and Statistics

There are many reasons to treat the distribution of artifacts in the End of Dyke Site with caution. Significant disturbance is in evidence Sanders 2014 and stratigraphic separation is non-existent in many parts of the site. The modern features that include roads, grubbing and grading, and the dumping and stockpiling of sediments churned up an unknown portion of the site and mixed artifacts throughout these modern features. Within the main occupation layer, similar contextual mixing is in evidence, with artifacts from different time periods occurring together. Although this disturbance must be kept in mind, there is nevertheless valuable information in the distribution pattern of ceramics across the site, particularly in contradistinction to other artifact classes. This is expected in certain contexts, such as hearth floors and middens, and distributions can actually uncover these features when they might not otherwise have been recognized.

Uneven distributions can be tested using the paired mean test, where, within each unit, one artifact class is compared against the whole number of artifacts. A probability score will indicate whether the distribution of the one artifact class reflects the same discard patterns as the other artifacts. When small areas of the site are identified as of particular interest in this regard, Chi-square tests can be used to test whether artifact class deposition is related to one area. If an activity area has been identified, distance from this area can be tested among different categories (artifact classes, groups of pottery, decorative types, and so on) in order to see if a relationship exists between some artifacts and the activity area, or to see if a hierarchy of relationships exists (e.g., processing area→cooking area→consuming area). Obviously, these techniques will work better on undisturbed and uncomplicated sites. Theoretically, in the case of artifact assemblages that have been churned to some degree, relationships should still be apparent if at a coarser resolution. These techniques work best in conjunction with spatial mapping of artifact distributions.

Mapping and GIS

Mapping is important for understanding the spatial attributes of, and relationships among, artifacts. A simple distribution of ceramics by density reveals areas of greatest concentration; in conjunction with distributions of other artifacts, locations of features, and divisions of artifacts by strata, significant information about discard behaviour can be acquired. A ratio between ceramics and other artifacts laid out by unit can quickly indicate areas of interest where statistical analysis may be appropriate. GIS was used to map the site and artifact distributions. Artifacts were not positioned within units (e.g., quadrant or depth) except by layer. Therefore, distributions can only be looked at by unit, making for a fairly coarse resolution in patterning.

Physicochemical Characterization and AMS Dating

Certain specialized analyses were employed to better understand some aspects of manufacturing practices. These were reserved for select specimens that were of particular interest, either because they represented a tradition, or because they could enlighten the research about some aspect of the assemblage. Larger-scale testing in this regard would have been preferable to achieve a representative sample that could be applied confidently to the assemblage, but such a project is best embarked upon after the first round of research has been completed and reported and sufficient grant money is secured to test an appropriately large sample with appropriate techniques. Therefore, the results of this first round of testing are reported as a preliminary study whose tentative conclusions should be expanded upon in the future.

Scanning Electron Microscopy

Scanning Electron Microscopy (SEM) is a relatively inexpensive, accessible method that can be applied to any archaeological ceramic assemblage. SEM enables direct observation of particle shapes, sizes, textures, and topography, from which can be inferred firing temperatures, crystal structures, and depositional histories (Chatfield 2010; Kingery 1960; Maniatis and Tite 1981; Maritan et al. 2007; Musthafa et al. 2010; Rodrigues et al. 2015; Woolsey 2010). In addition, SEM combined with Energy-Dispersive Spectrometry (EDS) provides semi-quantitative compositional data that can range from focusing on one grain to covering an entire surface. This technique is useful for understanding the mineralogy of the clay as well as the temper attributes. It can be used to differentiate between temper sources by roughly showing compositions of minerals such as feldspars and micas.

SEM work was conducted at the UNB Microscopy and Microanalysis Unit. Douglas Hall assisted in all image and spectra capture, and interpreted compositional data where these were available. The machine used is a JEOL JSM-6400 Scanning Electron Microscope, operating with an accelerating voltage of 15 kV, and with a probe current of 1.5 nA (nanoamps). The images were collected with Digital Micrograph (Gatan Inc.). Energy-Dispersive X-ray spectra were collected with an EDAX Genesis X-ray Microanalysis system.

Radiocarbon Dating

AMS dates were acquired from carbonized residues on the interiors of pots. The aim was to better delineate two or more traditions that were defined during analysis. A total of ten dates was acquired and the dates were calibrated using CALIB and the IntCal13 calibration curve (Stuiver and Reimer 1993).

APPENDIX 4: THE DATABASE

The Ceramic Analytical Database (CAD) is intended for two purposes. First, it is a curatorial tool for managing collections and keeping track of all data gathered about the specimens. Second, it is an investigative tool for data compilation, statistical analysis, cross comparison by attribute and context, and multi-level investigation. It was developed for research on the GLR ceramic assemblage, but is intended to be used for any Aboriginal ceramic assemblage in the Northeast. This appendix is intended as a guide to navigating the database and using it for further analysis.

The CAD is divided into a number of tables that record information at different analytical levels. These tables are 1) the individual specimen, or sherd, table; 2) the vessel lot table; 3) the archaeological site table; and 4) auxiliary tables that will be discussed later.

Sherd Table

The first table consists of data that can be gathered about individual sherds. These data are ordered according to the progression in which data is likely to be gathered. The interface is divided into folders entitled *Record Data*, *Site Data*, *Measurements*, *Vessel and Morphological Data*, *Paste and Temper*, and *Archaeometeric Analysis*. Ideally, data gathering for each specimen follows the same algorithm: the first data input will include information such as a unique specimen name, provenance, and so on, after which a set of physical measurements—such as neck thickness—are taken and classes assigned, whereupon information about the vessel that can be discerned from the sherd are input, leading to microscopic observations of temper and clay minerals and specific information about decorative tool, and finally, archaeometric data are input where analytical techniques have been performed.

Record Data

The fields in this section identify the sherd's provenance, catalogue information, number of pieces in the artifact record, and other identifying data. These data are frequently imported automatically from an excel spreadsheet containing the catalogue created during initial sorting and recording. Automatically input are the date the record was created, the date it was last modified, and the summary fields calculating the number of pieces in all selected records and the weight of all sherds in the selected records. There are also options for recording any samples that the artifact has been a part of and any particular kinds of images that have been acquired. Finally, a portal shows all the images of the artifact that exist along with any notes about those images.

Site Data

This section contains all the data that exist about the artifact's site, position, and excavation history. Site data are likely to exist in another catalogue and it may be automatically input by importing the spreadsheet. In the case of the GLR ceramics, all data were acquired from Cultural Resource Management Group Ltd.: the catalogue that was given to the Nova Scotia Museum was imported automatically while additional site data were manually input from a PDF master list of all artifacts. The data included unit name and level, feature (if any), excavator, and some notes taken about artifacts (charring, mending during cataloguing, etc.). Other information was added later, such as publications, and associations of charcoal. There is also a portal showing data from the related record in the unit and level database, as well as the northing and easting of each unit that was used for GIS applications.

Measurements

Sherd metrics are contained in this section. This includes measurements such as weight, thickness, dimensions, temper percent, presence/absence of the interior and exterior surfaces, temper type, mineral type, particle size and shape, abrasion type and region, and carbon core thickness. The regions of the vessel are identified and thicknesses for each taken, up to five measurements for each region. Also noted are the presence of certain attribute states, such as weathering, iron oxide, and carbon core. Sherds are also categorized by attributes such as coil break type, decorative type, and surface sheen. All of these metrics are used to generate information in the next section on the sherd's vessel lot.

Vessel Data

Information about the vessel is compiled in the section called "Vessel Data." Here, thicknesses taken in the "Measurements" section are averaged for each region and calculated for a maximum thickness. Each region of the vessel is classed for its shape, decoration, and surface treatment. Vessel metrics of diameter, length, and curvature for each region are recorded here. Also, several other related tables are summarized here: sherds assigned to the same vessel lot, surface modifications recorded for the vessel lot, temper data gathered across all sherds in the vessel lot, a list of all sherds belonging to the same assemblage, and storage and housing information. General descriptions are also kept for this section, such as notes about odd characteristics, important things to remember, and so on.

Paste and Temper

The "Paste and Temper" section contains fields relating to temper, clay, and overall fabric. Measurements that were taken in the "Measurements" section are also represented here, as are any images specifically of temper or fabric. Also in this section are description boxes for describing impressions about paste.

Archaeometric Analysis

In this section, archaeometric data is stored and summarized. Each technique has its own subfolder and portal showing records from tables storing data from that technique. Each sherd record may have multiple related records in any given analytical technique table. There is also a check list for each technique that helps identify whether a sherd is appropriate for analysis using that technique. For instance, sherds that have no carbonized encrustations are not appropriate for stable isotope analysis or AMS dating. An important feature of this section is the record of whether detritus and carbonized encrustations are available for use in archaeometric analysis, and if so, where these materials are stored.

Vessel Lot Table

The vessel lot table is intended to function as a dashboard that summarizes data in order to allow the analyst to make inferences about the original vessel from which the sherd came. Data is summarized in the following portals and sections: physical dimensions; attributes recorded during analysis; spatial distribution of sherds; images of sherds; radiocarbon dates; surface modifications; chemical characterization performed on sherds; paste data; and samples collected. The table also contains several descriptive fields for recording observations about the vessel lot.

Data Summary

The vessel lot table contains the data that can be ascertained from sherds about the vessel lots they represent. Data from the sherds is summarized, calculated, and imported so that it is available for drawing conclusions about the vessel lot and for comparison of vessel lots to each other. This enables statistical analysis amongst vessel lots, as well as evaluation of data within a vessel lot for measures of confidence, standard deviation, and so on.

Information about the vessel the specimen belonged to is gathered together. "Dimensions" includes region of the vessel represented, decorations (if any) present, and diameter of the lip or shoulder. "Images" contains a series of portals that show all the images taken of all the sherds in the vessel lot. "Attributes" include those attributes recorded during analysis, such as paste (partly determined by temper attributes), surface colour, carbon core, and wall texture. "Specs/Units" contains data on the spatial distribution of the sherds in the vessel lot. Surface modification, paste data, and stratigraphic context each are viewable through their own portals, as are archaeometric analysis and radiocarbon dates, and samples collected. Statistically relevant summaries are presented at the bottom of the page.

For each specimen, there should be some information obtainable for each of these categories, which is compiled along with other specimens in the vessel lot table. One example of how specimen data are compiled is an automatically generated average thickness for each region of the vessel represented, so that, at a glance, the analyst can see how much of the vessel profile exists, and approximately how thick it is overall. The compilation of data into a vessel lot record is accomplished by joining all specimen records with the same vessel lot name to a corresponding vessel lot record. The vessel lots and individual specimens are also linked to the archaeological site table by corresponding unit and level data. This allows the user to compare specimens by unit and level, and to compare vessel lots by unit and level.

Descriptive Fields

The descriptive are provided for recording observations about the vessel lot and summarize the following categories: decorative attributes; morphology; paste attributes; forming attributes; firing regime; use wear; analysis conducted on the vessel lot; and context description. These fields are meant to give descriptions that are drawn both from the summarized data and from observation during analysis.

Care has been taken to make these descriptions as accurate as possible and to record descriptions in these fields whenever observations were made, so that the resulting vessel lots are as complete a record of the vessel lot as possible. This is in contrast to my natural tendency to record observations in the sherd records where they tend to get burried when analyzing the assemblage at the level of vessel lots.

AUXILIARY TABLES

The following is a brief summary of the auxiliary tables in the database. These tables allow more nuanced data recording in certain areas because they allow one-to-many joins. In other words, for example, rather than being able to record one or a set number of photos, each photo stored in the "Images" table is connected to one vessel lot, so all the photos taken can be viewed in that record, whether they amount to one or one hundred.

Images Table

The table records data about the image (what kind of image it is, when it was taken, and so on), identifying data about the sherd and vessel lot it is connected to, and where it is stored, in addition to containing the images itself. Images are categorized in order to allow them to be filtered in different portals (e.g., temper photos, surface modification photos, etc.)

Surface Modification Table

The table records detailed data on each surface modification recorded on a vessel lot. It is connected in a many-to-one relationship with the Vessel Lot table. It contains a portal that allows photos of all the surface modifications photographed on the vessel lot to be displayed.

Composition Table

The table contains compositional data taken from any physicochemical characterization technique (SEM, laser ablation, etc.) as well as data about how the compositional data was acquired. The table is linked to the vessel lot table in a many-to-one relationship, but is also linked to the various archaeometric techniques tables (e.g., SEM, XRF, LA-ICP-MS, or Total Digest). The table also contains a portal through which all images (of spectra, micrographs, etc.) are viewable.

APPENDIX 5: DECORATIVE GROUPS

One of the main goals of this research has been to determine how important decorations are in the role of pottery manufacture at Gaspereau Lake. Because decorations have formed the core of seriations in this and other regions, they continue to be the main means by which pottery is evaluated. However, considering that decorations are neither necessary to the act of making pottery nor naturally stable because of material constraints, they are not necessarily a good indicator of group affiliation or chronological significance. Their role as chronological indicators and group markers should therefore be tested and investigated rather than assumed. This role can be investigated by delineating tool types in a sample and examining the vessel lots in each resulting group for whether other attributes, such as paste characteristics, temper minerals, forming and firing attributes, and morphology also exhibit homogeneity within each group. Chronological significance is shown by similar date ranges within groups and differences in date ranges between groups.

In the remainder of this section on surface modifications, I examine decorative attributes that cluster as groups, and I examine whether they relate to other attribute clusters and exhibit chronological significance. To do this, I first identify groups of decorations based on element shapes, tool shapes, and application methods; then I compare vessel lots in each group to evaluate their relative homogeneity or heterogeneity across multiple attributes. These groups are not statistically tested because, for the most part, they are too small. I therefore acknowledge that they await more rigorous testing once better sample sizes exist following further research.

Following are descriptions of classes of dentates and PSS decorations and details about the vessel lots that fall within each group. These classes have been defined based on common attribute states that indicate a type of tool.

Fine Straight-Edge Dentate

This tool type is the only dentate recorded in the assemblage that exhibits truly discrete elements. These elements are square-cornered and quite small on average (ca. 1.1 mm^2), both rocker- and simple-stamped, always horizontally oriented except in one case (GLNS:144). The elements are further distinguished by exhibiting a pyramid-shaped depression. Rocker-stamped impressions are always tight-angle; simple stamps are always closely spaced.

Vessel lots decorated with Fine Straight-Edge Dentate tools are generally thin (0.25–0.85 cm)—one exceptionally so (GLNS:144), with an average lip thickness of 0.18 cm and an average neck thickness of 0.25 cm. Most of the vessels in this group lack sufficient morphology to be easily compared, but they all appear to conform to the expectations of conoidal jars, with rounding presumably around the shoulders and excurvature below the lip. At least two vessel lots have squared rims with single-element indents around the exterior lip edge. All vessel lots in this group exhibit very smooth surfaces (interior and exterior), possibly scraped or burnished. In all except one case (GLNS:18), paste texture is fine and temper comprises below 10% of the paste. Grit and grog were noted in the case of two vessel lots, while the rest were tempered with grit only, most (*n*=6) with a notable dearth of mica. The exception is GLNS:18, with 30% temper, white and pink feldspar, plentiful mica, and quartz particles, and slightly larger dentate elements that are not as discrete as on other vessel lots. This vessel lot also comes from Locus 1. Doubt is therefore cast on whether this vessel lot really belongs in this group; however, it remains for the present study because it is considered a variant. No vessels in this group exhibit use wear, including carbonized residue. A number of sherds decorated with Fine Straight-Edge Dentate decorations exhibit a distinct carbon core, taking up 40–70% of the wall. Other vessel lots exhibit no carbon core.

Name	Fine Straight-Edge Dentate	Element Type	Dentate		
Type Piece	BfDd-24:5717	Type Vessel	GLNS:51	N of vessels	5
Vessel Lots:	18, 51, 103, 119, 137, 140, 141, 144, 146				
Modification type	Decoration	Tool spacing	Discrete, closely spaced		
Tool edge shape	Straight				
Application technique	Simple, rocker	Application class	Stamped		
Element spacing	Discrete	Element shape	Squared to triangular		
N of observed elements	>16	Tool length (cm)	n/a	Impression depth	Shallow
Mean element width (mm)	1.2	Mean tool width (mm)	0.9	Neck Thickness (cm)	0.2–0.9
Stamp orientation	Probably horizontal				
Vessel regions	Lip, neck, downward to an unknown extent, not shoulder				
Surfaces	Lip, exterior				
Paste texture	Predominantly fine	Temper type	Grit; grit and grog/iron oxide		
Temper minerals	White quartz, feldspar, mica, grog/iron oxide				
Area	Locus 1 and Locus 3				
AMS date (2σ)	none				

Blended-Edge Dentate

Blended-Edge Dentate encompasses a class of dentate/PSS decorations with conventional dentate elements that are connected by a ridge on one edge. This ridge is less deeply impressed than the dentate elements, so that the dentates are not really continuously connected but rather appear to blend together slightly. The dentates are usually rectangular tending towards trapezoidal. Because of the slightly trapezoidal shape and the variation of depth of the connecting ridge, the decoration can sometimes look more like PSS than dentate.

Vessel lots with the Blended-Edge Dentate decoration exhibit parallel, discrete but closely spaced (ca. 2 mm), impressions, oriented horizontally (*n*=4), vertically (*n*=2), and obliquely (*n*=2). The horizontal impressions often exhibit a slight curvature. There appears to be an areal division between vessels stamped horizontally and vessels exhibiting other orientations, the former coming from Locus 1 while the latter come from Locus 3.

Paste textures range from fine to medium-coarse. Temper is grit or grit and grog/iron oxide. At least two vessels (GLNS: 82 and GLNS:88) exhibit distinctive bluish-grey quartz particles, and most (*n*=7) exhibit feldspar. Most (*n*=6) exhibit excurvate necks, while one exhibits an incurvate or straight neck. Neck shapes are straight or rounded. Neck thickness ranges from 0.5 to 0.9 cm. Surface colour ranges from variegated orange to buff to medium-brown. All decorations occurred on the exterior and lip surfaces, and interiors were either finger- or anvil-smoothed. None co-occurred with punctates. Only one (GLNS:167) appeared to have a collar created by a deeply impressed row of the dentate tool just below the lip, so it is not a true collar. Clay colour is predominantly buff-brown to light or even white in all vessels.

Only one vessel lot (GLNS:82) exhibited use wear in the form of a substantial carbonized residue on the interior surface. This was dated to 1550±30 (417673 from Beta Analytic; see AMS Dates and **Table 15**). There may be a difference in date ranges between the Locus 1 and Locus 3 vessel lots because other indications (two AMS dates and differences in vessel pastes between the two areas) indicate slightly different time periods of use. This will be discussed in greater detail in the section on AMS dates later in this chapter.

Name	Blended-Edge Dentate	Element Type	Dentate/PSS				
Type Piece	BfDd-24:12512	Type Vessel	GLNS:82	N of vessels	8		
Vessel Lots:	22, 23, 25, 82, 112, 123, 145, 167						
Modification type	Decoration	Tool spacing	Discrete, closely spaced				
Tool edge shape	Straight tending toward curved						
Application technique	Simple	Application class	Stamped				
Element spacing	Blended	Element shape	Trapezoidal to squared				
N of observed elements	19–22	Tool length (cm)	6	Impression depth	Shallow–1mm		
Mean element width (mm)	1.4	Mean tool width (mm)	1.5	Neck Thickness (cm)	0.5–0.9		
Stamp orientation	Horizontal (4), vertical (2), oblique (2)						
Vessel regions	Lip, neck, downward to an unknown extent						
Surfaces	Lip, exterior						
Paste texture	Fine to coarse	Temper type	Grit; grit and grog/iron oxide				
Temper minerals	White and clear quartz, bluish-grey quartz, mica, white and pink feldspar, grog/iron oxide						
Area	Locus 1 and Locus 3						
AMS date (2σ)	Cal AD 420 to 575 (Cal BP 1530 to 1375)						

Trapezoidal Continuous-Element PSS

This decoration consists of a PSS tool that has sharp corners on one edge and a wavy line on the other edge, with elements running together. This creates the impression of a series of trapezoidal-shaped elements connected on their bases by a flowing line. Because elements are clearly connected, it has been labeled a PSS decoration, but a variation of this tool consists of discrete trapezoids, appearing to be dentates. This apparently occurs when the tool is not impressed with equal pressure on both sides so that only the trapezoidal shapes appear without their connecting bases. This decoration appears to be closely related to the Fine Straight-Edge Dentate tool both in similarity of decorative tool and application and in paste and vessel characteristics. Impressions are horizontal (3), oblique right (2), oblique left chevron (1) and unknown (2).

Vessel lots decorated with Trapezoidal Continuous-Element PSS are predominantly thin, with wall thicknesses ranging from 0.35–0.75 cm and a standard deviation no greater than 0.06cm across vessel wall measurements, indicating quite even thicknesses. Pastes are grit-tempered and range from medium-fine (10%) to medium-coarse (30%) in texture. At least two vessel lots are associated with an orange residue as well as containing grog/iron oxide, and appear to have been tempered with iron oxide. Pastes are predominantly hard. Temper minerals include quartz, feldspar, mica, and grog; four contain only quartz. Carbon cores are absent or distinct. Surface colours range from reddish or bright orange to medium brown to sooty brown (this last, GLNS:79, is apparently the result of having experienced intensive post-breakage heat). Morphologically, the vessels decorated with Trapezoidal Continuous-Element PSS are somewhat varied, and vessel shapes are not clear in all cases, but some are excurvate with squared lip edges and no collars. Neck diameters range from 12–22 cm. Very little evidence of use exists on any vessel lot in this group, although one has a small amount of carbonized residue on the interior surface whose origin (pre- or post-breakage, pre- or post-deposition) is not clear.

Name	Trapezoidal Continuous-Element PSS	Element Type	Dentate/PSS		
Type Piece	BfDd-24: 6753	Type Vessel	GLNS:79	N of vessels	8
Vessel Lots:	7, 13, 59, 70, 79, 99, 154, 159				
Modification type	Decoration	Tool spacing	Discrete, closely spaced		
Tool edge shape	Straight				
Application technique	Simple	Application class	Stamped		
Element spacing	Continuous	Element shape	Trapezoidal		
N of observed elements	19–22	Tool length (cm)		Impression depth	Shallow–1mm
Mean element width (mm)	1.4	Mean tool width (mm)	1.5	Neck Thickness (cm)	0.5–0.9
Stamp orientation	Horizontal (4), vertical (2), oblique (2)				
Vessel regions	Lip, neck, downward to an unknown extent				
Surfaces	Lip, exterior				
Paste texture	Med.fine to med.coarse	Temper type	Grit; grit and grog/iron oxide		
Temper minerals	Quartz, mica, feldspar, grog/iron oxide				
Area	Locus 1 and Locus 3				
AMS date (2σ)	none				

Precisely Impressed Classic PSS

As the name implies, this decoration consists of a classic PSS stamp characterized by crisp lines that are easy to identify. There is no mistaking the thin, even width of the wavy line, the continuous, even depth throughout the impression, and the rounded corners on each element. The potter(s) that used this decoration type seems to have wanted the beauty of the decoration tool to be noticed and admired.

All tool edges observed are straight. Impressions are discrete (simple) and closely spaced. Bands of impressions are in evidence, differentiation among them having been created by differential orientation of impressions. Impressions ranged from horizontal to vertical to oblique and multiple orientations were observed on single sherds. Element corners range from rounded to (more rarely) squared. Depth ranges from shallow to >1mm and <2mm. One element was measured at 1.2x1.8 mm. Tool length and number of elements were not determined in any case due to the small size and number of sherds in each of the vessel lots.

Vessel lots with this decoration tend to have highly smoothed—possibly burnished—interior and exterior surfaces and relatively bright red surface colours. Carbon core tends to be absent or light. Neck measurements range from 0.3–0.6 cm with one outlier at 0.9 cm; generally, neck thickness is relatively small. Pastes tend to be hard and many show signs of relatively high-temperature oxidizing firing regimes. Pastes are fine to medium-fine (0–12.5%) and are tempered with grit, especially with white quartz but also mica and possibly grog. Surface cracking is minimal, indicating that the vessels were probably not subjected to significant heat other than during the initial firing. No vessel lots in this group exhibited use wear.

Name	Precisely Impressed Classic PSS	Element Type	PSS		
Type Piece	BfDd-24:	Type Vessel	GLNS:	N of vessels	6
Vessel Lots:					
Modification type	Decoration	Tool spacing	Discrete, closely spaced		
Tool edge shape	Straight				
Application technique	Simple	Application class	Stamped		
Element spacing	Continuous	Element shape	Rounded corners		
N of observed elements	n/a	Tool length (cm)	n/a	Impression depth	Shallow–1mm
Mean element width (mm)	n/a	Mean tool width (mm)	n/a	Neck Thickness (cm)	0.3–0.6
Stamp orientation	Horizontal and oblique, various orientations on each vessel				
Vessel regions	Lip, neck, downward to an unknown extent				
Surfaces	Exterior				
Paste texture	Fine to medium fine	Temper type	None, grit; grit and grog/iron oxide		
Temper minerals	Quartz, mica, feldspar, grog/iron oxide				
Area	Locus 1 and Locus 3				
AMS date (2σ)	none				

Deeply Impressed Classic PSS

This group consists of apparent PSS decorations that are unusually deeply impressed in the clay surface, causing their individual elements to be somewhat obscured but nevertheless continuously connected. These impressions are discrete (simple) for the most part (only one instance of rocker stamping was observed) and are either straight or somewhat curved. Impressions are horizontal and oblique, and occur on the exterior surface and possibly on the interior surface. This decoration type is associated with multiple zones of decoration consisting of bands of impressions created by differently oriented sets of impressions. Bands are horizontal from what can be observed. Elements are, on average, 1x1mm, with number of elements and tool length unknown as a result of highly fragmented vessels consisting of few sherds.

Vessels decorated with Deeply Impressed Classic PSS exhibit medium to coarse pastes (20–40% temper, with a high incidence of white quartz along with observed mica, feldspar, and grog/iron oxide. Neck thicknesses range from 0.6–0.9 cm. At least two vessel lots exhibit sooty brown surfaces, indicating highly reducing conditions either during firing or post-depositionally. Cooking use is not likely to have created such even sooty colour throughout the paste, and post-depositional conditions that would deposit sufficient carbon to create the observed brown-black especially pronounced on GLNS:71 is unusual, so the original firing regime seems the most likely factor. It is not possible to see the clay colour on these sherds, but GLNS:125, the clay colour is orange-buff, although this vessel lot also exhibits some sooty colouring.

Name	Deeply Impressed PSS	Element Type	PSS		
Type Piece	BfDd-24: 14368	Type Vessel	GLNS:67	N of vessels	4
Vessel Lots:	4, 67, 71, 125 (62)				
Modification type	Decoration	Tool spacing	Discrete, closely spaced		
Tool edge shape	Straight or somewhat curved				
Application technique	Simple	Application class	Stamped		
Element spacing	Continuous	Element shape	Rounded corners		
N of observed elements	n/a	Tool length (cm)	n/a	Impression depth	1mm-2mm
Mean element width (mm)	1	Mean tool width (mm)	1	Neck Thickness (cm)	0.6–0.9
Stamp orientation	Horizontal and oblique, various orientations on each vessel				
Vessel regions	Lip, neck, downward to an unknown extent				
Surfaces	Interior, lip, exterior				
Paste texture	Medium to coarse	Temper type	Grit; grit and grog/iron oxide		
Temper minerals	Quartz, mica, feldspar, grog/iron oxide				
Area	Locus 1 and Locus 3				
AMS date (2σ)	none				

One vessel lot that was not included in this classification, but which might rightly belong in it, is GLNS:52. This vessel lot is decorated with PSS impressions that are less deeply impressed and so has been classified as a Precisely Impressed Classic PSS. However, it does not fit very well in the latter category because, even though the decorations are shallower, the wavy line is less precisely discerned than for most vessels with Precisely Impressed PSS. This possibly indicates that the tool has more in common with Deeply Impressed PSS. Additionally, the paste attributes are more like vessel lots in the Deeply

Impressed category, including evenly sooty brown colour of the clay, a predominance of white quartz particles, and a slightly thicker neck. This vessel lot might be considered intermediary between the two decoration types.

