THE PRODUCTS OF TURBULENT TIMES: CONTINUITIES AND CHANGE OF 17TH CENTURY NEUTRAL IROQUOIAN CERAMIC TECHNOLOGY

THE PRODUCTS OF TURBULENT TIMES: CONTINUITIES AND CHANGE OF 17TH CENTURY NEUTRAL IROQUOIAN CERAMIC TECHNOLOGY

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ABSTRACT

Archaeologists today increasingly consider the relationship between historical processes and the production practices of past potters. In this thesis, I utilize extant Neutral Iroquoian assemblages from Southern Ontario to explore continuities and discontinuities in ceramic production practices during a time of profound socio-demographic turbulence in the early 17th century A.D. The Neutrals contributed and responded to an increase in regional violence, migration, and cultural interaction that involved taking in refugees, escalating captive-taking raids against enemy nations, and intensifying regional trade-networks along European and indigenous routes, while also experiencing and responding to traumatic demographic losses produced by European-disease epidemics. I employ the relational and historical *communities of practice* approach to orient my perspectives on technical styles to the lived experiences of learning and production among Iroquoian potting communities. The distinct emergence of shell-tempered ceramics in the Spencer-Bronte Creek site cluster served as an anchor for my investigation on how Neutral potters renegotiated and articulated potting practices during times of turbulence.

I examined pottery production practices at the chronologically sequential Christianson and Hamilton sites through a multi-attribute analysis, ceramic petrography, and oxidation analysis. In this comparative approach, I found the likely presence of more than one community of practice at each site, speaking to the possibility of migration events. I found that a significant degree of continuities in technical style and a slight decrease in skill can speak to an adaptability of 'open learning' production communities, where broader numbers of persons held technical knowledge as peripheral non-specialists

and they could have taken up the craft during times of community member reconstitutions after epidemics. Through time, conditions of turbulence brought about a greater diversity of practices and styles among communities of production as indicated through an increased blending of alternative practices in local operational chains and a decrease in their regimentation. These alterations are likely produced through ‘micro-histories’ at play within the household production scales constituting each village.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

List of Abbreviations

CHR=Christianson
HAM=Hamilton
GBP=Glass Bead Period

Chapter 1: Introduction & Background

1.1: Introduction and Problem Orientation

In this thesis, I examine ceramic technological systems at two Neutral Iroquoian villages. My goal is to advance our archaeological understanding on the material impacts of regional socio-demographic turbulence within one Proto-Contact (ca. A.D. 1550-1615) to Contact-era (A.D. 1615-1650) cluster of Neutral sites located in Flamborough, Ontario (Figure 1.1). To accomplish this, I utilize fine-grained methodologies to explore the changes and continuities in technical styles of pottery production and the degrees of manufacturing skillfulness at the sequentially occupied Christianson (AiHa-2) and Hamilton (AiHa-5) villages (Fitzgerald 1981; Lennox 1977). The temporally sequential inhabitancy of these villages and their physical proximity (<5km away) to each other offer geologic and historical 'controls' for assessing changes and continuities through time.

Figure 1.1: Location of study. Modified from *Google Earth*, 2018

Neutral Iroquoian communities from the Proto-Contact to Contact-era produced, experienced, and responded to a time of profound historical processes that included intensified trade interactions along traditional and European routes (Jamieson 1992, 1999;

Lennox and Fitzgerald 1990), European-disease epidemics that killed up to 60% of Iroquoian communities (Snow 1996; Warrick 2003), increasing intensity of regional violence, forced migrations, and refugee movements (Fox 2009; Snow 2007; Trigger 1976; White 1991). Ferris (2006, 2009), however, cautions against the tropes (common to explanations by 20th century ethnohistorians and archaeologists) whereby the European presence either directly or indirectly destroyed indigenous lifeways. He highlights the broader, centuries-long continuities in Southern Ontario Iroquoian settlement-subsistence, mortuary patterns, socio-political structures, and material culture leading up until and beyond A.D. 1650 (Ferris 2006, 56-98). Ferris (2009) calls attention to the flexibility and fluidity in these societies to accommodate historical contingencies, in the way of 'changing continuities' that underscore the ongoing subtle adjustments and re-articulations of society even during times of profound trauma and stress. As such, researchers can utilize patterns of continuity and change in ceramic technology as one finer-scale of analysis in which these ongoing adjustments and re-articulations of society can materialize in the archaeological record. Thus, we can frame communities of potters as one indigenous cultural system that experienced and responded to these traumatic and dynamic socio-demographic circumstances.

Very few archaeologists have studied ceramic production practices in Iroquoian societies to understand the social reconfigurations that emerge in turbulent conditions, a diachronic approach that has been revealing in other contexts (Hollenback 2012; Lyons and Clark 2012; Stahl 2016; Stahl et al. 2008). In fact, few scholars (e.g. Holterman 2007; Pawlowski 2005) have analysed the extant Neutral ceramic collections that rest in repositories such as *Sustainable Archaeology,* as these collections have been utilized only minimally in primary research since their initial excavations and site syntheses (e.g. Fitzgerald 1981, 1982; Kenyon 1982; Lennox 1977, 1984a, 1984b; Noble 1972, 1980b; Warrick 1983; M.J. Wright

1977). As such, I examine these ceramic assemblages with alternative methodologies and theoretical perspectives while leveraging the rich ethno-historic record to contextualize varying scales of historical processes that constituted the experiences and contexts of production among Neutral potters.

I employ a *Communities of Practice* (Lave and Wenger 1991; Wenger 1998) approach as its focus on daily practices, through a relational and historical lens of mutual knowledge and shared practices, provides an analytical tool for connecting pottery production to social, political, and demographic transformations (Roddick 2009; Roddick and Stahl 2016). Around 1600-1650 A.D., potters in the Neutral Spencer-Bronte Creek cluster (location in Figure 1.2) shifted from their centuries-long usage of solely grit-tempered pastes (mixtures of clay and non-clay inclusions),and began to add crushed shell to their recipes (Lennox and Fitzgerald 1990, 417-419; Michelaki 2007, 144-147). This change in raw material choices allows me to move away from culture-historical approaches which focus on ceramic styles as markers of defined culture-groups (e.g. MacNeish 1952; J.V. Wright 1966). Instead, I use fine-grain methodologies (including ceramic petrography and attribute analysis) to tease apart typological categories such as 'grit' or 'shell' temper. This allows me to trace the changes in communities of practice during turbulent socio-demographic conditions and changing technological systems. I pursue an investigation of inter-site and intra-site (spatial) ceramic style variability to assess a diachronic change from Christianson to Hamilton while establishing a better understanding of how the different histories of learning in smaller social units can constitute the broader set of technical choices at each village.

1.2: Archaeology of the Neutral Confederacy

In the early 17th Century, the Neutral Confederacy was an Iroquoian alliance constituted by up to 8 nations, which archaeologists today recognize as site clusters (Lennox and Fitzgerald 1990). Scholars compare these site clusters to nations through an analogy to the multi-national Haudenosaunee (6 Nations Iroquois) Confederacy whom Europeans extensively documented from the 17th century onwards (Fitzgerald 1990). The Neutral clustered at the head of Lake Ontario and North of Lake Erie, coalescing around this region from the mid 16th to mid 17th centuries (Lennox and Fitzgerald 1990; Figure 1.2). Archaeologists consider the Neutral an Iroquoian people, a socio-linguistic category that is shared with several other socio-political groups in the region including the St. Lawrence Iroquoians, Haudenosaunee, Huron-Wendat, and Petun-Tionontaté (Warrick 2000).[1]

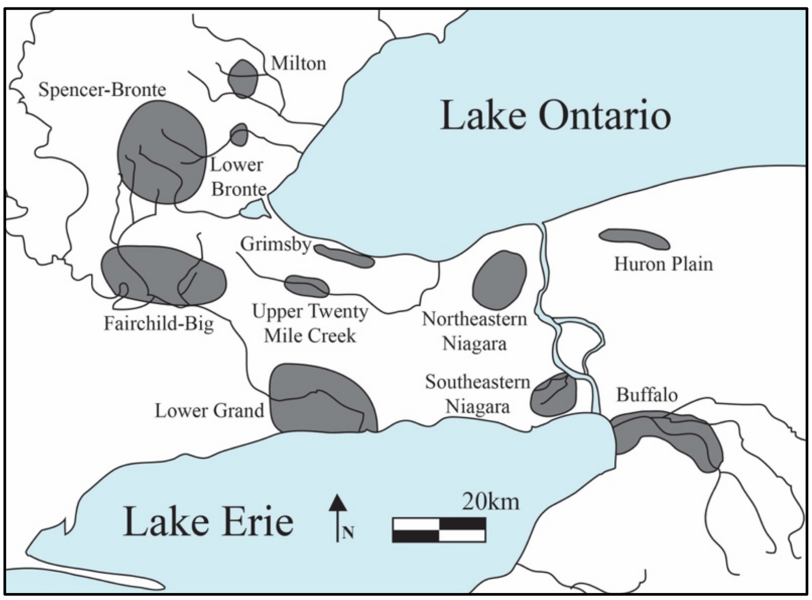

Figure 1.2: Site clusters of the Neutral Iroquoian Confederacy ca. A.D. 1550-1650. Redrawn from Lennox and Fitzgerald 1990, 411

Great Lakes Iroquoian communities of the Contact period emerged out of a pattern of community amalgamations in the 15th and 16th centuries (Birch 2015; Warrick 2000). These nations formed around single amalgamated villages and/or small collections of communities (Birch 2015; Engelbrecht 2007; Hart et al. 2016; Kuhn 2007). Antecedent or 'ancestral'

[1] Many of these broad Iroquoian socio-political units are conglomerates of multiple nations/tribes such as the 5 constituent nations of the 17th century Haudenosaunee - The Seneca, Cayuga, Oneida, Onondaga and Mohawk.

communities of the Neutral spanned across Southwestern Ontario, but by A.D. 1550 these communities ceased to settle villages west of the Grand River (See Appendix A Figure A.1; Lennox and Fitzgerald 1990; Warrick 2000). Archaeologists attribute this spatial settlement pattern to regional socio-political transformations in which multiple nations formed confederacies in the later 16th and early 17th centuries, with allied communities relocating into regional clusters (Lennox and Fitzgerald 1990; Englebrecht 1985; Hart and Engelbrecht 2012, 334). The exact nature of the Neutral socio-political unit and the associated practices or identities of its constituent members is not entirely understood. However, Fitzgerald (1990, 398) draws an analogy with the Haudenosaunee Confederacy (*sensu* Engelbrecht 1985) to conclude that the Neutral "confederacy council was essentially an institution designed to suppress blood feuds among member tribes and generally each tribe pursued its own interests."

The Emergence of Shell-Temper

In this study, I focus on the Spencer-Bronte Creek site cluster which is located in modern-day Flamborough, Ontario (Figure 1.2). This cluster was occupied from the early 16th century (Fitzgerald 1990), and more Iroquoians migrated into the region by the end of the century (Lennox and Fitzgerald 1990). Within this Neutral cluster, archaeologists recognize a change in some ceramic attributes within the Ontario Iroquoian Contact period (post A.D. 1615). Through this period, pottery attributes increasingly include "collarless rims, cord-roughened surface treatment, appliqued strips on vessel necks, dentate stamped and corded motifs on rim exteriors, and triangular plat motifs on high collared rims" (Lennox and Fitzgerald 1990, 417). In particular, local sites exhibit almost no shell-tempered vessels up to A.D. 1600, but sites from 1600-1650 show a marked increase in shell-tempering (Figure 1.3). Lennox (1977) ties the terminal Neutral (up to A.D. 1651) Hamilton site with the highest shell-tempered percentage at 64% of the site's total pottery assemblage. This current understanding of regional paste choices can represent a significant shift away from grit-based recipes that potters produced throughout Late Woodland Southern Ontario (Michelaki 2007).[2]

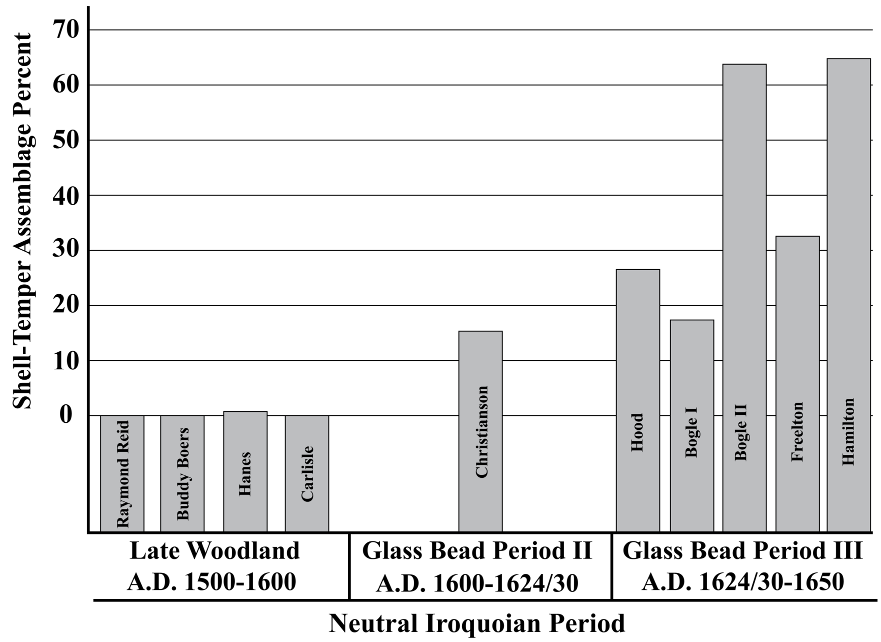

Figure 1.3: Diachronic trend for shell-tempering adoption in the Spencer-Bronte Creek site cluster. Each bar represents a different site of either hamlet or village sizes (Derived from Michelaki 2007 and Fitzgerald 1990).

Shell-temper emergences in the Spencer-Bronte Creek cluster were also a spatially unique occurrence to this one Iroquoian site cluster. Shell-temper production in other 17th century Neutral clusters was miniscule or non-existent, a pattern that echoes more broadly across Iroquoian societies of Southern Ontario and upstate New York. At all the other Neutral site clusters from A.D. 1550-1650, the vast majority of sites exhibit no greater than a 5% shell-tempered assemblage. While at the neighbouring Petun and Wendat Confederacies, shell-temper is either absent or makes a miniscule percentage (<1%) of the site's assemblage (see Appendix A Table A.2). These regional, temporal and spatial trends of shell-temper emergences in Iroquoian societies can connect to a broader pattern across the continent. North

[2] Past research suggests crushed coarse-crystalline igneous and metamorphic rocks, or sand deposits constituted grit pastes (Braun 2010, 2012, 2015; Chilton 1998; Holterman 2007; Martelle 2002; Schumacher 2013; Striker et al. 2017). Refer to Appendix A Table A.1 for a regional synthesis on the presence of shell-temper before A.D. 1580.

American scholars (Boszhardt 2008; Feathers 2006; Feathers and Peacock 2008), particularly focusing in the interior of North America, have investigated similar changes in technical styles towards the predominance of shell-temper at the onset of the Late Woodland/Early Mississippian period (A.D 700-1100). The practice gradually moved up the Ohio River valley (e.g. in the Fort Ancient and Monongahela archaeological cultures), and eventually was taken up by populations living around the Lake Erie Basin of Ohio, Michigan, and Pennsylvania by the 1400's A.D. (Brose 2001; Drooker and Cowan 2001; Johnson 2001; Stothers and Graves 1983).[3] Shell-temper appears in the southwestern edges of Ontario in the late 15th and early 16th century, associated with the Western Basin archaeological culture and possible ancestral Neutral communities (Foster 1990; Lennox and Fitzgerald 1990; Murphy and Ferris 1990). As such, this spatial and temporal peculiarity of the practice in the Spencer-Bronte Creek cluster draws upon and instills an uncertain connection to the macro-scalar 'diffusion' of this particular technical style.

Previous Models of Technical Change

Michelaki (2007) highlights the two models archaeologists use to account for these changes in Neutral potting practices. In the first explanation, archaeologists attribute certain pottery styles to the presence of 'foreign' potters. Lennox and Fitzgerald (1990) argue that the Neutral forcibly relocated captives into this one site cluster where they supposedly continued to practice their traditional pottery making techniques. Archaeologists propose this connection through the accounts of French missionaries and explorers that described a series of substantive captive-taking events by the Neutral against the Algonquin-speaking "Fire Nation" or Mascoutin (Fox 2009; Lennox and Fitzgerald 1990; Stothers 1981). These

[3] These regions along the Southwestern end of Lake Erie coincide with potters of the archaeologically defined Sandusky tradition and Whittlesey tradition which used shell-temper predominately by A.D. 1500 (Brose 2001; Murphy and Ferris 1990, 224).

researchers tie this ethnohistorically described Fire Nation to archaeological cultures located in northwest Ohio and Michigan in the early 17th century. To Stothers (1981), colleagues (Stothers and Graves 1983; Stothers et al. 1994) and Lennox and Fitzgerald (1990), the high prevalence of shell-tempered vessels at the early 17th century Indian Hills site (J. Graves 1984) in northwest Ohio, and its geographic correlation with cartographic texts, indicate the source of these captive potters.[4]

In the second explanatory model, archaeologists consider the broader emergence and spread of shell-temper after A.D. 800 (Feather and Peacock 2008) throughout the mid-continent in evolutionary terms. To some archaeologists (e.g. Feathers 2006; Steponaitis 1983, 1984) the emergence of shell-temper in different contexts across North America is best explained through experimental data that demonstrates shell-temper improves a vessel's resistance to thermal shock and mechanical stress. The predominant consideration for selectionists is that pottery is primarily a functional tool (Michelaki 2007, 148-149). In this perspective, pottery changes because of selective forces, that the practices which provide the optimal technical qualities for a particular task will be gradually taken up through time (Pauketat 2001, 75).

These models provide an incomplete understanding of stylistic changes in light of ceramic studies that focus on the socio-cultural connection between technical styles and pottery production (Chilton 1998; Dietler and Herbich 1998; Lechtman 1977). The two earlier models, summarized by Michelaki (2007), represent either an essentialization of human behaviours that orient choices of human actors as technical optimizations or they assume a normative conceptualization of culture can serve as a complete frame for

[4] 97.9% of the vessels at the Indian Hills site (occupied ca. A.D. 1550-1643) were shell-tempered, all were collarless, and 91.7% had corded bodies (J. Graves 1984, 181-186). See Appendix A Table A.2

understanding material culture (Jones 2007, 45; Pauketat 2001). Coupling theories on technical style and a situated learning (Lave and Wenger 1991) approach provides an alternative model. Even although pots are entangled with their intended use and the needs of consumers, theories of technical style demonstrate ceramics do more than serve functions. Technical choices are constituted by social meanings that extend beyond concerns of use-efficiency and are shaped by community histories (Dietler and Herbich 1989). Historically contingent knowledge and experiences constitute the context and shape the everyday practices of potters (Gosselain 2016; Roddick and Stahl 2016, 21). Thus, pots constitute (and are traces of) the social, political, and economic life in which they are produced. To understand what an historically learning perspective might offer I first must first examine the context of production and the compounding socio-demographic processes that the Neutral produced, experienced, and reacted to.

1.3: Situating Neutral Ceramic Production

The Organization of Production

Some researchers suggest Iroquoian potters were part-time specialists, with naturally skilled women crafting vessels (Braun 2010, 2015; Hart and Brumbach 2009; Lennox 2000; Martelle 2002, 2004; Trigger 1981, 7, 29). Two ethno-historic accounts note that women created pottery.[5] Gendered domains of activity and household/community labour contributions intersected with other identities such as age, sex, social and political status (e.g. captive) that tied individuals to different domains of activity at different stages in their life (Perrelli 2009, 24-25). This means that other community members, such as children, may

[5] These accounts include Recollect missionary Gabriel Sagard's description of the Wendat (A.D. 1632) and Jesuit missionary Joseph-François's description of the early 18th century Haudenosaunee (cited in Waugh 1916, 54). This gendered connection has broad cross-cultural commonalities in most small-medium scale horticultural societies and reinforces the likelihood that Iroquoian women created pottery (Michelaki 2007; Skibo 2013, 8).

have contributed to pottery production on the periphery, perhaps as part of broader suite of household chores and domestic tasks (Allen 1992, 136-138). Iroquoian women were associated with the village, including food production, household material production, and community politics (Michaud-Stutzman 2009, 145-150; Perrelli 2009, 24-26). Using ethnographic texts, Perrelli (2009) suggests that subsistence and material producers of these societies were generally circumscribed around a village domain (village proper and surrounding fields of activity) but family working groups would occasionally travel further distances for seasonal resource acquisitions. Beyond these daily and seasonal movements, ethnohistoric texts also demonstrate women occasionally travelled, particularly within their tribal territories and between allied communities (Engelbrecht 2007, 232).

Ceramic manufacture may have been a household-level activity for household consumption (Allen 1992, 134), or there may have been a more concentrated centre of production with experts connected beyond the household, such as in lineages and clans (Chilton 1998, 157). The high degree of routinization in some steps of production, such as the use of a small number of ceramic recipes and clay types (Braun 2010, 2012, 2015; Creese 2016), suggests a subset of potters that recurrently engaged in the craft (Martelle 2004, 30). Martelle (2002, 2004) drew upon a series qualitative and quantitative data and concluded that 17th century Wendat potters possessed a consistent degree of embodied skills in forming and in the technical knowledge for various production stages such as pastes and firing. To Martelle (2002), this represented a more concentrated centre of production on the continuum of household production levels. Neutral potters working from the 16th to mid-17th century also show a degree of consistent variability in forms (Figure 1.4) but further work is required to draw similar parallels of skill, standardization, and a concentrated organization of production between Wendat and Neutral ceramics.