Fine Triangular PSS

Fine Triangular PSS is highly distinctive but also variable. At one extreme, elements are evenly sized triangles connected by their bases in a thick, even line; on the other extreme, only the tips of the triangles are visible, creating what appears to be fine, discrete dentates. In one case, the tool was observed to be curved, but in all other cases, it is straight. The convex edge is straight where the elements connect, while the concave edge is jagged because of the triangles. The tool on GLNS:160 has been rocked on in alternating, oblique columns, a decoration strategy that is unique in the Locus 1 and Locus 3 samples across dentate, PSS, and cord-marked vessels.

PSS Treatment

This class of tool impressions is a fairly distinctive use of a PSS (or dentate) tool in which the impressions are closely spaced, usually rocked on in tight-angle impressions so that the entire surface is impressed within an area of the vessel. Sometimes bands are discernible where the tool's maximum length is apparent, but unlike in a decorative usage, this appears to be a limitation rather than a deliberately incorporated zoning. In other words, the aim appears to be texturing a large area rather than creating decorative bands or zones. In the End of Dyke assemblage, only one vessel lot exhibits PSS treatment, but it is worth noting because it is a common surface modification in other regions (e.g., Woolsey 2010).

Cord Marks

In the case of vessels decorated with cord marks, a similar diversity exists as for dentates and PSS. The first division made among cord impressions is between fabric- or net-impressed vessels and cord-wrapped edge-stamped vessels. In the former case, cord marks are a combination of the warp threads flexibly held together by the weft threads, so that two alignments (or at least one) of cordage can be discerned within a continuous textural field. These are impressed by pressure from the hands or paddle, or into a mould. Conversely, cordage wrapped around an inflexible or semi-flexible edge such as a stick or paddle edge leave a linear impression whose elements are characterized by the alignment, twist direction, ply, and tightness of the cord as well as by the contour of the wrapped edge.

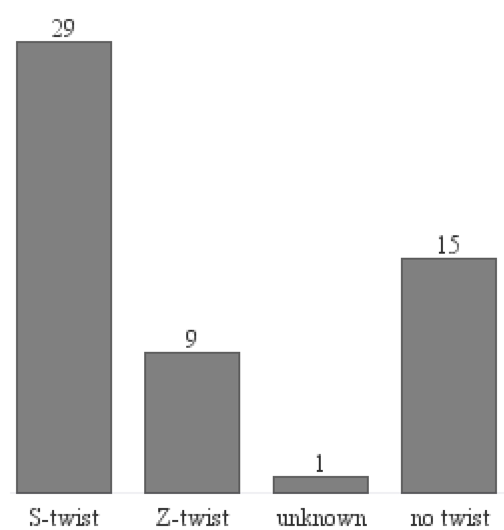

Figure 77: Distribution of cordage twist directions by vessel lot.

Another distinction exists between cords that are plied (more than one strand twisted together) or unplied (no twist). A third category not usually recognized—because it is difficult to distinguish from plied cords—are fibrous materials that are fortuitously twisted while being wrapped around a stick. To clarify this concept, a quick activity shows the mechanism for this fortuitous twist: try wrapping a long material, such as a piece of grass or an electric cord, around a dowel such as a pencil. It will be observed that a certain amount of twisting of the grass or cord occurs in this process, the avoidance of which requires careful manipulation and may not seem worth the effort. This class of cord mark, which I have called "wrap-twisted," is most recognizable by its lack of uniform pattern of beads, or segments within a cord impression, such that some elements have two or three discernible beads but many have only one continuous bead. Additionally, the twist appears loose compared with most plied or deliberately twisted cords.

Cord Twist Direction and Ply

Cords that are twisted—either plied or wrap-twisted—will exhibit a twist direction, which is either S- or Z-twist, so-named for the middle segments of letters S and Z, the former oblique-right, and the latter oblique-left. Each letter is used to denote the directional slant of the diagonal line created between beads within an element. This direction results from two or more threads twisted together, creating separate segments that twine around each other and create a distinctive slug-like impression in clay. Following Petersen (1996) and Adovasio (2010), twist directions have been reported here opposite to how they appear in the clay, reflecting that the impression is a negative or mirror image of the cord. The twist direction of cord has been recorded in this region (Petersen and Sanger 1991; Sanger 2003) and others (Petersen 1996; Adovasio 2010) as a possible marker of group boundaries because it is determined by learning lineages rather than by technological or communicative concerns (see Chapter 2). In other words, it is determined by the teacher's own muscle memory and how stable the learning lineage is; that is, whether the lineage is frequently interrupted or augmented, or whether the same twist direction is likely to have been passed on through multiple generations. Wrap-twisted cord also exhibits twist direction, but unlike in the case of plied cord, wrapped twist direction ought to be determined by handedness rather than learned muscle memory, so that the majority of wrap-twisted elements will exhibit a Z-twist corresponding to the majority of right-handed potters likely to exist in any group. This makes the identification of twist direction trickier and its significance more fraught, particularly considering that what some have identified as plied twist direction may actually be wrapped twist direction.

Both S- and Z-twist cord impressions occurred in the assemblage in roughly a 3:1 ratio across the Locus 1 and Locus 3 samples. While no vessels were found with two different cord twist directions impressed on them, there are at least two instances of vessels that were clearly related with the same cordage size, cord ply, paste, and manufacturing techniques that nevertheless exhibited opposite twist directions. GLNS:168 and GLNS:20 are an example of this. Both appear to have been over-fired. They exhibit similar paste, tightly twisted 2- or 3-ply cord-wrapped edge impressed vertically, and aggressive interior channeling. They also occur in the same unit and level. The fact that they exhibit S- and Z-twist respectively would conventionally indicate that they were made by members of different technological groups (Kenyon 1986:20; Petersen 1996; Petersen and Hamilton 1984; Sanger 2003), but such a case cannot be maintained here.

Materials

Plied-cord marks are further distinguished by whether they exhibit a tight or loose twist (Adovasio 2010). The former will result in more beads per element, the latter in fewer. Tightly plied cord may (but does not necessarily) indicate that the fiber requires greater twist to remain in cord form and not revert to untwisted, loose fibres. The division between "tight" and "loose" plies is arbitrary, and tight has been arbitrarily designated as exhibiting three or more beads per element on average, and also of being slightly better defined in the clay. There may be little real difference between them, however, which ought to be kept in mind in considering the validity of the classes here defined.

Unplied cords could consist of any number of materials. Some of the most likely ones are porcupine quills, bird quills, long grass and bulrush leaves, and root bark, all of which were known from ethnographic data to have been used in textile arts of the Mi'kmaq (Whitehead 1978; 1980; 1982; 1993). Because so little is known about the textile arts and practices of the Woodland Period, categories are tentative and material identification is broad and speculative for the most part.

One problem with the traditional designation of "cord-wrapped stick" is that cord marks often indicate that a stick was likely not the edge over which cord was wrapped. Cord wrapped around a dowel will exhibit a slightly tilted axis relative to the perpendicular axis of the dowel. This tilt becomes increasingly pronounced with increasing space between cord elements. Some decoration tools do exhibit this uniform tilt in their elements, but many do not. Again, because knowledge of textile arts during the Woodland Period is so incomplete, possible explanations for this structure are highly speculative; they including the edge of a semi-stiff textile such as a basket, a cord-wrapped paddle (the edge of which would have been used to decorate the surface after using the paddle to form the pot), or a quill-embroidered piece of leather or bark. In the case of true cord-wrapped stick decorations, there is also a semi-circular cross-section within element impressions and a semi-circular trough running the length of the tool edge between element impressions, caused by the roundness of the dowel, a feature that is lacking in many cord impressions. I have therefore classed linear cord-wrapped tools generally as cord-wrapped edges (or CWE) rather than the more traditional cord-wrapped stick, although I acknowledge that what I am describing is likely the same as what others have observed on similar ceramics, and I reserve the term "cord-wrapped stick" for tools that exhibit the characteristic tilt of elements and semi-circular trough shape. However, I retain the familiar "cord-wrapped stick" or "CWS" designations when speaking more comparatively about ceramics in this region and work conducted on them.

I have divided up cord mark decorations based primarily on the character of their elements, but also to some extent on the edge type, the orientation, and the spacing of impressions. Following is a description of the classes of cord marks observed in the Locus 3 sample.

Tightly Plied Cord-Wrapped Edge

This decoration class is characterized by loosely spaced cord elements with distinct beads resulting from tightly twisted plies (at least two). Most elements contain between two and four beads. In some cases, elements exhibit a slight tilt relative to the axis of the tool edge and a slight semi-circular-shaped trough running along the length of the tool, indicating a cord-wrapped stick, but in other cases, the cord appears to be attached to the edge differently because elements are oriented at right angles to the tool edge and no trough is evident.

The vessel lots with tightly plied cord marks exhibit considerable variability, suggesting that the class is not tied to one particular tradition. Paste textures range from fine to coarse and temper ranges from grit, to grit and grog/iron oxide, to organic, to a combination of these. Observed minerals include iron oxide, white and clear quartz, feldspar, and mica. Carbon cores and paste constitutions are variable, from no carbon core to indistinct to distinct and dark, and from crumbly to hard constitution; this probably indicates a range of firing regimes. Vessel neck thicknesses range from ca. 0.6 cm to 1 cm, while measured neck diameters range from 18 cm to 34 cm. Neck shapes range from straight to excurvate, while lips range from rounded to semi-squared and squared; at least two have an incipient collar. All are channeled on their interiors. Two vessel lots also have circular punctates, while one also has trailed lines. Twist directions of the cord marks are evenly split between S- and Z-twist (*n*=5 and 5, respectively).

Two dates were obtained for vessels bearing Tightly Plied CWE decorations. The calibrated date ranges at the 2σ level are 1350 to 1290 BP for GLNS:61 and 1400 to 1300 BP for GLNS:94 (see Table 15). These dates are similar but not overlapping, indicating non-contemporaneity.

Name	Tightly Plied Cord-Wrapped Edge	Element Type	Cord marks		
Type Piece	BfDd-24:2934	Type Vessel	GLNS:173	N of vessels	10
Vessel Lots:	29, 53, 56, 58, 61, 72, 94, 131, 164, 173				
Modification type	Decoration	Tool spacing	Discrete		
Tool edge shape	Straight				
Application technique	Simple	Application class	Stamped		
Element spacing	Discrete	Element shape	Plied		
N of observed elements	12	Tool length (cm)	2.3	Impression depth	Shallow–1mm
Mean element width (mm)	1.6	Mean tool width (mm)	3.7	Neck Thickness (cm)	0.65–1
Stamp orientation	Oblique right, horizontal, various orientations				
Vessel regions	Lip, neck, shoulder, downward to an unknown extent				
Surfaces	Exterior	Paste texture	Fine to coarse		
Temper type	Grit; grit and grog/iron oxide; organic				
Temper minerals	White and clear quartz, mica, and pink feldspar, iron oxide, shell (?)				
Area	Locus 1 and Locus 3				
AMS date (2σ)	Cal BP 1350 to 1290) Cal BP 1400 to 1300)				

Loosely Plied Cord-Wrapped Edge

Loosely Plied CWE is similar to Tightly Plied CWE, except elements average two beads and sometimes exhibit only one. Some appear to be CWS evident from the semi-circular trough running along the axis of the tool, while others do not exhibit evidence for a dowel. Elements are loosely spaced and there exists somewhat more space between impressions than for Tightly Spaced CWE, although this is most likely fortuitous and not particularly significant. Impressions are laid on in bands around the neck in the following orientations: horizontally (7), oblique right (3), oblique left (1), and unknown (1). Many of these exhibit various orientations further down the vessel.

One difference between this category and Tightly Plied CWE is that twist directions are not split evenly (S-twist =9; Z-twist=3), which may be an indication that some vessels thought to belong to this category in fact have wrap-twisted elements, which can create a similar-looking cord mark that is poorly defined in the clay and exhibits variable bead numbers.

As with Tightly Plied CWE, the 12 vessel lots within this class are highly variable. Paste textures range from medium-fine to medium-coarse, with the largest number (5) ranging from 20–30% temper. Tempers in the vessel lots are various combinations of grit, grog, and organic. Lip shapes are variable, with 3 round, one semi-squared, one squared, one thinned, and one angled outward (unknown=5). Most necks (n=8) are excurvate, with one straight and two incurvate necks. Coil breaks are ubiquitous in these vessels. Neck thicknesses range from 0.5–1 cm. Surface colours range from light or bright red to medium brown to sooty brown, and carbon cores are similarly variable. Constitution is, for the most part, only semi-hard; this probably indicates that these vessels were either not fired particularly long or high or that they are generally more coarsely tempered than other groups of vessel lots (one exception, GLNS:180, is noticeably harder and contains white clay).

Two vessels in this class, GLNS:135 and GLNS:38, have been AMS dated and calibrated (Calib) to a two-sigma range of 1290 to 1090 Cal BP and 900 to 725 Cal BP, respectively. The first vessel lot is most likely (p=0.95) to date between 1170 and 1290 years BP. The second vessel lot is most likely (p=0.77) to have a calendar date between 700 and 800 years BP. These vessel lots are clearly not contemporaneous and any apparent relationship between them ought to be scrutinized.

Name	Loosely Plied Cord-Wrapped Edge	Element Type	Cord marks		
Type Piece	BfDd-24:6710	Type Vessel	GLNS:60	N of vessels	12
Vessel Lots:	28, 60, 63, 64, 69, 77, 80, 97, 115, 116, 135, 180				
Modification type	Decoration	Tool spacing	Discrete		
Tool edge shape	Straight				
Application technique	Simple	Application class	Stamped		
Element spacing	Discrete	Element shape	Plied		
N of observed elements	n/a	Tool length (cm)	n/a	Impression depth	Shallow–1mm
Mean element width (mm)	1.3	Mean tool width (mm)	3.5	Neck Thickness (cm)	0.5–1
Stamp orientation	Horizontal, oblique right, oblique left, various orientations				
Vessel regions	Neck, downward to an unknown extent				
Surfaces	Exterior	Paste texture	Fine to coarse		
Temper type	Grit; grit and grog/iron oxide				
Temper minerals	White and clear quartz, mica, and pink feldspar, iron oxide				
Area	Locus 1 and Locus 3				
AMS date (2σ)	Cal BP 1090 to 1290 Cal BP 900 to 725				

Unplied Cord-Marked Fan

This class of decorations is the largest, including 19 vessel lots, and possibly the most distinctive of the cord-mark decorations. It consists of unplied or wrap-twisted cord wrapped around a curvilinear edge that does not appear to be a dowel because of the general absence of a semi-circular cross-section running through the impressions. Impressions tend to be shallow though occasionally they are deeply impressed and well defined in the clay. In only a few cases is any kind of twist discernible, most elements exhibiting a hard, squared edge within the impressions that is uncharacteristic of plied cord. Width of the tool (element length) is variable, ranging from 1.5 to 4 mm, although element width is curiously uniform, most measuring 1 mm. The tool itself seems closely connected with its method of application. The curvilinear tool is typically rocked on in tight-angled impressions such that a column is created, which has an overlapping fan- or scallop-like appearance. This column runs down the vessel of the tool is applied horizontally, or in a horizontal band around the vessel if applied vertically.

Vessel lots decorated with the Unplied Cord Fan decoration exhibit a number of common attribute states. None appear to exhibit vessel-related use wear, although some appear to have use-related abrasion and carbonized material from post-breakage use, possibly as scrapers, food coverings, or hearth paving. Insufficient carbonized material exists for dating; unfortunately, this means that no date can be assigned to any of the vessel lots. Paste textures range from 10% to 50% of overall paste, with the majority (n=11) composed of 20–30% temper.

The majority of these pastes are noticeably hard and compact. All vessel lots exhibit oblique or U-shaped lamellae and pronounced coil breaks. This indicates that paddling occurred but not aggressively enough to smooth out coil breaks or to thin vessels to the extremes seen on dentate and PSS vessel lots. Five vessel lots with this decoration have organic and possibly small amounts of grit temper, resulting in fine pastes; one organic-tempered vessel also has iron oxide temper. Of the 19 vessel lots, only two have recorded feldspar particles, and in both cases, the identification is extremely tentative. It is likely, therefore, that this decorative class is linked with a temper type that is feldspar-poor for some reason (see discussion in the section on temper in Chapter 4: Ceramic Manufacture at Gaspereau Lake). Eight vessels are tempered with quartz (white and clear) and mica as well as possible feldspar; five more are tempered with mica and quartz as well as iron oxide. Given that iron oxide can be present in pastes and easily avoid detection, and given the prevalence of iron oxide, it can be supposed tentatively that these two groups are in fact the same. The pastes associated with Unplied Cord Fan therefore appear to be roughly divisible into two, or possibly three, groups: 1) quartz and mica temper (and possibly iron oxide); 2) organic (and iron oxide) temper; and 3) possibly quartz, mica, and iron oxide temper.

The paste groups are further reinforced by channeling groups. All vessel lots except one (GLNS:66) in this decorative class exhibit channeling on their interiors. Two groups of channeling are evident, one characterized by aggressive gestures that have resulted in deep, uneven grooves with significant spillage, the other characterized by even, long grooves that overlap at right angles to each other and are highly smoothed or burnished in places. The first group is associated with grit-tempered vessels while the second is associated with organic-tempered vessels.

Another similarity among at least some of the vessel lots is the prevalence of distinct carbon cores. Carbon core sizes range from 10% to 90% of the wall, but in almost every case where these data have been available, carbon core is distinct. One vessel lot (GLNS:62) exhibits an exposed wall interior with a black carbon region sharply delineated and surrounded by a halo of what appears to be iron oxide. This vessel lot was tested for firing temperature with SEM (see section on firing temperature in this chapter) and was found to have reached a temperature of at least 900°C. Much of the carbon core was evidently allowed to burn out, indicating a higher temperature and probably an oxidizing atmosphere, but the firing time appears to have been insufficient to burn out all carbon. At least one other vessel (GLNS:65) contains the same layered carbon/iron oxide wall structure, and at least one other vessel lot (GLNS:104) exhibits a shiny exterior, possibly indicating a high firing temperature or even over-firing.

Another commonality of vessel lots in this class is the high incidence of light-coloured or white clay and distinctive bluish-grey translucent quartz temper particles where pastes are tempered with grit. Although not noted for all of the vessel lots, there nevertheless appears to be a pattern in this category not evident in others such as Tightly-Plied CWS. Because paste hardness, temper minerals, and firing attributes show relatively low heterogeneity across vessel lots within this class, there is good reason to believe that the vessel lots are related by manufacturing practices and raw material sources as well as by their decorations. In other words, it appears as though these vessels were made by people who accessed the same clay and temper sources, formed their pots in a similar way, used similar decorating and channeling tools, and fired their pots in the same manner. Thus, more than any other decorative group defined in the sample, the Cord-Marked Fan group is well linked to a technological group and appears to show some measure of standardization.

The vessel lots in this class are not particularly similar morphologically. The majority (*n*=10) have excurvate necks, while three have straight necks and seven are unknown. Lip shapes are mostly unknown but where they exist, they are squared (1), semi-squared (2), round (2), thinned (2), and angled outward (1). Neck thicknesses range from 0.6 cm to 1 cm with the largest number (*n*=9) occurring in the range of 0.7–0.8 cm. Neck diameters range from 20 cm to 26 cm, a relatively small difference. Two vessels possibly have the same squared lip and sharply excurvate neck shape just below the lip, and uneven rolling of clay down from the lip so that it appears to have a collar; more could share this attribute considering that many of the vessel lots are missing rim information. However, at least five have do not have this shape.

Another area of heterogeneity exists in the cord marks on each vessel. Most (*n*=15) vessel lots exhibit cord with no twist or unknown twist, while three exhibit S-twist and one exhibits Z-twist. Number of elements is also variable, ranging from 8–18. Some applications appear to be more of a treatment or texture while others clearly show individual cord marks and the crisp zoning effect they create. The similarity of element width is intriguing and probably points to a standardized material used in each of the tools; however, the difference in number of elements, the difference in element lengths, and the slightly different curvature of the tools indicates that the tools used on each vessel lot are not one tool but many (with perhaps two exceptions that appear to potentially be examples of different vessels stamped with the same tool). I hypothesize that the elements were created by porcupine quills attached to a flexible edge such as leather, which would create the approximately correct element width, would tend to exhibit no twist, and would have to be fastened to the tool edge in a different way than by simple wrapping, the latter of which can only be accomplished with a long strand. If this is the case, the uniformity of the element widths would be explained by the natural uniformity of porcupine quills, while the differential element length would indicate different tools of the same design with different edge widths, and different contour shapes would indicate different kinds of edges (round or squared).

Given the similarity of pastes, vessel lots impressed with the Unplied Cord Fan decoration appear to belong to a group with tighter criteria than other decoration classes. This could indicate contemporaneity or a strict manufacturing lineage. However, the differences in some attributes such as morphology and tool dimensions indicate flexibility in the forms as well as in the making of the individual tools. The large size of this group of vessel lots as well as the lack of use wear makes the significance of the Unplied Cord-Marked Fan decoration an intriguing problem. Unfortunately, given the lack of dates associated with the class, it is not easily placed in context alongside other groups. Its significance as part of a tradition is discussed in Chapter 3: .

Name	Unplied Cord-Marked Fan	Element Type	Cord marks		
Type Piece	BfDd-24:14344	Type Vessel	GLNS:65	N of vessels	20
Vessel Lots:	54, 55, 62, 65, 66, 83, 90, 92, 95, 96, 104, 110, 117, 122, 129, 136, 138, 139, 149, 165				
Modification type	Decoration	Tool spacing	Discrete		
Tool edge shape	Curved				
Application technique	Rocker	Application class	Stamped		
Element spacing	Discrete	Element shape	Unplied or wrap-twisted		
N of observed elements	8	Tool length (cm)	2	Impression depth	Shallow–1mm
Mean element width (cm)	0.1	Mean tool width (cm)	0.3	Neck Thickness (cm)	0.5–1
Stamp orientation	Horizontal, vertical				
Vessel regions	Neck, shoulder, downward to an unknown extent				
Surfaces	Exterior	Paste texture	Fine to coarse		
Temper type	Grit; grit and grog/iron oxide; organic				
Temper minerals	White and clear quartz, mica, and iron oxide				
Area	Locus 1 and Locus 3				
AMS date (2σ)	none				

Cord-Wrapped Stick

As discussed above, this category of decorations is defined by evidence that the edge is in fact a dowel and cord is continuously wrapped on. This creates a slight tilt to the axis of the elements relative to the axis of the tool edge, and in most cases, it also creates a semi-circular trough running through the centre of the elements the length of the tool. Elements also are often semi-circular in profile. The decorations identified in the End of Dyke samples are divisible into two groups, the first being loosely wrapped (elements are discrete; *n*=11) and tightly wrapped (elements articulate; *n*=13). Twist is generally easier to identify in the former group. Two in the latter group have unknown twist directions, although they appear to be twisted, evidenced by their irregular shapes; one is unplied. Of the loosely wrapped CWS, five exhibit S-twist, two exhibit Z-twist, and four are unplied. All applications are simple-stamped and discrete, and in all cases, the edge is straight. The tools have been applied mostly horizontally and oblique to the right, but in almost all cases, various orientations are evident in different zones. Zoning appears to be predominantly horizontal; that is, zones occur in horizontal bands around the vessel circumference.

Loose Wrap Variation

Loosely wrapped CWS vessel lots exhibit some homogeneity in morphological and forming attributes. The largest number of lip forms, aside from unknown (*n*=4), is round (*n*=4), followed by squared (*n*=2) and semi-squared (1). Necks are predominantly straight (*n*=5), followed by excurvate (*n*=2) and incurvate (*n*=1). Neck thicknesses range from 0.5–1.1 cm, with the majority (5) occurring between 0.7–0.8 cm. Capacities are on the large side, with neck diameters ranging from 18–34 cm and two vessels exhibiting an unusually tight neck constriction on large shoulders, although one of these vessels (GLNS:27) is extremely tentative owing to the small amount of remaining lip and neck material. All except one vessel lot (GLNS:158) exhibit oblique exterior, and sometimes U-shaped, lamellae, indicating that they are not paddled sufficiently to remove coil joins, and also that they are predominantly paddled in such a way as to create lamellae slanting up and out. Coil breaks are predominantly well-developed and, in some cases, exhibit irregular shapes. Although the vessel lots in this group are not manufactured according to strict criteria, as for Unplied Cord-Marked Fan, there is nevertheless a relationship evident in forming practices tying most of these vessels together. This relationship appears to be a lessened concern with paddling and smoothing coil joins.

Conversely, little evidence of homogeneous practices exist in paste attributes of Loosely Wrapped CWS. Temper types range from grit to grit and grog/iron oxide to organic, and minerals include mica, white and clear quartz, feldspar, and iron oxide. Figure 78 shows the various combinations of minerals across the ten vessel lots. The number of different mixtures indicates that little, if any, standardization existed in temper materials beyond the general rule that granitic rock, organic material, and iron oxide are suitable materials. Temper particle size ranges from maximum recorded values of 0.5 mm to 5.5 mm, a large margin, while paste textures range from fine (0–10% temper) to coarse (50% temper). Clay and surface colour are also variable, with a number exhibiting buff-coloured clay stained medium brown or soot-coloured in many instances, while other vessels exhibit a reddish colour to the paste, particularly those with observed iron oxide. In no case was distinctive blue-grey quartz particles observed, a difference from every other group of vessel lots based on decoration.

One last area of heterogeneity is the interior channeling on each vessel. Some gestural channeling marks look like those from other groups, but within this group, many types are evident and no one type stood out as more common. The significance of these gestural marks will be discussed later in the appendix.

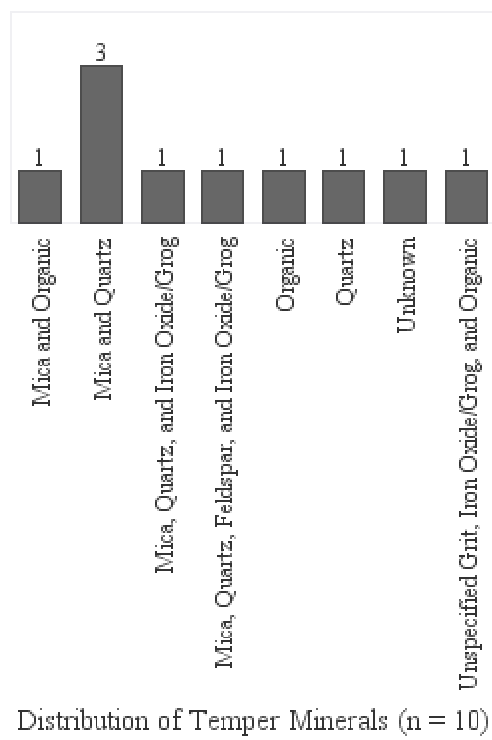

Figure 78: Distribution of minerals in vessel lots with the loosely wrapped variation of the Cord-Wrapped Stick decoration.

Tight Wrap Variation

In the case of Tightly Wrapped CWS, the sample size is too small to generalize (*n*=3), but paste, decoration application, and morphology bear some similarity. The CWS marks on all three vessel lots are evenly and closely spaced, without variation in orientation, unlike in the case of the loose wrap variation. The impressions are crisp and attention appears to have been paid to allowing for undecorated spaces. This last is tentative because insufficient material exists for any of the three vessel lots; however, it is notable that none of the three vessel lots have been channeled on their interiors, an unusual characteristic for cord-marked vessels at the End of Dyke Site.

Paste in all cases is medium (15% temper) to medium-coarse (35% temper), with white quartz occurring in all pastes. All three vessels have coil breaks, and at least one is characterized by oblique exterior lamellae. At least one sherd in each vessel lot was recorded as having a hard constitution, and especially for GLNS:78, a hard constitution is one of the defining characteristics of the vessel lot. GLNS:153 has a dark, distinct carbon core rimmed by iron oxide similar to GLNS:62 in the Unplied Cord-Marked Fan group, and another vessel, GLNS:111, has a layer carbon core interspersed with iron oxide. These two vessels apparently underwent a similar firing, while the third is heavily bleached so that any carbon core that existed is no longer visible. Because of these last similarities in paste and firing attributes with GLNS:62, and also because the cord impressions on GLNS:78 and GLNS:153 could be porcupine quills, there is a possibility of a relationship with the Unplied Cord-Marked Fan group. However, temper minerals are uniformly different between these groups.

Discussion

The two variations of CWS are similar in their variety of tempering materials and their exclusion of certain temper subtypes, such as granite with distinctive blue-grey quartz. Also similar is a tendency toward oblique-exterior lamellae and well-developed coil breaks. Otherwise, however, there is not enough to conclusively tie the two groups together. As mentioned above, the tight wrap variation appears to have more in common with the Unplied Cord-Marked Fan group than with the loose wrap variation in terms of forming and manufacturing attributes. However, because the sample size is so small, and because temper and lamellar character may indicate a similar manufacturing context, it remains part of the broader category of CWS rather than being designated as its own decorative class.

Name	Cord-Wrapped Stick (Tight and Loose)	Element Type	Cord marks		
Type Piece	BfDd-24:13816	Type Vessel	GLNS:164	N of vessels	13
Vessel Lots:	20, 27, 56, 78, 81, 93, 94, 111, 114, 151, 153, 164, 173				
Modification type	Decoration	Tool spacing	Discrete		
Tool edge shape	Straight				
Application technique	Simple	Application class	Stamped		
Element spacing	Discrete/Blended	Element shape	Plied and unplied		
N of observed elements	n/a	Tool length (cm)	n/a	Impression depth	Shallow–1mm
Mean element width (mm)	1.9	Mean tool width (mm)	4	Neck Thickness (cm)	0.5–1.1
Stamp orientation	Horizontal, oblique-right, oblique left, various orientations				
Vessel regions	Neck, shoulder, downward to an unknown extent				
Surfaces	Exterior	Paste texture	Medium-fine to coarse		
Temper type	Grit; grit and grog/iron oxide; organic; organic and iron oxide				
Temper minerals	White and clear quartz, mica, feldspar, and iron oxide				
Area	Locus 1 and Locus 3				
AMS date (2σ)	Cal BP 1175 to 1368 Cal BP 1400 to 1300				

Fine Plied Cord-Wrapped Edge

This class of decoration consists of impressions made by a small tool with markedly fine, plied cord wrapped on a straight edge. It is applied both in rocker and simple stamps, and in various orientations. Unfortunately, none of the four vessel lots with this decoration are composed of many sherds, making data about the vessel lots, including zoning and other decorative attributes, sparse. One thing that is common among the vessels, however, is a tendency toward thickened lips that almost appear to be collars (one occurring as a lip on the interior), and the inclusion of organic particles that may be tempering material in two vessel lots and is the only temper in a third. Clay appears to be uniformly buff-coloured across this group. One is channeled. GLNS:26 is decorated with what is clearly a fine CWS in a variety of orientations reminiscent of GLNS:94 of the CWS class, and also shares other attributes with GLNS:94, indicating a likely relationship. This group's common attributes across the four vessel lots (buff-coloured clay, organic inclusions, thickened lip) and consistency of cord elements indicate that the decorative tool marks a tradition.

Name	Fine Plied Cord-Wrapped Edge	Element Type	Cord marks		
Type Piece	BfDd-24:12918	Type Vessel	GLNS:14	N of vessels	4
Vessel Lots:	14, 26, 57, 77				
Modification type	Decoration	Tool spacing	Discrete		
Tool edge shape	Straight				
Application technique	Simple/rocker	Application class	Stamped		
Element spacing	Discrete/Blended	Element shape	Plied and unplied		
N of observed elements	n/a	Tool length (cm)	n/a	Impression depth	Shallow
Mean element width (mm)	n/a	Mean tool width (mm)	n/a	Neck Thickness (cm)	0.8–1
Stamp orientation	Horizontal, oblique-right, oblique left				
Vessel regions	Neck, downward to an unknown extent				
Surfaces	Exterior	Paste texture	Medium-fine to coarse		
Temper type	Grit, iron oxide, and organic; organic				
Temper minerals	White and clear quartz, mica, and iron oxide				
Area	Locus 3				
AMS date (2σ)	None				

APPENDIX 6: PASTE GROUPS

PASTE GROUPS

In this section, I report on the ceramic fabrics observed in the Locus 1 and Locus 3 samples and discuss the categories that were constructed based on homogeneous attributes. These categories were arranged without the aid of petrographic or compositional analyses and are based on macro-scale observations such as hardness, estimates of temper percent, minerals observable in stereoscopic analysis, and clay characteristics.

Paste has been characterized using two main categorization strategies: temper groups and clay groups. Temper groups aim to divide vessels along repeating attribute states of temper, based mainly on mineral/material type (e.g., mica, feldspar, organic), mineral colour (e.g., bluish-grey, white), and particle size (e.g., 1.1–4.5 mm). Because this was not always straightforward, and a number of overlapping temper types (e.g., iron oxide and organic, organic and grit), made for an unwieldy number of categories, an effort was made to create categories based on what I perceived to be the most defining particle type. This was a subjective process and other researchers may have created groups based on a different hierarchy of attributes. Secondary attribute states that were considered in this categorization, but did not necessarily preclude vessels from categories, were temper percentages and particle angularity. The reason for this is that attributes of particles can be indications of behaviour, and therefore, stability or change in particle attributes through time indicates continuity or disruption of behaviour, respectively.

The other strategy was clay groups, such that clay colour, hardness, and texture were used to divide vessels lots. Clay colour was only assumed to be known when a fresh break free from carbon core, leaching, and colouration due to iron oxide staining could be observed. This does not necessarily imply that the observed colour is the natural colour of the clay when fired, because clay colour is altered when mixed with other ingredients, particularly fine mineral particulates such as iron oxide. In addition, firing conditions obviously have a bearing on clay colour. Therefore, clay colour was used as a preliminary investigation of the priorities of potters in clay gathering, processing, and firing, although by no means was a clear-cut, theoretically justified classification in Dunnell's (1978) sense subsequently constructed. The result was rather the start of acknowledging and fleshing out the differences in clay constitutions, colours, and textures. The only verification used for these clay classes was a comparison with temper classes to see if some relationship existed.

These two strategies do not divide vessel lots by fabric attributes such as hardness, temper percent, and "mesh" or particle size. Yet these are also important in how a ceramic vessel functions and whether it is made in a recognizable tradition. A classification of fabrics was developed, but is not particularly useful except as a descriptor because the categories are too numerous to be analytically useful. It is hoped that future work to clarify the relationship of temper and clay groups to each other may help build an analytically useful third classification of fabrics. Presumably, such a classification would best represent the ideas of the potters as opposed to the inductively formulated categories of temper and clay.

The complexity if this system of classification is necessitated by the range and variability of the ceramic assemblage. Because the assemblage covers such a nuanced time-scale resolution, minute shifts in paste are important in understanding the trajectory of the manufacturing traditions. The main purpose of designating groups from microscopic work and without the aid of petrography and compositional analysis is not to positively identify sources but rather to uncover more complicated hierarchies that take into account behaviour and organization of production. These hierarchies are complicated because they are composed of combinations of attribute states that are repeated or related and thereby show considerations of the potters on a number of levels. These considerations include acceptable amount of labour in processing temper, appropriate materials, appropriate substitutions for ideal materials, advantages of certain paste textures over others, and so on. Where, in some regions, clays and tempers shift together through time and across space such that distinct types can be discerned and appear to represent behaviour, in the case of the GLR ceramics, shifts are nuanced and probably represent a more flexible ideology about pottery manufacture. These shifts are typically too coarse to be detected by a concentration on strictly mineral groups, but are too fine to appear in macro-analyses that group ceramics by temper type. Although for the most part, any conclusions reached via this system will need significant follow-up research to verify and understand the importance of the findings, this investigation shows that variability does exist and that it is meaningful.

Temper Groups

In this section, I detail some of the more prominent groups observed. Because some groups contained only one or two specimens, and are variations of other, larger groups, they are not described here and are listed only in the database.

Feldspar-Poor Granite

This category of temper is a granite composed mainly of mica and quartz (usually both white and clear) and exhibits a dearth of feldspar. Iron oxide or grog are also present in nearly half of pastes (*n*=22). Organic material is also reported for four vessel lots in this group. Paste textures range from fine to coarse with the majority falling on the medium-coarse side. Because this is the largest category (*n*=47), including both iron oxide-rich and non-iron oxide variations, it exhibits the largest range of particle size, decorative traditions, and morphology. Neck thicknesses range from 0.2–1.6 cm. All neck and lip shapes are

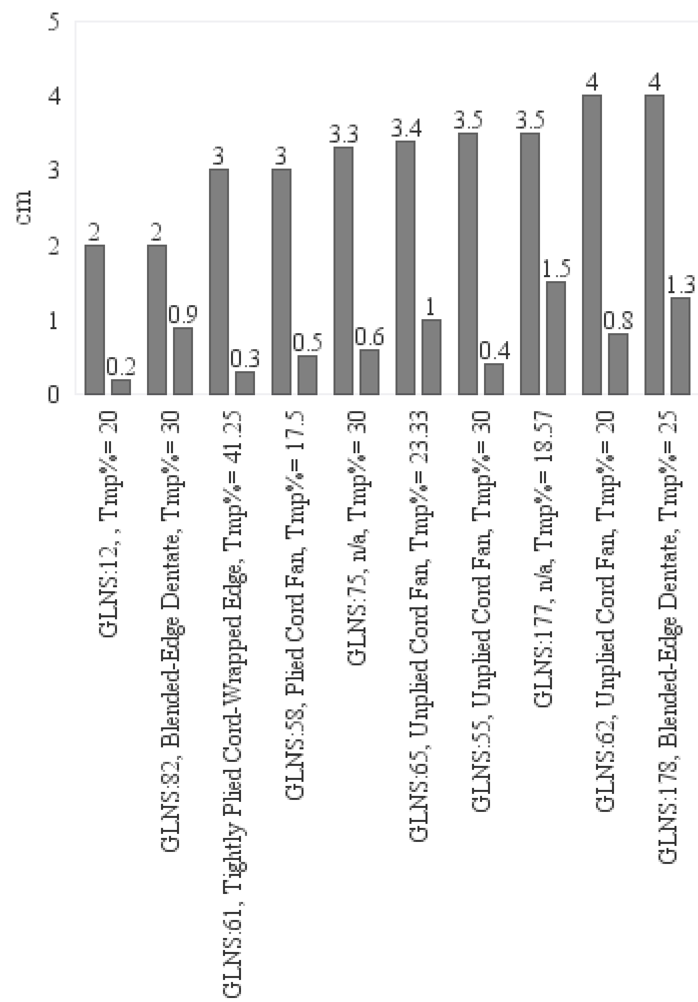

Figure 79: Distribution of maximum and minimum temper particle measurements in vessel lots containing the Bluish-Grey Quartz temper, in vessel lots for which these data exist (*n*=10).

represented. Particle size ranges from 0.5–6mm, and temper percentages range from 5–60%. Many vessels have some carbon core, ranging from 10–90% of the wall and with a peak around 70%, but 25 have no carbon core. This temper source appears to have been accessed throughout the history of ceramic manufacture represented in the Locus 3 sample, having been found in each of the PSS-, dentate-, and cord-decorated groups. The relative homogeneity of the temper mineral combinations indicates stability through time in resource procurement.

Vessel lots in this group are variable. All surface colours and clays are represented, as are all decoration traditions, lip and neck shapes, and carbon core types. Neck thicknesses range from 0.2 to 1.6 cm, with the largest number (*n*=9) falling between 0.7 and 0.8 cm. Neck diameters range from 12 to 36 cm. Two AMS dates were obtained on vessels in this group (given at the two-sigma range): 1560–1410Cal BP (undecorated); and 1400–1300 Cal BP (cord-marked).

The high variability exhibited by this group indicates that it represents a source that was accessed through much of the manufacturing history of Gaspereau Lake. This temper is feldspar-poor, an attribute not exhibited either by the bedrock in the area nor by glacially transported cobbles that would be expected to exhibit a range of materials. This temper is likely derived from the processing of pegmatitic granites outcropping in or surficially overlying the area, during which feldspars could be separated out, particularly if the materials were decomposed first by placing them in fires. This mixture of temper minerals is not seen in New Brunswick, where a variety of white, light pink, and salmon-pink feldspars characterize most ceramics and only rarely is a feldspar-poor sherd encountered.

Because this temper exhibits a lack of feldspar in common with the Bluish-Grey Quartz temper (see below), it seems possible that the two types are related. The bluish-grey quartz particles are frequently only observed as such when they measure more than 2mm in diameter, and frequently, other particles in the same sherd appear transparent or translucent. I note, therefore, that the variation within this distinctive quartz source, ranging from dark grey to lighter grey blue to clear and milky translucent, means that some vessel lots undoubtedly contain the distinctive quartz but were not recognized as such. This variation was also noted by Kontak (2003) and MacDonald et al. (1992). Future petrographic and chemical characterization techniques would resolve this question.

Bluish-Grey Quartz

The most distinctive characteristic of this temper (*n*=13) is its namesake, the particles of bluish-grey quartz that are generally angular and occur as large as 4 mm in diameter. This particle typically occurs alongside gold or black mica and iron oxide, mixed with buff-coloured or white clay, and temper typically comprises more than 25% of the overall paste but not more than 40%. Feldspar particles are absent, as a rule. Paste constitutions are frequently hard and the fabric tends to be compact with little organic content.

Vessel lots (*n*=12) made from this paste appear to belong predominantly to one of two decorative groups: Blended-Edge Dentate (*n*=3) and Cord Fan (*n*=4) (discussed in Appendix 5: Decorative Groups). The former exhibit an absence of channeling while the latter exhibit ubiquitous and often aggressive channeling. Channeling marks are similar to each other, exhibiting minimal cross-hatching and mostly horizontal followed by horizontal/vertical orientations; most were labeled as the same channeling type during analysis (Channeling 2, *n*=6). The cord-marked vessels also exhibit coil breaks. In some cases, the paste is so hard that the sherds have broken in angular, sharp fractures. Morphology is variable, but thicknesses cluster between 0.7–0.8 cm (*n*=8) with others ranging from 0.5 to 0.9cm.

Although the distinctive colour of the quartz particles was recognized early in the analysis, certainty that it was meaningful occurred relatively late. This meant that the colour was not noted in many instances, and my impression is that I came across this distinctive temper more frequently than I noted. In addition, the absence of feldspar is noteworthy and different from collections from New Brunswick. The fact that a large number of vessel lots do not have the distinctive particle noted but have in common with this temper a predominant lack of feldspar strongly suggests that these tempers represent more-or-less the same source and processing behaviour. If this is the case, as I suspect, then the overarching feldspar-poor granite group is the majority temper (*n*=48).

White Quartz

Vessel lots with White Quartz (*n*=14) are characterized, as the name implies, by a majority of white quartz particles. Not only the colour but the size of these particles is distinctive: typically, they are fine to medium (>2mm in diameter) and comprise more than 20% of the overall paste. They typically also occur alongside mica but rarely with feldspar. The clay fabric typically exhibits an even brown or sooty brown-black colour on interior and exterior surfaces, although colour varies to light brown and buff colour. Iron oxide particles are not typically identifiable within the matrix, but iron oxide layering occurs frequently in this group. Clay colour free from carbon staining is not accessible.

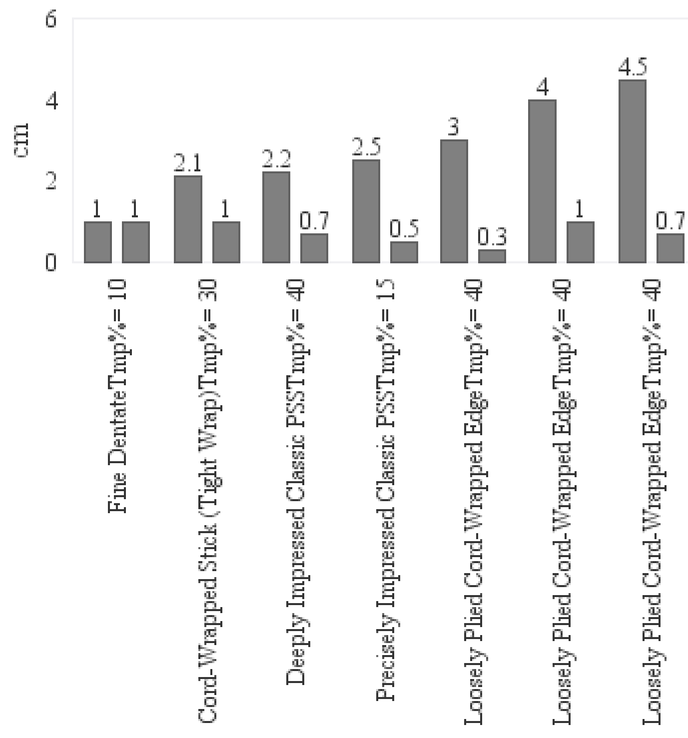

Figure 80: Distribution of maximum and minimum temper particle measurements in vessel lots containing the Bluish-Grey Quartz temper, in vessel lots for which these data exist (*n*=7).

Decorative traditions are variable within this group and show that the temper type is not particularly related to time period or decorative traditions. Included in this group are Loosely Plied CWE (*n*=3), CWS (*n*=1), Cord Fan (*n*=2), Precise PSS (*n*=1), Deeply Impressed PSS (*n*=1), Fine Dentate (*n*=1), and Trapezoidal PSS (*n*=3). There is strong correspondence with brown or sooty grey-black surface colour (*n*=12), showing that the temper appearance is probably related to either firing atmosphere or post-depositional heat, such as from a hearth. In addition, pastes are predominantly semi-hard (*n*=12), possibly indicating a short or low-temperature firing regime, but also possibly indicating post-depositional heat damage. Because temper type is more likely to be linked to firing regime than to post-depositional processes, I favour the latter explanation. Many of these vessel lots are associated with the hearth feature F-27, which may indicate that the vessels were broken during use and left in the fire or, conversely, that they were used as hearth paving. Either case would have stained the fabrics sooty brown or medium brown and possibly turned the otherwise clear quartz white, giving the temper a distinctive look. Nevertheless, the paste should be analyzed in the future to better understand its significance, particularly since other vessels exhibiting sooty or reduced-atmosphere colouration do not also exhibit these same distinctive white quartz particles.

A relationship may exist among the three CWE vessels regarding their temper particles and percentages, as shown in Figure 80. These vessels are composed of identical temper percentages and have similarly large particle measurement ranges compared with the other vessels, in addition to containing the same distinctive white quartz particles. Also, although they differ in decoration and morphology, all cord marks are S-twist.

Mica-Poor Quartz

This category of temper, consisting of nine vessel lots, is characterized by white and clear quartz with little or no mica particles. Grog/iron oxide is also contained in most or all of these vessel lots. Predominantly, the vessel lots in this group are PSS- or dentate-decorated (*n*=7), with two vessel lots decorated with cord marks. Paste is fine (>5%) to medium (>20%) with one vessel lot (GLNS:136), a cord-marked vessel, composed of 40% temper. Another commonality among the vessel lots in this group is an iron oxide staining on some surfaces and/or a reddish colouration, except in the case of GLNS:67, which exhibits an unbroken sooty brown colour, possibly obscuring an original reddish colour. Neck thicknesses are on the thin side, with four vessel lots under 0.5 cm thick. Necks range from excurvate to straight, but in the majority of cases where lip shape is known, lips are squared (*n*=3), followed by semi-squared (*n*=1) and angled outward (*n*=1), with an absence of rounded necks. A comparison of neck thickness by temper percent shows weak correlation (R^2=0.018, *n*=8), in contrast to the population, which shows a moderate correlation (see Paste Texture section). Numerous decorative traditions are represented with no one cluster.

Based on the variability of manufacturing attributes, this temper probably represents a variation of the Feldspar-Poor Granite temper group, such that mica was sorted out by the same mechanism that precluded feldspar. As discussed above, the large crystals of all three main minerals observed in pegmatitic granites would give a potter the choice of which constituents to choose for temper, and these vessel lots seem to indicate instances of a preference for a non-micaceous temper. Because it is a small group, such a preference cannot be explored far. Yet it is interesting to note that the majority of these instances appear to be earlier in the GLR manufacturing sequence.

Mica-Rich Granite

In contrast to the previous group, this group of vessel lots (*n*=3) shows an unusual amount of mica along with white and clear quartz and feldspar. Interestingly, these three vessels also share a relatively small particle range with what appears to be particle size sorting based on low standard deviations compared with other groups. Because there is little in manufacturing attributes to set this group apart, the most probable explanation for the distinctive temper is that stored processed temper reserves were getting low and the smaller particles at the bottom of the storage container were being used. Because mica flakes have such pronounced cleavage planes, they are more vulnerable to fracture along all axes, making them generally the smallest particles yielded by crushing granite. It would be expected that large numbers of the light, small mica flakes would sort to the bottom of any container or pile in which they were placed. This mechanism can frequently be seen in ceramic manufacturing situations where production is ongoing, but also occurs in any situation in which materials are stored for any length of time and accessed intermittently. It therefore does not necessarily indicate full-time production, but probably indicates a situation in which potters expected to be sedentary for an extended period of time. Although the converse situation rarely reveals itself archaeologically or ethnographically, it is expected in this other case that there would be no reason to process more than enough temper for an immediate need, especially considering that rotten granite is so easy to come by in the Maine–Maritimes Region.

Feldspar-Rich Granite

This category of temper represents a wide range of temper minerals that are united by including feldspar, in contrast to the majority temper, in which feldspar is absent. While other temper types cluster tightly in terms of the minerals included, such as bluish-grey quartz, Feldspar-Rich Granite exhibits a range of coloured feldspars (pink to white), quartz (pink, white, and clear), and mica (gold and black). Iron oxide is also sometimes apparent alongside these minerals. This category contains 27 vessel lots, 12 of which are dentate-decorated, an unusually high number compared with the other temper groups and suggests a temporally significant behaviour. Two vessel lots are decorated with PSS, one with fabric impression, and another eight with cord marks. Clays are also variable, spanning whitish to reddish to brownish colouration (discussed further below). The group's variability of minerals and its moderate association with dentate decorations suggests that it represents a collection of behaviours outside the majority behaviour of acquiring temper from one pegmatite source. Temper could have come from other sources around Gaspereau Lake, such as the glacially deposited materials (granites included) within some small basins that were shown to contain non-local materials (Nova Scotia Geospatial Atlas). Temper in this category could also have come from exotic sources such as trade, although—given the fact that some clays appear to be local and some decorations are very similar to majority styles in the sample—this probably represents a fairly small portion if import happened at all.

Iron Oxide Temper

This group of vessel lots (*n*=10) are defined by containing iron oxide as the main tempering ingredient. The pastes were tested using SEM (see discussion above), and while the results are not conclusive and require further investigation, the high iron content of certain large particles near sherd surfaces, coupled with the discovery of iron oxide particles in the paste using SEM, means that the particles are definitely not grog, as previously suspected (Woolsey 2010), and that the next most likely constituent is limonite. These vessel lots are characterized by noticeably hard and compact pastes, prominent iron oxide tempering, usually the presence of significant organic material, and light-coloured clay. These vessel lots mostly come from Locus 1 and are all cord-marked. They are also usually characterized by angular breaks so that sherds are sharp-looking and fracture pattern is concoidal. Other tempering material occurring in these vessel lots include grit temper, and some contain bluish-grey quartz. In fact, these vessel lots bear a number of similarities to Bluish-Grey Quartz pastes, including light-coloured clay and Unplied Cord Fan decorations. All vessel lots for which these data were recorded are composed of buff-coloured clay variegating to white and/or pink, the latter probably due to the iron oxide content. It therefore appears that Bluish-Grey Quartz and Iron Oxide tempers are related to each other and may either be contemporaneous or else one gradually replaced the other through time.

All the vessel lots in the Iron Oxide temper group are cord-marked except GLNS:172, which is dentate-decorated and tempered also with feldspar-rich granite. Four are decorated with the Unplied Cord Fan decoration. Five used Z-twist cord, one used S-twist cord, and three used unplied cord. All except one vessel lot (GLNS:172) exhibit interior channeling, many with a distinctive channeling style that appears to be a combination of aggressive but even channeling and subsequent burnishing so that many, but not all, striations are removed. This group exhibits the greatest degree of homogeneity across vessel lots, particularly in terms of paste, making it the best candidate for a distinct paste type of all those discussed in this section.

Discussion

The temper groups delineated in this research show a clear majority of granite minerals with a distinct dearth (although not complete lack) of feldspar. Although a number of vessel lots, not included in the above-described categories, exhibited equal or even greater proportions of feldspar with quartz and mica, these vessel lots tended to come from Locus 1 and/or to be unusual for the sample in other ways, such as in decoration or clay colour. As discussed earlier in this chapter, this seems to indicate a reliance on a particular granitic source with large enough crystals that feldspar could be manually separated from the mica and quartz crystals.

One obvious exception to this is the White Quartz category. Unfortunately, it is unknown whether the different and distinctive white quartz particles result from post-depositional processes or initial procurement and processing strategies. While these particles are most often accompanied by dark or sooty clay, which may indicate excessive heat, it is difficult to imagine that the sherds in this category would experience a fire hotter than the original firing temperature after they had been broken. It would not be expected that cooking fires would exceed 600°C except accidentally, and even then, it seems unlikely they would exceed the original firing temperatures sufficiently to change the appearance of the quartz. Fires used for other purposes, such as heat-treating lithics, might exceed these temperatures, and repeated heating events may also change the look of quartz particles. This question could be resolved experimentally. In any case, this group also exhibits a lack of feldspar particles, suggesting that the idea about feldspar as undesirable influenced the potters.

Clay Groups

In this section, I describe the clay groups observed in the Locus 1 and Locus 3 samples.