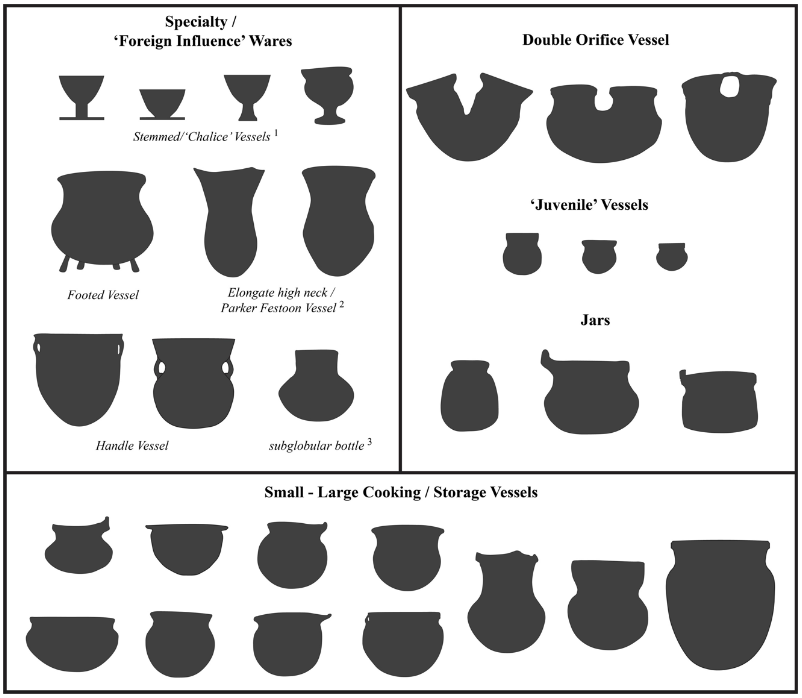

Figure 1.4: Preliminary assessment of forms in late 16th to mid 17th century Neutral assemblages.[6] Sourced from Finlayson 1998; Kenyon 1982; Lennox 1977; Lennox and Fitzgerald 1990; Martelle 2002; Ridley 1961; M. J. Wright 1981.

This household level of production may have also involved additional communal contributions that extended beyond a few master potters and their apprentices (Chilton 1998, 157). Archaeologists do not entirely understand the exact form in which community involvement took shape. However, Martell (2004) draws on ethnohistoric (Trigger 1976) and ethnographic (Parker 1968, Quain 1937) work into Iroquoian co-operative morality to suggest pottery may have been produced in communal labour mobilizations, perhaps under the direction of a select few master potters. To Martelle (2004), Iroquoian pottery production may have significant parallels to broader means of labour mobilization such as 'mutual aid

[6] Figure notation 1: Martelle identified a possible connection to Fort Ancient stemmed vessel (Griffin 1943, Drooker 1997, 88) while Latta (1987, 1990) argues these vessels are emulations of Catholic chalices. Notation 2: Fitzgerald (1981) identified the Parker Festoon type at Christianson, a type as defined by Abel (1999). Notation 3: this vessel is analogous to ceramic type defined in Mississippian contexts as subglobular bottle (Steponaitis 1983, 67). This form was identified at the Raymond Reid site (Finlayson 1998, 1552, Plate IV.4.84).

societies' and 'cooperative work groups' that ethnohistoric texts generally described in relation to subsistence activities.

Histories of Iroquoian Socio-Demographic Turbulence

Iroquoian potters living in the Spencer-Bronte Creek of the 17th century lived through significant socio-demographic events and historical processes. Iroquoian populations in the Lower Great Lakes suffered profound demographic losses through a series of European disease epidemics through the 1630's that researchers argue killed up to 60% of their populations (Snow 1996; Warrick 2003). Jackes' (2008) demographic and pathological profile and Fitzgerald's (1990, 226-39) chronological assessment of the 17th century Grimsby ossuary provides a tangible connection between the Neutral and their experience of epidemic trauma in the mid to late 1630's. Fitzgerald (2007) tied epidemic experiences to several material transformations after the mid 1630's that included a proliferation of animal bone "sucking tubes" and ceramic human effigy pipes that depict a healing procedure he connected to shamanistic healing rites. Demographic losses also reconstituted the levels of skill among potters in the neighbouring Wendat. Martelle (2002) utilized quantitative and qualitative measurements to investigate intra-vessel variability of the rim, lip, collar and wall thickness, collar heights, paste inclusions, and motor-habits in decoration execution at two pre and one post-epidemic Wendat sites. She argues that novices who were not yet competent potters created vessels in epidemic and post-epidemic Wendat communities because ceramics were increasingly irregular in shape, exhibited thicker bulky walls, and crumbly in paste texture (Martelle 2002, 290-311, 2004).

Researchers often identify the late 16th to early 18th century broader Eastern Woodlands and the regional Lower Great Lakes as part of a historical process called the "Shatter Zone" (Ethridge 2009; White 1991, 14). This macroscale conception refers to the disruptions of lifeways for some communities and ensuing reconfiguration of cultures that arose from the

Contact period's characteristic experiences. Increased levels of violence, traumatic disease, and socio-political instability brought significant dislocations of some populations and led to increased movements of people across the landscape as conquerors, captives, or refugees (Ethridge 2009; Fox 2009; White 1991).

The Neutral were embroiled in this regional development and eventual victims to it as the Haudenosaunee took Neutral captives and forced them out of Southern Ontario by A.D. 1651 (Garrad et al. 2003). Yet even before this shift, the Neutral may have been a multi-cultural society. For instance, direct historical accounts (from a rare Jesuit mission to a Neutral village) suggest that the Iroquoian Wenro were forced from Western New York by the Seneca in A.D. 1638/9, eventually migrating to Neutral territory (Thwaites 1896-1901:17, 25-29; 21, 231). Archaeologists have drawn on the high presence of Jesuit materials at the Hood site and the presence of ceramic attributes common in Western New York at the Freelton site to suggest these refugees were present at the Spencer-Bronte Creek cluster (Hawkins 2001; Lennox 1984a). By 1651, the Neutral received more refugees from dislocated populations. Jesuit accounts note inhabitants of a Neutral village, possibly in the Neutral Milton cluster (Figure 1.2), fled from a Seneca attack in 1647.[7] Ethnohistorians detail that a series of attacks by the Haudenosaunee against the Wendat and Petun in the Georgian Bay area in 1647-1649 led many of these dispersed peoples to seek refuge among the Neutral (Garrad 2014, 225, 261).

Ethnohistoric accounts also recorded a series of raids and an escalation of violence by the Neutral against the Fire Nation (Thwaites 1896-1901 22:195, 27: 25). Recollet Missionary

[7] Fitzgerald (1990, 263-265, 368-369) tied the attack to the adjacent Milton cluster based on this *Jesuit Relation* quote, "…a band of three hundred Sonnontoueronnons [Seneca of the Haudenosaunee] attacked the village of the Aondironnons, where they killed a great many . . . These Aondironnons are a tribe of the Neutral Nation who are nearest to our Hurons" (Thwaites 1896-1901, 33:81).

Gabriel Sagard and French explorer Samuel de Champlain report Neutral Raids into Fire Nation territory in A.D. 1616 and 1623 (Biggar 1922-1936, 3: 99-100; Wrong 1939, 158) with an unknown number of captives being taken. The Jesuit Relations, in turn, report raids into Fire Nation territory in A.D. 1640 (100 captives), 1641 (170+), 1643 (800 captives) (Fitzgerald 1981; Thwaites 1896-1901 21:195, 27:25-26). Some archaeologists also present the possibility that the dispersion of some archaeological cultures was the product of Neutral aggression, such as the disruption of lifeways in Western Pennsylvania (e.g. the Monongahela; Johnson 2001; Lapham and Johnson 2002).

The Neutral were also increasingly invested in a variety of trading routes. They participated in an intensified circulation and consumption of exotic items along a traditional southern route to the interior "Mississippianized" archaeological cultures (e.g. Monongahela and Fort Ancient) from the upper to central Ohio valley (Fox 2009, 68; Jamieson 1992; Johnson 2001; Lapham and Johnson 2002). Drooker (1999) also notes the presence of rare and unique ceramic forms at Neutral sites, including pedestalled vessels similar to those found at Fort Ancient sites in the central Ohio valley. Archaeologists see an intensification of trade towards the Atlantic coast by the end of the 16th century and through the 17th century, as seen through the increased presence of marine shell beads (occasionally as intact univalves) and other ornamental and ceremonial items (Jamieson 1999, 185-186; Lennox and Fitzgerald 1990, 429-434).

Neutral communities also participated in emerging "down-the-line" and occasional direct trade with French traders to the North that brought in new European materials (e.g. kettles as analogous to pottery; Lennox and Fitzgerald 1990). Fitzgerald (2001, 44) has argued that brass and copper scraps along with whole iron tools replaced chipped stone and ground stone tools among the Neutral. While earthenware pottery continued to be produced through the mid-17th century (Fitzgerald 2001, 44; Martelle 2004, 36-38; Trigger 1976, 410-411), indigenous ceramic vessels were no longer manufactured in the 18th century (Ferris 2009, 121). These indicators of intensified trade along indigenous and European routes do not only mean an increasing number of material goods were in circulation. It also captures a social landscape that reflects an intensification in social interaction networks that could "provide the means of disseminating . . . technical or ideological innovations, symbolic meanings and beliefs" (Ferris 2006, 69). As such, different forms, materials, and ideas could be in motion across the landscape.

1.4: Reframing Technical Styles in the Neutral 17th Century & Thesis Outline

Disease, alterations and intensifications in regional trade, violence, and migration. All these elements show the importance of foregrounding socio-historical processes in understanding material change. Many archaeologists today recognize the various ways pottery production is entangled with the social, economic, political, and environmental conditions in which the potters are situated (e.g. Pauketat 2001; Roddick 2009, 2016; Roddick and Hastorf 2010; Sassaman and Rudolphi 2001). For example, the rearrangement of values, social practices, power dynamics, and movement of people during the emergence of polities, such as Cahokia in the American Bottom or Tiwanaku in Highland Bolivia, can bring about regional changes in a variety of ceramic styles across the stages of ceramic production (Pauketat 2001, 2004; Roddick and Hastorf 2010; Roddick 2009; 2016). Ethnoarchaeological studies from contexts in Sub-Saharan African and the Amazon show that technical styles constitute social identities at varying scales, from broader ethnolinguistic categories to intra-community age-related identities (Bowser and Patton 2008; Dietler and Herbich 1994, 1998; Gosselain 2008).

This broader literature demonstrates the connection between turbulent socio-demographic conditions, where people, knowledge, and objects are in motion across the landscape, to the affordances for technical practices to be rearranged, rearticulated, or maintained (Lyons and Clark 2012; Stahl 2016; Stahl et al. 2008). As I expand on in Chapter 2, Jean Lave and Etienne Wenger's *Situated Learning* theory and their *community of practice* (Lave and Wenger 1991; Wenger 1998) analytical unit offer archaeologists conceptual tools to orient our understanding on material styles through an in-situ lens focused upon the varying relationships and experiences of craft producers. This couples well with a *chaîne opératoire* (Lechtman 1977; Lemonnier 1986; van der Leeuw 1993) methodology, shifting our focus from the finished product of a typological approach to the emergent relationships that produced these objects. I suggest these alternative analytical frames can help archaeologists better understand the social reproduction of technical styles among Neutral potters in the turbulent 17th century. In this second chapter I also outline my research questions which pursues the understanding of how Neutral potting communities materialize through space and time.

In Chapter 3, I highlight how the Christianson (ca. A.D. 1600-1624/30) and Hamilton (ca. A.D. 1624/30-1650) villages are well-suited for such questions. The extant collections from these sites provide a sequential chronology from which I can examine the continuities and discontinuities in technical style. I provide a summary of the geology surrounding these villages to connect the raw materials of pottery production with the landscape. I outline the local culture-history and the demographic trends of proto to early Contact-era Neutral Iroquoian communities. This background not only contextualizes my sampling strategy but highlights the particular settlement patterns of demographic change and community reconstitutions. I then detail my sampling protocol at the inter and intra-community scales and connect these sampling strategies to a communities of practice analytical unit.

Fine-grained methodologies such as ceramic petrography and attribute analysis provide essential tools to define past communities of practice and to track their transformation or persistence through turbulent conditions (Lyons and Clark 2012; Roddick 2009; Stahl 2016). As I elaborate in Chapter 4, these methodologies provide a more sensitive approach for tracking changes in technical styles in comparison to typological approaches that can homogenize a ceramic assemblage by prioritizing a vessel as a ‘finished product’ (Michelaki 2007; Roddick 2018). For example, I use ceramic petrography to investigate the choices behind previous paste typologies such as ‘grit’ and ‘shell,’ to understand meaningful variability of pastes and connect them to other choices in the production sequence through my attribute analysis.

I address my research questions by presenting my findings in Chapter 5. I highlight the continuities and discontinuities in technical styles and skill across the stages of pottery production at the Christianson and Hamilton sites. In Chapter 6, I analyze the implications of my findings within the social and demographic contexts potters at these two sites may have experienced. Here, I discuss the contributions my research brings to studies of ceramic technical style, and to our understanding of cultural interaction and the transmission of potting knowledge within Iroquoian societies. I found that socio-demographic processes led to an altered materialization in communities of potters, while being grounded by significant continuities in ceramic style. These findings show social theoretical frames can be a useful way of reconsidering material practices in Iroquoian societies and highlights the benefits of using alternative frames and methodologies on extant collections.

Chapter 2: Situating Production: Pottery and Communities of Practice

In the previous chapter, I outlined my goals of this thesis. I seek to understand the changes and continuities of Neutral potting communities during periods of profound socio-demographic turbulence. I suggested that attention to the socio-historical context for which pottery production was situated and a theoretical orientation that considers that production styles constitute varying entanglements will provide explanatory power to my ceramic analysis. In this chapter, I discuss Lave and Wenger's (1991) historical and relational framework of *situated learning* and its associated *community of practice* analytical unit (Wenger 1998). I outline what a community of practice is and how it guides my exploration of ceramic production practices at the Christianson and Hamilton sites. I suggest these theoretical approaches, when paired with theories of technical style (such as the *chaîne opératoire*) can help explain continuities and discontinuities in production practices while generating new kinds of fine-grained questions. I then outline how archaeologists have used these learning framework approaches to understand the transmission of technical knowledge within societies experiencing dynamic social, political, and demographic landscapes. I conclude by outlining my specific research questions.

2.1: A Situated Learning Theory

Emerging from the broader theories of practice (Bourdieu 1977; Giddens 1979, 1984), Lave and Wenger's (1991) *Situated Learning Theory* focuses our analytical gaze upon the activities of daily life and the relationships between practice and the broader social, political, economic and environmental contexts in which it is situated. Through shared histories of learning and mutual engagement in a shared interest, a community of practice can enmesh knowledge and practice between a group of individuals (Wenger 1998, 125). Through shared relationships of learning within social and physical spaces, everyday practices are shaped, the contexts of practice are constituted, and communities of practice emerge (Gosselain 2016, 46; Wenger 1998, 130). As such, communities of practice are closely interacting groups who learn together and develop similar habitual practices, developing a mutual identity in relation to their shared engagement (Wenger 1998, 72-73). A community of practice is also "a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice" (Lave and Wenger 1991). A community practice can then be conceptualized as an emergent, relational, and historically contingent analytical unit defined by these relational histories and constituted by individuals that experienced them. While the definitional focus on the mutuality of engagements can overemphasise thoughts of cooperative activity, a community of practice is also a heterogenous and contested social arena, a feature that harkens to its emergent quality (Lave and Wenger 1991, 36; Roddick and Stahl 2016).

Communities of practice can be defined by participants' engagement in the world through a particular activity. So, for those associated with earthenware pottery, we might consider 'communities of production' and 'communities of consumption.' While there is value in considering consumption, I place communities of production as the centre of inquiry in this thesis. Communities of consumption focus on the social nature of use and associated practices, while communities of production focus on the social contexts of manufacturing and how "ways of producing" are taught and learned (Mills 2016, 1-6; Roddick 2009, 2). In both ways, constituting members can be constructing identity through shared practices, establishing boundaries, and identifying the legitimacy behind participation and practice. Therefore, individuals can earn 'legitimate membership' by displaying normalized ways of doing, practices that are within the community's repertoire of legitimate activity (Lave and Wenger 1991, 29; Wenger 1998, 73, 86).

Lave and Wenger's (1991) *Situated Learning* theory highlights that in order for individuals to become a full member of a community of producers, novices or apprentices must be "legitimate peripheral participants" (Lave and Wenger 1991). Learning takes an essential role in understanding the constitution of these group identities whereby processes of exclusion can operate in tandem with those of inclusion. As such, legitimate learners take a position on the periphery where they engage the community of practice through "information flows and conversations" with old-timers to make sense of practical activity and receive opportunities for participation (Lave and Wenger 1991, 100-103). In ethnographic examples of pottery production, potters informally acquire knowledge by participating in less difficult steps: collecting and moving raw materials, kneading the clay and temper and preparing the bonfire. These activities garner skills, knowledge, and relationships that work towards acquiring a status of "professional or adult" (Gosselain and Livingstone-Smith 2005, Roddick 2016, 138). This process not only involves a development of abstract knowledge on technologies and what to do, but also how a practice should be executed. In the potting example, learners in a ceramic apprenticeship will copy and emulate the motions, actions, and gestures of the master, embodying a tradition of how they move through the act of ceramic production (Minar and Crown 2001; Sassaman and Rudolphi 2001). The ongoing cycle of learners moving from the periphery to the centre of practice provides the generational replacement of former "older-timers" (Bowser and Patton 2008, 108).

Bowser and Patton (2008, 108) highlight that Lave and Wenger's (1991) conception of learning through peripheral participation not only shows the ways in which communities of practice replace their membership over time but provides an understanding for how discontinuity and innovation in practices can arise. New full-members of a production community can have a new stake in a community of practice's development and they can establish their own identities at the same time 'old-timers' transition towards their eventual replacement (Bowser and Patton 2008, 108; Lave and Wenger 1991, 114-115). New "full-members" can make decisions to imitate or deviate from group styles, making choices as agents "at multiple levels of consciousness" as they continuously assess their social relations and make choices within the sets of meanings and understandings of their community (Bowser and Patton 2008, 106). This can mean that each generation can pursue particular practices to establish themselves within the historical processes that they and their community experience.

Mills (2016) and Crown (2016) also suggest that a peripheral learning processes cannot assume an inevitable faithful reproduction of past practice because the acquisition of community membership, through 'learning on the periphery,' entails varying conditions of power within these processes. Learning frameworks and learning environments are a key component for the enactment of varying degrees of power in communities of producers (Crown 2014, 80). Environments of learning can encourage or discourage the participation and experimentation by those on the periphery (Roddick and Stahl 2016, 137). Archaeologists consider a continuum between 'open' and 'closed' ceramic traditions (Crown 2001; Wallaert-Pêtre 2001). In potting communities, this can include ceramic traditions open to innovation, allowing those on the periphery to explore the craft creatively. This contrasts to a slow-changing and closed tradition with minimal variation in which those at the periphery are proscribed from creating 'errors' (Crown 2001; Wallaert-Pêtre 2001). Therefore, these different environments can have unique temporal patterns, with distinct patterns in change and continuity.

Current ceramic style research on Iroquoian ceramics seems in line with the former, the open type of learning. Archaeologists suggest the variability in particular technical styles produced by Wendat potters are the traces of unskilled persons who may have learned through style emulation, experimentation, and peripheral participation (Braun 2012, 2-4; P. Smith 1998; Striker et al. 2017). The hypothetical participation of 'work-groups' in creating Iroquoian ceramics also seems to align with a more open tradition as it hints at the possibility that ceramic production knowledge was not as restrictive. This would be the case when larger numbers of people, constituting work-groups under the guidance of masters, may have participated in the production of pottery (section 1.3; Martelle 2002, 2004; Perrelli 2009).

When Communities of Practice Meet: Constellations of Practice

Communities of practice though are not isolated units. They can be bridged through brokers. Brokers are individuals considered on the periphery of a community that contain "enough status to introduce change but who are not yet full participants within particular communities of practice" (Roddick and Stahl 2016, 10-11). They can originate from a different community of practice and they may possess the ability to bring in, introduce, and suggest different ways of doing (Wenger 1998, 10).

The theoretical concept of a broker highlights that communities of practice on its own cannot engage with larger scale social configurations of practices that are too far removed, diverse, and diffuse (Wenger 1998, 126-127). For greater scales of analysis, a *constellation of practice* (Wenger 1998, 126-133) can serve as a complementary broader theoretical unit for when connections are present but are not characterized by an ongoing mutual engagement. Constellations of practice are constituted by diffuse memberships that (alone or in combination) share historical roots, face similar conditions, have members in common, share artifacts, have geographical relations of proximity or interaction, have overlapping styles or discourses, or compete for the same resources (Wenger 1998, 127). However, these "members" that constitute constellations of practice may or may not contribute to or experience an overarching control from people keeping a constellation together, or even be recognized by its participants (Roddick 2009, 80; Wenger 1998, 128). The ties between communities of practice that form constellations of practice can be incidental, a product of "emerging circumstances," and socio-historical processes (Roddick 2009, 80; see also Wenger 1998, 128).

2.2: Communities of Practice and Ceramic Socio-technical Style

Archaeologists (e.g. Cordell and Habicht-Mauche 2012; Roddick 2009; Stahl 2008, 2016) have been keen to connect learning frameworks with formulations of socio-technical style (Chilton 1998; Dietler and Herbich 1989, 1998; Lechtman 1977; Lemonnier 1986). In tandem with practice theory approaches, these considerations of technical style reorient our perspectives of craft production towards considerations of choices, and that one style is within a continuum of alternative ways for how a particular thing can be executed (Lemonnier 1986; Michelaki 2007, 151). In this frame, most pottery making techniques have limited material constraints beyond technical-use considerations, bringing to the surface the agency of potters (Dobres 2000; van der Leeuw 1993, 239-241). For example, style can symbolically mark social identity in the ways that style and identity are polysemic or multivocal (Bowser and Patton 2008, 105). Micro-styles of local communities then can become the definer of shared learning histories while also being attached to larger cultural values and symbolic referents (Dietler and Herbich 1989; Lechtman 1986).

For many archaeologists (e.g. Braun 2015; Eckert 2012; Roddick 2009; Stahl 2016) technical styles can encompass the entire operational sequence through the *chaîne opératoire* (operational sequence) perspective (Lechtman 1977; Lemonnier 1986; van der Leeuw 1993). As a partonomy, a consideration of operational sequences further shapes the archaeological perspective towards viewing "the production of material styles as a temporally extended series of interrelated operational choices" (Dietler and Herbich 1998, 238) that can be used as threads to follow social networks of potters (Cordell and Habicht-Mauche 2012). The operational approach's way of tracking production choices reframes our perspective from "the finished product" and directs our analytical gaze towards understanding the myriad of entanglements and mutuality of practice. Through a ceramic analysis on the operational sequence of production, archaeologists can investigate raw material collection and processing, forming, finishing, decoration, and firing technology.