Buff-to-White

This group includes vessel lots that exhibit a buff- or off-white-coloured clay (*n*=17). Typically, the clay looks lamellar in fine bands, resembling flow-banding of volcanic rocks in the way the layering bends and curves. It is often interspersed with layers of iron oxide staining and/or carbon core. This colouration is unexpected, because surficial clays usually have significant iron oxide content, almost always ensuring they will fire to a bright red colour. Collections in New Brunswick generally range from red-brown to grey-brown to sooty brown, but usually do not exhibit buff-coloured clay in more than a few unusual pieces. This may therefore be a distinguishing attribute between Woodland ceramics of the two provinces, and with more comparative work, the light clay may turn out to be specific to the GLR site complex, further narrowing down the source of light-coloured sherds in this region.

Vessel lots in this group are predominantly cord-marked (*n*=13), with the remaining four decorated with dentates and three falling into the Blended-Edge Dentate decoration group. Of the cord-marked pottery, four are of the Unplied Cord Fan group. Temper groups represented by these vessels are Bluish-Grey Quartz (*n*=8), Feldspar-Poor Granite (*n*=5), Iron Oxide (*n*=2), Mica-Rich Granite (1), and White Quartz (1). Considering that Bluish-Grey Quartz and Feldspar-Poor Granite are likely related, the majority of vessel lots with white clay are tempered with a similar temper source. Paste textures are on the coarse side, with the majority (*n*=13) listed as between medium and coarse. Seven are listed as medium.

Neck thicknesses are relatively constrained compared with other groups, ranging from 0.5–0.9 cm; a weak negative correlation exists between neck thickness and temper percent (*n*=14, R=-0.1307, R^2=0.0171) with a low probability that the results are significant (*p*=0.66). Conversely, a comparison of neck thicknesses with temper percentages reveals a moderate negative correlation (*n*=7, R=-0.7453, R^2=0.555) with a possibility that the result is significant (*p*=0.054), just over the 0.05 significance level. The only explanation I am able to offer is that this progression leads from dentate-decorated to cord-marked vessels, such that thickness is likely to go up as predicted by Petersen and Sanger as well as by this research (see the section on morphology in Chapter 3: Variation and Variability in the GLR Ceramic Assemblage), but correlated decreasing diameter is harder to understand, particularly because it is not reflected in the assemblage as a whole, nor in any of the other clay groups.

Vessel lots heat-tested with SEM all appear to have been fired originally over 900°C, with most exhibiting distinct carbon cores and some exhibiting distinctively hard pastes. At least two vessel lots exhibit iron oxide halos around their carbon cores, possibly indicating the addition of iron oxide to the paste.

One AMS date was acquired for a vessel lot in this group. GLNS:61 was dated between 1350–1290 Cal BP at the 2-sigma range.

Buff-to-Pink

This group appears similar to the previous group in that clay often exhibits a buff colour, but in this group, it gradates toward pink or light orange rather than white. 11 of the vessel lots have iron oxide reported as a constituent, which partly explains the colouration. Unlike many of the Buff-to-White vessel lots, whose iron oxide particles are visible, these vessel lots appear to have a fine particulate rather than a granulate, evidenced by the even colouration and the pinkish, rather than orange-ish, hue. Temper ranges from grit to iron oxide to organic, in various combinations of these constituents. Temper groups represented are Feldspar-Poor Granite (*n*=5) (three containing iron oxide), Iron Oxide/Organic and Iron Oxide (*n*=4), Mica-Rich Granite (*n*=1), Mica-Poor Quartz with iron oxide (*n*=1), and Bluish-Grey Quartz with iron oxide (*n*=1), with two containing unrecorded temper. The fact that not all pastes with reported iron oxide have this pinkish colour, such as some belong to the Buff-to-White group, probably has to do with the fineness of the iron oxide particulate, the purity of the red ochre, and the degree of mixing before forming. It may also be the result of differential leaching post-depositionally.

The majority of vessel lots in this group have coil breaks, and most of those with coil breaks are pronounced and angular. Lamellae tended to be oblique, but this was not true for those vessel lots decorated with dentates. One possibility to explain this pattern is that potters were using the hardening property of iron oxide. While dentates were still in style, paddling was an important technique, but after cord-marked pottery became the norm, paddling decreased. In the former case, harder pastes may have been a by-product of the colour, whereas later in time, the hardening property may have allow potters to decrease the paddling stages.

Vessel lots in this group are decorated with cord marks (*n*=9) and dentates (*n*=4) (one unknown); interestingly, nothing that could be called a PSS decoration is included, suggesting that this clay colour resulted from practices occurring after the early Middle Woodland. Four vessels have Z-twist cord impressions, while two have S-twist cord impressions. The majority of temper percentages fall between 20–30%, while the rest range from 10–50%. Pastes tend toward the fine side with only one labeled as coarse and only two labeled as medium-coarse. All neck and lip shapes are represented. Neck thicknesses range from 0.2–1.6 cm, a large span, with a cluster (*n*=4) between 0.7–0.8 cm. When they have been recorded, carbon cores in this group tend to be distinct and cluster around 50–60%, slightly lower than in other groups. Most of the vessels with a recorded carbon core also tend towards hard pastes; this may indicate a slightly higher and more oxidizing firing temperature. SEM heating tests confirmed this in the case of GLNS:144, which appears to have originally been fired to higher than 800°C, and GLNS:131, which appears to have been originally fired higher than 900°C. GLNS:77 was also tested and was probably fired higher than 600°C and maybe higher. No radiocarbon dates exist for this group.

Brown-Buff

Clay in this group of vessel lots (*n*=17) appears similar to that in the Buff-to-White group: it is buff-coloured, exhibits a fine lamellar character that bends like flow-banding in volcanic rocks, and tends to break into sharp, angular edges. The main difference is that, in this category, clay is generally stained by carbon and/or reduced iron oxide, so that it appears overall more brown-coloured and darker than the light buff clay in the previous category. Temper groups represented by these vessel lots include Feldspar-Poor Granite (*n*=8), Granite/Feldspar-Rich Granite (*n*=3), White Quartz (*n*=3), Bluish-Grey Quartz (*n*=1), Mica-Poor Quartz (*N*=1), and one non-tempered vessel lot. Paste textures tend towards the coarse side, although all textures are represented; the largest paste texture (*n*=5) is coarse.

Temper percentages are evenly distributed from over 10% to under 50%, with one vessel lot containing no discernible temper.

PSS, dentate, and cord marks are all represented in this group. Interestingly, the only two instances of exterior channeling both fall into this group. Cordage twist is either S-twist or no twist, with three unknown cord twist directions. All lip and neck shapes are represented in this group. The majority of vessel lot neck thicknesses (*n*=8) for which these data exist cluster between 0.7–0.8 cm, and they range from 0.5–0.95 cm. The majority (*n*=13) exhibit coil breaks.

One vessel lot in this group, GLNS:93, was heat-tested using SEM, and appears to have been fired as high as 1000°C. This vessel lot was also radiocarbon dated to between 1368–1175Cal BP at the 2-sigma range. Two other vessel lots, GLNS:86 and GLNS:122, were dated, at the 2-sigma range, to between 1560–1410 Cal BP and between 1405–1305 Cal BP, respectively.

Brown Reduced

This clay group is composed of vessel lots (*n*=31) with brown-coloured clay, often (but not always) semi-hard or even soft and crumbling. Vessel lots in this group are more likely than in other groups (with the exception of Sooty Brown) to retain carbon coring, with a majority (*n*=19) exhibiting a measurable carbon core. These carbon cores range, fairly evenly distributed, from 10–100% of the wall, and they tend to be quite dark and distinct. Vessel lots in this group also frequently exhibit layering of carbon cores with bright orange layers of iron oxide. Vessel lots that have been included in this group predominantly exhibit a brown colouration, even though light-coloured clay was frequently observed within the walls exposed by fresh breaks (e.g., GLNS:28).

Paste textures range from fine to coarse, with the largest number (*n*=12) listed as medium. Temper percentages ranges from 0.75–60% of overall paste, with the largest number (*n*=9) containing between 20–30%. Temper types represented are Feldspar-Poor Granite (with and without iron oxide) (*n*=11), Granite /Feldspar-Rich Granite (*n*=6), White Quartz (*n*=5), Quartz with iron oxide (*n*=2), and Organic (*n*=2).

All neck and lip shapes are represented in this group. Neck thicknesses cluster between 0.6–0.8 cm, with a range from 0.4–1.1 cm, making this group slightly thinner on average than other groups. Cordage twist is mostly S-twist (*n*=10) with two Z-twist cords, and five cords have no twist. Three AMS dates were acquired for this group: Cal BP; GLNS:94 was dated to between 1400–1300 Cal BP; GLNS:135 was dated to between1287–1089 Cal BP; and GLNS:28 was dated to between 900–725 Cal BP, the latest date acquired for the site.

Sooty Brown

This group of vessel lots (*n*=3) exhibit sooty or dark brown colouration on a large portion of the sherds, indicating that they were exposed to open fire to a significant degree. This can have occurred in three main ways: during the initial firing, during cooking, or after breakage if the sherds have been left in the fire. Only three vessel lots have been listed as Sooty Brown, and in all cases, the charring event appears to have occurred post-breakage.

Only one exhibits possible use wear but none exhibit evidence of cooking events. Two of the three vessel lots are listed as containing White Quartz temper; the other contains Feldspar-Poor Granite. Two are probably from the Middle Woodland Period: one (White Quartz) is decorated with Deeply Impressed PSS, while the other (Feldspar-Poor Granite) is decorated with Trapezoidal PSS. The third is dated to the Late Woodland, from 1175–980Cal BP at the 2-Sigma range. All are medium-coarsely tempered, ranging from 25–40%. The only thing connecting these vessel lots is probably the fact that they experienced severe charring in contrast to the majority of vessels in the Locus 1 and Locus 3 samples.

Iron Oxide Red

Vessel lots in this group (*n*=9) exhibit a reddish or orange stain either on the surface or as part of the paste, or both. Often, these vessel lots do not contain iron oxide particulate that can be identified visually. Only two temper types are represented: Grit (*n*=8) and Grit and Grog (*n*=1). Paste textures range from fine to coarse with the majority (*n*=5) listed as medium, and temper percentages range from 5–40% with the majority (*n*=5) clustering around 30%. Temper groups represented are Feldspar-Poor Granite (*n*=5), Mica-Poor Quartz and Grog (*n*=2), and Feldspar-Rich Granite (*n*=1).

Neck thicknesses are unusually small in this group, with the largest number (*n*=4) falling between 0.7–0.8 cm, but the remainder (*n*=3) fall below this number, with a total range of 0.35–0.8 cm. Five vessel lots have excurvate necks; one has an incurvate neck. All known lip shapes are squared or semi-squared (*n*=5) or angled outward (*n*=1). PSS/dentate decorations are unusually well represented in this group (*n*=5), with three cord-marked vessel lots and one undecorated vessel lot. Two of the cord-marked vessels are Cord Fan decorations, while the PSS/dentate vessel lots are all fine-element tools including PSS Treatment (*n*=1), Trapezoidal PSS (*n*=1), Fine Dentate (*n*=1), Fine Triangular Dentate/PSS (*n*=1), and Precisely Impressed PSS (*n*=1). At least some of these vessel lots are likely to be from earlier portions of the Middle Woodland Period based on the fine-sized elements and pristine PSS decorations, but at least one (GLNS:140) is more likely to come from just prior to the Late Woodland based on its similarity to another, AMS-dated vessel lot (GLNS:160) (see section on Fine Triangular Dentate decorations in Appendix 5: Decorative Groups).

As discussed above in the section on Iron Oxide, it appears that the orange staining prevalent in the Locus 1 and Locus 3 samples comes from a number of possible sources. These include leached and redeposited iron oxide originally mixed in with the paste, leached and redeposited iron oxide from paintstones and other sources of red ochre that are abundant at the site, and leached and redeposited iron oxide from the soil. Because iron oxide almost certainly occurs as temper in ceramic pastes on the End of Dyke Site, it is reasonable to assume that at least some of this staining comes from the ceramics themselves. In the case of the Iron Oxide Red group, there is unusual similarity among vessel lots in their neck thicknesses, PSS/dentate decorations, and lack of visible iron oxide particles. Granite also appears to be similar, most vessel lots exhibiting Feldspar-Poor Granite temper. It seems likely, therefore, that most vessels in this group were made using a recipe that included a fine particulate of iron oxide mixed into the clay and the same feldspar-poor granite used in most vessels in the Locus 3 sample.

Light Red

As with the previous category, vessel lots in this group (*n*=12) exhibit a reddish colour and a possible relationship with iron oxide. However, in the case of Light Red ceramics, no staining is apparent, and instead, the paste itself looks light red rather than white, buff, or brown. There are other similarities to Iron Oxide Red vessel lots, such as the predominance of PSS/dentate decorations (*n*=9), the tendency (although not as strong) toward thinner necks, and a similar preference for granite minerals above organic. One difference is that several vessel lots have particles of iron oxide visible, a difference from the Iron Oxide Red vessel lots. Another difference is that only four vessel lots were composed of Feldspar-Poor Granite, while other granite vessel lots show different kinds of granite that may indicate variability of temper procurement strategies and/or exotic ceramics. At least two vessel lots (GLNS:70 and GLNS:120) have pink feldspar, highly unusual in the Locus 1 and Locus 3 samples; the former is also decorated with dentates and a rounded, decorated collar that is also unusual in the samples, while the latter is decorated with oblique right and left dentate fan decorations, also highly unusual in the samples. Another of the vessel lots (GLNS:108) is fabric impressed and exhibits granite with fairly equal proportions if mica, quartz, and granite, typical of ceramics in New Brunswick and other parts of the far Northeast. Only one Cord-Fan decoration was included in this group.

All known neck shapes in this group are excurvate; three lip shapes are squared or semi-squared, while two are rounded. The majority of pastes (*n*=6) are fine, with six listed as medium or medium coarse. Temper percentages ranges from 0–36% with the largest number (*n*=4) falling between 10–19%. One vessel lot, GLNS:160, was AMS dated to between 1525–1355 Cal BP at the 2-Sigma range.

The vessel lots in this group are mostly without carbon cores. Two vessel lots (GLNS:51 and GLNS160) have even, distinct carbon cores occupying 50–60% of the vessel wall; these vessels are part of the same decorative tradition as well, and exhibit similar pastes and finishing techniques. The other vessels appear evenly reddish and many (*n*=6) tend toward hard constitutions; this probably indicates that they were fired in similarly oxidizing conditions, possibly relatively high. Heat-testing with SEM revealed that firing temperatures were, in fact, relatively high. GLNS:108 and GLNS:160 both appear to have been fired over 900°C. The fact that they were independently identified as belonging to the same clay and paste group probably means that these ceramics were fired in a similar firing regime, which may indicate a tradition.

This clay group exhibits some unique attributes that set it apart from the others. While clay used in these vessel lots may be the same as that used in others such as the Buff-to-White group, there is a significant lack of angular broken edges, startlingly white clay revealed in fresh breaks, and distinctive banding and layering seen in some other groups that relate them without doubt to the Buff-to-White group. Rather, in the Light Red group, clay appears to be composed of fine and flexible particles, evidenced by the lack of surface cracking and the blocky appearance to the clay in broken wall cross-sections. Additionally, SEM compositional analysis for GLNS:160 revealed that the Al:Si ratio is slightly lower than in other clays; the significance is that this vessel lot is somewhat representative of this group in terms of its paste because of how unusual it is, and because it is obviously related to another vessel lot in this group.

Discussion

Clay groups, excluding the Light Red group, are closely related to each other. The similarity in distributions of paste attributes across the groups indicates that processes other than differential clay sources are responsible for the differences in clay behaviour within the GLR pastes. Additionally, clays across the groups (with the exception of Light Red) exhibit similarities in breakage patterns, lamellar character, colouration, and hardness, which suggest that the majority of vessels studied are made from the same clay that exhibits low iron content and fires to a buff or white colour. In addition, I predict that a study of the clay type and particle size will reveal relatively large particles based on the tendency of the GLR ceramics to break in sharp, angular edges and the proliferation of unbroken surface cracks extending from temper particles: these are both different from trends evident in collections from New Brunswick and suggest low shrinkage rates and relative inflexibility of the clay body, which occur as a result of large particle size and low interlayer water absorption (Rice 2005). The reverse situation—small clay particles with high interlayer absorption—tends to result in a fine network of surface cracks which develop during drying rather than firing, caused by high shrinkage rates and concomitant increased flexibility when temper particles expand during firing. Breakage patterns also tend to be more irregular and less straight along edges where significant pre-firing shrinkage has occurred because particles have already undergone micro-fracture during this pre-firing shrinkage. If clay particle size is in fact larger than in New Brunswick, a relatively large kaolinite percentage may be the cause. Because kaolinite factors so greatly into the industrial landscape of Nova Scotia, this hypothesis does not seem unreasonable, particularly given the striking differences in archaeological clay bodies from GLR and New Brunswick.

The fact that White Quartz temper is reported in larger numbers in successively darker clay categories indicates that the distinctive-looking white particle probably results from the same process that darkens the clay colour. A Chi-square test that investigated the relationship of Bluish-Grey Quartz, Feldspar-Poor Granite, and White Quartz to Buff-to-White, Brown-Buff, and Reduced Brown showed that a relationship is likely to exist at the 0.05 significance level (χ^2=12.7; p=0.13; n=32). This could result from a firing or post-depositional mechanism, but it could also result from a choice of materials that coincides with a particular firing tradition. Concomitantly, the decrease in Bluish-Grey Quartz temper as clay gets darker supports the evidence that the two are inversely related to certain clays/processes, but does not resolve the issue of whether these are different processes or procurement behaviours. Compositional testing and petrographic analysis would resolve this issue.

In contrast to the Buff-to-White group and its related groups, the Light Red clay group exhibits characteristics that would be expected from other sites in the Maine–Maritimes Region. Clay is reddish in colour and tempers exhibit a mix of granite mineral types with feldspar well represented. These vessels seem more in line with the assumed practice of opportunistic manufacture, gathering clay close at hand and using glacially transported granite cobbles that inevitably will exhibit mixed mineral assemblages. The fact that the decorations are mostly associated with the Middle Woodland Period may indicate a social dynamic taking place before potters became concerned with expediency and increased production, in which potters opportunistically gathered materials but had more leisure time to experiment and labour over their work than in other places, possibly as a result of increased sedentism and more intensive resource procurement and processing at Gaspereau Lake. At least two vessel lots in this group appear to indicate a distinct firing tradition that creates a signature carbon core, and this—coupled with the similar dentate decorations—may indicate closely related potters that intended their pots to convey a message of group affiliation, affluence, and technical skill. Indeed, many of the pots in this group exhibit a highly and attractively smoothed interior and exterior, as well as carefully applied, tiny stamped tools; it is not hard to imagine that these pots were elite or highly prized pots within the corpus of the Gaspereau Lake manufacturing tradition. In any case, there is a commonality in this group of unusually red, precisely decorated vessel lots that were probably made with compositionally variable temper sources.

The relationship of the Light Red group to the Iron Oxide Red group is intriguing. Where in the former case the clay may be reddish by its composition, in the latter case, there is reason to suspect the same clay as in the Buff-to-White group but with a fine particulate of iron oxide added. In other ways, the groups are similar, as noted above: PSS/dentate decorations are unusually well represented, and vessel lots are on the thin and finely tempered side. However, in the latter group, temper appears to coincide more closely with the Buff-to-White group, indicating that the same ideas about granite sources and processing were in place. It seems possible that these groups represent similar time periods or contemporaneity, and that one group was an imitation or variation of the other. While some vessel lots are clearly not meant to look red—since no effort has been taken to slip the vessels with iron oxide-enriched clay, for example—in other cases, an effort does seem apparent to colour the white clay red or, at least, pink. BfDd-24:6552 exhibits a distinct exterior surface that not only is a different colour but is also slightly melted, a result consistent with the fluxing action of an iron oxide coating or an iron oxide-rich slip. It is possible that the white-coloured clay was desirable for some reason (for instance, hardness when fired or workability), but the red colour was preferred aesthetically or for some other reason; to solve the problem, iron oxide was added.

CONCLUSIONS

Temper and paste attributes of the Locus 1 and Locus 3 samples seem to indicate stability of resource procurement through time. Temper seems mostly to come from three sources: organic material that could be harvested during the spring, summer, and fall, such as cattail fluff or cut-up grass; iron oxide that was used for a variety of purposes besides pottery manufacture; and crushed granite from a pegmatitic source that allowed separation of crystals. These three sources were mixed and matched in pastes such that categorizing them by broad temper type is challenging and does not capture the manufacturing tradition very accurately. On the other hand, a more fine-grained categorization of temper groups by constituents seems to indicate that the same sources were used repeatedly, but that potters employed different configurations of the materials yielded by those sources. This mixing and matching in some cases may indicate preferred recipes, but in other cases, may indicate substitutions when materials temporarily ran out, or unintended sorting from storing large amounts of processed temper.

APPENDIX 7: PASTE ANALYSIS

Temper mineral combinations in Late Woodland pastes indicate mixing and matching behaviour characteristic of contexts where long-term processing and stockpiling is the norm for paste preparation. Many pastes exhibit minerals characteristic of granite, but lack feldspar, one of the main minerals in granite. In the case of one major paste group, the granite used for temper was probably the South Mountain Batholith pegmatites that outcrop throughout much of south-central Nova Scotia, and the large crystals of feldspar were removed before the other minerals were crushed. More feldspar content is apparent in PSS- and—to some extent—dentate-decorated vessels, probably indicating that temper during this earlier period was more commonly derived from glacially transported granite cobbles with much smaller crystals impossible to sort out. Additionally, many pastes exhibit various combinations of mica, quartz, iron oxide, and organic temper, indicating flexibility in recipes and paste preparation, not seen in assemblages from New Brunswick. This indicates that ingredients were standardized, but recipes were not. Because these different combinations do not line up with other classes such as decorative or firing classes, they probably represent circumstances such as availability rather than technological or communicative function. This kind of mixing and matching is typical of a small-scale production line in which pottery manufacture is continuous and substitution is preferred to ceasing production.

In the following sections, temper in the assemblage is described generally and compared to other assemblages to establish manufacturing context. Temper is then divided into tentative groups based on attributes such as mineral types and grain size; and finally, the implications are discussed.

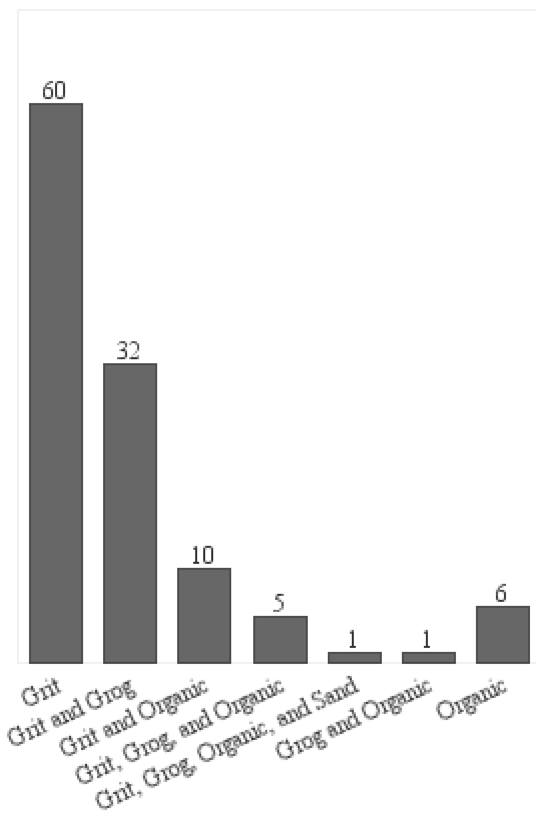

Figure 81: Distribution of temper types in the Locus 3 sample (*N*=115).

OVERVIEW OF TEMPER

Three main temper types were observed in the Locus 3 sample: grit, iron oxide, and organic (grass, cattails, or other plant fibre is assumed though unconfirmed. Other vessels contained no tempering materials that could be discerned or very small amounts of non-plastic inclusions that may have been fortuitously included. Grit-tempered vessels are by far the most common (*n*=108) in the Locus 3 sample, followed by organic-tempered vessels (*n*=23). At least 10 vessel lots are suspected to have been untempered. Finally, shell-tempered vessels were vanishingly few (*n*=1, with 5 sherds recorded, all from Locus 1). 67 vessel lots contained visible grog or iron oxide, but there is no reason to believe grog and/or iron oxide were not constituents of all pastes, considering how difficult these can be to spot.

A similar trend is mirrored in the larger sample including Locus 1, except that organic- and iron oxide-tempered vessels appear to be in greater number.

Paste Textures

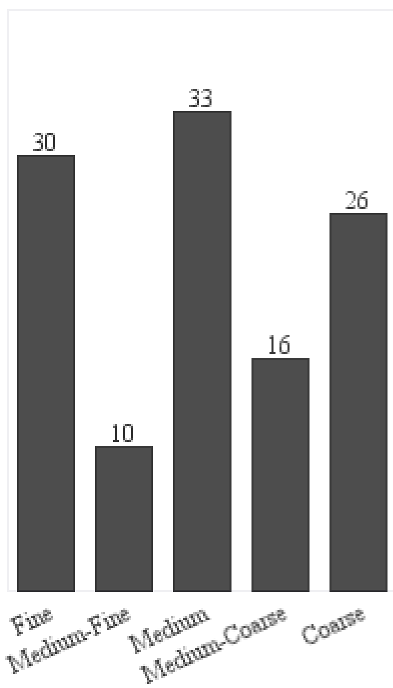

Figure 82: Distribution of paste textures in the Locus 3 sample (*N*= 115).

Within the Locus 3 sample, paste textures—how coarse the paste is as a result of mineral inclusions—is relatively evenly distributed from fine (temper <10% and <2mm particles) to coarse (temper >40% and >4mm particles). The lower amounts in the categories of Medium-Fine and Medium-Coarse are a reflection of the classification method used rather than a distributional trend. It was necessary to create the in-between categories to accommodate the differential reporting of textures across sherds in the vessel lot, a result of how much variation can exist within a single vessel.

Tests of dependency between paste texture and decorative tool revealed a tendency toward coarser pastes later in time. The tool categories included cord-wrapped stick (CWS), dentate, and PSS. Fabric impression was not used because the small number of vessel lots (n=2) would have resulted in too many unpopulated categories. A Chi-square test showed that paste texture is correlated with decorative tool ($p<0.001$), and a Wilcoxon Signed-Rank test indicated that paste texture is probably correlated with decoration tool (Z=-2.7055,p=0.007, W=658.5, n=91). Although the distribution of paste textures by decoration tool shown below (Table 28) indicates some obvious clustering, it is also easy to see that the dependency is not absolute, and—particularly in the case of cord-marked pottery—a range of variation exists.

Table 28: Distribution of paste textures compared with decoration tools.

	Fine	Medium-Fine	Medium	Medium-Coarse	Coarse	Total
CWS	11	4	20	7	17	**59**
Dentate	9	3	2	4	1	**19**
PSS	6	0	6	0	1	**13**
Total	**26**	**7**	**28**	**11**	**19**	**91**

Temper also bears some relation to wall thickness. During the process of classifying sherds by comparing them to a test tile of known temper percentage, I observed repeatedly that thicker walls tended to be classified as higher in temper. This is partly because thicker exposed wall cross-sections appear to be more likely to contain larger particles, but it may also result from a physical requirement of thinner walls to have lower temper amounts because strength to support wall weight during forming is decreased with increasing temper. This question requires more research to answer, but in order to test my observation, I correlated neck thickness with the amount of temper I estimated for each vessel lot in the Locus 3 sample for which these data exist. The resulting score shows a moderate correlation (R^2=0.2655, p<0.0001, n=67). I assumed that, if I were estimating paste textures higher based on increased wall thickness, this relationship should show up more clearly when the same test is conducted on sherds, since no "smoothing out" of data would have occurred—in contrast to the averaging of data in the vessel lot records. However, I found that the relationship appears weaker when tested on sherds (R^2=0.1586, p<0.001, n=78).

Because this appears to be a technological relationship, I tested all vessel lots so far defined from the End of Dyke Site for this correlation on the grounds that the relationship should hold across all vessels, no matter what time period. The relationship is shown to be weaker across the 96 vessel lots for which these data exist (R^2=0.1758, p<0.001, n=96).Considering the likelihood that part of the strength of the relationship may come from underestimating temper percentage in thinner specimens, I consider the moderate effect observed on the Locus 3 sample to be an important consideration but not necessarily a strong premise for coarser wares later in time at Gaspereau Lake. It therefore appears that, although higher temper percentages probably did incline Woodland potters toward thicker walls, potters were not limited by this inclination. This probably also indicates that paddling was an important skill in pottery making because paddling would be the only means by which some of the observed thinner walls could be achieved without the use of fast rotation. It is tempting to infer that paddling was more important during the Middle Woodland, since pots decorated with PSS and dentates tend towards thinner necks, a question that will be addressed in the section on manufacturing practices

Temper Minerals

Temper types are somewhat difficult to classify because a great deal of mixing of different kinds of temper minerals is in evidence. Even in cases where pastes appear only to contain ground-up granitic rocks, four different categories of mineral combinations are represented (not counting those with unspecified grit minerals). This represents a higher degree of variability than is usually reported in tempers from this region (cf. Kristmanson 1992; Nash and Stewart 1986; Sheldon 1988). The explanation may lie partly in the general practice of classifying grit and organic temper differently than I have done in this research: usually, any grit present in the paste (including sand, not actually grit at all and possibly only fortuitously included) would relegate a vessel lot to the "grit-tempered" category while the absence of grit but the presence of pore spaces would have constituted "organic-tempered." (Grog has never been reported in any pastes, nor has iron oxide, by another researcher in the Maine–Maritimes Region.) However, for the Locus 3 sample, this method broke down as I found no clear divides between grit and organic, both frequently occurring together in a range of percentages. Another, concurrently plausible explanation is that the vessels at Gaspereau Lake represent a different kind of assemblage in which greater variability is not simply observable but is an important indication of the kind of pottery manufacture at the site. This will be further discussed later in the chapter.

Despite the observed variability in temper types and minerals, temper nevertheless exhibits homogeneity in some important respects. Quartz and feldspar are, on the whole, pale, varying from white to off-white to clear with very few observed pink particles as is common in assemblages from New Brunswick. This indicates a somewhat homogeneous source, as I will discuss in the next section. Processing practices also suggest relative stability through time, such that particles are usually not larger than 4 mm in diameter and average around 2 mm. Because granite crystals range from less than 1 mm diameter to well over 5 mm on average and even larger, this kind of continuity indicates ideas about appropriate grain size.

Grit Temper

Grit temper is ubiquitously composed of granitic minerals: quartz, feldspar, and mica. However, unlike in other parts of the Maine–Maritimes Region, most ceramics lack substantial amounts of feldspar. This likely indicates a behaviour of separating large feldspar crystals from the quartz and mica particles (see Chapter 3: Variation and Variability in the GLR Ceramic Assemblage) and discarding them, grinding the other particles into a coarse-grained particulate before adding them to the clay. Usually, quartz particles are both white and clear. Sometimes quartz is pink, which probably indicates staining from iron in the clay matrix rather than a colourant in the quartz (e.g., rose quartz). Mica also occurs alongside quartz in most instances, but is absent in enough specimens (n=24) to be significant. Feldspar was also noted on occasion, and also showed up regularly in SEM compositional analyses, but generally, it is not a major component and does not tend to occur as particles visible in hand specimens. When I have identified a particle as feldspar in the Locus 3 sample, usually it is a single occurrence, indicating that it is either a fortuitous inclusion or it is a misidentified quartz particle. Therefore, the lack of feldspar across the Locus 3 sample is one index of homogeneity and is not seen in other assemblages. This is not the case in the Locus 1 sample, however, where feldspar is more obviously a constituent.

Another axis of homogeneity is the bluish-grey quartz particles observed in a number of vessels. Translucent quartz particles can often exhibit a bluish look, and it is not unusual to encounter a number of sherds in an assemblage that look this way. However, in this assemblage, the particles look distinctive and appear in enough vessel lots that they are probably not simply an effect of translucency. Rather, they appear to have darker bluish-grey banding in some cases, which would suggest an elemental composition that is responsible for the colouration. The distinctive colour is probably also most recognizable in larger particles, meaning that smaller particles might not have been labeled as the same even though they are coloured by the same processes. Therefore, a large number of the vessel lots could potentially contain this particle. If this is so, then the End of Dyke temper minerals exhibit a high degree of homogeneity compared with the George Frederick Clarke Collection and other assemblages in New Brunswick.

Organic Temper

A significant portion of the Locus 3 sample (*n*=16) are tempered only or primarily with organic temper. Organic temper (usually plant material or fibre such as hair) is identifiable by the numerous pore spaces left after perishable material has been burnt out during firing, and is distinguishable from shell temper by the softer pore space edges, the lack of shell particles (which often partly remain within shell-tempered fabrics), and the slightly heavier feel to the ceramic body. Shell-tempered pottery also tends to be thinner. In the Locus 3 sample, organic matter is visible in many vessel lots, though it is likely to have been fortuitously included in many of these cases.

The issue of fortuitous inclusion deserves attention in the case of organic temper. According to Rice, tempering materials are, strictly speaking, only those substances that were intentionally added, and other materials—such as silt or algae included in a clay—are instead to be termed *non-plastic inclusions*. This is both to distinguish them from intentional actions on the part of the potter, such as acquisition of particular tempering materials over others, and to show the indifference (or lack thereof) of a potter to certain conditions, such as the impurities of clays. These actions or inactions on the part of potters have frequently been explained in terms of cost-benefit analysis and (lack of) knowledge about techniques and sources. Rarely have actions or inactions been thought of in terms of rationales within wider cultural values and understandings. It is interesting to note that within the End of Dyke ceramics significant variation in paste composition occurs in the amount of impurities such as organic matter and small non-plastic mineral inclusions, and that this variation is cross-cut by all different variations of temper type. This leaves the impression that potters sometimes accessed clay free from organic impurities while at other times they opted for clay with greater impurities, and at still other times, they went so far as to increase organic content by adding plant or animal fibres. Rather than selecting a clean clay source, it is equally possible that clay with fewer impurities was carefully washed to remove unwanted organic matter. Reasons for allowing organic matter to remain include the increased workability of the clay as well as a potentially more durable and thermal shock-resistant fabric once fired on account of the increase in pore spaces, to mention only a few. Reasons for avoiding organic-rich clay include a denser, harder fired fabric and a better-oxidized clay (primarily a matter of colour preference). In any case, this appears to be another facet of flexibility exhibited in the pottery manufacturing traditions of Gaspereau Lake.

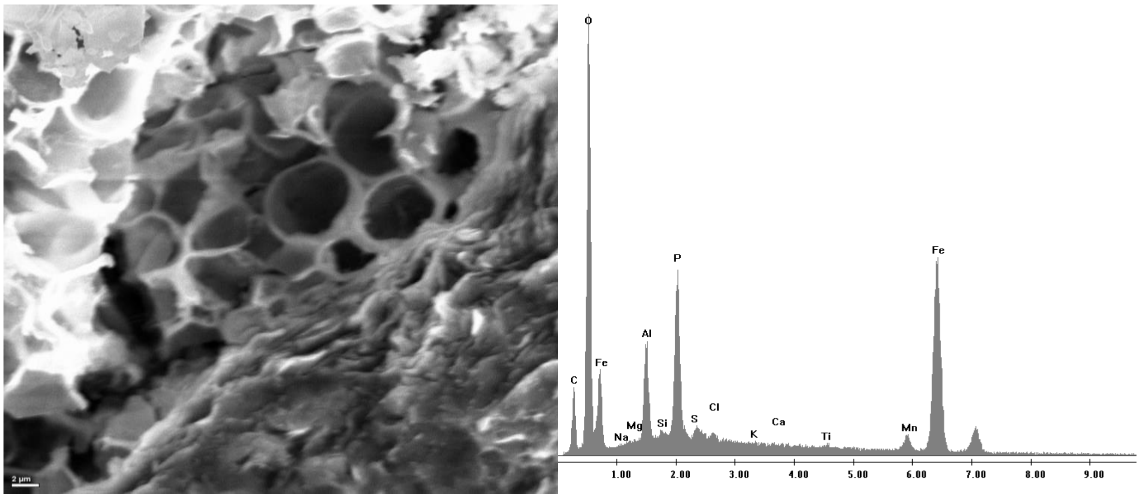

Figure 83: SEM image (left) and spectrum (right) from an iron alumino-phosphate particle within the paste of GLNS:77.

A clue to the tempering materials of organic-tempered vessels was found in GLNS:77. SEM detected a number of particles with a honeycomb-like structure that consisted primarily of phosphate, iron, and alumina (Figure 83). The particle withstood heat up to 1100°C during re-firing. Presumably, plant and animal fibres would burn out completely during the initial firing, and would certainly have been long gone by the time the ceramic was fired to 1100°C. These particles, therefore, represent a class of tempering material, probably a mineral that maintains its structure even at high temperatures. The honeycomb structure indicates that the particle is not shell, which typically has a more compact, platy or columnar, structure, depending on the species (Wilmot et al. 1992). One possibility is feather-tempering, a practice that has been reported from Alaska (Anderson 1968; Dumond 1984:31; de Laguna 1940:64–65; Lucier and VanStone 1992; Neusius and Gross 2007:167) and from Finland (Mökkönen 2008:129). Because feather quills clearly play a role in decorating End of Dyke ceramics, they might also be considered as tempering materials. However, I have found no compositional or microstructural studies of feather-tempering, most evidence for the practice having been gathered from ethnographic studies of pottery-making peoples in parts of Alaska (Lucien and VanStone 1992). Experimental studies of feather-tempered pottery would help answer this question. For the present study, I note that the similarity between the GLNS:77 SEM pictures and some images of quills, as well as the likelihood that quill structure can survive high temperatures to some extent (Jagadeeshgouda et al. 2014), make for an intriguing possibility that feathers were used as temper.

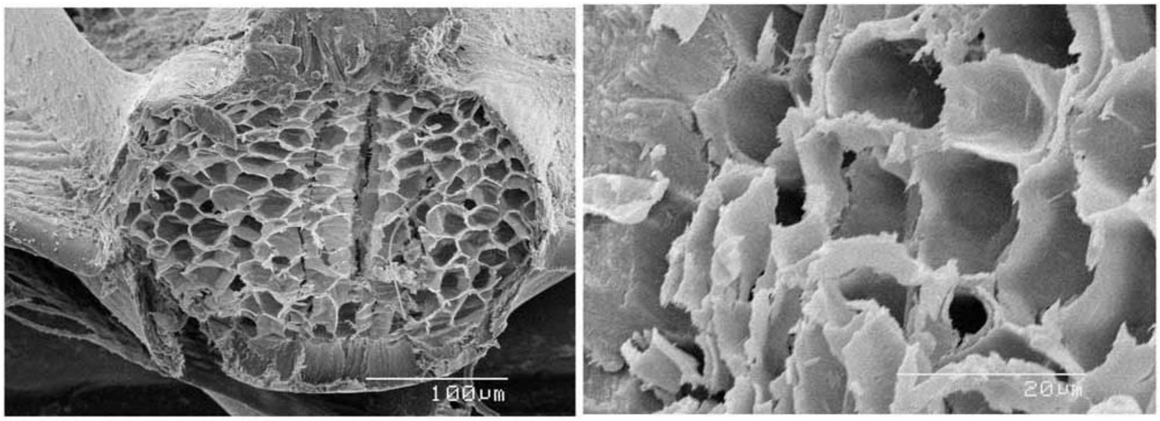

Figure 84: SEM images of woodpecker feather quills, wing (left) and down (right). Images were acquired by Gregory S. Paulson, professor of biology at Shippensburg University. The images were accesed at http://webspace.ship.edu/gspaul/SEM%20of%20feathers.html on September 22, 2015.

Shell Temper

Although shell temper does not factor into the sample to any degree, there is some reason to believe that shell-tempered ceramics did make their way to Gaspereau Lake or were made there. Because shell temper is more susceptible to weathering and hydrological processes, it breaks down at a faster rate than other ware types. Considering the amount of flooding the site was probably exposed to, it is reasonable to assume that shell-tempered pottery would have broken down at an even faster rate than in other Nova Scotia sites. Thus, the presence of any shell-tempered pottery ought to be considered an indication that this ware was a part of the original output at Gaspereau Lake.

Iron Oxide

The ceramic assemblage is associated in a variety of ways with a red and orange particulate that probably represents iron oxide brought to the site in quantity. The presence of the particulate is a problem for understanding the ceramics. It appears to have been added to the paste, which would be consistent with practices in other parts of the world if it does—as I believe—represent iron oxide. However, it is also found adhering to the surfaces of ceramics along with other soil and matrix material. Red ochre is reported to have been found in a number of units across the site and particles were found over much of the site (Sanders, Finnie, et al. 2014). Red and yellow iron oxide also occur within the broken wall surfaces of some ceramics and it is unclear whether these instances represent iron oxide that has leached out of the ceramics and been deposited on the surface, iron oxide that has leached from elsewhere and been deposited on the ceramics, or iron oxide that was added to the paste and formed brightly coloured layers during firing.

The particulate occurs as a frequent addition to ceramic pastes, ranging in size (visible in a microscope) from 0.1 mm to 8 mm in diameter. These particles appear markedly red-orange compared with surrounding clay matrix, are rounded, and range from very hard to soft and chalky. Two particles were tested using SEM, but the results were inconclusive: some spectra indicated clay and quartz, with no significant iron content, but some spectra showed ca. 50% iron content. Higher iron content would be expected if the particulate represented iron oxide as an additive to the paste, but the dilution might be explained by the mixing of iron oxide with other material such as blood, fat, or clay before being mixed with the clay body. Because SEM images show a clay-like structure and composition mixed in with some of the more iron-rich particles from one sherd (BfDd-24:12813), clay is the most likely additive.

Bright red particles adhering to the surfaces of sherds are a common occurrence in the sample. These pieces frequently appear to be part of reconstituted ceramic material composed of small white quartz particles, small shell particles, small black mica flakes, and fine soil residues that are probably zeolites, a common weathering product of both ceramics and granites. The bright red particles could therefore represent material from the ceramics themselves, or they could come from the by-product of red ochre processing activities that may have occurred over much of the site, for which there is evidence. It is also possible that the particles occur in the soil around Gaspereau Lake.

A third association between ceramics and possible iron oxide is a coating on a number of ceramics that ranges from bright red (even pink) to bright orange-yellow. Usually, this colouration coats the surfaces of ceramics, including, occasionally, the broken wall surfaces, leading to the suggestion that it was deposited post-depositionally from other leached sources of iron. Some ceramics have orange-stained vesicles that clearly had originally contained iron-rich particles, meaning that the ceramics themselves were a likely source of leached and redeposited iron. In places, the particulate seems thicker and exhibits cracking. The cracks in the layer resemble desiccation cracks, which would be consistent with a post-depositional deposit, but in places, they appear melted and reminiscent of a glaze that has crawled, an effect that usually results from poor adherence to the clay body. The sections with a melted appearance tend to align along exposed lamellar surfaces, contributing to the impression that iron oxide was added to the clay body; otherwise, it would just as likely occur over any exposed surface. Layers of orange and red particulate are not more associated with one kind of manufacturing method or decoration type, although they were observed more frequently associated with highly lamellar ceramics. This means that there is little reason to believe at present that these layers were indicative of time period.

A combination of different factors—inclusion of iron oxide in the clay body, leaching from the clay body outward, and depositing of iron from other sources—may have contributed to this residue. Further investigation is needed to clarify what caused the colouration over many of the sherds in the sample, but current evidence points conclusively to iron oxide having been added to the clay bodies of most, if not all, ceramics manufactured at Gaspereau Lake.

Homogeneity and Heterogeneity of Temper

It is important to note that hand specimens are not reliable in how much information about sources and homogeneity they can impart. Observations on hand specimens are best understood as indicative, but not conclusive, of temper groups. Because this research did not allow for petrographic or compositional analysis in any depth, no further conclusions can be made in this regard; however, future petrographic and compositional analysis would clarify this issue as well as potentially bring to light specific geographical sources. Because the sourcing and processing behaviour of ancient potters in regard to tempering materials can potentially indicate a great deal about priorities and organization of manufacture, and because the GLR ceramics present such an excellent assemblage for investigating this problem, assays of temper homogeneity should be a high priority of ceramic analysis in the future. Despite this caveat, the above discussion suggests that the temper in the End of Dyke assemblage is relatively homogeneous in some respects.

The main axis of homogeneity is the prevalence of grit temper lacking feldspar. If transported cobbles were being used as temper, a range of colours, particle shapes and sizes, and angularities would be expected. This situation can be observed in collections from New Brunswick. While researching the George Frederick Clarke Collection, I observed feldspars that ranged from white to deep pink-red and quartz that ranged from clear to white to pink to blue. These tempers could not be assigned to any well-justified classification because they clearly exhibited high heterogeneity, probably as a result of the diverse range of granite materials spread out over the New Brunswick landscape, but probably also due to the mobility of the potters. There are significant granite outcrops in New Brunswick, but from a mobile hunting-and-gathering potter's perspective it would make little sense to chisel out material from an outcrop or to pick up freshly broken pieces when rotten granite presents itself with moderate abundance and is much easier to process than freshly broken pieces. Therefore, variations in granite minerals would be somewhat meaningless without in-depth temper assays because it would not be clear whether such a classification were dividing tempers by granite sources, manufacturing locales, processing behaviours, or all of these. It is therefore noteworthy that the majority of vessel lots from the Locus 1 and Locus 3 samples exhibit no feldspar, suggesting one source/outcrop of granite, one manufacturing locale, and one main processing behaviour. It is worth considering the possibility that many rotten granite cobbles were available to Woodland potters that all exhibited the same megacrystic formulation, which would cut down on the work of processing, but it would not, by itself, explain why these were selected over the finer-grained granite cobbles, of which there are an abundance around the End of Dyke Site.

Another axis of homogeneity is the bluish-grey quartz particles observed in a number of vessels. Translucent quartz particles can often exhibit a bluish look, and it is not unusual to encounter a number of sherds in an assemblage that look this way. However, in this assemblage, the particles look distinctive and appear in enough vessel lots that they are probably not simply an effect of translucency. Rather, they appear to have darker bluish-grey banding in some cases, which would suggest an elemental composition that is responsible for the colouration. The distinctive colour is probably also most recognizable in larger particles, meaning that smaller particles might not have been labeled as the same even though they are coloured by the same processes. Therefore, a large number of the vessel lots could potentially contain this particle. If this is so, then the End of Dyke temper minerals exhibit a high degree of homogeneity compared with the George Frederick Clarke Collection and other assemblages in New Brunswick.

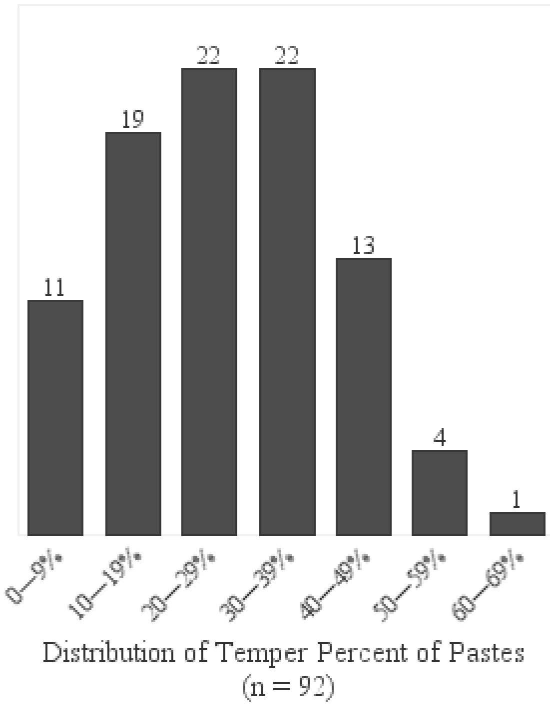

Figure 85: Distribution of temper percent in all pastes from the Locus 3 sample.

These observations of homogeneity lead to two inferences. First, the rock from which the vast majority of Locus 3 grit-tempered ceramics was made was granitic, an observation consistent with other studies of ceramics in the Maine–Maritimes Region (Allen 1981; Deal 1986; Owen et al. 2014; Petersen and Sanger 1991; Woolsey 2010). Second, the absence of feldspar, especially the near-complete absence of pink feldspar, indicates high homogeneity of grit sources and therefore the ceramic assemblage most likely represents local manufacture with little or no imports. It is worth stating again that this absence does not necessarily represent a rock source devoid of feldspar, but rather, it may represent temporally stable processing practices of particular granites that deliberately reduced the amount of feldspar in pastes.

In spite of the observed homogeneity, there is some variation in quartz minerals, and significant variation in grit particle size, colour, and percentage of overall paste composition. Quartz minerals vary from entirely opaque and white to both white and translucent to translucent with a bluish-grey tint. These variations probably represent both differing post-depositional conditions and slightly different access points to the same source. However, considering that granite in the area of Gaspereau Lake probably all comes from the relatively homogeneous South Mountain Batholith (Owen et al. 2014), the "source" could theoretically represent a large geographical area spanning hundreds of kilometers.

Particle size and percent of overall paste, on the other hand, probably represent different intentions of the potters. Some vessels contain up to 50% or more grit, making for a difficult-to-work paste. On the other hand, some vessels contain little to no grit temper. Carbonized encrustations occur on pastes at both extremes (highly tempered and no temper) and so pastes cannot unproblematically be divided along lines of technological function.

Discussion

The overall tempering practices at Gaspereau Lake are, in some ways, a reflection of practices elsewhere in the Maine–Maritimes Region. The dominance of grit temper that is ubiquitously composed of crushed granite is the norm in this region, with only a few exceptions. The shift from finer to coarser pastes seen in the Locus 1 and Locus 3 samples also can be observed in assemblages from New Brunswick, and has been repeatedly remarked upon by researchers. The large percentage of organic temper is somewhat unusual, but some sites, such as the Brown site (Sheldon 1992), exhibit similar ratios of organic to grit temper materials. The absence of shell tempering is somewhat unusual for a site with such a strong Late Woodland component, but again, this is not unheard of, particularly considering the site is well inland.

In other ways, the assemblage is unusual. The degree of homogeneity of tempering minerals and accompanying behaviours is not typically seen in collections from New Brunswick, presumably because potters in that region moved around more and made pottery opportunistically from materials at hand. Another difference between this and other assemblages is that mixing and matching of tempering materials appears to occur more regularly than in other places. The implications of this are discussed in Chapters 3 and 4.

APPENDIX 8: MORPHOLOGICAL ANALYSIS

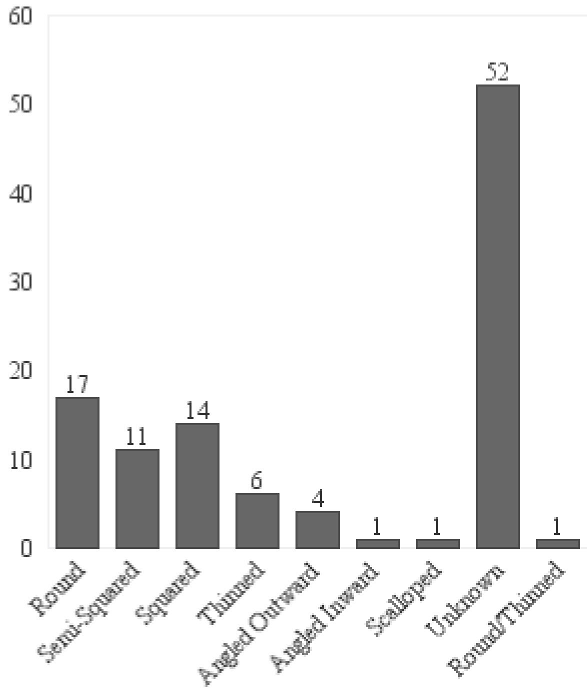

Figure 86: Distribution of lip shapes in the sample from Locus 3.

The nature of the assemblage prohibits comprehensive comparisons of vessel morphology. Because most of the pieces are small (<5 cm maximum length), and vessel lot reconstruction has proven time consuming and tentative, only fragmentary morphology is accessible for most of the assemblage.

One problem with the fragmentary nature of the End of Dyke assemblage is that lip, neck, and shoulder shapes are difficult to apprehend, while body shape is usually completely inaccessible unless pieces can be refitted (conceptually or physically), and in most of the vessel lots, refits are rare. Although small pieces from these regions can give an idea of shape, classifying them—such that other shapes can be ruled out—is rarely accomplished with any confidence on vessels with less than 10% of the rim circumference represented in the vessel lot. I have classified every vessel lot shape that could be classified, but unlike in the case of other attributes, the distributions presented here should be treated with greater caution in interpreting trends. Another problem is the large amount of variation within lip and neck shapes. This forces the classes to be divided too thinly (Table 29), so that tests of relationships are not really possible on such a small sample size. Additionally, as the distributions of neck and lip shapes show (**Error! Reference source not found.** and 3), uncertainty about shapes occurs for a large number of vessel lots in the sample.

Having said this, some trends did emerge from looking at vessel shape. It can be seen from Table 29 that excurvate rims with squared or semi-squared lips form the largest group. Also, round lips more

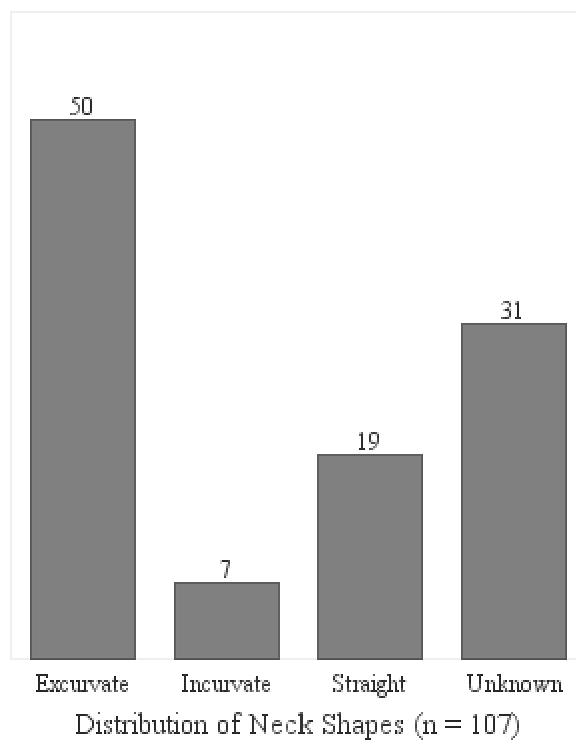

Figure 87: Distribution of Neck shapes in the sample from Locus 3.

commonly occur on incurvate necks than semi-squared or squared lips do. Semi-squared lips occur overwhelmingly on excurvate necks. Thinned lips mainly occur on straight necks, though also on excurvate necks.

Table 29: Distribution of lip shapes by neck shapes in the sample from Locus 3.