This shift in focus, and the analytical tools available for tracking disparate steps of production, may be one reason why ceramic studies have been a substantive avenue for archaeologists and ethnoarchaeologists to engage with a situated learning frame (e.g. Bowser and Patton 2008; Habicht-Mauche 2008; Roddick 2009; Sassaman and Rudolphi 2001; Stahl 2016; Eckert 2012). As communities of practice develop conceptions of legitimate practice, the maintenance and development of boundaries (Roddick 2016, 140), then their presence may be noted through normalized ways of doing, a routinization around practices that are within the repertoire of legitimate activity (Lave and Wenger 1991, 29; Wenger 1998, 73, 86). This means that technical styles within the operational chain serve as the materializations of communities of practice that archaeologists can attempt to define through their patterning in space and time. For example, archaeologists have defined communities of practice on a single trait such as raw material choices for paste (Braun 2012, 2015) or glaze paints (Eckert 2012), or can involve a series of choices through the operational chain that tend to coalesce in a significant number of pots (Habicht-Mauche 2008; Hollenback 2012; Roddick 2009, 2016). What this represents is that the potting communities may have developed a distinct and habitual technological style, a shared set of aesthetic values and meanings, a shared tradition of embodied practices (e.g. gestures, and movements), and a shared set of tool-types

(Roddick 2016, 134-139; Habicht-Mauche 2008, 190; Sassaman and Rudolphi 2001; Wenger 1998, 72-73).

2.3: Communities of Practice and Turbulent Social Conditions

A community of practice framing not only helps archaeologists understand continuities but can also help address past "turbulent conditions in which value, knowledge, and power were" altered or (re)produced in similar or unique ways (Roddick and Stahl 2016, 5). These alterations or continuities arise from a set of experiences that "turbulence," as a historical process, sets against the former routinization in communities of practice. For example, historical processes that bring about new or alternative social networks, relations, and exposures with alternative "ways of doing" provide affordances for communities of practice to expand their repertoires or "harden extant ones in the face of unfamiliar practice" (Stahl 2016, 179). As such, connections with and the formation of new constellations of practice can bridge communities of potters to knowledge, and objects on the move, reshaping their daily practices (Roddick 2016, 144-145; Stahl 2016, 181-182).

Additionally, socio-demographic processes produced by migration, violence, and death can alter the demographic composition of a community of practice. Constituting members may be more readily replaced by novices, altering apprenticeship frameworks (Hardin and Mills 2000; Hollenback 2012). Members of a community of producers may include individuals from a distant place that, based on their status in the new community, may act as brokers either in the periphery or as legitimate agents for pushing a community of producers in a unique direction (Habicht-Mauche 2008, 186-190; Lyons and Clark 2012). Archaeologists have pursued these questions of turbulence to understand the changes in the conditions of learning and of the rearrangements in technical practice through varying cases such as in West Africa (e.g. Stahl et al. 2008; Stahl 2016) and in North American contexts

(Hardin and Mills 2000; Hollenback 2012, 2017; Martelle 2002, 2004). Below I briefly provide examples from these two contexts to highlight the ways other archaeologists have utilized theoretical frames and ceramic assemblages to explore fine-grained questions.

Case Study: West Africa, Warfare, and Economic Transformations

Stahl et al.'s (2008) study shows how the analysis of operational chains and learning frameworks can reveal the dynamics of technical practices in turbulent social conditions. The authors investigate west central Ghana over 1000 years, a period in which potters experienced a sequence of scalar transformations that at different times included histories of state formation, reorientations in trade towards the Atlantic, and dislocations and movements of populations on the landscape due to pressures of slaving and warfare (Stahl et al. 2008). They use compositional groups (through petrography and INAA) to track the patterns of production, exchange and consumption to vessel forms. Stahl et al. (2008) note sequences of contractions and expansions of compositional groups across the landscape and the emergence of alternative recipes. They tie these patterns to historical processes that at different times included village circumscriptions due to warfare, raiding and slave trading, new formulations of production along community specialization, participation in larger exchange networks and market zones, and development of alternative recipes such as slag temper that emerged in part of developments in other technological productive systems like metallurgy (Stahl et al. 2008, 379). However, changes in production steps and in practices of consumption "did not occur in lock-step fashion across the region" as a continuity in recipes would be masked by distinct changes in vessel forms and decorative techniques. Thus, dynamic social processes can impact particular operational chains in different ways.

Case Study: North America and European-Disease Epidemics

Hardin and Mills' (2000) examination of historic Zuni (late 19th century) ceramics coupled European-disease epidemics and additional historical processes to explore drifts in technical styles. The Zuni of the late 19th century experienced smallpox epidemics and museum collectors seized 1000's of old vessels that were likely created by the specialized potters lost to disease (Hardin and Mills 2000, 143, 157). They suggest that a rapid change in decorative symmetry classes were the result of epidemic-related disruptions to household learning, the removal of old pots (by museum collectors) that could have acted as visual models, and the increasing commercialization of the craft (Hardin and Mills 2000, 157-160).

North American scholars have analysed and compared ceramics in contexts from pre and post European-disease epidemic communities by tracking continuities and discontinuities in embodied skills and technical styles throughout the operational chain (Hollenback 2012, 2017; Martelle 2002, 2004). While Hollenback (2012, 2017) analyses the ramifications of demographic trauma with the Hidatsa, Martelle (2002, 2004) examines the relationship of local epidemic experiences to specialization, skill, and the organization of production amongst 17th century Wendat potters.[8] Both Hollenback and Martelle show broad continuities in technical styles (e.g. forms, decorative motifs, mineral/rock types for temper, surface finishes) but the skill, quality and technical understanding of materials declined (e.g. coarser and poorly sorted tempers, thicker and uneven walls, misshaped forms) after epidemics (Hollenback 2012, 406-420, 2017; Martelle 2002, 290-311). They believe epidemics brought about reallocations in labour towards other daily tasks, creating an increased concern to "expedite" ceramic manufacture; which begat a social process whereby communities of producers and consumers alike reduced their expectations on the quality of ceramics (Hollenback 2017, 172; Martelle 2004, 32-34). Both archaeologists considered continuities in

[8] Hollenback (2012, 2017) examined pottery making in the Awatixa subgroup through two different epidemic periods (A.D. 1782 and 1837). She analysed sherds from 5 affiliated sites from A.D. 1600-1885. Martelle (2002, 2004) analysed Wendat pottery through the A.D. 1630's epidemic period of the Lower Great Lakes region. She examined three sites ranging in occupation from late 16th century to ca. 1649.

styles, coupled with evidence of inexperience or 'incomplete' embodied knowledge, as part of a more 'open-learning' (*sensu* Wallaert-Pêtre 2001) local production system where knowledge of potting practices were diffused across a population beyond the immediate potters. Whereby the decline in skill means some novices with a generalized understanding of production practices (and perhaps aided by curated pots) occasionally took up the craft (Hollenback 2012, 2017; Martelle 2002, 2004). As such, we can interpret this later process as a demographic reconstitution in communities of producers.

These historical processes in West Africa and in North America can be partially analogous to a series mutually articulating and compounding processes of the 17th century Neutral experience. Archaeologists can re-envision the Neutral intensification of indigenous and European trade as the development of, or increasing connections with, constellations of practice that would move forms, materials, and ideas across the social landscape. Disease and migration would reconstitute Neutral communities of practices and bring about possibilities for alterations in power and learning environments, with the introduction of new brokers as (captives and/or refugees) creating unintended consequences for rearrangements in practice.

2.4: Research Questions and Hypotheses

My goal is to understand the material transformations, the alterations in learning conditions, and (re)constitution of material traditions in the Spencer-Bronte Creek site cluster during the dynamic and turbulent social conditions of the late 16th to mid 17th centuries A.D. To accomplish this, I pursue a fine-grained analytical approach to investigate discontinuities and continuities of technical styles within local communities of practice. As such, I prioritize my analytical gaze towards the *chaîne opératoire* and the relationship between particular practices, as Neutral archaeology first requires a greater understanding of these operational sequences (Michelaki 2007, 151). I address these research objectives through three lines of inquiry that consider the complexity of interrelating variables that may affect local potters. First, I seek to characterize distinct communities of practice pre and mid/post epidemic. Second, I look for heterogeneity within a community of practice at each settlement through intra-site spatial patterning and interpret what these finer scales of homogeneity or variability might mean. And third, I pursue variations in particular forms of practice such as identifying degrees of skillfulness.

1. What technical styles defined the communities of practice at each site? How were potting communities impacted by socio-demographic turbulence? How were technical styles rearranged, altered, or maintained through time?

To address this first set of questions, I use attribute and micro-style analysis to identify the technical styles at each site. As I elaborate in Chapter 4, attributes are the traces of different steps in pottery production, such as raw material processing, forming, finishing, decorating, and firing. These patterns in ceramic production are materializations of communities of practice. The increased use of shell-temper in the Spencer-Bronte Creek cluster means that paste can be one analytical entry point into understanding the changes and continuities in potting practices as we know some paste frequencies altered through time.

More than one set of attribute expression clusters in the operational chain at each site can indicate that not only was there more than one learning community operating at either site but there also was a limited interchange of cultural knowledge. For example, a distinct vessel form made with one particular paste type which has only one type of surface finish might represent the actions of a group or an individual from a separate learning community. These patterns might be indicative of the population movements (e.g. captives, refugees) that the ethnohistoric texts detail, as Stahl (2008, 39) suggests "discontinuities in technological practices might signal an influx of people from a different community of practice." Across the Northeast, archaeologists generally define increased degrees of variability of form and decorative styles at sites as an indicator of an amalgamated community with disparate histories (Boulanger and Hill 2015; Engelbrecht 2007).

Across the broader attribute dataset, if I find operational chains intersect, or are increasingly interchangeable and variable then this might represent a degree of exchange in technical knowledge from new shared histories of learning and mutual engagement. This might include new and alternative forms and "ways of doing" for a particular sequence. This can include different pastes or new combinations of recipes that speak to a 'mixed' tradition. In new configurations of proximity, local communities of practice may have experienced enough sustained mutual engagement with brokers to create "a new locality of their own, even if their backgrounds had little in common" (Wenger 1998, 130). Increased variability and a reduced degree of routinization can also speak to a community of practice's loss of control over learning environments, in which knowledge transmission and application becomes more open, allowing for innovation and experimentation. Variability and experimentation along operational chains can also speak to the likelihood that communities of practice lived through scalar transformations in their relationship to broader constellations of practice (Gosselain 2016; Wenger 1998, 127-128). Emergent experiences from population movements, and expanded trade and social networks can reformulate practical knowledge "through exposure to new techniques, forms, and representations" (Stahl 2016, 189). From this first set of questions, I then further contextualize the results of the two additional sets of questions.

2. Were communities of practice at each village reconfigured and/or reproduced by historical contingencies that acted upon smaller social units of production? As such, is there a spatial patterning to technical styles, are they consistent across each site? How does change and continuity play out at intra-community scales?

Spatial patterning of ceramics may be related to communities of consumption but, as presented above in section 1.3 and further explored in section 3.4, I assume that communities of production, consumption, and material deposition, are spatially intertwined. Inhabitants of Christianson and Hamilton experienced different historical events and broader historical processes throughout the 17th century. The spatial distribution of attribute expressions within each site can highlight the historical contingencies at play in each community and how they were materially produced at lower social scales. In the case of an Iroquoian context, these contingencies may involve social fluidity as part of residential relocations and the adoption of individuals from varying backgrounds (e.g. captives or refugees). Different areas of the village may have disparate concentrations of particular operational chains, bringing to the surface how different learning communities can be situated across the built environment. Although particular 'micro-histories' (historical events that relate to a finer and smaller scale) and patterns in technical styles are difficult to pair, certain arrangements in ceramic practices can still speak to the backgrounds of potters and can be spatially compared. For example, if Household 1 only used one paste type while Household 2 had a greater diversity of pastes, then the former house may have a more regimented history of learning and production while the latter house may allow for innovation and/or might have potters with different learning backgrounds (e.g. migrants).

Iroquoian archaeologists suggest that some technical styles are produced due to social networks and/or political affiliations that often originate from intra-village social units (Hart and Engelbrecht 2012; Hart et al. 2016; Ramsden 2016). A spatial examination of the dataset thus demonstrates potential sources of changes and continuity come from the household context of production. Disparate traces of technical patterns across household contexts would highlight that the locus of change and/or persistence of certain ceramic styles originated from these household contexts of production, and perhaps the histories that constitute and produce these material traces. Thus, spatial analysis can reveal the micro-scale diversity that an aggregated village-level representation of technical styles would homogenize.

3. Did the broader turbulent conditions of the 17th century lead to alterations in embodied skills and technical knowledge of Neutral communities of practice? How does skill vary within and between Christianson and Hamilton?

Turbulent social conditions can impact not only the constituting members that define a community of practice but also the transmission of technical knowledge and embodied knowledge required to skillfully execute a craft (M. Graves 1984; Hardin and Mills 2000; Lyons and Clark 2012, 28). This can be particularly relevant to the experiences of mid/post-epidemic societies such as the Neutral Hamilton site (A.D. 1624/30-1651) which can be compared to patterns of the pre-epidemic crafting communities within the Christianson site (A.D. 1600-1624/30). Archaeologists can recognise the qualitative expressions of 'skillfulness' in specific attributes. An unskilled potter, lacking guidance from a skilled practitioner, can be ineffective with motor stability and may be missing necessary technical knowledge across various stages of production (Crown 2001). Martelle's (2002, 2004) study on the pre and post-epidemic Wendat, a neighbouring confederacy to the Neutral, illustrates the potential for similar findings of reduced motor and technical skills within Neutral assemblages. Such patterns in Neutral territory would suggest communities of practice experienced a demographic reconstitution analogous to Martelle's (2002, 2004) and Hollenback's (2012, 2017) interpretation of the Wendat and Hidatsa respectively.

Evidence of change in potting skills are likely influenced to some degree by a broader demographic consequence of European-disease epidemics. If the loss of potters parallels the death-rate among the broader population, then up to 60% of skilled potters may have died in the mid-late 1630's (Warrick 2003). As I discuss in Chapter 4, a decreased use of efficient hand gestures, seen through wall thickness, contours, rim evenness and the degree of consistency in applying decorations, would suggest such a change. An increase in cracking, which acts as visual cues to the degree of technical knowledge of clay drying, paste recipes, and of the firing process, would also support changes in skill. Hamilton potters may have worked towards creating pots like their Christianson predecessors – with similar forms, use of similar raw materials, decorations, and surface finishing – yet resulted in poorly executed copies. This would mean novice potters attempted to emulate legacy (curated) pots or attempted to copy and learn from surviving skilled potters but experienced an altered, and perhaps temporally deficient, process of 'peripheral participation.' They thus did not receive the same amount of teaching from old-timers compared to pre-epidemic learners. A decrease in skill coupled with stylistic changes (examined in question 1) might represent an "open" learning system. A more open system might have adjusted to the profound condition of turbulence, where these communities of producers allowed for a decreased quality in production coupled with an additional social license for innovation and experimentation.

2.5: Chapter Summary

In this chapter I provided a brief overview of communities of practice, technical style, and the *chaîne opératoire* approach. I illustrate how this alternative way of examining extant Spencer-Bronte Creek collections can address new kinds of fine-grained questions through a diachronic analysis that compares technical styles at two sites. Building on Martelle's (2002, 2004) findings, I pursue a situated learning approach that argues learning is embedded in all of social practice (Roddick 2009, 67). This framing can provide explanatory power to the changes and continuities of ceramic technological systems among Iroquoian potting communities. Thus, this approach bridges the materialization of technical styles and regimens of skill acquisition in the ceramic archaeological record to the series of historical processes that Neutral Iroquoians produced, experienced, and reacted to. This approach thus helps move

Neutral archaeological work beyond the syntheses of archaeological assemblages, as was produced by the initial archaeologists working on the sites several decades ago (e.g. Fitzgerald 1981; Lennox 1977, 1984a, 1984b; Lennox and Fitzgerald 1990). I provided my research questions, detailing what I might expect from the ceramic assemblages and what certain outcomes might represent. In the next chapter I discuss my sampling strategies and further contextualize the landscape and demographic contexts in which potters lived.

Chapter 3: Sampling the Contact Era Neutral

I begin this chapter with a brief overview of the Flamborough region through a summary of its local geology. In order to connect paste types to choices on the landscape, this review includes the lithology and mineralogy available to Iroquoian potters. I then discuss the archaeological Spencer-Bronte Creek site cluster, its connection to a surficial understanding of local demography and how this connects to broader historical processes. I outline how my sampling strategy contributes to my investigation into the historical and social processes on ceramic production. I then present the Christianson and Hamilton sites, discussing the excavations at each site, the nature of their collections, their archaeological chronologies, and I describe my intra-site sampling strategy. I conclude by investigating the social and taphonomic processes that could potentially bias the ceramic dataset.

3.1: The Geology of the Neutral Spencer-Bronte Creek Site Cluster

Pleistocene glaciation events, including the glacial retreat of the early Holocene, sculpted the landscape of the former Flamborough municipality (currently a district of Hamilton, Ontario). The Wisconsin glacial episodes, which lasted between 100,000 to 7000 years ago, left glaciofluvial, glaciolacustrine, glaciomarine, and glacial moraine deposits (Marich 2010, 22; Figure 3.1). Successive depositions of sediments occassionally created till layers greater than 15 metres in the form of drumlins and some areas were scoured down to the Paleozoic bedrock (Marich 2010). Most of Southern Ontario possesses a calcium-carbonate sedimentary bedrock that is interspersed with bands of fine-grained clastic sedimentary rocks (primarily shale). The Neutral Spencer-Bronte Creek site cluster sits on Guelph formation dolostone and Lockport-Amabel formation dolostone while being bordered by the Queenston red shale formation east of the Niagara escarpment and by the Salina formation dolostone, shale, gypsum and salt west of the Grand River (March 2010, 32; Appendix A Figure A.2).

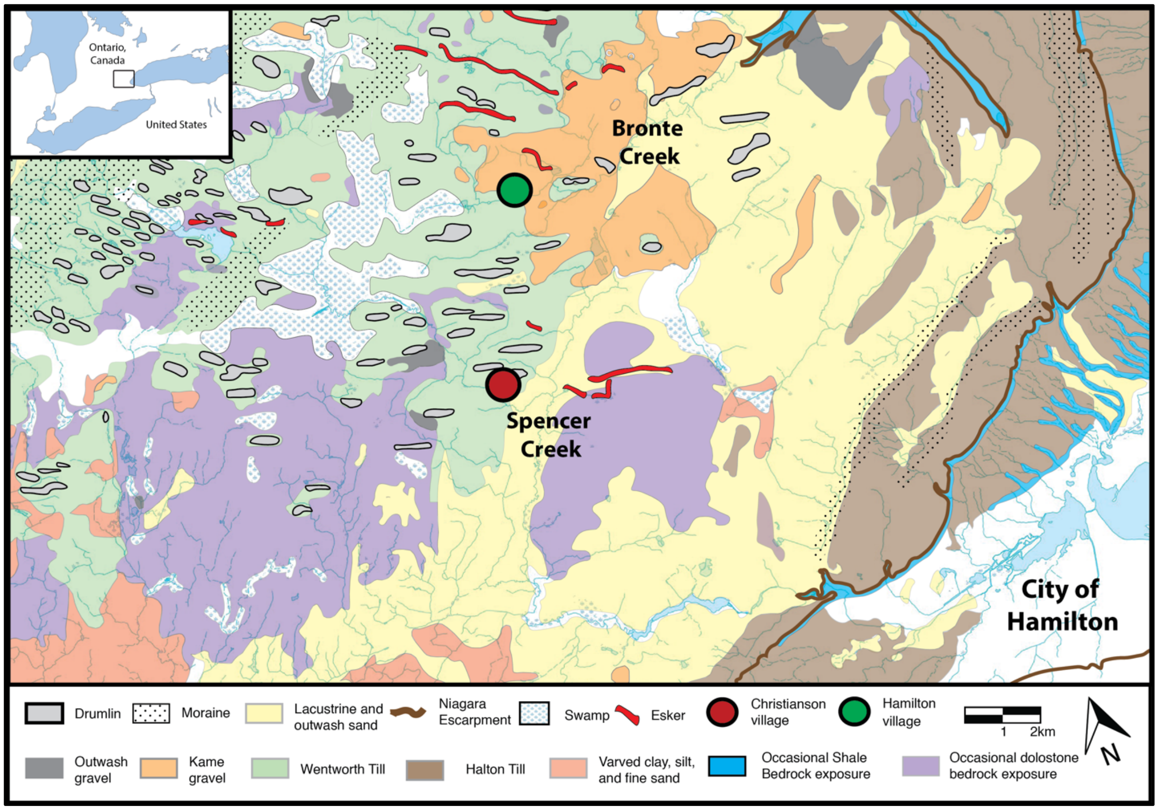

Figure 3.1: Local physiography and Paleozoic bedrock of the Flamborough, Ontario area (derived from Barnett et al. 1991; Chapman and Putnam 1973; Karrow 1987; Marich 2010).

Flamborough lies within part of the Lake Ontario drainage, with an elevation of 203 m.a.s.l. down to 75m (the level of Lake Ontario). The drainage consists of major streams including the Spencer Creek and Bronte Creek, along with other smaller creeks that together drain a series of moraines, and the Beverly Swamp (Karrow 1987, 5; Figure 3.2). These streams deeply dissect the drift, often down to the bedrock in some locations (Chapman and Putnam 1973, 153). The region is composed of two till types (Wentworth Till and Halton till), drumlins (Figure 3.1, 3.4), and interspersed exposures of the Paleozoic bedrock. Geologists characterize Wentworth Till as a sandy-silt to silt matrix that is very calcareous, with clasts deriving from the local limestone and dolostones churned up in glacial actions (Barnett 1991;

Karrow 1987, 42; Marich 2010, 10). The drumlins of the Flamborough Plain extend down from the north as part of the Guelph drumlin field. These drumlins are low smoothly rounded elongated hills created out of glacial materials, formed by the flow of advancing ice sheets and often contain gravel bars at their crests (Marich 2010, 21). Interspersed between the drumlins are occasional swampy environs (Chapman and Putnam 1973, 218; Figure 3.2). South and east of the Flamborough Plain lies the Norfolk Sand Plain that contains glaciolacustrine and glaciofluvial sand within its soil matrix and contains occasional ice-contact kames (mounds of poorly sorted till) and eskers (sinuous ridges of sorted sand and gravel) (Marich 2010, 11; Figure 3.3).

Figure 3.2: The Beverly swamp (Photo by author, November 2017).

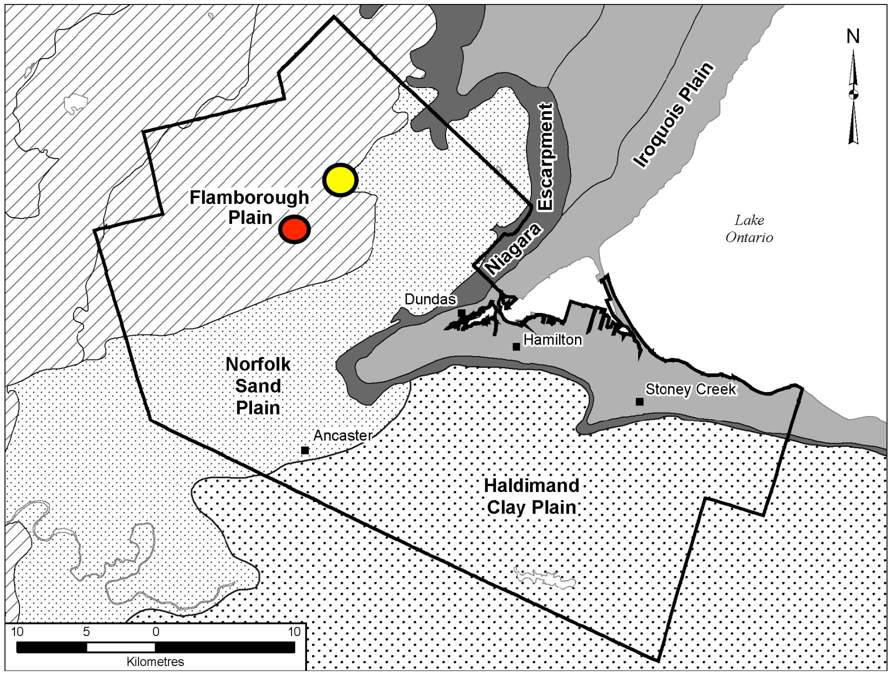

Figure 3.3: Physiographic zones of Hamilton. Red=Christianson; Yellow=Hamilton (from Marich 2010, 10).

This glacially shaped landscape would have provided Iroquoian potters different mineralogical raw materials. Glacial deposits contain igneous and metamorphic rocks transported down from the Precambrian Canadian Shield (Chapman and Putnam 1973). Much of the previous work on Iroquoian ceramic pastes suggest the exploitation of glacial deposits. Archaeologists conducting Late Woodland/Iroquoian petrographic studies (Braun 2012, 2015; Holterman 2007; Striker et al. 2017) and macroscopic paste studies (Mather 2015; Schumacher 2013) found potters predominately used plutonic and metamorphic rocks and minerals that are either categorized as felsic or intermediate. The mineralogical composition of Wentworth Till may result in calcareous clays with carbonate inclusions. With this type of local soil, the clay sources Iroquoian potters may have used were rich in carbonate inclusions, as exemplified by petrographic studies on sites in similar geologically carbonate-rich areas near Lake Simcoe (Braun 2015), Mississauga (Braun 2012), and North of Toronto (Striker et al. 2017).

Figure 3.4: Photo (by author, January 2018) of the drumlin field in Flamborough, Ontario. Photo taken on top of a drumlin east of the Hamilton site, facing South-west.

Exposures of the Queenston Shale Formation at the base of the Niagara escarpment (as seen in Figure 3.1) would have provided suitable alluvial clays low in impurities and uniform in composition, material used today in the Ontario brick and tile industries (Guillet 1977; Rutka and Vos 1993, 19-20).[9] The red coloured Queenston shale was also used over the last century for various pottery and artware products such as "slips in plaster moulds . . . flowerpot blanks or thrown on the potter's wheel" (Guillet 1977, 23). Queenston shale consists of about 60% clay (<0.005mm minerals, primarily illite) and 40% non-clay minerals (Rutka and Vos 1993, 22). It is readily broken down by weather, forming red clay soil layers (Guillet 1977, 23) as most shales are friable and can completely disintegrate when permeated by water (Reedy 2008, 41-42).

Eskers would have been convenient and easily recognizable sources of sand and gravel on the landscape as these dense and sorted surficial deposits have a height between 7-23 metres, and their poor soil makes vegetation sparse (Chapman and Putnam 1973, 31, 81).

[9] Refer to Appendix A Figure A.2 for the bedrock composition of the region. It shows the Queenston Formation lies east of the Niagara escarpment cliffs.

Neutral potters could also have used gravels and sands from drumlins. These geologic contexts would include the stony till that composes the Guelph drumlin field, the glaciolacustrine deposits from former glacial lake shorelines along some of Flamborough's drumlins (Marich 2010, 10) or the kames that are often present on the slopes of the drumlins in Ontario (Chapman and Putnam 1973, 26).

While the regional geological maps shown in Figures 3.1, 3.3, and Appendix A Figure A.2 are essential for compositional work, there are important limitations. Archaeologists conducting ceramic paste analysis studies in Southern Ontario suggest that much of the geologic boundaries marked on maps do not always account for the substantial textural, and lithological variability within each landform (Braun 2015; Striker et al. 2017). This limitation is important to consider as I explore the archaeological record for Neutral Iroquoians living on this landscape. Although Neutral sites are close to each other (within 5km), theoretically inhabiting a shared geologic landscape, pottery raw material choices may also be impacted by these 'micro-variations' on the landscape. This heterogeneity in geologic makeup may be subtle or indistinctive to past potters but might be recognized as important differences in mineralogical and textural compositions to the archaeological petrographer. Therefore, in the next section, I explore the cultural and spatial patterning of Neutral Iroquoian sites on this landscape and how the geological and archaeological record informed my sampling strategy.

3.2: Archaeology of the Neutral Spencer-Bronte Creek Site Cluster

Neutral Iroquoians occupied what archaeologists call the Spencer-Bronte Creek site cluster (Figure 3.5, Table 3.2) from the early 16th century until their dispersal around A.D. 1650 (Lennox and Fitzgerald 1990). Ethnohistoric accounts suggest this collection of villages represented a nation that the Wendat called the Oheroukouarhronon, "the People of the Swamp" (Fox 2009, 68). This site cluster provides a significant opportunity for archaeologists to understand how the demographic upheavals of European diseases and (coerced) migration affected the technological styles of Iroquoian potters in the 17th century. Archaeologists recognize a significant shift towards shell-tempering and an adoption of other attributes such as appliqué neck decorations and alternative surface finishing in this cluster's pottery (Lennox and Fitzgerald 1990, 417). By considering two sites that may be constituents of a single national/tribal unit and that have a similar set of raw material affordances through a shared geologic landscape, I can consider the (re)arrangement in potting communities of practice as they progress through time.

Academic and non-academic activities contribute to our current archaeological understanding of the Spencer-Bronte Creek site cluster (sites recorded in Figure 3.5). This includes collections from early 20th century antiquarians such as David Boyle, the accumulated work of collector/avocational archaeologist activities (e.g. Ridley 1961), and academic projects from the 1960's through the early 1990's by William Noble, David Stothers, William Fitzgerald, Paul Lennox, Ian Kenyon and W.A. Kenyon. These scholars directed strategic surveys and excavations. The Christianson site excavation represents 12% of the total village size, Hamilton at 18% (Lennox 1977), Hood at 25% (Lennox 1984a), Bogle I at 35% (Lennox 1984b), and Bogle II at 20% (Lennox 1984b). Archaeologists conducted an extensive excavation (percentage estimate not available) at Zap (MPP 1989a, 1989b), and unspecified percentages at Freelton (Macdonald 1991), Carlisle (Kenyon 1986) and Buddy Boers (Fitzgerald 1990, 282-283). Archaeologists only conducted surveys at Mills, Mount, Robertson, Hunter-Ward, Cane, Richer, and Kralt (Fitzgerald 1990). Archaeologists conducted excavations at all three of the ossuaries and cemeteries noted in Figure 3.5, but these sites had already been looted for many years (Fitzgerald 1981, 1982; Kenyon 1986; Ridley 1961; Stothers 1968).

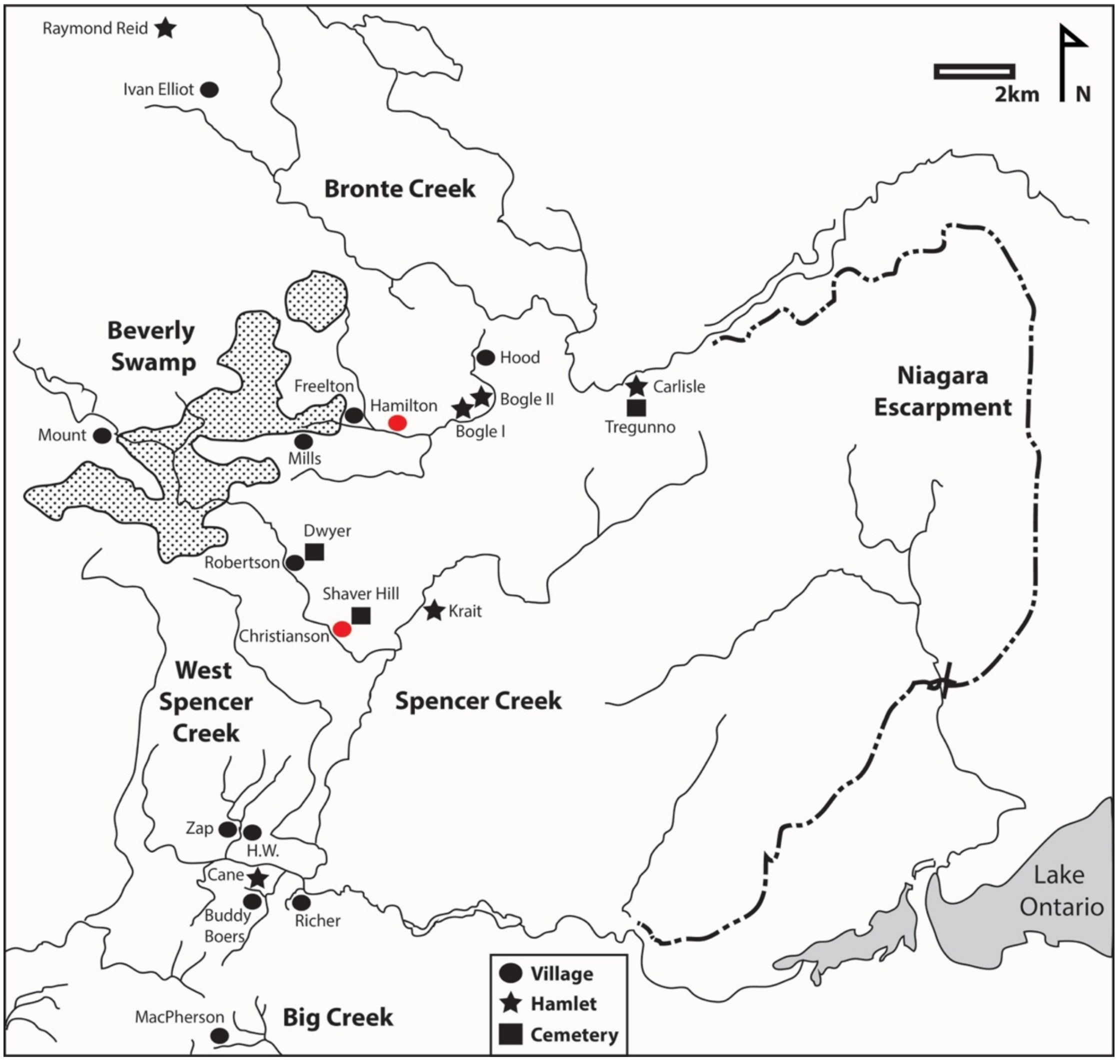

Figure 3.5: Archaeological sites in the Spencer and Bronte Creek drainages in Flamborough, Ontario from the early 16th to mid-17th century A.D (modified from Fitzgerald 1990, 279).

<table>
<tr><td rowspan="7">Late Woodland
A.D. 500/800 - 1650</td><td colspan="2">Princess Point A.D. 500-1050</td></tr>
<tr><td colspan="2">Early Iroquoian A.D. 900-1280</td></tr>
<tr><td colspan="2">Middle Iroquoian A.D. 1280-1400</td></tr>
<tr><td rowspan="4">Late Iroquoian A.D.
1400-1650</td><td>Pre-Fur Trade A.D. 1500-1580</td></tr>
<tr><td>Glass Bead Period I A.D. 1580-1600</td></tr>
<tr><td>Glass Bead Period II A.D. 1600-1624/30</td></tr>
<tr><td>Glass Bead Period III A.D. 1624/30-1650</td></tr>
</table>

Table 3.1: The Late Woodland Period in Southern Ontario (Derived from D. Smith 1997 and Lennox and Fitzgerald 1990).

Archaeologists work with a more specific chronology for the Proto-Contact to Contact Era Southern Ontario (Table 3.1). Fitzgerald, I. Kenyon and T. Kenyon created four phases based on European trade beads and a variety of other temporally sensitive European trade materials (e.g. kettle forms and their metal types, coins). The logic of these temporal phases is based on the historically documented fur-trade, where the presence of European trade beads represents the emergence of fur-trading networks amongst First Nations groups and with Europeans. The first time-range consists of the "pre-fur-trade" (PFT) period (A.D. 1500-1580). These archaeologists break down the "fur trade-period" (A.D. 1580-1650) into Glass Bead Period 1 (GBP1) (A.D. 1580 - 1600), Glass Bead Period 2 (GBP2) (A.D. 1600 - 1624/1630) and Glass Period 3 (GBP 3) (A.D. 1624/1630 -1650) (Lennox and Fitzgerald 1990).

The Neutral cultural period terminates with their dispersion and incorporation by the Haudenosaunee sometime within A.D. 1647-1651. This terminal period, however, may require some rethinking if we consider the (re)establishment of Iroquoian villages in Southern Ontario within two decades after the 1650 "dispersal" of Neutral, Petun, and Wendat populations (Heidenreich and Burgar 1999; Konrad 1981, 1987; Richter 1992). There is at least one ethno-historically described small 'Seneca' village in 1669 called Tinaouatoua/Outinaouatona that was located adjacent to the Beverly Swamp (Lajeunesse 1960), potentially constituted by Neutral peoples (and others) that previously lived in the region (Ferris 2006, 108; Fox 2009, 70).

Site	Site Type	Site Area	Time Period
MacPherson	Village/Town	1.3 ha	Mid-16th century (PFT)
Buddy Boers	Village	1.5 ha	ca. 1500-1580 (PFT)
Richer	Village	n/a	ca. 1500-1580 (PFT)
Cane	Hamlet	n/a	n/a
Hunter-Ward	Village	1.5 ha	ca. 1500-1580 (PFT)
Zap	Village	1.5 ha	ca. 1500-1580 (PFT)
Raymond Reid	Hamlet	0.6 ha	ca. 1530 (PFT)
Ivan Elliot	Village/Town	2.5 ha	16th century (PFT)
Buddy Boers	Village	1.5 ha	ca. 1500-1580 (PFT)
Carlisle	Hamlet	0.1 ha	ca. 1580-1600 (GBP1)
Mount	Village	2.0-2.4 ha	ca. 1600-1624/30 (GBP2)
Christianson	Village	1.4 ha	ca. 1600-1624/30 (GBP2)
Bogle I	Hamlet	0.3 ha	ca. 1630-1641 (GBP3)
Bogle II	Hamlet	0.3 ha	ca. 1640-1651 (GBP3)
Robertson	Village/Town	2.8 ha	ca. 1624/30-1650 (GBP3)
Mills	Village	2 ha	ca. 1624/30-1650 (GBP3)
Freelton	Village	1.3 ha	ca. 1640 (GBP3)
Hood	Village/Town	2.7 ha	ca. 1630-1641 (GBP3)
Hamilton	Village/Town	2.4 ha	ca. 1624/30-1650 (GBP3)

Table 3.2: Identified sites in the Spencer-Bronte creek drainages. Ha=hectare, GBP = Glass Bead Period, PFT=Pre-fur trade period (Derived from Fitzgerald 1990, Lennox and Fitzgerald 1990).

Different site types existed among the 16th-17th century Spencer-Bronte Creek site cluster as they did throughout much of Southern Ontario's Iroquoian societies since at least the early 14th century, but size distinctions become more pronounced in the early 1500's (Table 3.2, Pearce 1996; Warrick 2000). The smaller communities are called hamlets, which contain a few longhouses, are occasionally palisaded and are generally smaller than 1 hectare. Villages are densely inhabited communities with clustered longhouses, multiple rows of palisades, middens, occasional open plazas, and can range from 1-6 ha (Ferris 2006, 80-81). Noble (1984, 13) suggests further distinctions, defining villages larger than 2ha as towns to address the substantially larger communities present in the Contact period. Lennox and

Fitzgerald (1990) suggest that all settlement types were involved in similar subsistence activities, but larger communities played a central role in controlling regional interactions and exchanges. Although no extensive research on material culture has taken place to validate these claims beyond Lennox (1984b, 266-272), the "presence of such a settlement form . . . suggests both mobility and fluidity in village membership and residential choice" (Ferris 2006, 82). Archaeologists believe that hamlet and small camp style sites are usually "satellite" communities which exist within a 1.5-2.0km radius of a larger village (Finlayson 1998; Fitzgerald 1990; Pearce 1996). Ossuaries or cemeteries are also located nearby, thought to serve the inhabitants of several villages. This localized pattern is seen at Christianson with the Shaver Hill ossuary and Robertson with the Dwyer ossuary (Fitzgerald 1990).

Neutral Site and Modern Archaeological Conditions

A significant number of large-scale archaeological excavations in Ontario today are implemented by Cultural Resource Management (CRM) firms in the private industry, responding to the needs of developers and provincial legislation (Ferris 2002; Williamson 2010). However, it is unlikely that further archaeological data from the Flamborough area (and the adjacent Fairchild-Big, and Upper Twenty Mile Creek clusters) will be produced in the near future. This land's provincial 'Greenbelt' designation protects these areas from development and hence any need for the conservation work from CRM firms (Greenbelt Act 2005; Ontario Ministry of Municipal Affairs and Housing 2017). It is therefore unlikely that CRM archaeologists of the near future will extensively excavate, survey, and produce research from these sites like in recent research on the Wendat which draws upon recent large-scale CRM excavations (e.g. Birch 2010; Birch et al. 2016). However, archaeologists can still be confident in the likelihood that a significant number of large post-A.D. 1500 Iroquoian sites in the Spencer-Bronte Creek cluster have been found. Fitzgerald (1990, 288-291) refers to the early 1890's notes from Neutral archaeology 'pioneer' Frederick Houghton to suggest that there might only be two ossuaries and one village that archaeologists did not locate. With more than a century of "accidental finds, casual collecting, and avocational and professional archaeological survey," the dense concentrations of artifacts on Contact-era sites would be quite visible on the landscape, especially since they are located in areas under agricultural cultivation (Warrick 2008, 105-106).

3.2.1: Regional Demographics

I suggest that the Spencer-Bronte Creek cluster exhibits demographic processes that not only represent histories of fluid membership (through notions of self, community, place and movement) but also demonstrates local histories of immigration. These demographic, residential and migratory processes would likely impact the constituting memberships of local communities of practice. The MacPherson site (ca. A.D. 1530-1570, Figure 3.6) experienced at least two expansions (Fitzgerald 1990). In the adjacent Milton site cluster, archaeologists fully excavated one longhouse in the sizable (4+ ha) Irving-Johnston site (ca. A.D. 1563-1583) (Stewart and Finlayson 2000, 20). Archaeologists found that this house expanded twice and was built over a double row of palisade, indicating the village expanded at least once (Finlayson 1998, 396). These two sites perhaps represent a local history of coalescence and multi-community aggregation, part of a larger pattern of increasing spatial clustering of villages throughout much of Iroquoian Ontario and New York from the mid-15th century (Birch 2015, 284-287). Migrants from South-western Ontario may have come to live in the MacPherson and Irving-Johnstone villages because by A.D. 1550 ancestral Neutral communities did not live east of the Grand River (Warrick 2000, 451). These movements might have included the relocation of early 16th century villages such as Wolfe Creek, Clearville, Southwold, and Lawson (Foster 1990). Lennox and Fitzgerald (1990, 418-419) use similarities in pottery attributes (shell-temper, surface finishes, rim, handles, appliqués) along with ethno-historically described patterns of violence to suggest Wolfe Creek and Clearville are direct ancestral communities to the Spencer-Bronte Creek site cluster.

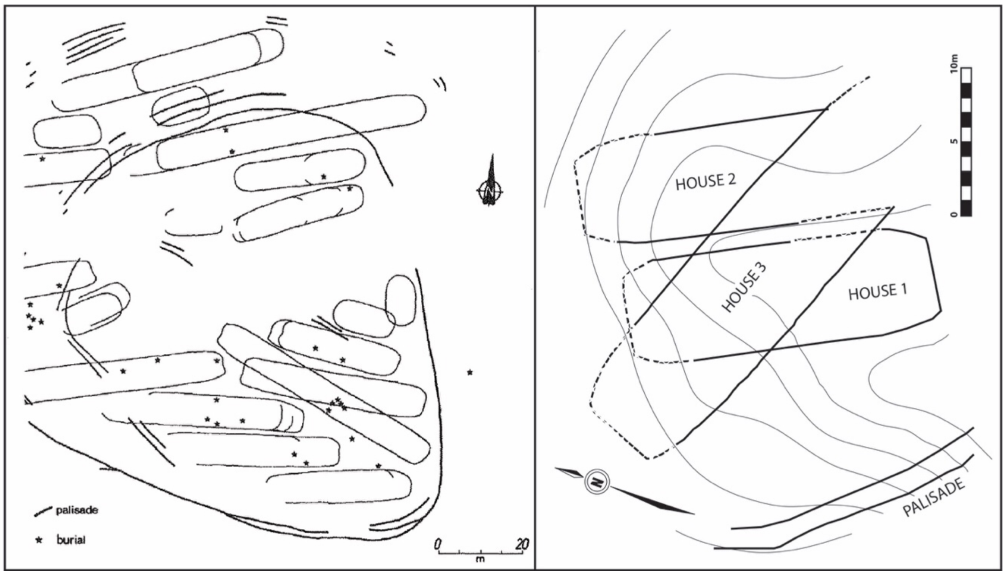

Figure 3.6: MacPherson and Carlisle site maps. Left: Three times expanded MacPherson village (Fitzgerald 2001). Right: Carlisle hamlet (Derived from Kenyon 1986, 12).