	Round	Semi-Squared	Squared	Thinned	Other	Unknown Lip	Total
Excurvate	6	10	6	2	3	23	**50**
Incurvate	4	0	2	0	0	1	**7**
Straight	5	1	5	4	0	4	**19**
Unknown Neck	3	1	0	1	2	24	**31**
Total	**18**	**12**	**13**	**7**	**5**	**52**	**107**

In order to test these apparent relationships, a Chi-square test was performed on selected classes. The lip shapes of round, semi-squared, and squared lips were compared with excurvate, straight, and incurvate necks. The sample size is low (*n*=39) and one category (incurvate neck with semi-squared lip) contained no members, so the categories are not ideally populated. Nevertheless, a possible relationship was found at the 0.1 significance level. This is not very strong, but considering the sample size, it should be considered a possible indication ($p = 0.08$) that the variables are interdependent. Particularly given the fact that, though the sample is small, it is divided over nine categories, inferences are likely to be somewhat more accurate (Yates 1934:217). When a Chi-square test was performed using the combined categories of semi-squared/squared and incurvate/straight (making a 2x2 contingency table), significance was not shown at any level (p=0.1). The sample size could be increased by looking at all vessels so far defined for the End of Dyke Site, but there are enough differences in the populations from Locus 1 and Locus 3 that conclusions should be regarded with caution. The conclusion from these investigations must be that a relationship may exist between rim lip and neck shape, but the current sample size is insufficient to show such a relationship. It therefore appears that lip shapes are not particularly tied to neck shapes.

Neck Thickness

Petersen and Sanger (1991) note that thickness seems to have increased from the earlier Early Woodland through to the Late Woodland. In particular, they found that PSS-decorated vessels tended to have thinner walls than cord-marked pottery, with dentate exhibiting a range of thicknesses. In order to test this hypothesis, neck thicknesses were compared from all vessel lots with neck portions from Locus 3 (*n*=85) and then from all recorded vessel lots from the End of Dyke Site (n = 125) (Figure 88 and Figure 89).

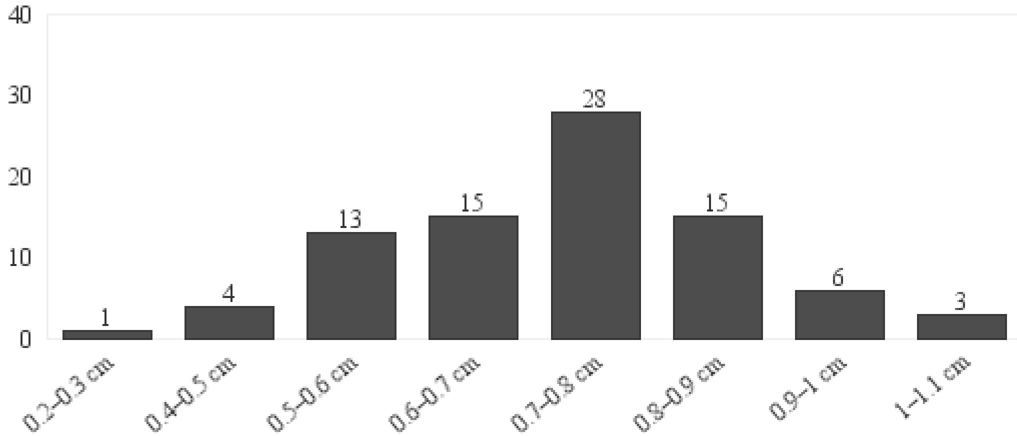

Figure 88: Distribution of neck thicknesses in increments of 0.1 cm for the sample from Locus 3. *N* =85; mean=0.72; median=0.71; minimum=0.2; maximum=1.2; s.d.=0.15.

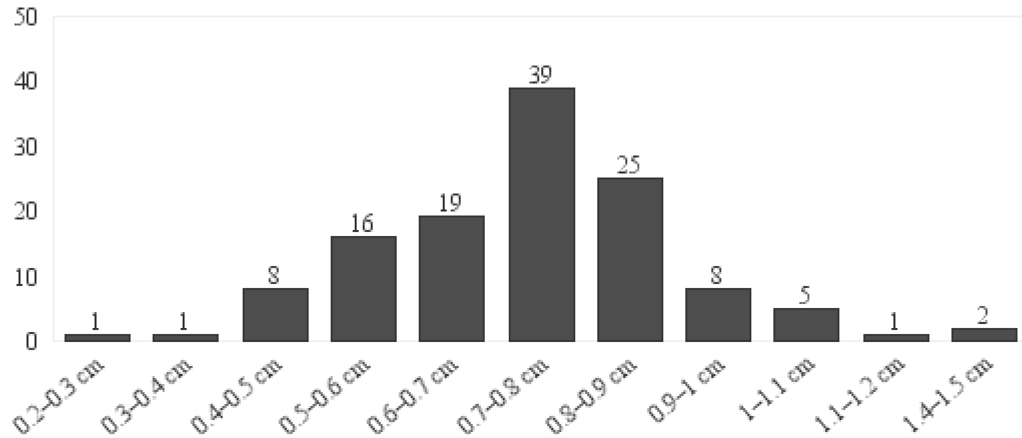

Figure 89: Distribution of neck thicknesses in increments of 0.1 cm for all vessels so far defined from the End of Dyke Site. *N* =125; mean=0.73; median=0.72; minimum=0.2; maximum=1.6; s.d.=0.18.

Neck thicknesses are basically normally distributed, clustering around 0.75 cm in both the Locus 3 sample and the larger sample including Locus 1. Unfortunately, thickness cannot be reliably compared to capacity or rim diameter because these data are missing for the majority of sherds, but on a limited sample size of 28 vessel lots from the Locus 3 sample for which this neck diameter and thickness measurements were possible, little correlation was found to exist (Figure 90). The Pearson's Correlation Coefficient was used to compare neck thicknesses with neck diameters. R^2 value (0.1) shows that the relationship between the variables is weak. Expanding this to all vessel lots so far defined resulted in a similar distribution and weak relationship (R^2=0.025 on *n*=40). A further problem is that neck diameter is not a reliable measurement because few vessel lots contain enough information to measure diameter reliably. Preferably, at least one quarter of the total circumference of the region being measured will exist, but for the majority of vessel lots, less than one tenth exists. Therefore, little can be said about the relationship between thickness and diameter, and therefore, about capacity.

Figure 90: Plot of neck thicknesses by interior diameter of neck on a sample of 28 vessel lots from the Locus 3 sample.

One strong relationship did emerge between neck thickness, neck diameter, and decoration class. I looked at the possibility that decorations might be related to thickness to some extent, and found that, although little difference exists between the thicknesses of PSS- and dentate-decorated vessels, a high probability (p<0.0001) exists that differences between cord-marked vessels (n=50) and PSS-decorated vessels (n=12) are significant (t-score=4.6), and a slightly less strong, but still significant at the 0.1 level (p=0.06, t-score=1.97), difference between cord-marked vessels and dentate-decorated vessels (n=12). If decoration classes are taken as indications of broad time period, this seems to indicate a progression from a tendency to be thinner during the early Middle Woodland to thicker during the late Middle Woodland and finally to be even thicker during the Late Woodland. In addition, although little correlation exists between neck thickness, neck diameter, and decoration for PSS-decorated and cord-marked vessels, a very strong correlation exists for dentate-decorated vessels within the (albeit, small) Locus 3 sample consisting of five vessel lots (n=5, R^2=0.9922, p=0.000292).

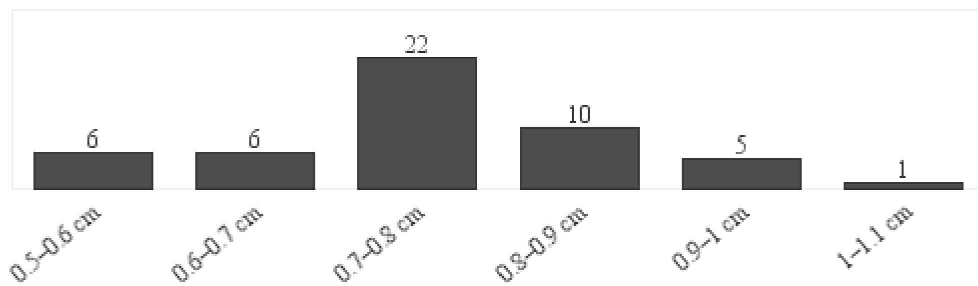

Figure 91: Distribution of neck thicknesses for cord-marked vessels in the Locus 3 sample. *N*=50; mean=0.75; median=0.76; mode=0.79; minimum=0.35; maximum=1.2; s.d.=0.12.

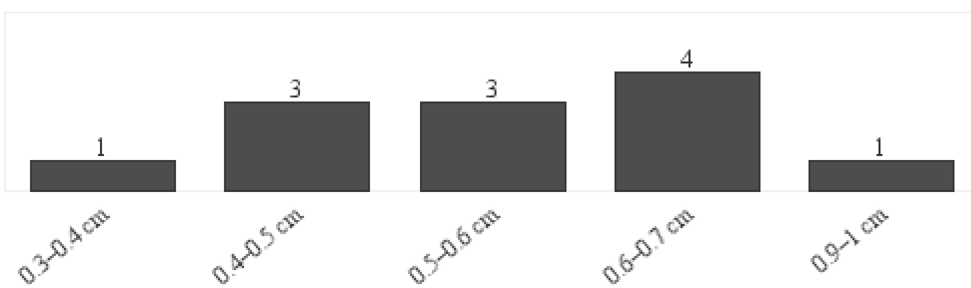

Figure 92: Distribution of neck thicknesses for PSS-decorated vessels in the Locus 3 sample. N =12; mean=0.56; median=0.57; mode=0.33; minimum=0.3; maximum=1.2; s.d.=0.16.

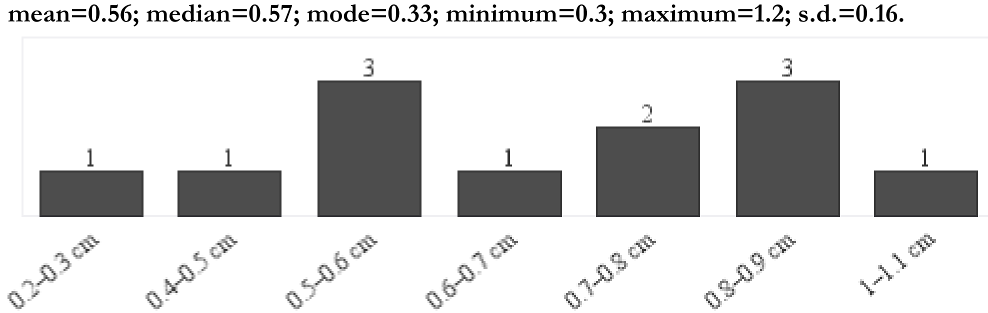

Figure 93: Distribution of neck thicknesses for dentate-decorated vessels in the Locus 3 sample. N =12; mean=0.66; median=0.68; mode=0.83; minimum=0.2; maximum=1.1; s.d.=0.21.

In order to test to strong relationship between thickness and diameter on dentate-decorated vessels with a larger sample size, I extended the correlation test to all 13 vessel lots so far defined for the End of Dyke Site that were dentate-decorated and contained data for neck thickness and neck diameter. A similar pattern emerged, but the relationship is weak to moderate and not particularly significant (R^2=0.26, *p*=0.075, *n*=13) owing to what appear to be outliers. In one case (GLNS:36), the vessel is unusually thick (1.45cm) and with an unexpectedly small diameter (18cm), so it is only an outlier in the sense that it doesn't fit expectations. It is interesting to note that other morphology assumptions are also violated by this vessel lot, particularly that the shoulder appears to be more-or-less non-existent, meaning the vessel may have been more of a cone or beaker shape than a conoidal shape (although an unusually long neck would also explain the absence of a shoulder, as nothing below ca. 7cm remains). Two other vessel lots (GLNS:13 and GLNS:18) are better candidates for outliers: they are part of the original sample, defined using only one sherd each, and my original measurements may have been conservative. Additionally, all three of these vessel lots came from further south in the site and it is likely that their contexts are unrelated to the larger set from Locus 3 and Locus 1 surrounding F44. A fourth vessel lot, GLNS:172, contains insufficient existing neck portions to accurately measure the diameter, and doubt is cast on whether the recorded measurement can be considered accurate. These four also have the lowest diameters in the set. If these four are removed (leaving *n*=9), the R^2 value becomes high again (0.9) and significant (*p*>0.0001). From these tests, it can be seen that dentate-decorated vessels are ca. 0.2 cm thicker at their necks with each increase of ca. 5 cm in neck diameter, except below ca. 12 cm in neck diameter, below which this relationship can no longer be seen.

It is worth stating again that a number of problems exist with the attributes used, the inaccuracy of measurements, and the low sample sizes. However, two hypotheses are reasonably generated from the above results. First, the assessment of Petersen and Sanger that neck thickness seems to have increased through time beginning in the early Middle Woodland seems borne out by these results, although significant variability exists throughout time, particularly in the Late Woodland. Second, dentate decorations appear to be associated with a more strict relationship between thickness and diameter. Why this would be is not clear from the data, but it is a hypothesis that should be tested on other assemblages and, if shown to exist again, an explanation ought to be sought.

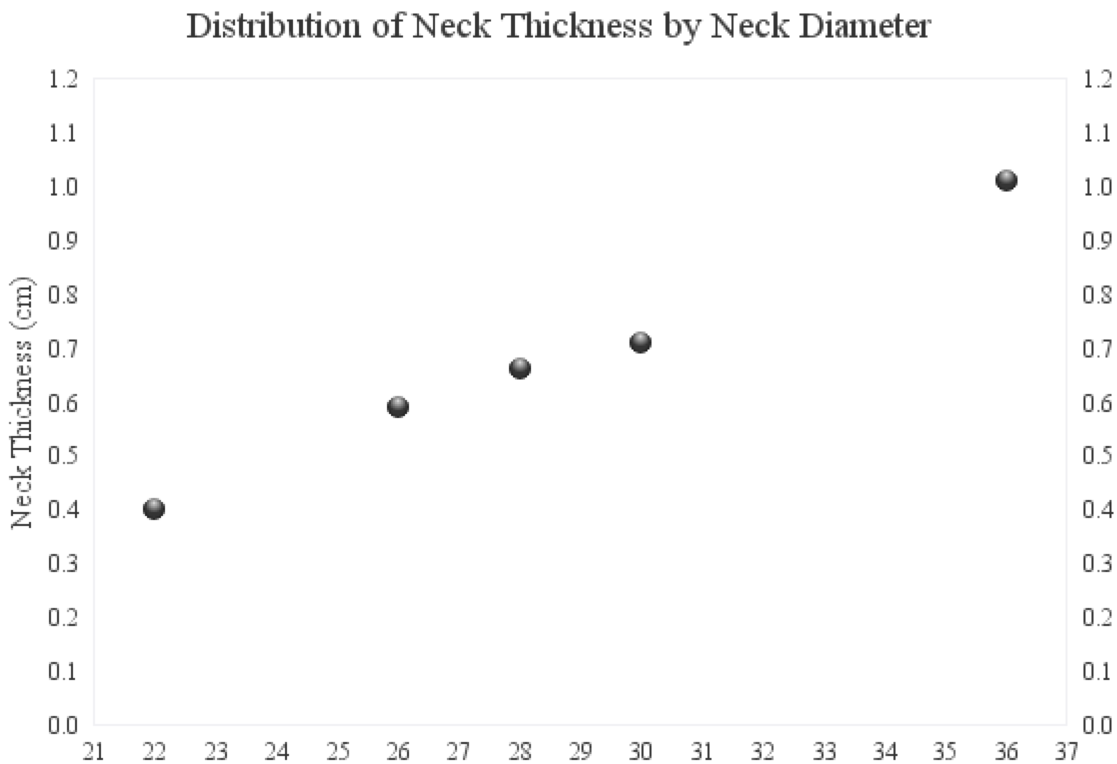

Figure 94: Plot of neck thickness by neck diameter for dentate-decorated vessels from Locus 3 (*n*=5).

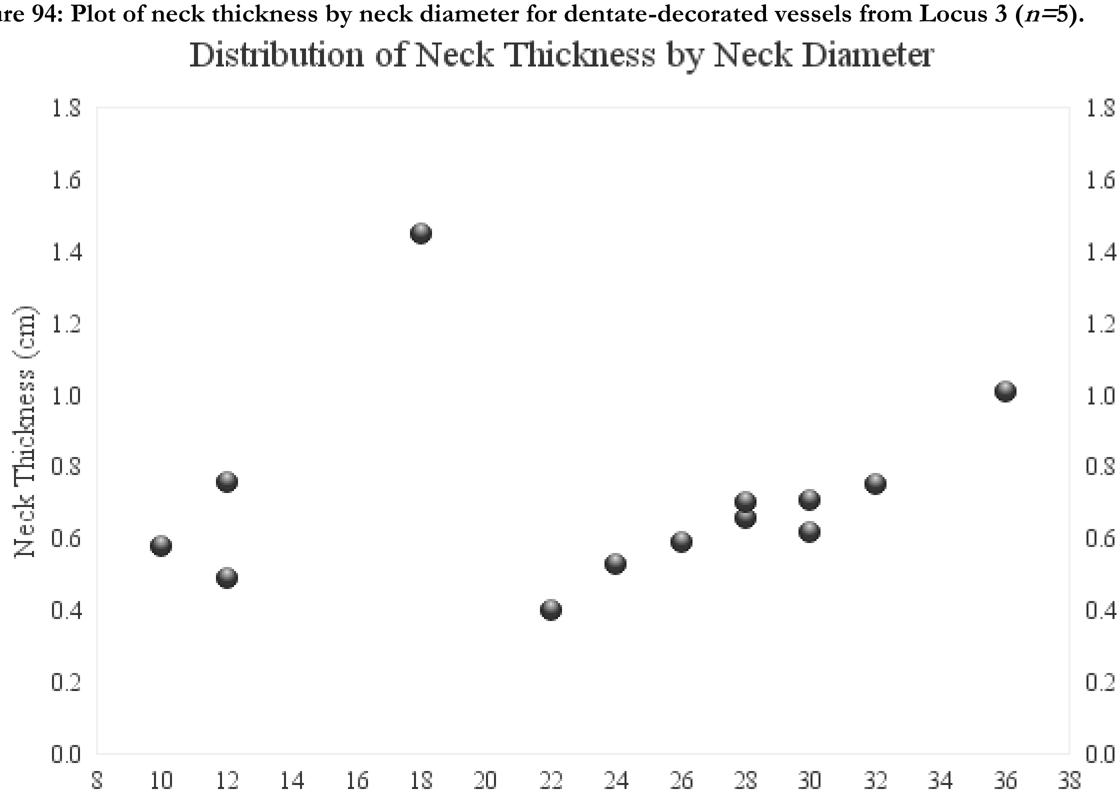

Figure 95: Plot of neck thickness by neck diameter of all 13 dentate-decorated vessels from the End of Dyke Site for which these data exist.

APPENDIX 9: FORMING ATTRIBUTE ANALYSIS

Evidence for Coiling and Paddling

Coil breaks are usually easily identified because the broken wall edge along a coil break is different in character from non-coil breaks. Coil breaks tend to exhibit smooth sections on at least part of their surfaces in contrast to a non-coil broken edge, which will generally exhibit jagged, uneven, and lamellar surfaces as a result of predominantly unoriented clay and non-plastic particles. Surfaces can usually be categorized as concave, convex, oblique, or flat, and each is caused by particular idiosyncrasies of the forming method. For instance, flat, horizontally oriented coil breaks indicate that minimal joining has taken place and that the wall has been squished down somewhat. This may happen when the potter perceives that the wall has become too thin and will attempt to thicken by pushing the wall downwards while smoothing, but avoids paddling or smoothing the wall further in case it becomes even thinner. In contrast, convex/concave coil breaks indicate that both interior and exterior surfaces of the coil were smoothed down equally into the previous coil during attaching. Oblique coils are the most typical, resulting from the opposite actions of thumb and forefinger smoothing in opposite directions on opposite sides of the wall, one up and one down. Flanges on one or both sides of an edge also usually indicate coiling because they represent an area of systematic smoothing creating a thin, distinct layer over the two joined coils.

Paddling is evident from anvil marks and lamellae in the wall cross-section. Anvil marks on the interior of a vessel are not always discernible after other finishing techniques have been employed, but when not obscured, they are recognizable as a series of flat facets that look somewhat rough by comparison with slip-brushing, finger-smoothing, and wiping. Lamellar character is also highly indicative of paddling because the process squeezes clay particles laterally, creating layering where the particles are forced to flow around non-plastic inclusions such as temper or organic material in the clay. It also aligns the clay particles along the axis of the wall, with platy sides together. These platelets are bonded but susceptible to breakage along this plane, causing highly paddled walls to be at greater risk for lamellar splitting, particularly where the accompanying non-plastic inclusions have a high thermal expansion rate, such as in the case of quartz. Lamellar character is therefore indicative of paddling, and lamellar splitting often indicates intensive paddling, particularly if lamellar splitting is accompanied by highly lamellar character and intra-wall cracks are associated with temper particles.

Paddling and Lamellar Character

A Chi-square test on sherds in the Locus 1 and Locus 3 samples shows that lamellar character is likely to be dependent on coil breaks at the significance level of 0.01 (χ^2=30.98, p< 0.001, n=699). The largest number (n=330) of sherds exhibit medium lamellae, but in the case of vessel lots with coil breaks, a tendency exists toward fine or medium lamellae rather than coarse lamellae, whereas a tendency exists toward medium and coarse lamellae rather than fine for vessel lots with no coil breaks. Statistical tests among variables of particle size, thickness, temper percent, and constitution were performed, but in all cases, no significant difference exists between vessel lots with coil breaks and those without. Therefore, although the relationship between the variables of lamellar character and coil breaks clearly exists, the nature of the dependency is not well understood.

Table 30: Distribution of sherds with coil breaks compared with lamellar texture.

	Lam. Fine	**Lam. Medium**	**Lam. Coarse**	**Total**
Coil Breaks	112	194	58	**364**
No Coil Breaks	85	136	114	**335**
Total	**197**	**330**	**172**	**699**

A further investigation of the relationship between lamellar direction and coil breaks was investigated using a Chi-square test. The investigation revealed that vertical lamellae result from the same process that causes a lack of coil breaks, while oblique and U-shaped lamellae result from the same process that results in coil breaks. In other words, vertical lamellae and coil breaks are signs of intensive paddling, while U-shaped and oblique lamellae and many coil breaks are signs of less intensive paddling. U-shaped and oblique (direction unspecified) lamellar directions have been grouped because they have often been observed to co-occur in sherds. The groups are listed as Oblique/U-shaped and Vertical in Table 31. First, a Chi-square calculation was done on sherds, in which a direct relationship between coil breaks and lamellar direction should be observable. Second, the same test was performed on vessel lots, in which case a lower significance value would be expected based on numerous sherds within one vessel lot possibly having different lamellar states recorded for them. The assumption is that, if dependence of variables is found to exist at the 0.05 level or greater for both sherds and vessel lots, then they probably both depend on the same manufacturing practice (extent of paddling) and identification of one will allow inference of the existence of the other.

Table 31: Distribution of sherds with coil breaks compared with lamellar direction.

	Oblique/U-Shaped	**Vertical**	**Total**
Coil Breaks	60	23	**83**
No Coil Breaks	91	80	**171**
Total	**151**	**103**	**254**

The first test at the level of sherds showed that a relationship is very likely to exist at the 0.01 significance level (χ^2=8.4318, p=0.0037, n=254). Because of the different attribute states reported in the same vessel lot in some cases, the second test, at the level of vessel lots, is more complicated. Chi-square tests proceeded as follows. The lamellar attribute states of Oblique/U-Shaped, Vertical, and Both were compared with vessel lots with and without coil breaks, resulting in a significant probability that the attributes are dependent (χ^2=6.13, p=0.047, n=87). To uncover the relationship between variables, two Chi-square tests were performed: one compared vessel lots exhibiting vertical lamellae and both vertical and oblique/U-shaped against frequency of coil breaks, while the other compared vessel lots exhibiting oblique/U-shaped lamellae and both vertical and oblique/U-shaped against frequency of coil breaks. In both cases, the relationship between variables was not significantly proven (χ^2=1.8, p=0.18, n=42 and χ^2=0.52, p=0.47, n=63, respectively). Finally, only vessel lots exhibiting either vertical or oblique/U-shaped lamellae, but not both, were tested against frequency of coil breaks. The result shows that lamellae are more likely to be vertical when associated with a lack of coil breaks and vice versa, significant at the $p<0.05$ level and just shy of the 0.01 level ($\chi^2=6.15$, $p=0.014$, $n=69$).

Table 32: Table 2: Distribution of vessel lots with coil breaks compared with lamellar direction.

	Oblique/U-Shaped	**Vertical**	**Both**	**Total**
Coil Breaks	34	11	12	**57**
No Coil Breaks	11	13	6	**30**
Total	**45**	**24**	**18**	**87**

Thus, oblique/U-shaped lamellae can be said to co-occur with coil breaks while vertical lamellae co-occur with a lack of coil breaks. The ambiguity of the "Both" category presumably results because differential paddling in one vessel lot will leave traces both of coil breaks and of the different types of lamellae. Fortunately, this occurs in a minimum of cases. When this ambiguous category is removed, the relationship becomes clear again. It is also significant that, for a majority of vessel lots, lamellae are clearly either vertical or U-shaped/oblique. This seems to indicate a manufacturing trend at the level of individual vessel, such that, for the most part, vessels are either intensively paddled, or they are minimally paddled; this may result from multiple paddling stages in the former case and only one in the latter.

These tests confirm what was repeatedly observed during analysis. Oblique and U-shaped lamellae frequently could be seen to radiate out from oblique or convex/concave coil breaks. Similarly, lamellar splitting was frequently observed in association with vertical lamellae, the latter of which sometimes appeared responsible for the former.

Having shown the relationship between lamellar direction and coil breaks allows the further observation that both attributes can be seen as gradations rather than states. The extremes of coil breaks and no coil breaks in fact have significant in-between states, such as coil breaks that are rough instead of smooth, coil breaks that show smooth breaks in certain sections but rough breaks in other sections, and breaks that probably followed coil orientations but the original coil surface is not visible. The extremes of vertical and oblique lamellar direction can often be seen to gradate into each other even in the same sherd, and U-shaped lamellae often exhibit a greater tilt towards one side or the other, sometimes making them appear oblique with a slight curve. These attributes therefore can be used to assess degree of paddling.

Decorative Associations with Coil Breaks

In order to demonstrate that forming practices changed through time, I tested the distribution of coil breaks compared with the decorative classes of PSS, dentate, and cord marks. As previously noted, these decorative classes are often reported as chronological categories, the first two typically representing the Middle Woodland while the last represents the Late Woodland. Based on this assumption, a difference in forming attributes among the decorative classes indicates a substantial change in learning lineages from the Middle to the Late Woodland. The attributes that changed through time—coil breaks and lamellar direction—indicate that paddling became less intensive through time.

A Chi-square test found a high probability that the presence of coil breaks depends on the decorative class to which the vessel lot belongs (χ^2=31.3, p<0.001, n=142). As can be seen in Table 33, a much larger number of cord-marked vessel lots exhibit coil breaks than lack them, while for both dentate- and PSS-decorated vessels, coil breaks are much less frequent. One possible explanation for this is that cord-marked vessel lots tend to include larger numbers of sherds, likely increasing the chance that they will include coil breaks. To test for this, I performed the same test on 100 randomly selected sherds that met the criterion that they belong to one of the three main decorative classes. Significance was not as high, but still revealed a high probability of dependence (χ^2= 7.9, p=0 .019, n=100). Another test of randomly selected sherds resulted in a similar score.

Table 33: Distribution of vessels with coil breaks compared with decorative type.

	PSS	**Dentate**	**Cord Marks**	**Total**
Coil Breaks	4	10	57	**71**
No Coil Breaks	12	35	24	**71**
Total	**16**	**45**	**81**	**142**

To test that the dependence is related to the Middle/Late Woodland shift, a similar test was performed on cord marked vessel lots and dentate/PSS vessel lots. The result showed an even higher likelihood that the variables are dependent (χ^2=32.9, p<0.001, n=163). These tests show that paddling was, as a rule, more intensive during the Middle Woodland than during the Late Woodland.

CONCLUSION

The above analysis shows that coli breaks and oblique or U-shaped lamellar character are associated attributes. Similarly, vertical lamellae and a lack of coil breaks are also associated. Both attributes indicate the degree of paddling that occurred during manufacture. Tests of association with decorative type indicate that the degree of paddling went down over time.

APPENDIX 10: RADIOCARBON DATING

INTRODUCTION

Continuous occupation at the End of Dyke Site is indicated by the radiocarbon sequence acquired from carbonized residue on ceramic interiors. This sequence spans ca. 700 years, beginning as early as 1550 Cal BP and ending ca. 700 Cal BP. PSS decorations indicate that the ceramic manufacturing tradition began earlier than the first radiocarbon date, and manufacturing probably continued after the last radiocarbon date.

The ceramic manufacturing sequence was constructed using three main sources of evidence: 1) the AMS dates acquired on 10 ceramics in the sample; 2) the spatial and stratigraphical distribution of the ceramics; and 3) the attribute groups constructed during analysis, which were used to form larger groups (or traditions) of vessel lots. The AMS sequence shows that ceramics were manufactured continuously from ca. 1550 BP to ca. 950 BP, although it reveals little about how to characterize manufacture. The distribution of ceramics across the site and in association with features contextualizes the AMS sequence by indicating likely depositional histories of ceramics. In other words, groups of ceramics were deposited at specific moments in time to form a palimpsestic history that is investigated using the AMS chronology. The potential to understand the history of ceramic manufacture is increased by introducing the evidence accruing from the ceramic groups created along broad dimensions of manufacture (detailed in Chapter 2). The evidence from these three sources were used to create the chronology of ceramic manufacture at Gaspereau Lake. This evidence and the reasoning process for inferring time periods is detailed in this appendix.

AMS SEQUENCE

Ten dates were acquired on carbonized residue adhering to the interiors of ceramic sherds. These dates were calibrated using Calib407, the most recent version of a free online software created by Minza Stuiver and Paula J. Reimer out of the ^{14}Chrono Centre at Queen's University (Stuiver and Reimer 1986, 1993; Stuiver et al. 1998). An effort was made to acquire dates on a range of decorative classes, pastes, and areas of the Locus 3 section of the End of Dyke Site, but so few ceramics had carbonized material adhering that, ultimately, the dates represent only those vessel lots that had a burnt food event.

Carbonized residue, resulting from burnt foodstuffs adhering to the interior surface, theoretically dates the last cooking event experienced by the pot. Therefore, it is considered a directly associated date because the dated event would have occurred within the use-life of the pot. An ethnoarchaeological study of the Kalinga in the Philippines (Tani and Longacre 1999) concluded that clay cooking pots were used on average for two years before being broken or beyond utility as a result of abrasion; a similar use-life may have been expected for the Woodland peoples of Nova Scotia. If so, an AMS date range with a 1-Sigma range of 30 years would resolve around a two-year span, which is effectively a historical moment, rather than a time span. The AMS date therefore represents the moment the pot was manufactured even though, technically, it dates the last time the pot was used.

The carbonized foodstuffs used for the AMS dates were probably not affected to a large degree by the marine estuary effect. When marine material is dated, it tends to skew the result to earlier than the real calibrated date as a result of unusually high ^{13}C percentages (Beta Analytic, http://www.radiocarbon.com/marine-reservoir-effect.htm). The GLR ceramic sample, however, registers a ^{13}C signature predominantly below the level of -20, meaning that the organic material was probably terrestrial or mostly terrestrial (Figure 5). Three vessel lots registered a ^{13}C signature between -21 and -25 and could potentially result from marine birds, anadromous fish such as gaspereaux (*Alosa pseudoharengus*), and C_3 herbivores. These signatures should be viewed with caution because they could potentially represent a source of marine carbon; however, the skewing effect, if any, ought to be minimal. The rest are clearly terrestrial in signature and can be considered accurate when calibrated with the IntCal13 calibration curve (Reimer et al. 2013). I have decided to regard the AMS sequence as accurate, including the three potential partly-marine signatures.

Taken together, the ten radiocarbon dates indicate continuous use of ceramic vessels for cooking throughout a 500 year spread between ca. 1500–1000 Cal BP. This indicates site occupation for the same continuous period. A gap appears between ca. 950 and 850 BP: GLNS:28, the vessel lot dated to latest in the sequence (most likely between 702–803 Cal BP at the 2-Sigma level, 0.77 relative area under the curve), is from Locus 1, an area of the site about which much less is known in terms of ceramic manufacture and use.

The dated ceramics show some trends through time. There appears to be a trend from lighter to darker colour through time, with more reduced clays tending to occur later and whiter or pinker clays tending to occur earlier. As expected, earlier decorations are PSS/dentate, while later decorations are cord. No significant trend occurs in twist direction, lack of twist, or decorative group. One interesting insight obtained from the radiocarbon sequence is that the earliest date was obtained from a very coarsely tempered (ca. 50%), undecorated vessel lot, confirming that not all vessels from this period (ca. 1500 BP, or CP3) fit the concept of Middle Woodland pottery as finely tempered, elaborately decorated, and high-fired (e.g., Petersen and Sanger 1991). Another insight is that the thickest vessel lots, with the greatest temper percentage and the most well-developed coils, tended to occur toward the end of the sequence, but the final dated vessel lot is thinner, finer-tempered, and with poorly developed coil breaks, an apparent reversal of the trend.

SPATIAL DISTRIBUTION

In this section I look at the distribution of ceramics in the samples analyzed to reconstruct a history of deposition. Ceramics distributed around the Locus 3 section of the End of Dyke Site show patterns of continuous primary and secondary discard (Figure 51 and Figure). Importantly, one area (Unit 971N/981E) contains evidence of primary discard in the form of vessel storage, while pieces of these same vessels occur in the other area (Unit 973N/983E) with evidence of secondary discard. Unit 971N/981E is characterized by a high ratio of ceramics (49.66%) to other artifacts and a condensed artifact cluster. Unit 973N/983E, conversely, has a similarly high number of ceramics and ratio of ceramics to other artifacts, but exhibits looser clustering and large numbers of ceramics and other artifacts in the surrounding units. This indicates that it may at one time have been a midden. Ceramics are not strongly associated with either of the two large transgressive hearth features (F-27 and F-29), and in fact show a negative relationship given the large concentration of ceramics around 973N/973E, which does not contain any features.

Methods

Spatial relationships of ceramics and relationships of ceramics to other artifact classes were assessed statistically using Chi-square tests to indicate likelihood of relationships and Pearson Correlation tests to assess the degree to which ceramics and other artifact classes are depositionally related. These results were used to infer the processes by which ceramics were deposited, and whether they were the same as for other artifact classes. Ceramics were also assessed for whether their spatial positions were related to features such as hearths. Finally, vessel lot distributions were compared with each other to determine the spread of ceramics from the two main units of interest (971N/981E, or primary depositional unit, and 973N/983E, or secondary depositional unit).This allowed the assessment of which ceramics likely were deposited at the same time and which were mixed after having been deposited.

Hearth Features

F27 and F29 appear to be transgressive hearths forming large areas of scorched subsoil, charcoal and hearth remains, and in places, stone linings (Sanders et al. 2014:219) (Figure 50). Ceramic distributions exhibit an inverse relationship with these features (Figure 53). In a plot by number of sherds per unit, ceramics cluster generally outside the features (Figure 51). When F27 and F29 ceramics are compared to ceramics in the main occupation layer, it can be seen that the majority are either outside the features or right on the edge of features (Figure 53)Figure 53: Spatial distribution of ceramics showing differences in association versus non-association with features F-27 and F-29.. In no case do ceramics cluster in the middle of these two features. While other artifact types including lithics and faunal remains also exhibit this inverse relationship to features to some degree, the relationship is not as pronounced, and also, other artifacts are not evenly distributed with the ceramics (Figure 52). Some ceramic piles, such as the primary refuse in 971N/981E, appear to be somewhat separate from other artifacts.

Distribution of Ceramics

Statistically, ceramics exhibit a different distribution pattern from other artifacts at the significance level of 0.01, although a moderate correlation is evident. A Pearson Correlation test found a moderate correlation between ceramics and other artifact classes (R=0.6243; R^2=0.3898; p<0.001; n=70), while a Moran's I test found the clustering significance higher for other artifacts (0.634, compared with all artifacts at 0.628) than for ceramics (0.339 compared with all artifacts at 0.628), indicating a difference in deposition and/or dispersion between ceramic and non-ceramic artifacts. A Chi-square test showed that ceramic amounts per unit were very likely to be associated with whether those units contained features (χ^2=70.3501; p=0, n=25708), but the large population makes the relationship overly significant. A paired mean test on the units, comparing numbers of ceramics to non-ceramic artifacts, revealed a difference in how the two artifact types are distributed (t=-5.179229; p<0.001). Although a difference in ceramic numbers between feature- and non-feature-containing units is expected, it is not expected to be so large.

While ceramics are not common within features, neither are they entirely absent from features. Many vessel lots are represented by both feature and non-feature unit layers. The discard behaviour resulting in the Locus 3 ceramic distribution therefore probably is only indirectly related to the features. In other words, there is no evidence that people using and discarding ceramics were doing so while taking account of hearths and other features. GLNS:93 is composed of multiple sherds that appear to have darkened from their original buff colour as a result of heat and/or soot. However, other sherds in this vessel lot do not exhibit this same colouration when they occur outside of the hearth feature. The darker sherds are mostly associated with units containing F-27, while those with lighter colour are furthest away from the hearth feature. Additionally, soot-darkened sherds exhibit dark colouration over interior and exterior surfaces as well as over broken wall edges, indicating that charring occurred post-breakage.

The differential sooting on sherds of this vessel lot is evidence that the pot was broken prior to the hearth's age and then partly removed when the hearth was dug, to be deposited near the hearth along with other artifacts. Two lines of evidence indicate this depositional history. First is the fact that the hearth is dated later—ca. 760±BP—than the pot, which was dated to 1346±30. Second is the differential positions of the sherds in the vessel lot, some occurring within the hearth and some occurring in the cluster of artifacts to the east of the hearth. These two lines of evidence are addressed in detail below.

It would be expected that if the pot broke in a fire, it would be removed either piecemeal or as part of a hearth-cleaning activity, to be dumped in a midden elsewhere. Therefore, most sherds would not remain in association with a hearth feature, unless it was subsequently abandoned. Also, it would be expected that leaving the pot in the fire would create significant surface soot as well as fire damage, as in the case of GLNS:79, but neither case is true, suggesting that the fire was only indirectly affecting the pot's surface. The differential colouration on variously dispersed sherds suggests, instead, that the pot was already interred when a fire was burning over top of it or, at least, part of it, and that the individual sherds were already partly dispersed. The pieces of the vessel lot deposited outside the hearth occurred with significant soot and other artifacts, although they were not themselves charred; they were therefore likely removed in the process of digging in preparation of making the hearth of F-27, along with other refuse including debitage and previous hearth material.

The second piece of evidence comes from the late radiocarbon date acquired on F-29 by CRM Group Ltd. (Sanders et al. 2014:346). This date of 760±30 BP (uncalibrated) is later than any of the AMS dates acquired on pottery. By no means a definitive chronological context, the late date nevertheless suggests that F-29 was created, at least in part, after the peak of ceramic use at Locus 3. These three pieces of evidence—a large cluster of ceramics outside features, a vessel lot differentially and indirectly burnt by a hearth, and a late date for one of the hearth complexes—suggests that pottery discard behaviour mostly occurred prior to the creation or expansion of the two large hearth complexes.

Primary Discard in the Unit 971N/981E

Unit 971N/981E contains a primary discard location for pottery. Situated on the periphery of F-27, it contains the remnants of two distinct manufacturing periods that are less than one hundred years apart. Vessel lots represented by the second of these moments are fairly homogeneous in terms of paste and temper. AMS dates from vessel lots related by manufacturing attributes to vessel lots in this unit indicate this separation in periods, but also, the attributes of the sherds themselves—the earlier period marked by dentate and PSS decorations, the later marked by cord marks—reinforce a shift through time. The fact that two distinct periods can be linked to this unit indicates that depositional behaviour at this place was continuous during those two periods, after which discard behaviour shifted to a focus on the nearby cluster surrounding 973N/983E.

Vessel Lots in the Unit 971N/981E

Two sets of vessel lots are discussed in regard to what they show about the depositional history of Gaspereau Lake: GLN:156 and GLNS:61, the former from the earlier Middle Woodland (ca. 1550 BP)and the latter from the Late Woodland period (ca. 1400 BP).

The most significant vessel lot in this unit is GLNS:61 because of what it indicates about the manufacturing context and depositional history of the unit. It represents a manufacturing moment of increased production and possibly greater standardization. Entirely contained in the unit 971N/981E in the extended hearth feature F27, its 27 sherds are distinctive in their light-coloured clay, coarse temper including bluish-grey quartz particles, mica, and iron oxide, and aggressive interior channeling. It is an unusual vessel lot in its rim shape, with a rounded lip, overhanging collar, and thickened neck ca. 2 cm below the lip. Cord marks show S-twist and tightly plied cordage was used on a loosely wrapped edge. Given the tight distribution of the sherds, it is possible that GLNS:61 was stored as were certain other vessels around the End of Dyke Site.

This unit is unusual in that a large number of vessel lots were represented within it, four of which are related to GLNS:61 by belonging to the same groups of temper (Bluish-Grey Quartz group), clay (Buff-to-White group), and channeling (Channeling 2 group). These other vessel lots are also quite hard in their constitutions and exhibit similar coarse-mesh, coarse-texture pastes. All but one vessel lot are S-twist in their decorations, and the one Z-twist vessel lot (GLNS:58) is so similar to one other vessel lot (GLNS:62) that doubt has been repeatedly cast on whether they are in fact from different vessels or from the same vessel with two different cordage twists. Firing attributes, including carbon cores (all distinct and greater than 70% of the wall), are also similar. Additionally, it is likely that one or more of these vessel lots represents more than one original vessel with similar pastes, decorations, and lamellar character. Aside from these five vessel lots (including GLNS:61), the other cord-marked vessels in the unit are all S-twist, suggesting continuity among them.

Because of these similarities, which represent some of the most striking relationships in the Locus 3 sample, it appears that one of two manufacturing situations is visible in this case. Either the vessel lots represent a standardization of pastes and firing practices, with similar decorative attributes indicating one learning lineage or community of practice, or else an unusually large number of vessel lots survived that were made from the same large batch of tempered clay. In either case, increased production can be inferred.

Another, slightly earlier manufacturing moment is also visible in the same unit evident by similar decorations and manufacturing attributes. Within 971N/981E, PSS/dentate vessel lots are also unusually homogeneous in their decorations and other attributes. Linking all these vessel lots together through decorations and firing attributes is GLNS:156, a thin, fine, reddish vessel lot decorated with PSS/dentates and exhibiting distinct, even carbon core. This vessel lot exhibits many attributes in common with the other PSS/dentate-decorated vessel lots from this unit. Three of the vessel lots in the unit, including GLNS:156, are classified as Trapezoidal PSS, representing close to half (*n*=8) of all vessel lots included in this group. Furthermore, none of the other vessel lots in the Trapezoidal PSS group can be said to cluster as they do in this unit. Fine triangular dentate appears to be a decorative variation of Trapezoidal PSS, evidenced by a tendency in both groups for walls to be thin and carbon cores to be even and distinct, indicating that manufacturing practices are similar for both groups. Finally, Precisely Impressed PSS may also be related to Trapezoidal PSS if GLNS:156 is considered a transitional decoration between classic PSS and trapezoidal/triangular-shaped dentate elements. The decoration on GLNS:156 moves from distinctly wavy line to distinctly squared corners and inconsistently connected bases. Also, this vessel lot exhibits a carbon core similar to the distinct carbon cores of vessels in the Fine Triangular PSS/Dentate group. GLNS:156 thus belongs to the same firing class as GLNS:160, dated to between 1524–1365 Cal BP at the 2-Sigma range. Finally, one vessel lot in the unit 971N/981E is a member of the Fine Triangular Dentate decorative group as is GLNS:160; unlike other decorative groups, firing and paste attributes are quite similar across the members, indicating an unusually homogeneous group and therefore a high likelihood of a single manufacturing practice. Because GLNS:160 has been dated, the vessel lot in 971N/981E that is of the same decorative group can also be considered dated to this range.

These three decorative groups (Precisely Impressed PSS, Fine Triangular Dentate/PSS, and Trapezoidal Dentate) are probably variations within a loosely defined convention (Figure 76). Because these vessel lots may be related by decoration, and two vessel lots are related to the dated GLNS:160, also a Fine Triangular PSS/Dentate member, the combined vessel lots represented in the unit 971N/981E probably represent a manufacturing moment occurring within a range of 1524–1365 Cal BP at the 2-Sigma range.

Table 34: Distribution of PSS/dentate-decorated vessel lots with sherds in unit 971N/981E.

Fine Triangular PSS/Dentate	**Precisely Impressed PSS**	**Trapezoidal Continuous-Element PSS**
1	1	3

Unit 973N/983E

This unit is also outside any of the features defined by Sanders et al. (2014). It is different from 971N/981E in that it is at the centre of a number of units with high ceramic numbers and relatively high ceramic to non-ceramic artifact ratios. While the ceramic number in this unit is smaller than in the adjacent unit, 973N/984E (365 and 431, respectively), this unit is significant in that it has the second highest ceramic-to-non-ceramic ratio after 970N/979E, at 57.66% of the total artifact count. Three dates were acquired on vessel lots associated with this unit that help interpret the significance and history of the unit: GLNS:93, GLNS:94, and GLNS:122.

This unit is also significant in that it is clearly a depositional site for ceramics and other artifacts, but unlike the unit 971N/981E, it is much less homogeneous in its ceramic traditions than 971N/981E. Ceramics from many periods, traditions, and loci appear to have been deposited here, evidenced by the multiple kinds of paste groups and decorations. PSS, dentate, cord marks, and undecorated ceramics are all represented, and fabric-impressed sherds occur in an adjacent unit. Additionally, whereas 971N/981E exhibits relatively tight clustering in the distribution of vessel lots (at least two are entirely contained within the unit), in the case of 973N/983E, vessel lots tend to be spread out amongst many units. One vessel lot, GLNS:62, is identified as belonging to the second manufacturing moment seen in 971N/981E, but only four of its sherds are from 971N/981E, the majority spread out in and around 973N/983E.

Despite the high level of diversity, 973N/983E and surrounding units are dominated by vessel lots with many coil breaks, smooth coil break surfaces, reddish-coloured and hard pastes, S-twist cord impressions, and smoothed-and-burnished interior surfaces (discussed further in the chronology section). Two dates were acquired on vessel lots exhibiting these similarities—GLNS:93 and GLNS:135—and though they are not tightly agreeing as in the case for the unit 971N/981E, they nevertheless appear to come from a distinct ceramic period. The unit therefore represents a somewhat delimited manufacturing moment, although an earlier date was also acquired.

GLNS:94 dates this unit to the range 1302–1396 Cal BP at the 2-Sigma range, contemporaneous with GLNS:61 and GLNS:122. This means that it is part of the same manufacturing moment as seen in the unit 971N/981E involving GLNS:61. Although this vessel lot is different from GLNS:61—including Z-twist cord, unusual decorative zoning, and a distinctly brown surface colour—there are also similarities. Channeling marks on the interior are similarly aggressive and pronounced to those on some vessel lots represented in 971N/981E. Temper is from the same feldspar-poor granite observed in many of the vessels of 971N/981E. These similarities indicate that the learning lineage represented by GLNS:94 had contact with, or was the same as, the learning lineage represented by GLNS:61 and blended with it to some extent while retaining distinctive and possibly emblemic attributes.

Another vessel lot that dates this unit is GLNS:93, with a range of 1175–1368 Cal BP at the 2-Sigma range, and most likely 1239–1308 Cal BP (0.83% under the curve at the 1-Sigma range). This is a somewhat different period than that represented by GLNS:94, occurring approximately a century later. This vessel lot was used for cooking and was probably either broken in a fire or broken and then heat-damaged by a subsequent fire, possibly the one that occurred in the nearby unit 971N/982E (Sanders et al. 2014:Figure 34). No attempt at repairs is evident. The majority of the sherds from this vessel lot show indirect fire damage in the form of darkened colour and occurred in the F27 feature layers of units 972N. The vessel lot was definitely used for cooking, confirmed by the extensive carbonized encrustation on the interior surface, but no other use wear is apparent, indicating that the vessel lot was probably discarded early in its use life.

973N/983E shows relationships with various parts of the Locus 3 area. These relationships are both similarities of vessel lots in disparate locations and vessel lots spread between this cluster and other parts of the site. This probably means that ceramics were placed in this cluster after a primary depositional event such as breakage while cooking or storing. This frequently occurs when hearths are cleaned and all material is dumped in one site; a concurrent practice sees pot fragments deposited in middens or provisional discard piles by being pulled out of a hearth by hand. The 973N/983E cluster appears to represent such a situation, as many vessel lots from all over the Locus 3 area appear, in part or all together, in this cluster. As mentioned earlier, the late date on F-29 probably indicates that the preparation for the two large transgressive hearth features entailed digging up material and depositing it in a mixed-context pile in between the two features (973N/983E and surrounding units).

Discussion

Although the AMS dates acquired on ceramics cannot resolve all the issues of contextualization and temporal relatedness, an outline of some of the manufacturing traditions has been revealed by comparing ceramic attributes, spatial distributions, and absolute date information. One of the most striking things revealed by the chronology is the broad, gradual move from more elaborate to more expedient through time. Where ceramics during the late Middle Woodland (ca. 1500 BP and before) were apparently made to be admired and probably cherished, showcasing the expressive abilities of the potter (Fineware), already there were some vessels being manufactured with more standardized criteria of which individual expression was not a part, or at least not to the same degree. These were the Blended-Edge Dentate pots, easily recognizable by their distinctive decorative tool. Later, ceramic pastes were mixed in larger batches to make the more expediently produced Cord-Marked Buff pots, which may have rendered the Blended-Edge Dentate pots obsolete. These pots, though apparently standardized in paste preparation and firing technique, employed variable and expressive decorative strategies, though nowhere near the extent of the much smaller and more carefully placed PSS/dentate decorations of the previous period. Other influences were seen at this time, and these influences would go on to create hybrid traditions that blended the expedient techniques of Cord-Marked Buff with the finer pastes and higher firing temperatures of the Complex Cord-Wrapped Stick and Complex Cord Transitional pottery traditions. These traditions appear to be uniformly higher-fired, with pastes that are unusually hard and red and frequently exhibit shiny surfaces where they may have been slightly melted. This harder paste was probably partly achieved by increasing the amount of iron oxide added to the paste. This appears to be a culmination of a practice of adding iron oxide from the earliest period. Locally available pegmatitic granite was also continuously accessed, processed, and sorted for temper materials throughout the history of ceramic manufacture at Gaspereau Lake.

SITE USE

The End of Dyke Site has a complicated history of feature use and re-use, particularly in regard to the hearth features, many of which are complex, extended, and transgressive. Five stone-lined hearths were recorded, as well as a significant amount of mixed earth, fire-cracked rocks, and charcoal (Sanders et al. 2014:101, 286, Figure 20, Figure 21, Figure 31), all telltale attributes of earth ovens (Black and Alston 2014).

F27 and F29: Transgressive Hearths from Locus 3

A particular characteristic of the Locus 3 area is the two large, transgressive hearths with multiple depressions in the subsoil. The temporal context for these features is largely unknown, but the northern corner of F29 (971N/986E, layer 2, F29-A) is dated to 760±30 BP. Because the ceramics from Locus 3 largely come from an earlier temporal context, F29 at least partially post-dates them. F27 appears to be more complex, with at least five activity foci identified and areas of possible disturbance (Sanders et al. 2014:219). The interesting thing about these two features is that this same pattern of transgressive hearth features is not seen to any extent on the rest of the site. Coupled with the largest density of ceramics, the numerous pieces of red ochre, the clustering of ceramics and other artifacts outside of features, and the lack of evidence for a domestic structure or hearth, Locus 3 appears to have been primarily characterized by manufacturing activities.

F44: a Stone-Lined Hearth from Locus 1

One of the most interesting hearth features is F44 from the central portion of Locus 1. This feature is a hearth with at least two focal points and stone paving on one portion. Red ochre pieces were found within and around the feature (Sanders et al. 2014:284), possibly indicating that it was used as an iron oxide roasting pit to turn yellow ochre to red ochre. Three radiocarbon dates were obtained from this feature, but rather than contextualizing the feature chronologically, the dates are confusing in relation to stratigraphy and surrounding artifacts. The southwestern portion of the feature is dated to 2490±30 BP (Sanders et al. 2014:286) in its topmost layer of hearth accumulation (F44-A), while hearth material from the same layer on the other side of the feature was dated to 1520±30 BP (Sanders et al. 2014:286). A nearby charcoal sample was dated to 1550±30 BP (Sanders et al. 2014:286). To complicate matters, the latest date in the ceramic AMS sequence came from within and directly adjacent to the feature, representing a range of 905–702 at the 2-Sigma range (GLNS:28). Some of the members of this vessel lot appear fire-damaged and occurred in the subsoil possibly below, but certainly adjacent to, the segment of the feature dated to 2490±30 BP (unit 925N/1013E, layer 3, F44-A). The mixture of dates, the indications that it was used for purposes other than cooking, and the differentially stone-lined sections of the hearth suggest it was a semi-permanent structure that was reorganized at different points in time (Sanders et al. 2014:286). These confusing data indicate that the feature not only enjoyed a lengthy history of use but also transformations and probably repurposing through time.

CONCLUSION

The Locus 3 use history is partially revealed by the distribution of ceramics. Clustering of some vessel lots and tight distribution of sherds belonging to some vessel lots (such as GLNS:61) indicate that some spots, such as in the unit 871N/981E, contained numerous vessels, possibly stored and subsequently broken. Conversely, the large deposit of ceramics and other artifacts not associated with the two large hearth features, F27 and F29, contain sherds from vessel lots occurring all around Locus 3. This differentiates it from the other high-density ceramic deposits that appear both more tightly clustered (sherds of multiple vessel lots occurring together) and more tightly distributed in terms of vessel lots (sherds of vessel lots occurring in close proximity). Taphonomic history also appears to differentiate these two kinds of clusters, especially concerning the lack of charring on sherds from the central cluster, whereas sherds from the same vessel lots occurring in or close to the hearth features tend to exhibit charring and carbonized material not consistent with use wear. Therefore, the ceramics that occur in the central artifact cluster appear to have been moved from their original depositional positions and deposited, along with soil and other artifacts in this central cluster.