At the Carlisle site (Figure 3.6, Kenyon 1986), a hamlet dating to GBP1, archaeologists found longhouses superimposed on each other, indicating houses were taken down and rebuilt in different arrangements at one point in the hamlet's occupation. This re-arrangement of household space may speak to demographic and residential histories in the area. At the GBP2 Christianson site, there is a possible village expansion (Figure 3.7) as Household 6 lies outside of a palisade wall. This time coincides with the first reports by a French explorer and missionary of raids into the Fire Nation territory (Grant 1907, 303-304; Wrong 1939, 158). Christianson's inhabitation corresponds archaeologically with the disjuncture in land-use of the Late Woodland Whittlesey Culture out of the North-east Ohio Lake Erie Basin and into the Upper Ohio Valley, possibly a result of a disruptive dispersion (Brose 2001; Redmond and Ruhl 2002).

Into the 1630s (early GBP3), Iroquoian populations in the Lower Great Lakes region experienced an approximate 60% depopulation from European disease epidemics (Snow 1996; Warrick 2003, 2008). Even with this demographic trauma, the Spencer-Bronte creek cluster appears to maintain a significant population. This cluster has at least three contemporaneous large villages (<2ha) in during GBP3 with a series of smaller villages or hamlets (Table 3.2). In particular, the Christianson community village relocation grew in size, from Christianson's 1.4 ha to Robertson's 2.8 ha (Figure 3.5). This broader pattern contrasts with contemporary sites from other Neutral clusters (tribes/nations) that became smaller after the epidemic period (Fitzgerald 1900, 299). Within the Hamilton site (GBP3), 1 out of the 4 completely excavated households expanded (Figure 3.11; Lennox 1977, 21-22). In the Contact period when household lengths were not effective symbols of social or political prestige but more likely representative of a "full occupancy" (Varley and Cannon 1994), studies on the microhistories within Iroquoian villages then suggest that household expansions may represent unanticipated growth (Fogt and Ramsden 1996).

These GBP3 sites coincide with more substantive raids into Fire Nation territory and the flight of the Iroquoian Wenro people from Western New York into Neutral lands, as documented by Jesuit missionaries (Thwaites 1896-1901:17, 25-29; 21, 231). Similarly, Jesuits record that many Wendat and Petun fled to Neutral territory following attacks by the Haudenosaunee between 1647-1649 (Garrad 2014, 225, 261). This also coincides archaeologically with the dispersal of the Monongahela archaeological culture from their traditional territory in Northern West Virginia and Western Pennsylvania by ca. A.D. 1635 (Johnson 2001, 67). Archaeologists suggest the Neutral or Seneca (one Haudenosaunee nation) were responsible for this dispersal, with Monongahela populations likely becoming a mix of refugees fleeing attacks or captive migrants taken into one of the Iroquoian socio-political units (Johnson 2001; Lapham and Johnson 2002). The possible coerced migration of peoples into these communities is but one significant social process potentially creating these settlement patterns.

Another factor during the Contact-period was the fluidity of Iroquoian social membership, which involved community fusion and fissioning, the movement of households, and the adoption of individuals and families into lineages (Engelbrecht 2007; Hart and Engelbrecht 2012; Ramsden 2009). In Southern Ontario and New York Iroquoian societies, longhouses trend towards a decrease in size since the 15th century (Fitzgerald 2001; Tuck 1978). Archaeologists attribute this trend to the emergence of regional alliance systems that gave families and individuals greater residential flexibility, creating the social conditions for a fluid longhouse membership (Engelbrecht 2007, 227; Warrick 2000, 449). The patterning of Martelle's (2002, 304-305) fine-grained micro-variable analysis of pottery at pre-and post-epidemic sites led her to suggest the possibility that the post-epidemic site may have formed from a coalescence of multiple nearby Wendat communities after experiencing population loss. Whether analogous demographic patterning played out in Neutral communities is yet to be understood until further study. In the next section I provide an overview of my sampling regimen which I designed to link social and demographic patterns with technical styles of pottery production at Neutral Iroquoian sites.

3.3: Sampling

I chose to use ceramic sherds from a variety of contexts at the Christianson and Hamilton sites, including middens, small refuse pits, household hearths and/or cooking features (Table 3.3). By analysing sherds from small refuse pits on the outside of houses and internal household domestic features I could consider the possible micro-histories of pottery manufacture and conditions of learning operating at household scales. I am assuming that sherds from these contexts largely derive from domestic production and consumption for a household, or a cluster of households that may constitute other socio-political units such as a lineage (Allen 1992). Ethno-historic research and archaeological research show that lineage, household, and kin-based clan units are the primary constituents of social and economic organization in Iroquoian societies (Ramsden 2009, 2016; Michaud-Stutzman 2007; Starna and Watkins 1991, 40; Trigger 1976). Ramsden (2009, 2016) employed this assumption that ties production, consumption, and deposition to households and their adjacent village spaces to understand micro-histories of political factionalism at ancestral Wendat sites in the Balsam Lake region. As such, these sherds deposited within or in the immediate vicinity of a household might represent refuse coming from the daily tasks of people within and around the household, where smaller sherds might fall into hearths or were swept away into pits and depressions with the house's floor or deposited in makeshift pits surrounding the household (Hayden and Cannon 1983; Michaud-Stutzman 2007).

Household and household cluster scales of analysis are useful as patterns of ceramic attribute distribution can be historically contingent, such as the disproportional adoption and incorporation of new community members into particular households or political factionalism that Ramsden (2009, 2016) suggests occurred at the Benson site. My examination of middens (Table 3.3 and 3.4) allows me to consider the possible depositional contributions of household clusters that may represent "kin-based clan barrios or neighbourhoods" (Warrick 2000, 444). As such, inhabitants of more than one house may contribute sherds to Iroquoian middens as a form of organized deposition of larger and more cumbersome rubbish (Finlayson 1985, 398; Hayden and Cannon 1983; Ramsden 2009). Midden contexts are thus useful for analysing previously excavated materials as archaeologists did not excavate the totality of the Christianson and Hamilton sites. These excavated middens potentially contain broken pottery deposited by households that may or may not have inhabited the adjacent spaces unexcavated by archaeologists.

Although Fitzgerald (1981) and Lennox (1977) provide stratigraphic profiles for some midden features, the ceramics I analysed from Christianson and Hamilton could not be firmly dated in a relative sequence. Based on the previous archaeological practices and/or the decades of storage, these micro-contexts were either lost or not recorded at the site. Using post-mold density analysis with standardized rates of tree species decay, Warrick (1990, 267-295) suggests that Contact-era (post-1615) sites in Southern Ontario average 15 years of occupation. Archaeologists are not certain of the exact temporal span of each site within their glass bead phases, but Christianson then represents a possible occupation of approximately 15 years sometime within GBP2 and Hamilton within GBP3 (Fitzgerald 1990).

3.3.1: The Christianson Site (AiHa-2)

The Christianson village is located in Flamborough, Ontario along Concession Road 6 West and Westover Road, along the eastern side of the Spencer Creek and on the western edge of a drumlin (Fitzgerald 1981; Figure 3.7). Ian Kenyon and David Stothers conducted excavations at Christianson in 1968, William C. Noble excavated the site in 1969 (Noble 1970) and William Fitzgerald as well in 1979 (Fitzgerald 1981, 1-2). According to Fitzgerald (1981, 2), the 1215m² of excavated land represents approximately 12% of the 1.4-hectare (3.5 acre) village. Using Heidenriech (1971, 128) and James Wright's (1977, 184; 1987) averaged population density of 450-600 people per hectare (12-15 longhouses per hectare, average of 36 people per house), approximately 630-840 persons occupied the Christianson site. Although Warrick (2008, 69) rightly critiques this simplistic population density model and employs other variables for his demographic study of the Wendat and Petun, no similar study has been conducted on Neutral sites. As such, the persons/ha model serves as a proximate formula that provides the relative understanding of the number of people inhabiting the site.

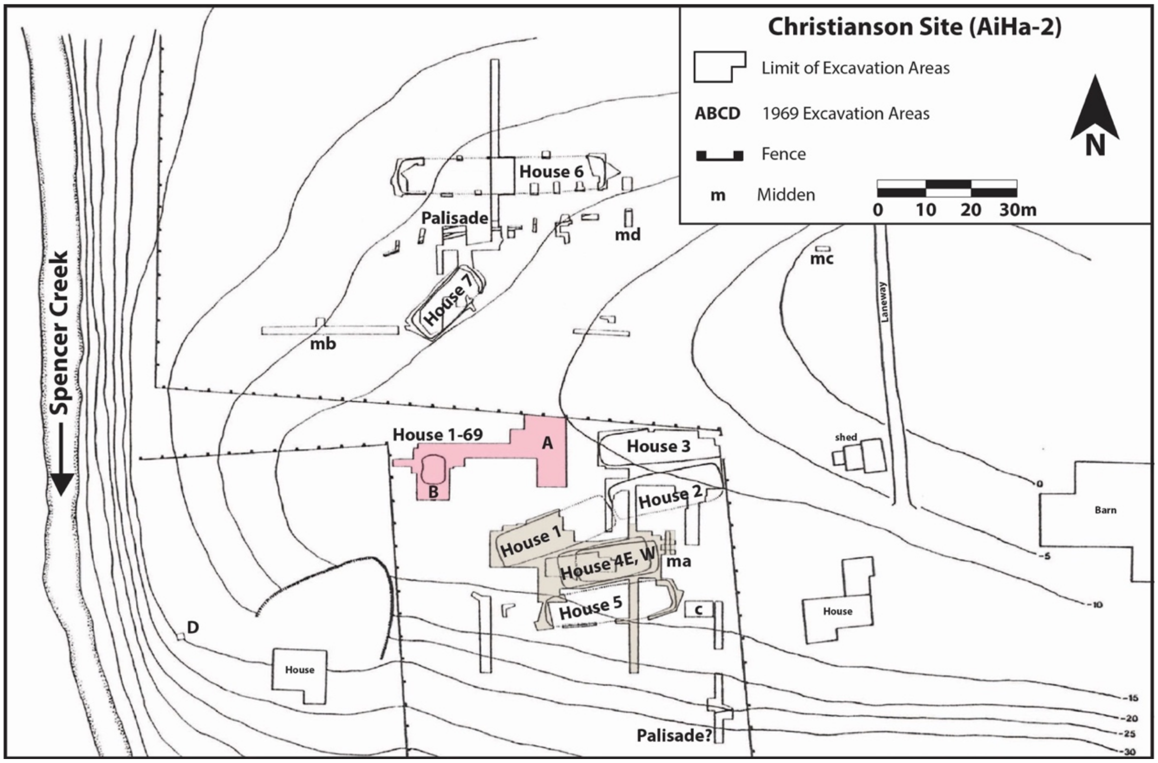

Figure 3.7: Christianson Site Map (Modified from Fitzgerald 1981, 3). Figure 3.8 represented in light tan. Figure 3.9 represented in pink

Based on European trade beads and a variety of other temporally sensitive European materials (e.g. kettle types), Fitzgerald (1990) suggests that Neutral Iroquoians occupied the site within A.D. 1600-1632. This places Christianson as the only excavated GBP2 site in the Spencer-Bronte creek cluster. Although the community's antecedent village is unknown, Fitzgerald (1990, 284-285) draws on upstream village relocation patterns and the frequency of (e.g. lack of) European trade goods to suggest that villages along the West Spencer Creek are ancestral to Christianson (e.g. Zap, see Figure 3.5), and he uses European trade beads at the Robertson Site (surveyed) to suggest it is the later village relocation.

At Christianson, archaeologists uncovered 8 house structures along with 8 middens scattered across the site (Figure 3.7). The location of House 6 outside the palisade wall hints at a possible village expansion or migration of people to the village sometime after its initial construction (Fitzgerald 1981, 36). House 4 represents an initial construction (4E) and a reconstruction (4W) along a different outline after a fire. Fitzgerald (1981, 78-81) suggests House 4E was the earlier house outline because it exhibits evidence of shorter habitation with a "relative lack of non-structural features and shallow hearths" along with the presence of ash or fire reddened soils in posts from all sections of House 4E. This reconstruction shifted the location of the adjacent midden A-2 to the A-1 midden location making MA-2 relatively earlier in chronology to MA-1 (see Figure 3.8) (Fitzgerald 1981, 81-83).

I analysed sherds from within House 1 and focused on feature 3 (Figure 3.8; Table 3.3). Archaeologists uncovered about one half of the house during excavation, stretching from a complete post-mold outline of the west end wall to the approximate centre of the house (Fitzgerald 1981, 53). Feature 3, located in the centre of the house and adjacent to the west, is a large (184x134x30cm) pit that contains an abundance of carbonized organics (e.g. wood) and concentration of artifacts (333 sherds, 12 lithic flakes, a discoidal shell bead; Fitzgerald 1981, 55). Fitzgerald (1981, 56) suggests the pit was not used for refuse deposition but instead functioned as a food preparation pit due to the abundance of carbonized material, the presence of carbon encrustation on rim sherd interiors coming from this feature and due to the proximity of post molds around the pit. Fitzgerald (1981, 57-59) also suggests that the relatively higher number of hearths in the house (total of 5) represent a relatively long term of occupation and he suggests that "the abundance of ash filled post molds in the southwestern corner of the house" was potentially the result of the same fire that consumed portions of House 4.

Context Type	Location	Feature	Articulated Sherd Count	Total Sherd Count	Notes
Midden	MA-1	-	447	447	Relative later temporal deposition to MA-2*
	MA-2	-	271	271	Relative earlier deposition to MA-1*
	Area A	x-1,2,3,4,5,6,7	167	270	1969 excavation by William Noble
Domestic	House 1	Feature 3	81	137	Large food preparation pit
Total	-	-	966	1125	-

Table 3.3: Christianson site sampling contexts employed in this study and descriptions (Context identification based on Fitzgerald's 1981 Christianson site publication).

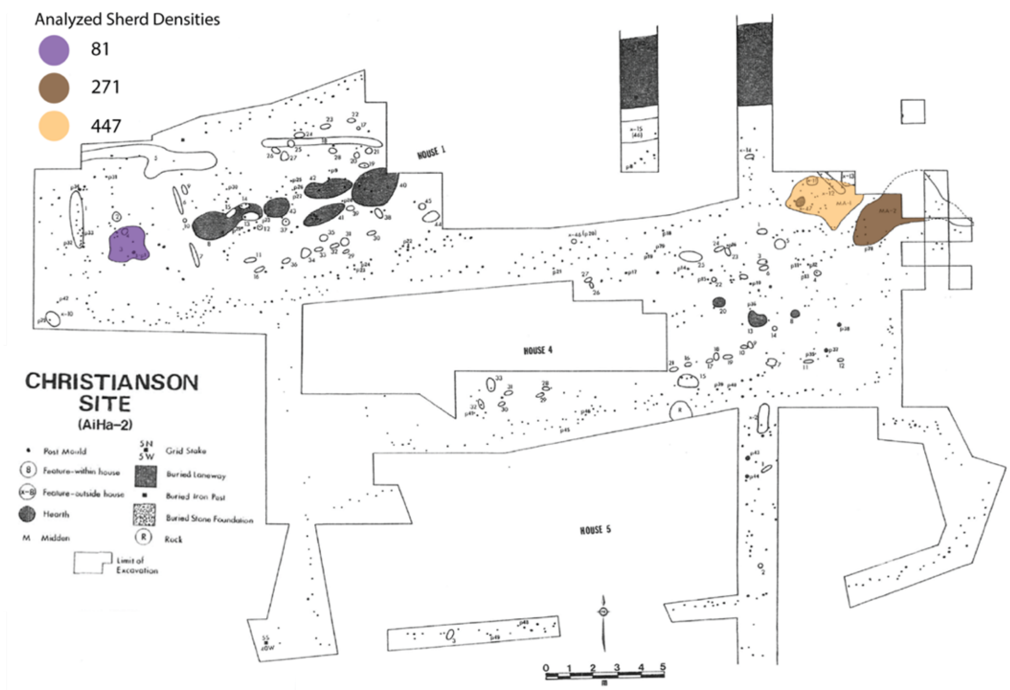

Figure 3.8: Sample context location and analysed sherd densities in Christianson's southern house cluster (Modified from Fitzgerald 1981, 54).

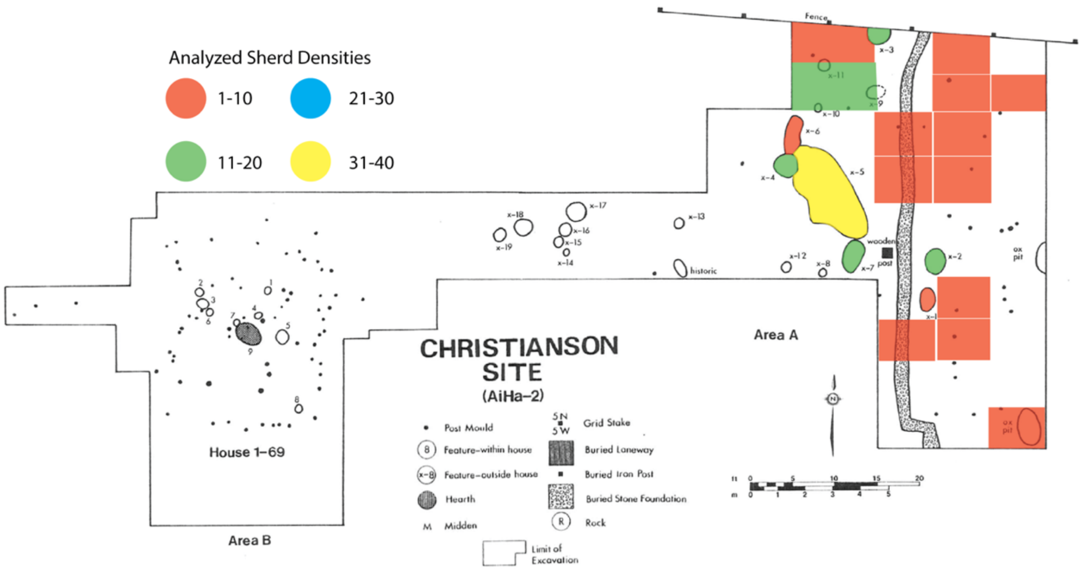

Figure 3.9: Sample context locations and analysed sherd densities in Christianson's 'Area **A'** (modified from Fitzgerald 1981, 89)

The densest concentration of ceramics is located in midden deposits followed by cooking/hearth features with post-mold or "slash-pit" features containing the lowest density.[10] (Fitzgerald 1981). Midden MA-2 includes the second densest concentration of sherds at the site with 1329 sherds identified by Fitzgerald 1981, 44). The densest concentration of sherds (n= 2144) comes from the Area A, excavated by William Noble in 1969. This area consists of several pit features and a centrally located refuse pit (Pit 5/x-5; Figure 3.9) situated in a natural depression (Fitzgerald 1981, 43-44). The distribution of sherds coming from excavation squares outside of the pits (seen on the right side of Figure 3.9) may represent sherds dragged out of the pit and midden features by ploughing actions.

3.3.2: The Hamilton Site (AiHa-5)

The Hamilton Site village is located on the north bank of a Bronte Creek tributary and off Concession Road 8 in Flamborough, Ontario (Figure 3.10). The site is adjacent to the

[10] These sherd concentration patterns are deduced from Fitzgerald (1981) for Christianson and Lennox (1977, 14-30) makes a similar claim for Hamilton site.

Beverly Swamp within a depression and situated atop of sandy loam (Lennox 1977, 12). William C. Noble excavated the village in 1970 and 1971, as did Paul Lennox in 1976 (Lennox 1977, iv). These researchers excavated 4386m², representing approximately 18% of the 2.4-hectare site (Lennox 1977, 9). Heidenriech (1971, 128) and James Wright's (1977, 184, 1987) averaged population density estimate of 450-600 people per hectare would mean that 1080-1440 persons inhabited the Hamilton site. Fitzgerald (1990, 394) draws on European trade beads to suggest the site was occupied from A.D. 1632 to 1651 and using assumed patterns of village relocation along the Bronte Creek he believes that the Mount and Mills villages were the community's sequentially antecedent locations. As such, Neutral Iroquoians occupied Hamilton during and after the series of epidemics and was a terminal Neutral village before being dispersed by the Seneca in 1651.

Archaeologists completely excavated four longhouses, part of another, and located seven middens (3 of which were excavated). Researchers (e.g. Lennox and Fitzgerald 1990; Stothers 1981) highlight Hamilton's large site size (compared to previous villages), household expansions (including two expansions in House 2, Figure 3.11) and its pottery tradition, which is 64% shell-tempered. Two middens excavated by William Noble were particularly deep and included several undisturbed contexts. Midden A is 76.2cm deep, with several stratified layers and Midden C with an undisturbed context of 30.5cm (Lennox 1977, 16-18). I examined sherds (Table 3.4) from House 2 (Figure 3.11), House 3 (Figure 3.12), and House 4 (Figure 3.13). These include features from within and outside the household. I also analysed sherds from Midden A (Figure 3.11), B, and C (Figure 3.10). I suggest midden B and C are particularly useful for considering the presence of households on unexcavated areas that surround these middens.

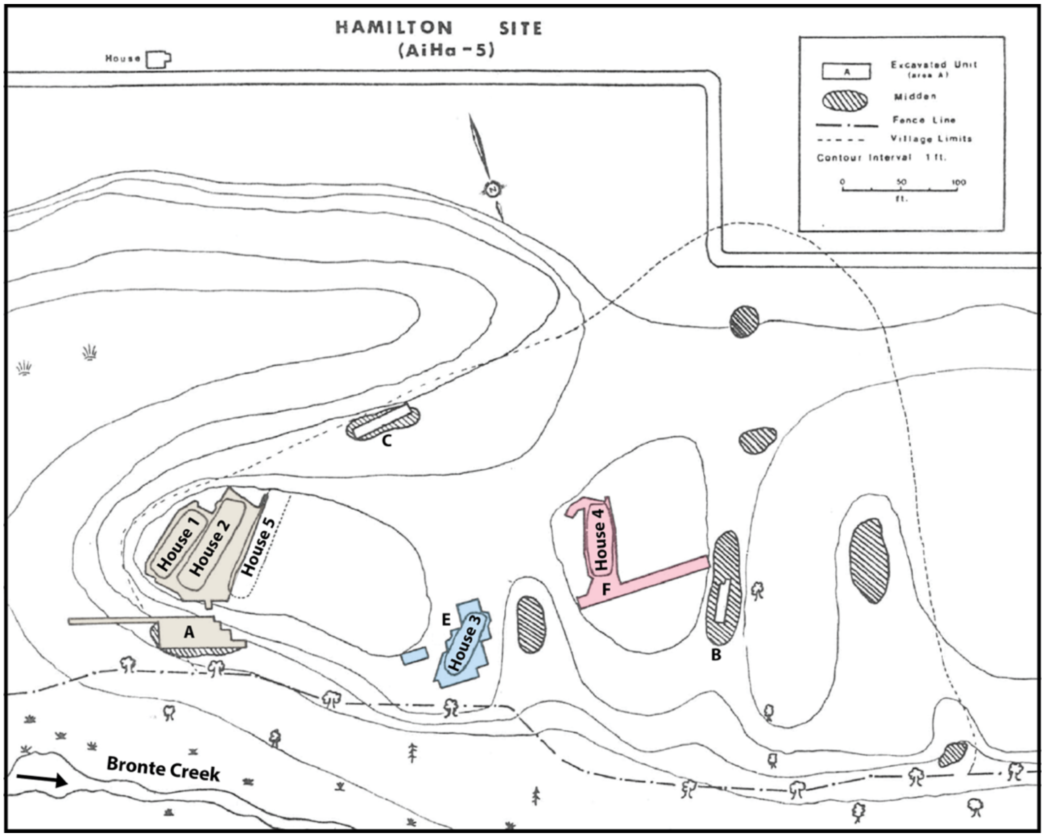

Figure 3.10: The Hamilton site map (Modified from Lennox 1977, 10). Figure 3.11 represented with light tan. Figure 3.12 represented by light blue. Figure 3.13 represented by pink.

Context Type	Location	Feature	Articulated Sherd Count	Total Sherd Count	Notes
Midden	Area A	-	224	265	-
	Area B	-	63	65	-
	Area C	-	62	69	-
Domestic	House 2	Pit 20, 45, 47	17	21	(45) Hearth feature, (47) pit filled with hearth-based refuse
	House 3	Pit 15	32	60	Storage pit
	House 4	Pit 6, 33, 45,	32	35	Pit 45 + 33 cooking refuse deposit outside house. Pit 6 specialized cooking feature
Total	-	-	430	515	-

Table 3.4: Hamilton site sampling contexts employed in this study and descriptions (Context identification based on Lennox's 1977 Hamilton site MA thesis).

Archaeologists excavated a significant portion of House 2 (Figure 3.11). Lennox (1977, 22) suggests the house had an original size of 16.15 meters but expanded twice during the occupation of the site, with an approximately 4.57m extension to the northern end of the house and an extension on the southern end that continues into unexcavated space. The house contains three central hearths and two side hearths. Pit hearth 45 was relatively deep at 41.9cm, included much refuse (e.g. pottery), and Lennox (1977, 22-23) suggests it served as a roasting pit due to its alternate layers of sterile fill, fire-broken rock, ash, charcoal and fire-reddened sand.

Archaeologists excavated the full extent of House 3 (Figure 3.12) but Lennox (1977, 23) found the southern and eastern walls were poorly defined, and that no hearths were preserved, likely due to plowing activities. Pit 15 produced significant numbers of refuse with an assemblage of faunal decorative ornaments, unbroken tools (2 projectile points, 2 preforms, a scraper, 2 abraders, 1 brass point), 1 broken brass needle, 4 pieces of brass scrap, 10 shell beads, 100 sherds (4 vessels), and lithic flakes (Lennox 1977, 25). Lennox (1977) suggests Pit 15 was a storage pit as a limestone slab sat right over the centre of the pit (marking its location), and it was not a disturbed feature because it sat below the plow-zone.

In Area F (Figure 3.13), archaeologists uncovered House 4 which was clearly defined by post-molds and one central hearth was found (Lennox 1977). Lennox (1977, 26) suggests that one feature (Pit 6), which reached a maximum thickness of 30cm, was a specialized cooking or backing feature because it contained fire-cracked rocks, a layer of charred wood, and fragments of pottery and chert. Archaeologists found many posts outside the house that have no apparent patterning but Feature 33 and Pit 45 produced some refuse. Lennox (1977, 28-29) suggests that Feature 33 was a large refuse pit due to the presence of charcoal, bone, fire-cracked stone and pottery, and he suggests Pit 45 was a refuse deposit connected to outside cooking activities due to the presence of deer bone, pottery and charcoal fragments.

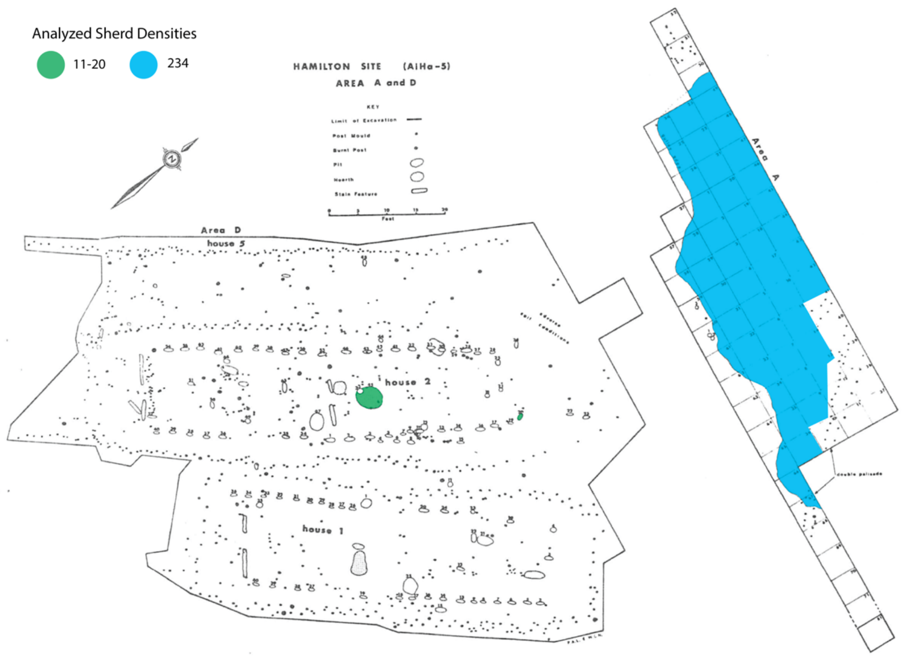

Figure 3.11: Sample context locations and analysed sherd densities in Hamilton's Area A and D. Excavated area represents the westernmost house cluster and midden. The house 2 extension is visible on its north-western end (Modified from Lennox 1977, 15).

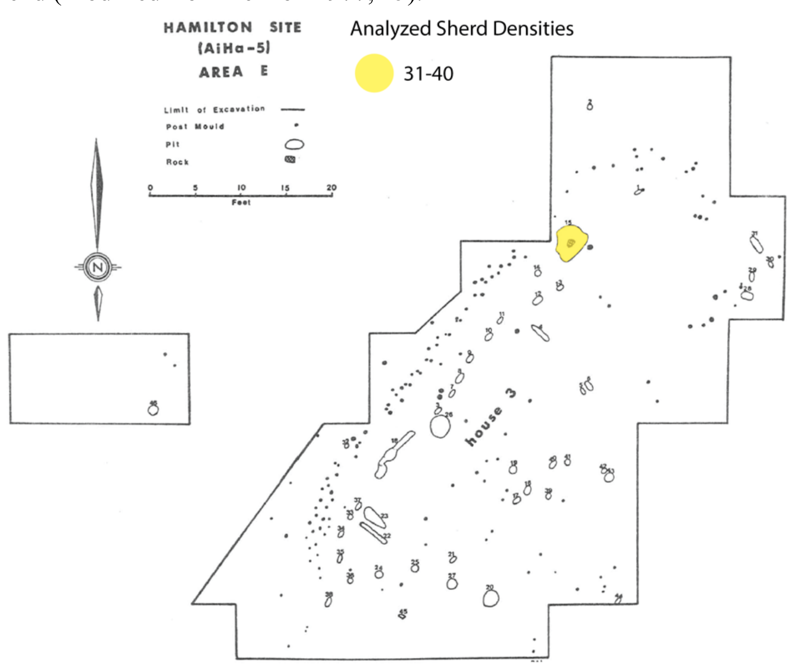

Figure 3.12: Sample context locations and analysed sherd densities in Hamilton's Area E. Excavation includes House 3 (Modified from Lennox 1977, 24).

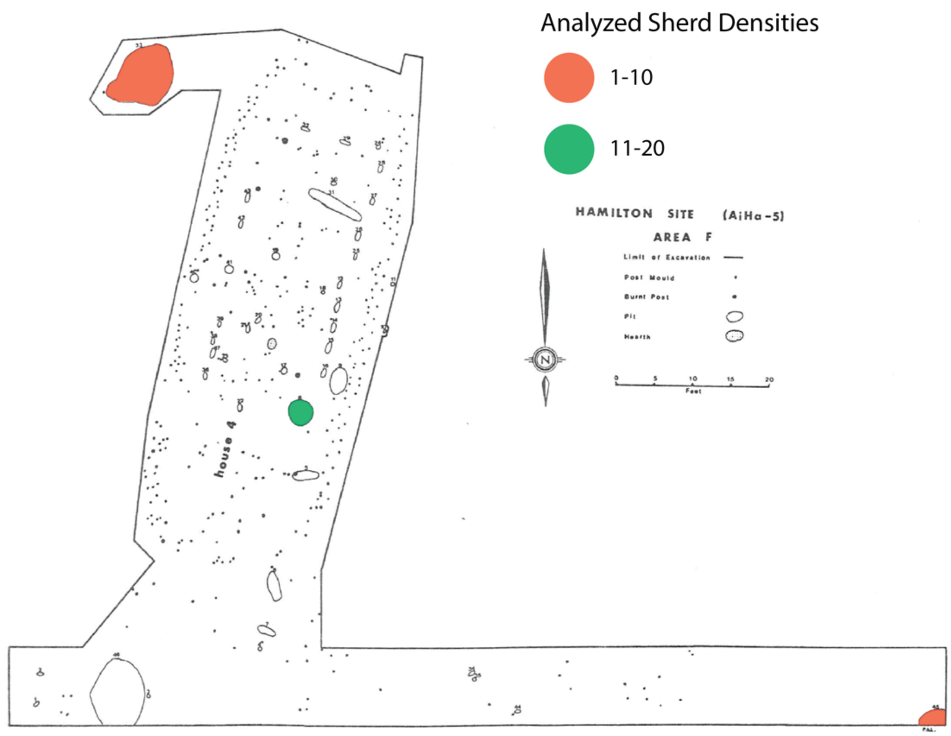

Figure 3.13: Sample context locations and analysed sherd densities in Hamilton's Area F. Excavation includes House 4 (Modified from Lennox 1977, 27).

3.4: Taphonomy and Deposition

I tested the possibility that taphonomic processes biased my sampling strategy as certain paste types may be impacted differently in depositional contexts and create a systemically higher count for one paste type. Experimental work suggests that temper type can alter the abrasion resistance of pottery (Skibo and Schiffer 1987). The weight of sherds provided a relative taphonomic indicator for the state of erosion for each paste type (Roddick 2009, 98). I present these patterns in Figure 3.14 and Table 3.5.

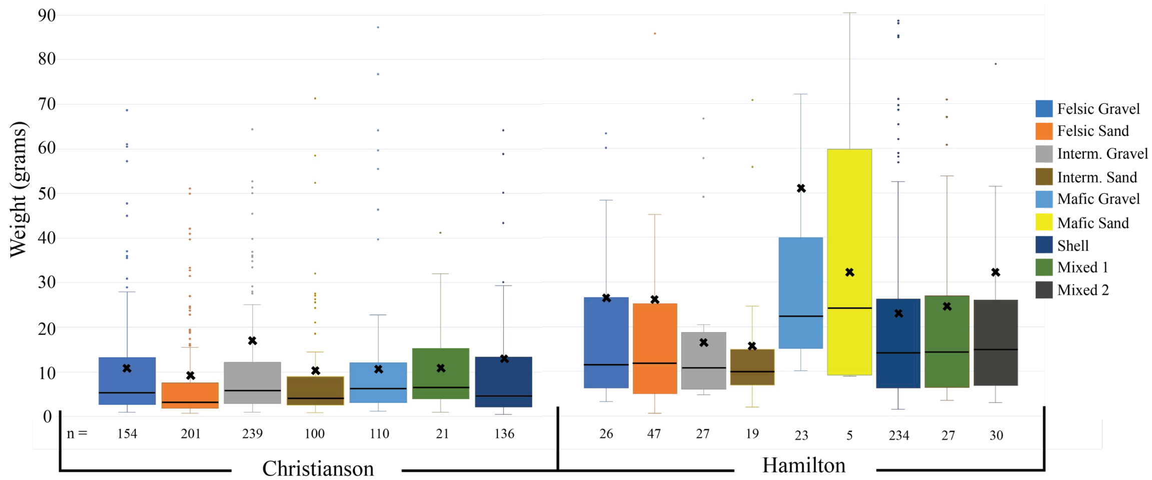

Figure 3.14: Weights across pastes groups and sites. X=average, line=median. Refer to sections 4.3.1 and 5.1.1 for definition and constituency of paste types.

Paste Values	Christianson (7 Paste Groups)	Hamilton (9 Paste Groups)
Standard Deviation of Averages	2.57g	5.42g
Co-efficient of Variation for Averages	21.98%	26.46%

Table 3.5: Statistical values derived from the averages and medians of weights for each paste group present at the Christianson and Hamilton sites. Measured in grams.

Amongst each site there is some variation between the paste groups, but I suggest it is not from a profound systemic bias from the physical qualities of a ceramic recipe. To ensure this cursory conclusion is correct. I calculated the mean of all averages (seen in Figure 3.14) present for each paste type (Table 3.5). I calculated the standard deviations and coefficients of variation to describe the variation in the averages at each site. I suggest these statistical values (Table 3.5) represent an acceptable level of variation between paste groups. Taphonomic processes are likely not the cause for variation and should not significantly alter my findings and ceramic counts through my thesis. I account some variation to the correlation between the texture of pastes (e.g. gravel >2mm to sands <2mm inclusions) and the size of vessels, where coarser pastes were generally used for larger vessels and these vessels are generally thicker

(Rice 1987, 227) which can increase the weights.[11] I did notice that shell-tempered sherds were more prone to break through the centre of the core, parallel to the interior and exterior surfaces.[12] I account the differences between Hamilton and Christianson sherds (as Hamilton weights are generally higher) to 1) the observation that previous archaeologists and students working with the Hamilton assemblage partially mended more vessels by gluing them together and to 2) Hamilton's sample (the 'n' value) being smaller than Christianson and more prone to outlier influence.

Cultural Deposition Patterning

Beyond taphonomic processes, the assumptions I make which connect sherds from houses and middens to social units (households, clans, lineages) must also take into account the cultural processes that affect the spatial distribution of sherds. Pieces of a broken vessel can be located in different middens, as Alicia Hawkins (2001) mended sherds from two middens 30.5 metres away from each other at the Wendat Ossossané site (abandoned ca. A.D. 1635). Archaeologists also find pottery cross-mends between houses at the Early Iroquoian Calvery site (Timmins 1997, 173), the Middle Iroquoian Antrex site (Archaeological Services Inc. 2010, 68) and Elliott villages (Fox 1986, 28), and the ca. A.D. 1550 Eaton site (possible Iroquoian Erie Nation; Salisbury 2001). Glencross and Warrick (2018, 12) also note a cross-mended juvenile vessel which is constituted by sherds comings from two different Wendat sites in Simcoe County. Such spatial patterning of cross-mends extends beyond pottery and archaeologists note the spatial distribution of ceramic pipe mends between different longhouses at the pre-Contact Wendat Draper site (von Gernet 2002) and Salisbury and

[11] Although thickness can relate to use (Rice 1987, 227-228), I found thickness correlates with coarser textured pastes, and larger (in diameter) vessels. (See Appendix A Figure A.15 and 16).
[12] See Appendix B Figure B.10 for examples of this pattern of breakage. This pattern of breakage may be associated with the laminar orientation and the elongated shape of shell inclusions and with manufacturing techniques. Although, this pattern of breakage was also present in grit-tempered vessels. See section 5.1.3 for a discussion on the relationship between breakage patterns and pottery manufacturing techniques.

Englebrecht (2018) examined the spatial distribution of projectile point mends across the Eaton site.

Attempting to understanding the depositional processes that create these patterns can be increasingly complex considering new research that demonstrates Iroquoians deliberately broke some of their material culture. This pattern is not limited to the North-East, the practice of deliberately breaking pottery occurs in many cultures based on particular symbolic connections to pottery and their ontologies (Gosselain 1999; Vanpool and Newsome 2012). Braun's (2015) experimental study broke pipe replicas in recreated 'deliberate' and 'accidental' ways, where he was able to distinguish deliberate versus accidental fractures. Based on this he found that 80% of pipes at the Middle Iroquoian Antrex and Holly sites were deliberately broken and argued that broken pipes were deposited in symbolically meaningful ways (Braun 2015, 173). Kenyon (1982, 99-100) also noted a similar pattern of deliberate breakage and deposition of ceramic pipes at the Neutral Grimsby cemetery (GBP3) where broken pipes were placed near the head of deceased individuals. Future research is required to make similar connections to pottery breakage patterns but this theoretical frame, which takes an alternative perspective on deposition patterns, is interesting in light of some descendent community voices that pronounce feelings of discomfort with archaeological excavation because they are concerned for the active and continual spiritual entanglements of a ceremony to which artifacts may have contributed to (Nahrgang 2013, 210).

The spatial dispersion of sherds from a single vessel can also be accounted for by more quotidian activities. Ethnographic studies demonstrate that broken pots can be used in a variety of secondary ways (Deal 1985; Hayden and Cannon 1983; Longacre 1985; Silva 2008). One example can include individuals collecting sherds as props to stand a pot upright (Silva 2008) and Paul Lennox (1977, 69) suggests some Neutral Iroquoians reused sherds as paint dishes. Archaeologists found red ocher on the interior of 9 body sherds at Christianson (Fitzgerald 1981, 108), 66 sherds at Hamilton (Lennox 1977, 69) and 4 sherds at the Hood site (Lennox 1984a, 77). A variety of playful actions by children, such as throwing objects around, can also have a dispersal effect on inorganic refuse like sherds (Deal 1985; Hayden and Cannon 1983, 131-132).

Although symbolic gestures and more casual engagements with broken pottery can both disperse sherds across the site, I rely on the assumption that such activities are unlikely to dislocate the majority of sherds from their primary locale of usage and disposal (e.g. from a household to a nearby midden). I rely on this assumption because ethnographic studies suggest a significant amount of refuse experiences a predictable 'discard life' that keeps the majority of refuse spatially connected to the household that used the original unbroken product (Deal 1985; Hayden and Cannon 1983). This discard life can include an immediate permanent discard into a midden or into temporary discard outside of the household if the refuse is not too cumbersome for daily activities in this discarded space (Deal 1985; Hayden and Cannon 1983). This assumption then means that a significant number of sherds can be tied and attributed to social units in past Iroquoian societies such as the household or clusters of households that represent kin-based lineages (Warrick 2000, 444). From this, I suggest that the household scale of analysis is appropriate for tracking the historical and social processes at play within each village as communities of production, consumption and then patterns of deposition are likely correlated.

3.5: Chapter Summary

In this chapter, I provided a geological overview of the Flamborough area to highlight the shared geological landscape and a shared set of raw material options available to Neutral Iroquoian potters living at the Christianson and Hamilton villages roughly 400 years ago.

This background knowledge of the landscape provides context to my *chaine d'operatoire* (Schlanger 1990) approach with the ceramic dataset. I focused on our current archaeological understanding of the Spencer-Bronte creek site cluster, situating local archaeological patterns within broader regional social and demographic processes. The Neutral nation, constituting the Spencer-Bronte Creek site cluster, experienced a demographic influx even during (and after) periods of severe demographic depopulation from European disease epidemics. I presented a sampling strategy that is influenced by my theoretical frame, and by the current archaeological understanding of Iroquoian social organization and refuse deposition. I concluded with an examination of the taphonomic processes, social practices, and post-depositional processes that could impact the counts of paste types and the spatial distribution of a broken vessel. I suggest such variables are unlikely to systemically bias the ceramic assemblage but future research into alternative depositional perspectives may be useful to archaeologists.

Chapter 4: Methods

In this chapter, I outline the methods used to analyse pottery sherds from the Christianson and Hamilton sites. I suggest that archaeologists can understand the impacts socio-demographic turbulence had on these communities of practice by coupling *chaîne opératoire* theoretical perspectives with a set of fine-grained ceramic methodologies. With such an approach, I track discontinuities and continuities of technical styles to provide an evidentiary basis for interpreting any alterations in their learning frameworks and the presence of potters with alternative learning histories. I begin by discussing my attribute-based system for studying Iroquoian ceramic styles, I highlight its advantages over typological approaches, and I follow with my complementary set of attributes related to motor-skills. I then provide the methods of macroscopic paste categorizations and my petrographic analysis of representative samples. I conclude with my sherd refiring oxidation analysis that I employed for the proximal examination of firing technology.