APPENDIX 11: COMPOSITIONAL DATA

Detritus particles are good surrogates for the sherds from which they were shed because their composition is identical to the parent sherds, but they can be subjected to destructive analysis, having already been lost naturally and thus usually treated as dust or refuse (Woolsey 2010). Particularly in the case of SEM work, particles as small as 0.5 mm across are sufficient for analysis as long as they can definitively be said to come from one sherd. For the technique we report here, the region of the vessel and the portion of the wall (e.g., core, interior, or exterior) is presumed to be more-or-less inconsequential (but see Riccardi et al. 1999); nevertheless, an effort was made to ensure that particles came only from just below the interior or exterior surface. Careful preservation of particles as they are shed (usually during examination) ensures that they represent the vessel lot of the sherd from which they were collected.

Sample Selection

Sample selection was based on the degree to which vessel lots were representative of manufacturing traditions (a number of vessel lots sharing the same manufacturing attributes), what their manufacturing and decorative attributes were, and whether they contributed to a cross-section of paste types observed in the assemblage. All samples came from the Locus 3 area. Three of the vessel lots sampled are dated (**Error! Reference source not found.**).

SEM

SEM was used to examine microstructure of the ceramics and the temper particles and to gather semi-quantitative data. Detritus particles collected from specimens were examined in order to avoid wear and tear on sherds and to avoid carbon-coating. Samples of detritus were mounted on platforms using double-sided carbon-coated tape and carbon coated. Compositional data were collected on both clay and temper particles. Some images of particles and clay were also acquired.

Table 35: Samples selected for SEM analysis. Middle Woodland (MW) (2150–1350 BP), Late Middle Woodland (1650–1350 BP), Early Late Woodland (ELW) (1350–1000 BP), and Late Woodland (1350–500 BP).

Sherd No.	Vessel Lot	Characteristics	Reason for Selection	Inferred Period
6749	61	CWS, grit	Distinctive Blue-Grey Quartz	ELW
13725	62	CWS, grit	Hard paste, fan decoration	LW
13369	77	CWS, organic	Organic temper, shiny residue	LW
13979	88	dentate, hard	Hard, buff paste	MW
7093	90	CWS, organic	Fan decoration, hard paste	LW
7166	93	CWS, no temper	Thick-walled, fine paste	ELW
7353	108	FI, grit	Early Woodland?	EW
13891	109	CWS, grit	Most complete vessel	LW
8074b	131	CWS, trailing	Zoned cord marks	LW
5550	143	cord marks, grit	Round-lip, channeled, dark paste	LW
5689	144	Dentate, grit	Fine paste, thin	MW
8558	160	PSS, grit	Medium paste, imported?	LMW

Table 36: SEM compositional analysis of iron oxide particles, reported in atomic weight. Iron is assumed to be Fe_2O_3. The differential amounts of iron in each of the particles is interpreted as reflecting the "hematization" of feldspars at Gaspereau Lake, reported on by O'Reilly et al. (1982:64) and others (MacDonald and Ham 1992). Hematization is one the processes occurring on decomposing K-feldspars in which an assemblage of new minerals was formed, including limonite or iron oxide. Some particles with a high amount of iron appear to be chlorite or proto-clay, whereas others exhibit unusual structures such as honeycomb structures. Note the high amount of phosphorus, a phenomenon that showed up in all compositional analysis of clay and temper.

VL#	61	21	21	12912	12912	12912	77
Specimen Name	BfDd-24:6761	BfDd-24:12813	BfDd-24:12813	BfDd-24:12912	BfDd-24:12912	BfDd-24:12912	BfDd-24:13369
Al	12.37	6.52	4.19	9.44	7.8	20.25	3.29
C							21.92
Ca	0.28	0.26	0.08	0.27	0.23	0.42	0.03
Cl							0.23
Fe	12.31	21.82	30.72	23.99	31.74	14.89	18.28
K	0.40	0.79	0.64	0.61	0.33	0.23	0.03
Mg	0.24	0.48	0.33	0.46	0.33	0.21	0.05
Mn	0.5	0.19	0.19	0.33	0.53	9.66	1.26
Na	0.16	0.33	0.08	0.13	0.06	0.00	0.00
O	65.45	58.76	60.46	54.91	52.42	45.67	49.53
P	6.27	0.91	0.62	2.08	2.09	6.77	4.84
S							0.26
Si	1.67	9.37	2.44	7.57	4.27	1.63	0.14
Ti	0.35	0.56	0.26	0.21	0.2	0.26	0.15
Total	**100**	**99.99**	**100.01**	**100**	**100**	**99.99**	**100.01**

XRF

XRF was used to examine composition of temper particles prior to laser ablation. The samples were mounted in 1" diameter epoxy pucks and a combination of wet-dry sandpaper of increasing grit size was used to reveal the sherd material. The pucks were then polished on a Buehler Minimet polisher using 6, 3, and 1 μm diamond paste. The polished pucks were placed in a Bruker M4 Tornado micro-X-ray fluorescence (μ-XRF) instrument equipped with a Rh X-ray source, a 20 μm polycarpellary focus tube, and dual peltier-cooled energy-dispersive (ED) detectors. Elemental maps were produced by scanning the samples under the X-ray beam operated at 50kV and 400μA; a full ED spectra is collected at each pixel. A step size of 20 μm was used. At the end of the mapping session composite images comprising combinations of Al, Si, P, K, Ti, Fe, an Zr were used to identify the major mineral phases present. Mineral identification was also guided by inspection of energy-dispersive spectra for regions of interest selected within each phase.

LA ICP-MS

Laser ablation was used to identify precise composition of temper particles in order to compare with granite sources of Nova Scotia published in the literature. Samples were the same as those used for XRF.

Table 37: Composition of a particle of K-feldspar using XRF from GLNS:62. Iron is assumed to be Fe_2O_3.

Element	Normalized to 100 (wt.%)	Normalized without O (wt.%)	Error (2 Sigma)
O	45.61		
Na	0	0	0
Mg	0	0	0
Al	9.56	18	0.58
Si	29.79	63.72	4.87
P	0	0	0
K	14.32	17.25	0.16
Ca	0	0	0
Fe	0.55	0.79	0
Zn	0.01	0.01	0
Rb	0.04	0.04	0
Sr	0.01	0.01	0
Rh	0	0	0
Cs	0.13	0.13	0
Total	**100**	**99.95**	

Table 38: Composition of a particle of quartz using XRF from GLNS:62. Iron is assumed to be Fe_2O_3.

Element	Normalized to 100 (wt.%)	Normalized without O (wt.%)	Error (2 Sigma)
O	53.22	0	0
Al	0	0	0
Si	46.99	99.83	10.97
P	0	0	0
K	0.01	0.02	0
Ca	0	0	0
Ti	0	0.01	0
Fe	0.10	0.14	0
Zr	0	0	0
Rh	0	0	0
Total	**100**	**100**	

Table 39: Composition of a particle of Fe-Ti oxide (limonite) using XRF from GLNS:62. Iron is assumed to be Fe_2O_3.

Element	Normalized to 100 (wt.%)	Normalized without O (wt.%)	Error (2 Sigma)
O	36.98	0	0
Mg	1.55	2.58	0.01
Al	7.75	14.64	0.16
Si	9.08	19.43	0.21
P	0.51	1.17	0
S	0.23	0.58	0
K	8.10	9.76	0.02
Ca	0.02	0.03	0
Ti	3.12	5.20	0
Cr	0.03	0.04	0
Mn	0.55	0.71	0
Fe	32.08	45.87	0.26
Rh	0	0	0
Total	**100**	**100.01**	

Table 40: Composition of a particle of apatite using XRF from GLNS:62. Iron is assumed to be Fe_2O_3.

Element	Normalized to 100 (wt.%)	Normalized without O (wt.%)	Error (2 Sigma)
O	39.88	0	0
Al	0	0	0
Si	0	0	0
P	17.92	41.07	1.56
Ca	40.67	56.91	1.21
Mn	0.77	1.00	0
Fe	0.51	0.72	0
Sr	0	0	0
Y	0.18	0.23	0
Rh	0	0	0
Ce	0.07	0.08	0
Total	**100**	**100.01**	

Table 41: Composition of a particle of apatite using XRF from GLNS:62. Iron is assumed to be FeO.

Element	Normalized to 100 (wt.%)	Normalized without O (wt.%)	Error (2 Sigma)
O	47.95	0	0
Na	0	0	0
Mg	0.26	0.43	0
Al	17.16	32.42	1.05
Si	24.12	51.60	2.1
P	1.78	4.07	0.01
S	0.09	0.22	0
K	2.09	2.52	0
Ca	0.38	0.53	0
Ti	0.72	1.20	0
Cr	0.02	0.02	0
Mn	0.02	0.03	0
Fe	5.32	6.84	0.01
Ni	0.01	0.01	0
Cu	0.01	0.01	0
Zn	0.04	0.05	0
Rb	0.02	0.03	0
Sr	0.02	0.02	0
Rh	0	0	0
Total	**100**	**100**	

Table 42: Compositional analysis of biotite particles in five vessel lots using laser ablation, part 1. Amounts are in parts per million (ppm). The column marked "VL" lists vessel lot numbers. Cells marked with "<LOD" indicate an amount below levels of detection.

VL	Si	Li	Be	Na	Mg	Al	P
61	5.12E+05	221.4	2.94	2170	34430	1.19E+05	10260
61	4.80E+05	342.9	2.12	1496	31080	1.21E+05	14890
61	4.12E+05	262	3.15	1515	44080	1.35E+05	11120
62	4.16E+05	227.3	2.39	773	37990	1.18E+05	724
62	4.48E+05	382	2.16	1135	37890	1.20E+05	216
62	4.54E+05	197.6	0.87	1120	36580	1.19E+05	262
62	3.89E+05	1674	1.74	1100	43310	1.26E+05	720
62	5.15E+05	1573	2	978	40520	1.16E+05	175
62	4.75E+05	990	1.63	1311	40990	1.20E+05	821
82	4.76E+05	280.2	2.19	827	40300	1.18E+05	184
82	5.02E+05	210	4.61	757	3.68E+04	1.12E+05	950
88	4.40E+05	616	2.41	1029	39530	1.23E+05	251
88	4.55E+05	621.1	2.61	1036	39680	1.22E+05	342
88	4.70E+05	624	2.96	937	40080	1.24E+05	293
88	4.56E+05	88.1	1.95	432	42330	1.21E+05	810
160	2.89E+05	173	2.3	1260	3.97E+04	1.59E+05	4690

Table 43: Compositional analysis of biotite particles in five vessel lots using laser ablation, part 2. Amounts are in ppm. The column marked "VL" lists vessel lot numbers. Cells marked with "<LOD" indicate an amount below levels of detection.

VL	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Rb
61	84280	440	64	17600	318.6	147.6	4390	1.72E+05	586
61	86180	502	68.5	23990	344.2	178	2329	1.69E+05	533.4
61	85270	278	79.9	30860	447.0	213.2	5470	2.23E+05	528.8
62	101900	150	74.4	26280	365.2	173.4	3354	1.97E+05	820
62	102500	<LOD	75.3	26430	372.8	158.1	3357	1.96E+05	855
62	101860	246	76.4	28240	403.6	167.7	3364	1.98E+05	867.2
62	95600	183	81.7	24780	362.8	163.7	3089	2.08E+05	714
62	99780	<LOD	76.0	25650	365.5	157.2	2607	1.94E+05	671.2
62	99310	155	76.4	25670	383.0	164.3	2621	1.92E+05	708.2
82	95400	510	67.7	22760	338.0	144.9	2720	2.03E+05	734
82	81500	618	151	19200	288.0	111.1	2490	1.80E+05	658
88	99960	133	73.2	20140	313.4	93.4	3272	1.94E+05	889
88	101070	<LOD	70.7	20460	316.4	104.4	2963	1.95E+05	844
88	99400	92	71.2	19620	344.8	112.1	3116	1.93E+05	868
88	93500	196	70.9	21310	331.3	130.9	2821	1.91E+05	895
160	86000	142	81.6	25000	403.0	293	2600	1.97E+05	634

Table 44: Compositional analysis of biotite particles in five vessel lots using laser ablation, part 3. Amounts are in ppm. The column marked "VL" lists vessel lot numbers. Cells marked with "<LOD" indicate an amount below levels of detection.

VL	Sr	Cs	Y	Sn	Ba	W	Tl	Pb
61	13.1	23.36	7.0	12.22	1193	2.07	3.58	10.89
61	19.5	18.19	10.8	10.27	3665	1.71	3.22	20.85
61	9.3	16.70	34.9	13.38	3604	2.83	3.17	29.80
62	1.36	17.44	1.11	18.25	3204	3.79	4.40	3.54
62	1.21	25.97	1.05	17.80	2079	4.34	4.55	3.60
62	2.34	37.53	0.94	16.46	792	4.66	4.31	4.17
62	2.12	34.30	75	13.60	2750	2.34	4.34	8.40
62	1.03	12.23	0.37	12.43	4220	1.80	3.97	3.83
62	2.5	18.81	2.48	12.72	3070	3.02	4.09	5.68
82	2.28	20.87	9.30	12.36	1005	3.79	4.02	11.2
82	4.78	31.70	1170	10.38	1000	3.83	3.53	11.7
88	1.68	72.60	0.249	23.61	684	6.35	4.48	4.87
88	1.84	41.30	1.45	23.36	445	4.77	4.63	6.04
88	1.55	139.4	0.14	24.16	618	5.93	4.52	3.52
88	3.25	130.4	0.51	18.31	1121	4.52	4.85	7.33
160	5.00	55.80	25.3	11.00	2690	1.57	3.55	14.2

Table 45: Compositional analysis of K-feldspar particles in five vessel lots using laser ablation, part 1. Amounts are in ppm. The column marked "VL" lists vessel lot numbers. Cells marked with "<LOD" indicate an amount below levels of detection.

VL	Si	Li	Be	Na	Mg	Al	P	K
61	8.53E+05	4.6	0.57	9080	6.6	99100	350	1.29E+05
61	9.10E+05	9.6	1.04	1.68E+04	9.3	101000	244	1.12E+05
61	9.87E+05	4.7	1.46	9270	4.49	99630	226	1.43E+05
61	7.45E+05	12.9	<LOD	4880	2.76	103400	148	1.31E+05
62	8.31E+05	12.8	0.23	9870	8.2	100100	786	1.25E+05
62	8.37E+05	14.4	0.126	7250	5.3	99200	848	1.31E+05
62	8.42E+05	12.9	0.18	9150	6.0	100400	1057	1.27E+05
62	1.00E+06	13.9	<LOD	7670	4.4	97000	472	1.35E+05
62	1.02E+06	10.6	0.85	6060	8.6	96000	819	1.33E+05
62	9.21E+05	14.0	0.70	6140	3.86	99500	736	1.32E+05
62	8.31E+05	14.3	<LOD	8770	1.39	100200	397	1.29E+05
62	9.58E+05	6.2	<LOD	5680	3.65	95500	650	1.33E+05
62	9.93E+05	27.7	0.32	9420	8.1	98500	916	1.27E+05
62	9.48E+05	37.1	<LOD	9290	8.9	95900	1126	1.35E+05
62	9.30E+05	29.5	<LOD	11920	9.7	95600	1157	1.30E+05
82	9.78E+05	6.6	0.28	1.26E+04	17	98400	425	1.16E+05
82	9.57E+05	<LOD	<LOD	8790	14.6	100600	413	1.30E+05
82	1.06E+06	4.3	0.29	11100	18.2	95900	533	1.22E+05
82	7.89E+05	<LOD	<LOD	8530	38	100900	533	1.29E+05
82	7.80E+05	<LOD	0.45	8341	9.14	102600	326	1.27E+05
82	8.49E+05	5.7	0.71	6930	8.40	101100	400	1.31E+05
82	1.06E+06	4.6	<LOD	6570	9.78	95900	998	1.35E+05
82	9.88E+05	8.7	0.84	9220	15.9	98700	414	1.28E+05
88	9.36E+05	12.6	<LOD	17350	12.8	96500	323	1.10E+05
88	9.34E+05	4.5	<LOD	14350	12.9	100600	317	1.19E+05
88	1.03E+06	14.1	0.62	9950	25	100700	636	1.21E+05
88	1.01E+06	13.1	0.52	7760	5.92	99680	430	1.26E+05
160	8.70E+05	<LOD	<LOD	4456	2.1	97900	<LOD	1.33E+05
160	8.23E+05	<LOD	<LOD	4916	1.49	100600	<LOD	1.33E+05

Table 46: Compositional analysis of K-feldspar particles in five vessel lots using laser ablation, part 2. Amounts are in ppm. The column marked "VL" lists vessel lot numbers. Cells marked with "<LOD" indicate an amount below levels of detection.

VL	Ca	Sc	Ti	V	Cr	Mn	Fe	Rb	Sr
61	627	2.30	31.5	<LOD	2.94	10.4	64.7	245	254.2
61	5670	2.35	18.9	<LOD	2.53	9.1	82.2	215	227.7
61	2660	2.56	29.8	0.30	2.8	5.1	308	298	100.0
61	630	2.25	24.1	<LOD	3.3	6.7	57.1	251	292.4
62	293	2.58	32.7	<LOD	<LOD	12.6	170	418	102.1
62	312	2.23	42.7	<LOD	3.5	14.2	42.6	568	111.9
62	174	2.78	30.9	<LOD	4.11	13.5	42.7	492	88.9
62	271	2.21	35.8	<LOD	3.15	15.7	76	428	113.2
62	314	2.52	38.4	<LOD	3.41	9.9	76.7	756	107.9
62	286	2.43	31.2	<LOD	4.07	9.8	24.1	755	120.9
62	461	2.33	44.9	<LOD	3.20	4.8	55.5	215	296.7
62	276	2.46	26.7	<LOD	2.76	11.2	74.8	420	90.6
62	298	2.41	33.6	0.20	2.69	14.7	157	376	105.6
62	327	2.25	34.6	<LOD	<LOD	11.3	220	488	89.0
62	469	2.36	32.4	<LOD	4.90	11.8	108	381	75.9
82	634	3.21	35.0	0.33	4.80	75	1.10E+03	257	194.0
82	706	2.68	37.0	<LOD	3.20	17	86	243	220.2
82	751	2.63	36.6	0.30	3.70	78.3	210	255	207.3
82	378	2.73	32.7	<LOD	2.70	6.3	57	222	172.2
82	452	2.49	30.9	<LOD	3.60	8.1	68.5	219	199.4
82	448	2.53	35.9	0.80	4.10	30	190	224	196.0
82	435	2.50	27.4	<LOD	2.60	9.1	101	277	103.6
82	833	2.61	24.1	0.15	2.57	13.5	248	251	172.9
88	980	2.11	48.2	0.24	2.90	61	170	204	238.2
88	794	2.25	46.6	0.80	3.91	10.9	141	233	242.1
88	550	2.27	29.0	<LOD	3.29	15.3	180	255	137.8
88	342	2.37	26.8	<LOD	3.15	8.4	39.9	246	182.1
160	220	2.59	4.10	<LOD	<LOD	12.9	197	733	100.5
160	195	2.54	3.60	<LOD	2.88	<LOD	<LOD	720	121.6

Table 47: Compositional analysis of K-feldspar particles in five vessel lots using laser ablation, part 3. Amounts are in ppm. The column marked "VL" lists vessel lot numbers. Cells marked with "<LOD" indicate an amount below levels of detection.

VL	Y	Sn	Cs	Ba	W	Tl	Pb
61	0.0068	0.71	4.27	1067	0.0015	0.936	94.2
61	0.199	0.437	4.28	1758	0.000	0.816	77.3
61	3.34	0.179	5.04	2240	0.000	1.25	19.6
61	0.261	0.133	2.38	10800	0.007	0.965	68.4
62	0.015	3.28	7.3	818	0.000	2.53	52.6
62	0.043	3.23	14.96	1166	0.034	3.05	65.2
62	0.031	2.51	8.07	949	0.000	2.61	50.3
62	0.053	3.41	5.19	2431	0.064	1.79	74.7
62	0.047	2.58	28.5	1244	0.069	3.59	74.4
62	0.035	2.11	37.5	1238	0.0078	3.46	77.1
62	0.065	0.754	1.299	5720	0.000	0.928	70.9
62	0.087	0.648	6.57	827	0.089	1.704	60
62	0.098	1.055	6.46	971	0.043	1.65	62.4
62	<LOD	1.96	5.22	721	0.000	2.62	59
62	0.037	1.55	4.1	485	<LOD	2.02	46
82	0.061	0.62	3.12	3850	0.210	1.09	71.8
82	0.030	2.22	1.449	2886	0.002	0.991	70
82	0.027	1.89	1.168	1658	0.002	1.131	68.5
82	0.0095	0.98	2.42	3106	0.000	0.855	65.1
82	0.030	1.25	2.581	2659	<LOD	0.863	71.81
82	0.108	1.38	2.37	3960	<LOD	0.905	80.2
82	0.026	1.94	4.04	549	<LOD	1.133	55
82	0.333	0.748	2.66	2466	<LOD	1.093	54.7
88	0.082	1.67	1.97	3238	0.170	0.795	70.3
88	0.075	1.42	2.44	3804	0.180	0.892	66.7
88	0.043	1.55	3.98	819	0.095	1.09	62.4
88	0.021	0.511	3.12	1268	0.000	0.871	73.5
160	0.048	0.083	6.14	2232	0.000	2.82	17.69
160	0.018	0.137	5.92	2178	0.000	2.81	21.38

Table 48: Compositional analysis of plagioclase particles in four vessel lots using laser ablation, part 1. Amounts are in ppm. The column marked "VL" lists vessel lot numbers. Cells marked with "<LOD" indicate an amount below levels of detection.

VL	Si	Li	Be	Na	Mg	Al	P	K	Ca
62	5.58E+05	16.2	3.7	65370	28	148300	274	4220	4.73E+04
62	6.24E+05	35.3	9.2	69960	81	134100	170	3118	34210
62	6.49E+05	9.4	10.8	70480	2.14	131500	187	2106	33260
62	6.53E+05	14.1	6.7	68880	7.5	134200	152	2988	35880
62	6.12E+05	28.5	4.7	70010	5.6	133800	255	3237	33950
62	6.72E+05	12.9	5.1	68370	2.1	135400	227	3434	35300
62	7.08E+05	9.3	4.6	68400	1.8	132900	279	3536	33660
62	6.15E+05	94.4	4.8	66840	22.2	142700	313	2040	4.53E+04
82	6.50E+05	<LOD	2.2	65790	178	136500	516	3190	40610
82	6.29E+05	<LOD	5.0	65770	2.9	142000	247	1977	45000
82	6.77E+05	51.7	3.37	68530	75.7	133100	429	3830	32420
88	5.77E+05	<LOD	4.82	70850	2.1	134300	282	4180	33630
88	6.07E+05	<LOD	4.03	67060	3.8	138800	190	4532	39780
88	6.48E+05	<LOD	5.40	69570	2.4	130300	304	4624	31400
88	5.96E+05	5.3	5.76	67600	2.3	141400	220	1600	42790
88	6.37E+05	<LOD	3.71	67150	2.4	138700	188	3335	39710
88	6.89E+05	21.3	8.10	71100	15.9	128500	243	1923	32730
94	6.09E+05	15.3	4.34	67660	8.0	137800	150	2004	40530
94	7.00E+05	14.0	11.6	72250	2.1	124300	370	2789	28450
94	6.20E+05	13.7	6.90	67630	4.7	139200	399	1487	41850
94	5.91E+05	<LOD	1.91	66450	3.7	142300	311	2581	44500

Table 49: Compositional analysis of plagioclase particles in four vessel lots using laser ablation, part 2. Amounts are in ppm. The column marked "VL" lists vessel lot numbers. Cells marked with "<LOD" indicate an amount below levels of detection.

VL	Ti	V	Cr	Mn	Fe	Rb	Sr	Y	Sn	Cs
62	28.7	<LOD	5.0	94.6	126.5	1.37	503	1.27	0.73	0.111
62	23.4	<LOD	<LOD	109	177	2.6	238.5	0.535	0.428	0.47
62	18.3	<LOD	<LOD	12.6	69.6	0.34	250.9	0.449	0.217	<LOD
62	17.0	0.29	<LOD	23.4	68	0.91	255.7	0.587	0.338	0.061
62	31.0	<LOD	<LOD	58.1	79	0.9	226	0.48	1.1	<LOD
62	20.6	<LOD	3.3	66.9	72.8	0.9	226.8	0.543	1.13	<LOD
62	24.0	<LOD	3.9	60.4	67.7	0.93	224.3	0.533	1.12	<LOD
62	25.4	<LOD	4.0	28.7	123	5.6	325.6	1.29	0.183	0.83
82	69	4.91	3.4	164	1310	2.97	473.7	1.56	0.52	0.396
82	28.3	0.62	3.5	61.3	62	0.42	323.1	1.26	0.421	<LOD
82	62	2.87	3.6	222	1130	13.7	372.5	1.49	0.507	5.09
88	18.7	<LOD	3.9	53.7	103	0.72	203.2	0.389	0.68	0.093
88	21.3	<LOD	5.4	79.1	112.1	2.57	298.1	0.91	0.73	0.07
88	18.2	<LOD	<LOD	51.9	87	1.49	182.4	0.319	0.94	0.075
88	27.3	<LOD	3.9	59.9	730	0.4	263.8	1.06	0.436	<LOD
88	21	<LOD	4.8	78.1	65.1	0.75	265.7	1.02	0.84	<LOD
88	18.9	<LOD	3.0	37.9	66	5.32	227.3	0.68	0.45	2.22
94	22.5	<LOD	4.3	42.4	68.3	0.47	276.4	1.08	0.427	0.12
94	21.4	0.65	3.2	22.6	533	0.76	214.4	0.258	0.439	<LOD
94	51.0	2.2	5.2	160	2610	0.74	326.8	0.79	0.247	0.22
94	39.2	0.37	6.0	61	200	1.09	470.5	1.33	0.68	0.14

Table 50: Compositional analysis of plagioclase particles in four vessel lots using laser ablation, part 3. Amounts are in ppm. The column marked "VL" lists vessel lot numbers. Cells marked with "<LOD" indicate an amount below levels of detection.

VL	Sc	Ba	W	Tl	Pb
62	1.99	285	0	<LOD	29.57
62	1.96	45.9	0	0.021	22.81
62	2.03	41.7	0	<LOD	22.51
62	1.84	45.3	0.0065	<LOD	23.29
62	2.10	39.6	0.08	<LOD	24.25
62	2.27	40.4	<LOD	<LOD	25.01
62	2.16	38.1	0	<LOD	24.37
62	1.88	106.4	0.012	0.078	29.02
82	2.35	243.9	0.053	0.047	26.7
82	2.29	93.8	0.003	<LOD	27.79
82	2.27	228.6	0.123	0.126	25.01
88	2.01	31.1	<LOD	<LOD	24.37
88	1.86	50.3	<LOD	0.038	28.17
88	2.16	31.7	0.016	0.0186	24.07
88	2.28	82	<LOD	<LOD	27.92
88	1.82	47.4	0.0029	<LOD	27.78
88	1.92	72.4	0.013	0.033	23.86
94	1.78	67.7	0	<LOD	28.6
94	1.98	38.5	0	<LOD	22.66
94	2.05	75	0.026	<LOD	31.9
94	1.91	247.7	<LOD	<LOD	27.82