4.1: Attribute Analysis

Early researchers in Iroquoian archaeology crafted ceramic typological systems in Ontario and New York to develop a chronology for the 'Iroquoian tradition' (e.g. Emerson 1954, 1968; MacNeish 1952; Parker 1922; Ritchie 1965; Ritchie and MacNeish 1949; J.V. Wright 1966). These scholars used typologies and taxonomic categories to scaffold time and space. J.V. Wright (1967) outlined the benefits and consequences of the typological approach as a counter-point to initial ceramic orderings of the 'Iroquoian tradition.' He concluded that "attribute analysis . . . appears to be the most effective method of tracing the complex interplay within and between the evolving traditions of the Iroquois co-tradition" but he also noted that archaeologists should be selecting attributes that are most beneficial for tracking meaningful differences in space and time (J.V. Wright 1967, 67-68). Archaeologists subsequently highlighted the inadequacies of typological approaches in Iroquoian ceramic studies and introduced attribute-based analysis systems (e.g. Engelbrecht 1971; Lennox and Kenyon 1984; Ramsden 1977). Some researchers found that traditional Iroquoian types had overlapping attributes leading to conflicting observer assessments on where typological boundaries should be drawn (Lennox and Kenyon 1984). In the past twenty years of Iroquoian archaeology, the taxonomic associations of ceramic types have come to be seen as a limiting factor in our understanding of technical practice and the social information that can be understood from spatial, temporal, and thematic associations of particular attributes (Hart and Brumbach 2003, 737-738).

However, ceramic typologies and their associated culture-historical paradigms remain in use in Ontario archaeology. One reason might be the proliferation of Cultural Resource Management firms, who conduct the majority of archaeology in the province (Ferris and Cannon 2009). Archaeological site reports submitted to the province must define the “cultural affinities” of the assemblage (Ferris 1999) and archaeologists commonly use the decorative classification systems devised by MacNeish (1952) and J.V. Wright (1966) (Braun 2015, 34-35; Mather 2015, 13). In comparison, the majority of recent ceramic studies consistently employ multi-attribute or micro-style techniques (e.g. Chilton 1998; Hawkins 2001; Holterman 2007; Martelle 2002; Mather 2015; Ramsden 2016; Schumacher 2013; Suko 2017; Watts 2008). However, some Iroquoian archaeologists are utilizing the vast typological datasets generated by Cultural Resource Management firms to understand historical developments at intra-site and regional scales (Birch et al. 2016.) For them, typologies are “not simply the handmaiden of culture-history” (Birch et al. 2016, 136).

In this study, I employed a multi-attribute analysis on the Christianson and Hamilton sites. This methodology allows me to observe variability in production practices in a short timeline and I can track technical styles along the whole chain of operations (Michelaki 2007; Roddick 2009). An attribute is an irreducible variable that can be observed from archaeological ceramics, and each attribute can be "expressed" in a variety of ways based on the choices of potters. One example of an attribute can be the type of surface finish. Out of their repertoire, a potter can choose to finish a vessel's surface through burnishing (polishing the surface with a smooth stone) and an archaeologist can recognize that choice as one particular expression of the 'surface finishing' attribute.

One of the primary benefits to an attribute approach is that we can understand a series of potters' choices rather than limiting our analysis to the final product (Roddick 2009, 168). Archaeologists using typologies tend to ignore differences in attribute expression by prioritizing some attributes and ignoring variation that might provide information for comparison and further inquiry on the historical developments of past societies. Ramsden's (2016) study of the 16th century ancestral Wendat in the Balsam Lake region illustrates this point. In his close examination of the "barred motif," he found that this decorative attribute was not mutually exclusive to a 'traditional' Wendat or St. Lawrence Iroquoian vessel type (dominant local types) and that its association to other attributes can represent a historically contingent usage. Ramsden (2016) argued that the barred motif's increased application through time, its spatial correlation with other St. Lawrence Iroquoian material in villages, its correlation with "hybrid" vessel categories, and its correlation with larger vessels meant that the motif represented an active symbolic signal of resistance and/or political factionalism.

A multi-attribute approach then can complement a community of practice theoretical perspective (Chapter 2) and lend to interpretations of particular historical developments. Gosselain's (2017, 105) ethnoarchaeological work in south-western Niger and northern Benin highlights that a consistent mutual engagement of pottery production can often lead to a form of routinization of practices amongst potters through a shared aesthetic repertoire, and a set of aesthetically connected meaning, tools, and raw materials. Archaeologists then can outline these shared histories of learning and shared values (communities of practice) through patterns of routinized attribute expressions delineated within a consistent set of possible choices. Attribute clusters within a *chaîne opératoire* analysis then can present the possibility of a past learning community (Roddick 2009, 2016, 136-137). Continuities and changes within these clusters or even the wholesale introduction of alternative expressions refocus our attention to the historical contingencies that acted on these communities in such a way as to maintain and circumscribe traditions or in the case of change, as to circulate and allow for alternative ways of doing (Stahl et al. 2008; Stahl 2016; Wallaert-Pêtre 2001).

Turning our gaze towards the potters living in the Neutral Spencer-Bronte Creek site cluster, the pattern of increasing shell-tempered vessels during turbulent times acts as a key starting point for archaeologists to understand broader continuities and changes in the local technological system. As such, these attributes serve to track the loss or persistence of embodied knowledge, the introduction of newcomers into a community, and broader social processes that can broker in alternative forms or ways of doing across production stages.

4.1.1: Attributes of Study and Process of Analysis

My attribute analysis drew upon Steadman's (1995) attribute-driven approach to ceramics in highland Bolivia. From her attribute analysis system, I employed a revised version of her codes and forms for firing cores, surface finishing, Munsell colour associations, and levels of carbonization.[13] I drew upon the Iroquoian attributes reference collection at Sustainable Archaeology (SA) at McMaster Innovation Park[14] to correlate

[13] Presented in detail in Roddick (2009) Appendix 2
[14] William Noble developed this collection using the legacy F.S. Wood and Everett J. Case collections

Steadman's (1995) attribute analysis forms to particular attribute expression found on Iroquoian ceramics, including SA's surface finishing collection. To explore other Iroquoian ceramic elements (discussed in Ramsden 1977, Martelle 2002, and Holterman 2007), I analysed attributes relevant to a vessel's form. These included neck and collar heights and style-based attributes such as collar thickness and decoration method. Decoration type, motifs, appliqué orientation, profiles, and castellation types, which were part of the original M.A. theses on the Christianson (Fitzgerald 1981) and Hamilton (Lennox 1977) sites, were also included.

My process of attribute analysis consisted of the following steps. First, I selected a bag from a particular context and sorted the sherds based on their size. Sherds smaller than $2cm^2$ were not selected for analysis because I deemed them too small to access an accurate observation of paste, surface finish, and Munsell colour. Based on the varying arrangements of storage for the two sites (the usual condition of legacy collections), a single bag could contain hundreds of one type of sherd (e.g. body sherds) from dense middens. Alternatively, some sherds were in more individualized bags from less dense site contexts or were previously placed in individualized bags as diagnostic sherds (e.g. decorated rims). I randomly selected from within a bag, or from a set of bags, my samples for analysis.[15] In *Microsoft Excel* I recorded the sherd ID and the excavation context, provided the sherd with a catalogue number, identified the sherd type (body, rim etc.), recorded the weight (in grams measured with an electric scale), the sherd count, and then a variety of production and use attributes.[16] If a sherd articulated with other sherds from the same or adjacent context (e.g. an adjacent square but from the same excavation context) I left its count as 'one.'

[15] See Section 3.3 for my spatial context sampling strategy.
[16] For a full list and description of attributes see Appendix B.

The attributes I chose to analyse can defer to particular micro-style choices by potters that speak for histories of learning and their social experience (Dietler and Herbich 1998; Gosselain 2017). However, this should not negate the fact that a potter's choice is also entangled with technological constraints of materials and a ceramic's intended task such as cooking or storage (Rice 1987, 227-243). I collected some attributes in a high degree of detail (splitting rather than lumping) but I did re-cluster them thematically on an attribute-to-attribute basis. For example, I included rim profiles that were collared or collarless but within a 65-46º angle range within a broader 'flared' category. Overall, the attribute expressions I later lumped into broader categories included macroscopic paste types, surface finishes, rim profile, motif, and firing core.

I analysed some attributes on all the sherds, including maximum thickness (in millimetres), the paste type (see section 4.3), and if the inclusions were oriented as random (r), weak (w), moderate (m), or strongly (s) parallel to the vessel walls. Inclusion orientation can be the result of forming techniques (Shepard 1985, 183-186). For example, if inclusions orientate parallel to the vessel wall then one possibility is that the potter utilized the paddle and anvil as a secondary forming technique (Quinn 2013, 174-176). I noted forming techniques if they could be recognized from the sherds, such as relic coils or coil breaks.

I then noted the interior and exterior surface finishing[17] which included combinations of wiped, plain, smoothed, cord roughened, ribbed paddle, smoothed over cord, smoothed over ribbed, burnished, and scarified (Figure 4.1). Neutral Iroquoian archaeologists recognize the potential in this attribute in conceptions of cultural interaction and captive immigration due to temporal and spatial trends of surface finish types after ca. A.D. 1580. Poulton et al. (1996, 43) note the highest percentage of cord-based surface finishings (such as cord paddle

[17] Refer to the Appendix B Table B.6 for surface finish combination codes.

& cord malleated) at the Spencer-Bronte Creek cluster which ranged from 14% at Christianson and 64% at Hamilton. Cord surface finishings are also present throughout multiple Neutral site clusters such as below 24% on most Milton cluster sites (Finlayson 1998, 354, 850-851) and below 10% at the remaining site clusters such as the Lower Grand (Poulton et al. 1996), the Fairchild-Big cluster (M.J. Wright 1981), the Lower Bronte cluster (D.R. Poulton & Associates 1993, 32) and the northeastern Niagara cluster (Noble 1980, 52). Lennox and Fitzgerald (1990, 417-419) suggested a correlation between shell-temper and corded surface finishing and equated this pattern to 'foreign' influences by captives. By extension, this means smoothed or burnished was defined as 'local' or 'original Neutral Iroquoian' but work by Dodd (1995, 246) on a Neutral cabin site provides a nuanced perspective to surface finish trends as he demonstrates the two attributes are not always correlated.

Firing atmospheres provide some insight into the technical remedies needed for the potential issue of 'limespalling' in shell-tempered vessels. Calcium carbonate ($CaCO_3$) is a significant chemical constitution of some aplastic (non-clay) materials such as limestone, calcite, and shell (Rice 1987, 97). When fired to high temperatures, calcium carbonate decomposes into lime (CaO) and carbon dioxide in a chemical reaction:

$$CaCO_3 \rightarrow 650\text{-}900^{o}C \rightarrow CaO + C0_2 \uparrow$$

During the cooling processes, the hygroscopic lime readily absorbs atmospheric moisture, forming quicklime ($Ca[OH]_2$), causing a volume expansion and a release of heat (Feathers and Peacock 2008, 290; Rice 1987, 98). Archaeologists identify this chemical reaction in ceramics as "limespalling" and "lime popping." This process impacts pottery especially if the carbonates are large (e.g. temper) because it leads to very low strength, causes fracturing, cracking and even crumbling in the worst cases (Rice 1987, 98). This can be mitigated in a variety of ways such as lowering the firing temperatures, adding salt to the fabric, wetting the vessel with water while still hot, or by firing the vessel in reducing atmospheres where the high concentration of CO_2 raises the temperature point in which calcium carbonate chemically reacts (Feathers and Peacock 2008, 290; Rice 1987, 410; Rye 1976; Shepard 1985, 301).[18] As such, the uniqueness of firing technology for shell-tempered vessels can speak to an additional distinct technical style in the chain of operations for this paste. A distinct firing technology with shell-temper may indicate that the potters creating these vessels have distinct histories of learning in comparison to potters creating grit-tempered vessels.

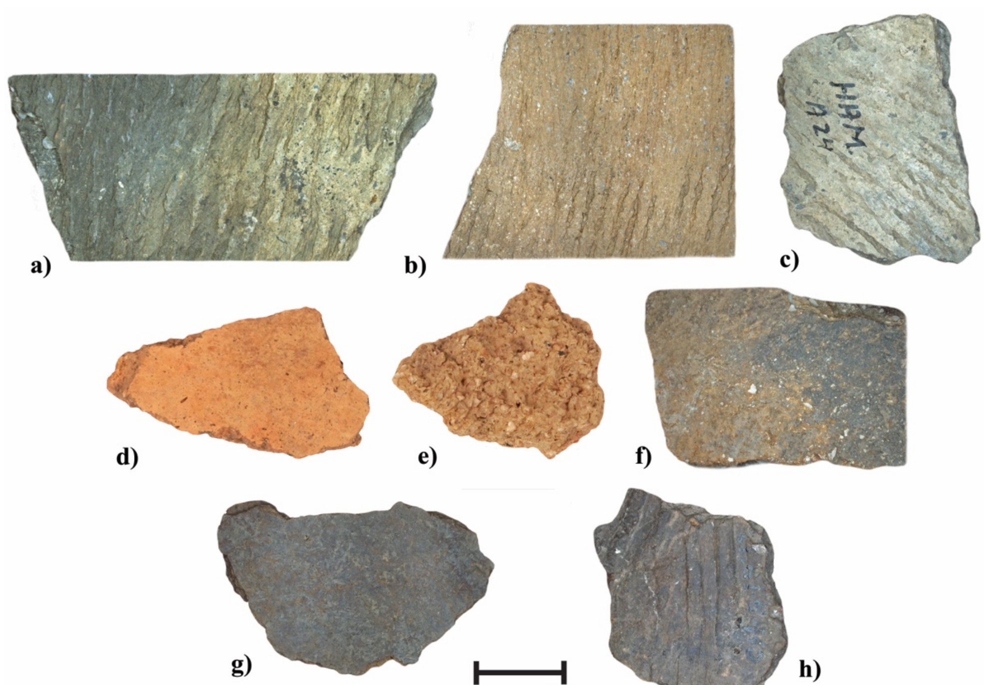

Figure 4.1: Surface finish types from the Christianson and Hamilton sites: a) cord roughened b) smoothed over cord c) burnished over cord d) plain/smoothed e) eroded f) scarified g) burnished h) ribbed paddle

[18] Herbert's (2008) experimental study on replica shell-tempered vessels suggest reducing atmospheres improved the survivability of vessels. Feathers (2006) suggests in his study on shell-temper's emergence in Southeastern Missouri's Late Woodland/Early Mississippian period (A.D. 700-1100) that the increased use of shell-temper correlated with an increased use of reduction in firing.

To understand firing atmospheres, I observed sherd surface colours using the Munsell Soil Colour Chart (Beck 2006; Rice 1987). I recorded the Munsell code and categorized a series of codes into broader colour groups (e.g. 10YR 6/2 represented 'light brown').[19] Along the fresh break, I also noted the firing core colour and, if there was more than one colour, I would note if the colour boundaries were sharp (s) or diffuse (d). These values also serve to help archaeologists understand the firing atmospheres (Orton and Hughes 2013, 154; Rice 1987). The firing code system included varying arrangements of black, brown, light brown, and red brown.[20] Steadman's system provided 34 firing cores, but I added 9 more codes after examining my samples.

I then identified sherds from the rim, shoulder, neck, castellation, base, appliqué, lug, or handle as diagnostics. I analysed these types of sherds in greater detail and recorded more attributes to define particular technical styles. I noted the form by recording attribute data such the rim profile, castellation type, the rim height, neck height, and shoulder shape. I used a rim diameter chart to find the diameter and diameter percentage of rims and I would make a ceramic drawing of rims that represented more than 5% of the vessel's diameter. Attributes analysed that may correlate with embodied traditions included the direction of finish, the lip thickness, the collar/rim thickness, neck thickness, and lip form. Attributes analysed that may correlate with stylistic choices included the presence/absence of a collar, the collar height, the decoration type, motifs (rim exterior/interior, lip, collar, shoulder, neck, castellation, shoulder, appliqué), the orientation of appliqués, and the presence of a handle or lug.[21]

4.2: Attributes of Skill and Decorative Motor Functions

[19] Refer to the Appendix B Tables B.7 and B.8 for colour codes.
[20] Refer to the Appendix B Figure B.9 for a list of firing cores.
[21] Refer to the Appendix Figure A.3 for the visual qualities of appliqués and lugs, and Appendix B the full list, visual quality, and description of attributes taken from diagnostic sherds.

Archaeologists suggest that, within the Iroquoian household scale of ceramic production, there were part-time specialists (section 1.3; Chilton 1998; Martelle 2002, 2004). Turbulent social conditions can impact the skillfulness of members constituting a community of practice (Hardin and Mills 2000; M. Graves 1984). Archaeologists can recognize quality and skill in expressions of specific attributes. An unskilled potter, lacking guidance from a skilled practitioner, can be ineffective with motor stability and may be missing necessary technical knowledge across various stages of production (Crown 2001). I here outline the attributes and micro-variables I analysed to understand these changes in skill.

The surface contour and rim undulation provide the first two attributes I used to track the skill of potters. The contour and rim undulation of diagnostic sherds can relate to motor function controls during forming and the consistency in surface finishing, particularly near sharp changes in wall direction and thickness (e.g. from the neck to the rim on a sharp angle; Crown 2001; Martelle 2002). I scored the rim undulation, interior and exterior contour on a gradient consisting of very even, even, medium, slightly irregular and irregular.

With a comparative collection of similar vessel sizes,[22] a higher averaged maximum wall thicknesses can relate to higher intra-vessel variability, insufficient shaping and forming, unfamiliarity with the qualities of a paste (e.g. drying) and inconsistent surface finishing (Martelle 2002, 275). Pottery through the Late Woodland trends towards a reduced wall thickness until the Contact period (ca. A.D. 1615) (Hart and Brumbach 2009, 373; Hart 2012), reaching as thin as 2-3mm at Contact-era Wendat sites, (Lennox 2000, 57; Martelle 2002, 390) the Christianson site (Fitzgerald 1981, 110) and the Hamilton site (Lennox 1977, 68). Archaeologists that investigated this trend argue for a causal connection to skill (Martelle

[22] See the comparison of size classes and percentages between the Christianson and Hamilton sites in section 5.1.5. As larger vessels generally have thicker walls (Rice 1987, 227-228), the similarity in size classes between both sites provides a control for assessing changes in the irregularity of wall thickness.

2002, 2004) or the increased concern for technical qualities (e.g. thermal conductivity and thermal shock resistance) due to an increased water-based processing of maize (Hart 2012). These social and technological causes need not be mutually exclusive, and an understanding of the functional quality of paste types, thermal shock resistance, motor skills, and intended use can interplay into a skilled potter's choices (Skibo and Schiffer 2008, 15, 39-40).

Cracking can be another indicator of skill because it can relate to a potter's technical knowledge of raw materials, required firing conditions, and forming techniques. Cracks can form from inadequately mixed clay, unfamiliarity with the shrinkage rates of clays (more shrinkage results in more cracking during drying) an unfamiliarity with the amount and texture of temper required for some clays and an unfamiliarity of firing regimens (Rice 1987, Rye 1981). For example, tempers can stop crack propagation and temper can be used to prevent shrinkage in very pure clays (Skibo 2013, 102, 121; Tite et al. 2001, 310, 319). Rapid drying can also compound shrinkage rates (Martelle 2002, 275). I categorized cracks as either 1) star-shaped cracks radiating from large inclusions 2) network of superficial cracks or 3) pitted cracks. I did not include cracks radiating from the broken ends of sherds and instead noted cracks that were likely present before breakage and discard.

I examined the evenness of decorative motifs as an indicator of motor performance skill. I defined this variable through the levels of consistency in spacing intervals in repeating motifs that were applied through incising, impressions, punctates, or stamping. With regular practice and close apprenticeship training, a potter can habituate certain motions and reduce one's variability (Creese 2012, 49-50; Crown 2001; Stark 1995, 233). I first applied qualitative measures through a visual scoring analogous to that of the rim undulation and contours, between very even (e) and irregular (i). To quantitatively define motor skills, I employed a coefficient of variation on the width (millimetres) between the space of the outer edge of a single applied decoration (e.g. a single punctate) to the outer edge of the adjacent decoration. Iroquoian archaeologists (Braun 2012; Dorland 2017; Martelle 2002) have used this technique on ceramic collections and suggest that a smaller coefficient of variation represents the work of individuals who are more skilled than those with a larger coefficient of variation. Martelle (2002, 394) found that many researchers (Benco 1988; Longacre et al. 1988; B. Stark 1995) use a coefficient of 10% as a cut-off for specialists. Alternatively, ethnographic cases show that some specialists can have a coefficient up to 20% (B. Stark 1995, 242-243) and that variability by specialist craft producers can often arrive from occasional natural human errors or from the on-and-off seasonal engagement in a craft by part-time specialists (DeBoer 1990, 88; Wiesner 1983).

4.3: Ceramic Pastes

In this section I outline the importance of utilizing ceramic pastes as a significant attribute of inquiry in this study and provide the macroscopic and petrographic methodologies I used to characterize the raw material combinations used by potters. Ceramic pastes are unique mixtures of clay and non-plastic inclusions (e.g. minerals). It is one attribute that can be recorded from all ceramics, even from the small fragmentary body sherd. This attribute, particularly at the microscopic level, provide key insights into the first stages in the operational sequence of potters' technical styles (Lechtman 1997). It is at the moment of raw material collection and processing that potters, with their own unique histories of learning and embodied knowledge, may begin to share their distinct practices in mediating and liminal spaces (Gosselain 2016; Lyons and Clark 2012). This is particularly important as pastes, or "recipes," changed in tempering composition from grit and towards a higher prevalence of shell-temper in the Spencer-Bronte Creek cluster. The adoption of shell-temper represents a significant but methodologically understudied change in Neutral Iroquoian pottery production. This change will be better understood after characterizing the entire repertoire of paste types and with a broader comparison to other sequences in the chain of production (Michelaki 2007).

4.3.1: Macroscopic Paste Analysis

I first received training in ceramic paste recognition and categorization by Dr. Roddick on ceramics from highland Bolivia. With this baseline of training on ceramic recipes I then referenced previous studies that examined Iroquoian pastes (e.g. Braun 2010, 2012; Holterman 2007; Schumacher 2013) to understand the minerals and textures I should expect in my samples. I then referred to inclusion identification resource keys (Druc 2015; Orton and Hughes 2013, 280-281). I created two sets of paste groups (one for the Christianson Site and one for the Hamilton Site; Figure 4.2) based on visual characteristics of the inclusions, their estimated mineralogy, the qualitative percentage of inclusion occurrence, textural characteristics, and compactness (Table 4.1, 4.2). I found in my training and preliminary observations that lithologies are difficult to observe from a fresh break with a hand lens due to varying levels of mineral alteration and core atmosphere. Instead I focused on the colour and shape of mineral inclusions to be indicative of a particular, or possible set, of mineral(s) (Table 4.2). I proceeded with the understanding that a petrographic study would reveal the "truth" of macroscopic classifications and allow me to identify specific rock types. This macroscopic mineral-based protocol allowed me to analyse a significant sample size. I did not, however, consider the matrix colour for creating paste types because firing atmospheres and organic content can be responsible for this attribute (Skibo 2013). Different parts of a single vessel, and other vessels with the same paste could have been exposed to varying levels of oxygen, even in a shared open-pit firing (Quinn 2013, 76; Rice 1987, 155-157).

Paste Attribute	Classification
Inclusion Categories	Grit, Shell, Mixed (Grit and Shell)
Inclusion Colours	Pink, white/opaque, translucent, black, gold, Grey(shell)
Shape[23]	Rounded (r), Sub-rounded (SR), Sub-Angular (SA), Angular (A)
Texture	Fine - Coarse
Compactness	Compact to subcompact
Modes	Unimodal, bimodal
Size	Small to large

Table 4.1: Paste classificatory schema (Based on Druc 2015; Roddick 2009)

Inclusion Classification	Colour	Mineral/inclusion
Felsic	Pink	Alkali feldspar/quartz
Felsic	White/opaque	Plagioclastic feldspar/Quartz
Mafic	Black, Dark Green, Brown	Ferro-Magnesian minerals: Biotite, Amphiboles, Pyroxenes, olivine, iron oxides
Mafic	Gold	Muscovite
Non-mineral	Grey-White	Shell
Argillaceous	Dull brown/red	Clay pellet/grog

Table 4.2: Inclusion identification key for inclusions in Iroquoian ceramics (Derived from Druc 2015; Orton and Hughes 2013, 280-281)

The second step in creating paste groups involved a general 'sample survey' of the Christianson and Hamilton site pottery. I took a total ceramic count from both sites to see what was available at the Sustainable Archaeology repository and see which contexts were materially rich. During this count, I observed the variability in recipes and delineated sherds based on substantive differences. I then placed the most representative samples into a tackle box, with separate zones for each suspected group. Due to the heterogeneity of Iroquoian pottery (even within a single vessel), I ensured that these representative sherds contained an exposed surface of at least 3cm. I used a fresh break on all of the analysed sherds to examine

[23] Refer to Appendix B Figure B.3 for grain shapes guide.

their pastes because an unexposed interior is less likely to be eroded or be impacted by post-depositional processes, such as the precipitation of secondary calcite (Quinn 2013, 76). I examined these fresh breaks macroscopically under a 20x magnification hand-lens. As I moved through the sherds, conducting my attribute analysis, I occasionally added paste types or subcategories if they did not adequately fit with my reference collection. I then photographed these reference samples using a Zeiss Axiozoom V16 high resolution manual microscope with motorized zoom which was equipped with a Zeiss 12.0MP high resolution colour digital camera with ZEN imaging software.[24]

	Felsic	Intermediate	Mafic	Ultra-mafic
Metamorphic	Quartzite, felsic gneiss, felsic granofels	Slate, amphibolite, schists, intermediate granofels, intermediate gneiss	Mafic schists, mafic gneiss, amphibolite	
Igneous	Granite, alkali feldspar granite, rhyolite	Syenite, monzonite, diorite, andesite, dacite	Gabbro, dolerite, basalt	Peridotite

Table 4.3: Common igneous and metamorphic rocks with each category defined on the percentage of silica ($Si0_2$) and light/dark tones (Derived from Braun 2015, 71; Mackenzie et al. 1984)

I later decided to group pastes together based on colour and texture as these traits might have been a readily conceivable way for past potters to differentiate the technical qualities of certain sediments and rocks. Colour differences are based on broader geological distinctions of rocks as either “felsic,” “intermediate,” or “mafic,” a product of their proportions by weight of silica ($Si0_2$) (Le Maitre 2002). A large content of silica represents light coloured minerals while a low content creates darker coloured minerals. Felsic rocks possess greater than 66% of their weight in silica and are therefore the lightest, intermediate

[24] Refer to Appendix Figure A.7 and A.8 for representative paste images.

possesses 52-66%, mafic possesses 45-52%, and ultra-mafic possesses less than 45% making them the darkest (Mackenzie et al. 1984, 78; see Table 4.3).

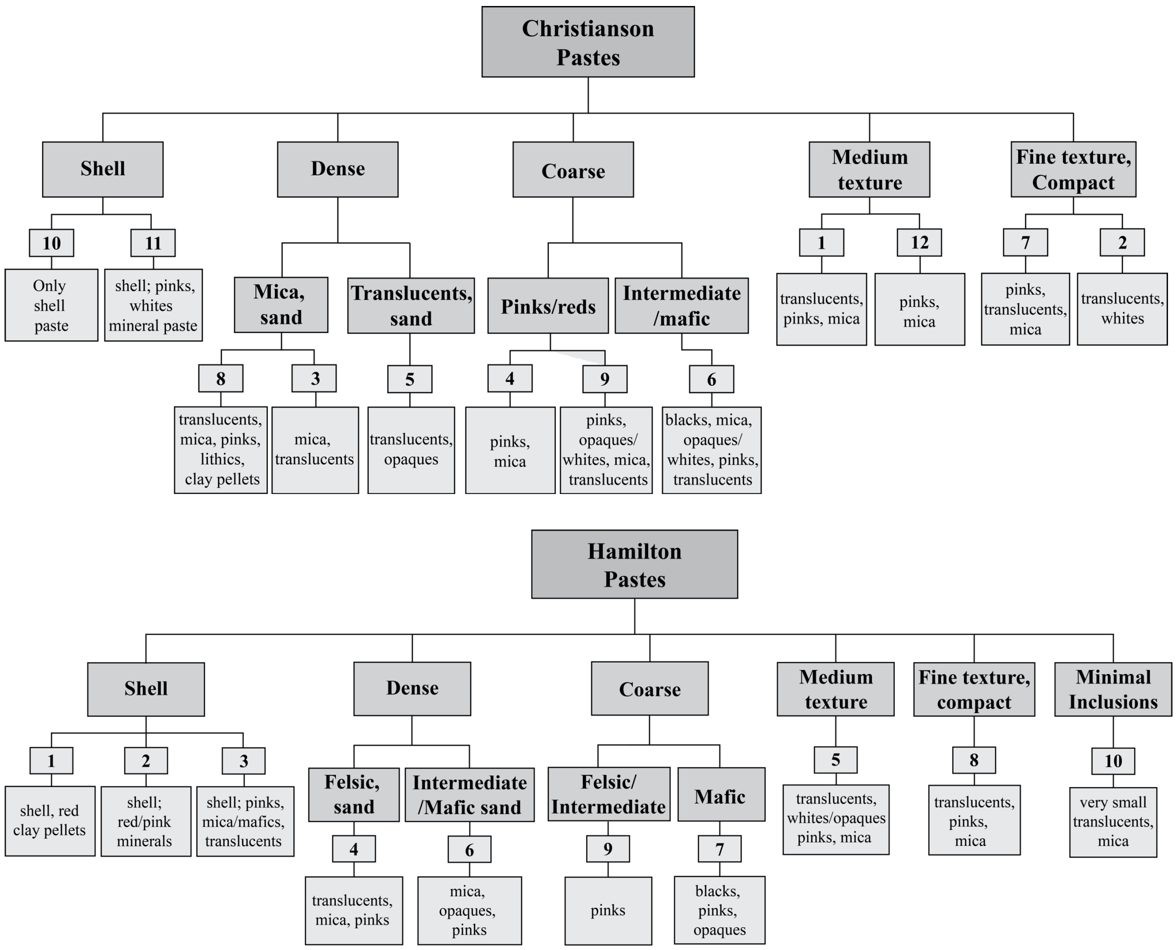

Figure 4.2: Christianson and Hamilton paste group flowchart with subgroups, type numbers and descriptions.

To consider continuity and discontinuity in mineral-based pastes between the two sites, colour is a meaningful way to group these choices. Crushed rocks, often used for temper by Iroquoian potters, can be large enough to visually distinguish between mineral colours and the strong choice of metamorphic and igneous rocks over the more geologically abundant carbonate sedimentary rocks, as seen in previous studies, highlight some degree of technical knowledge and choices (Braun 2012, 2015; Braun Petrography Report, cited in Holterman 2007, 203-207; Striker et al. 2017).

Colour-based temper choices may also be meaningful in relation to symbolic associations. From the ethnohistoric record of the Northeast, researchers understand that colours were associated with a select set of meanings (Hamell 1983, 1992). For example, light, bright, and white things were abstractions for life itself and "positive states of physical, social, and spiritual well-being" (Hamell 1992, 455). Inspired by these potential symbolic associations gleaned from European texts and patterns in Contact-era exchange goods (Hamell 1992; Michelaki et al. 2013), Braun (2012, 2015) found distinct patterning in inclusion type colours between ceramic pipes and pottery at two 13th-14th century A.D. Iroquoian sites. Although my study does not focus on these potential ontological entanglements between potter choices, it must be recognized that a community of practice's set of values and aesthetic principles may be informed by these broader systems of colour that are present in ethno-historic records contemporary to the Neutral. From this we can think of coloured materials in Iroquoian societies as part of a learned cultural system where colours are "functioning as signifiers on multiple levels – functional, social, and symbolic" (Braun 2015, 200). As such, discontinuities from the Christianson to Hamilton site in these mineral colour frequencies can represent reconfigurations or a re-articulation of these values and meanings within communities of practice.

4.3.2: Petrographic Paste Analysis

Thin-section petrography is a material characterization methodology first developed by geologists to classify rocks, soils, and minerals (Quinn 2013, 4; Reedy 2008, 1). Under a light polarizing microscope, a petrographer will have a two-dimensional representation of a 0.03mm thin sample. With this standard thickness, the microscope's light passes through minerals in predictable ways due to their crystal shape and chemical structure (Nesse 2004). Light consists of electromagnetic vibrations that move about in all directions from its source (Gribble and Hall 1985, 1). The first light setting on a petrographic microscope is plane-polarized light (PPL). PPL makes the light 'polarize,' meaning it only vibrates on a single plane (Gribble and Hall 1985, 1). In the second light setting, an additional polarizer is placed in view above the sample which is called cross-polarized light (XP). With this additional polarizer, light coming through a crystal (mineral) is split in two rays and recombine in the second polarizer to produce an altered light wave length (known as birefringence) and an altered level of intensity based on the rotational orientation of the microscope's stage (Gribble and Hall 1985).[25] These two settings provide a series of optical effects that are used to identify inclusions and can complement other microscopically observed attributes of a particular mineral such as shape and a crystal's plane of weakness (Nesse 2004; Quinn 2013, 4-6).

Until a few recent studies (Braun 2012, 2015; Striker et al. 2017), ceramic petrography was rarely employed in Iroquoian ceramic analyses and more broadly in North-East Woodland archaeology (Boulanger and Hill 2015; Mitchell 2017; Stoltman 1989). Petrography offers a methodologically congruent way to test my macroscopic paste groupings and elicit further information from raw material collection and processing stages of production. Several archaeologists have employed ceramic petrography to understand changes and continuities of pastes in communities of practices within the context of socially dynamic landscapes (e.g. Eckert 2012; Roddick 2009; Stahl et al. 2008). Stahl et al. (2008) used ceramic petrography as one analytical technique to explore patterning in pastes to

[25] See Appendix B Figure B.1 for the different optical characteristics of PPL and XP light under the microscope.

document continuities and changes in ceramic production, exchange and consumption during the turbulent socio-political times of West Central Ghana. My petrographic study below investigates a similar set of question as Stahl et al. (2008) but with a prioritization on communities of production. I investigate the differences within 'shell' or 'grit' tempering typologies. As such, I explore how paste groups are technical styles tied to potential sources on the landscape, and how choices in paste recipes change or persist through time.

I thin-sectioned representative samples from each paste type (Table 4.4). I followed Miksa and Heidke's (2001, 208-209) sampling suggestions for studies that use a binocular microscope on a larger 'macroscopic' sample and later test these findings through petrographic analysis. This meant that I aimed to thin-section 5% of my macroscopic sample. I reached a 3.5% representation at Christianson and 5.6% at Hamilton by petrographically analysing at least two representative samples for each paste group defined in Figure 4.2. I avoided a 'double-sampling' of the same vessel by using sherds from contexts across each site and if two samples came from the same context, they would be from different paste groups (e.g. a mineral paste versus a shell paste).

Site	**Body Sherds**	**Diagnostics**	**Total Thin-Sections**
CHR	29	5	34
HAM	17	7	24
Total	46	12	58

Table 4.4: Total petrographic sample selected for this study

I utilized whole samples that had a complete profile and intact surface. I thin-sectioned sherds along their vertical plane when the orientation was known. I selected the vertical orientation because more information about forming can be observed (Quinn 2013, 23). Using the sample preparation protocol in Braun (2015, 73-76), I created 0.03mm thin slices of ceramics onto microscope slides with the equipment available at the Laboratory for the Interdisciplinary Research of Archaeological Ceramics (LIRAC) at McMaster University, Sustainable Archaeology at McMaster Innovation Park, and the Brockhouse Institute of Material Sciences. I then analysed thin-sections at LIRAC using a Nikon Eclipse 600 POL microscope in conjunction with digital imaging software (NIS Elements 3.2). I utilized ceramic petrography texts (Quinn 2013; Reedy 2008) and geological atlases (Adams et al. 1984; MacKenzie et al. 1984; MacKenzie and Guilford 1980; Nesse 2004; Yardley et al. 1990) for the analysis.

Qualitative and Semi-Quantitative Methodology

I used Patrick Quinn's (2013) parallel version of Whitbread's (1995) qualitative and semi-quantitative descriptive method for my petrographic analysis. Quinn (2013) adjusts the descriptive terminology that Whitbread initially drew upon from soil micromorphology and he provides a succinct 'guidebook' on the way petrography can inform our archaeological understanding of a variety of ceramic technical practices. With this method, petrographers describe the textures and mineralogy of inclusions, the shape and orientation of voids, and the visual qualities and characteristics of the clay matrix and silt groundmass. These characterizations are aided by multiple forms of visual estimation charts such as an inclusion estimation chart. This method can be an alternative to the quantitative forms of characterization. A quantitative methodology entails a point counting procedure which is generally derived from sedimentology. Some ceramic petrographers highlight the difficulties in obtaining representative point-counts in silty, coarse grained, and poorly sorted ceramics (Braun 2015, 77-78; Mitchell 2017); an issue that can be compounded by practical variables like time. I conducted several pilot studies which showed that the Whitbread (1995) method takes significantly less time compared to point-counting procedures. This descriptive approach recognizes the potential subjectivities in analysis but provides a means of expressing complex petrographic images for the purpose of communicating a variety of information beyond the sedimentological variables of potential temper (Whitbread 1995, 387). Although there is a loss in quantitative rigor required for a statistical analysis, I can still speak to the choices made by past potters, and the mineral constituency of chosen raw material deposits. Therefore, I used the qualitative and semi-quantitative information to note the presence and type of temper, potential forming techniques, clay-type selection, processing and potential mixing, and proximal firing temperatures (Quinn 2013; Reedy 2008).

Petrographic Paste Groups

To test the usefulness and 'truth' of my macroscopic observations, I arranged the thin-sectioned samples into petrographic paste groups. I conducted an initial blind visual assessment of the samples. I did not know which macroscopic paste group each sample derived from. I separated the samples into paste groups through a visual characterization that prioritized patterns such as the volume/abundance of inclusions, minerology, the angularity/roundness and shapes of inclusions, and the degree that inclusions were sorted. I noted this initial grouping, randomized the sample arrangement, and then came back to the samples several days later to repeat the process "blind." I then conducted the thorough qualitative and semi-quantitative analysis and conducted any necessary re-ordering of the paste groups based on the added information. I defined the taxonomies, and the petrographic paste groups came to align with macroscopic pastes, as I defined in Figure 4.2. For a higher ordered classification and to define meaningful potter choices in the heterogeneous petrographic dataset, I later lumped mineral-based recipes into broader pastes defined by their commonalities in minerology, colour and texture. These included Felsic Sand, Felsic Gravel, Intermediate Sand, Intermediate Gravel, Mafic Sand, Mafic Gravel.

Inclusions

I used the Udden-Wentworth scale (Appendix B Table B.1) for delineating inclusion size classes in my petrographic samples. Size can tell petrographers about what might be natural inclusions within the clay, what might be temper, the characteristics of the temper's sediment deposit, and what form of processing created the temper (e.g. crushing coarse-grained rocks; Stoltman 1991). I first recorded inclusions as a percentage of the total field of view and included their size range. I noted how sorted the inclusions in each thin-section were based on this size range. I scored how sorted the inclusions were as either well sorted, moderately sorted, poorly sorted, or very poorly sorted (Appendix B Figure B.2). This can speak to the type of raw material deposit, and when combined with other indicators (such as angularity) can tell petrographers if the temper was crushed.

I then noted the spacing of all the inclusions observed as a whole. Close spaced (grains have points of contact), single spaced (the distance between grains is equal to their mean diameters), double-spaced (the distance between grains is equal to double their mean diameters), open-spaced (the distance between grains is more than double their mean diameters) (Whitbread 1995, 381). I then identified inclusion types (e.g. quartz) and recorded their presence as a percentage of total inclusions. They were classified as dominant 50-70%, Frequent 30-50%, Common 15-30%, Few 5-15%, Very Few 2-5%, Rare 0.5-2%, or Very Rare <0.5% (Quinn 2013, 89-90). I then scored the inclusion shape as either equant (eq) or elongated (el), and the inclusion type roundness as angular (a), subangular (sa), subrounded (sr) or rounded (r) (Quinn 2013, 90; Appendix B Figure B.3). Angularity and shape are important for considering the distance that clastic materials have been transported from their source, the amount of weathering the inclusions experienced, and if inclusions were broken up with force such as crushing (Quinn 2013, 83). I included argillaceous inclusions, such as clay pellets, as part of the inclusion percentage whole and characterized them based on their boundaries, optical density (for clay constituency), concordance/discordance and colour.

I also sorted inclusions into different size fractions, or modes, based on their constituent minerals and rock types. Size fraction classifications of 'fine' and 'coarse' were useful to define the differences in inclusion types which were noticeable above and below 0.2mm in diameter. For example, the vast majority of inclusions below 0.25mm, in the fine fraction, were monocrystalline minerals. A significant difference in minerology between the two size modes can indicate different sources. Angular gabbro rocks in the coarse fraction and rounded quartz in the fine fraction, for example, can indicate a mix of sources constituting this paste. Gabbro does not contain quartz and the different levels of weathering (e.g. one more rounded and equant, other more angular and irregular shaped) would suggest these two inclusions are unlikely to be from the same source. The fine silt fraction typically is a natural constituent of the clay source and a significant mineralogical difference with the coarse fraction can indicate temper from a different deposit was added to the clay (Stoltman 1991). I also noted the orientation of the inclusions as the physical force used to shape the plastic clay can align the inclusions, matrix and voids in particular orientations. This can include, but is not be limited to, a circular alignment of inclusions around a relic coil, the opposing diagonal orientation of inclusions as two coils being blended, or the strong alignment of inclusions to the vessel walls as evidence of paddle and anvil secondary forming (Quinn 2013, 176-181).

The silt "groundmass" can be natural constituents of the clay and be compared among the samples to recognize mineralogical similarities or differences in clay type choices (Whitbread 1995). Clays impact subsequent choices and it coincides with a knowledge of the landscape, in addition to the variety of meanings attached to clay sources (Gosselain and Livingstone-Smith 2005; Roddick and Klarich 2013). This study can also make a modest contribution to the emergent discussion on whether the presence or absence of carbonate inclusions can be an indicator for defining choices on the landscape in Iroquoian ceramics, based on the local geology in a micro-regional approach (Braun 2015, 175-179; Striker et al. 2017). The difficulty in defining these choices is particularly prevalent with the glacially crafted physiography that overlays a rather mineralogically consistent carbonate (e.g. dolostone, limestone) or clastic (e.g. shale) sedimentary bedrock that surround the Christianson and Hamilton sites by at least 150km in all directions (Fisher et al. 1971; Marich 2010; Slucher et al. 2006). This supposed bedrock homogeneity though is countered by a heterogenous glacial till (Chapman and Putnam 1973).

Voids

Void characteristics were recorded as they provide data on the drying and forming stages of pottery manufacture (Quinn 2013, 176-181). I classified voids based on their shapes through descriptions such as channel, vugh, planar, and vesicles (Quinn 2013, 97-99). Thin elongated parallel voids might represent differential shrinkage of wet clay, vesicle-shaped voids can represent bloating pores from gases released during vitrification of the clay matrix (turning to glass at high temperatures), thick planar voids can represent compressive forces on the clay altering channels, and vugh voids can indicate a lack of compressive pressure on the clay body (Quinn 2013, 97-100, 188). The percentage of the surface area taken by voids was recorded and void sizes were described as 'micro' (<0.05mm), 'meso' (0.05-0.5mm), 'macro' (0.5-2mm) and 'mega' (>2mm) (Quinn 2013, 97-98). I then scored the orientation of voids on a range of slight, moderate, or strong alignment with the vessel walls. The orientation of voids can help identify forming techniques. This can include the concentric orientation of a relic coil or the parallel orientation of voids that represent the compressive forces of a primary forming technique like slab building or a secondary forming technique like paddle and anvil (Quinn 2013, 177-181).

Matrix

The matrix refers to the minute <2µm clay mineral crystals of hydrous aluminum silicates that often constitutes most of a ceramic's volume (Quinn 2013, 39, 42). Ceramic petrographers are interested in the clay matrix because its characterized traits can help archaeologists understand the clay source deposit, ceramicists can potentially recognize clay processing techniques (e.g. levigation, clay mixing, degree of kneading), it can be used to understand the technical qualities of the clay (e.g. a highly calcareous matrix will have limespalling risks), and can reveal the technological traits of firing (Quinn 2013, 93-97).

One trait I analysed was the optical activity of the matrix. This represents how much the clay minerals go in and out of extinction (goes from light to dark) when rotating the microscope's stage in crossed polarized light. The optical activity of the matrix in each thin-section was scored as inactive, slight, moderate, and high (Appendix B Figure B.6). Ceramic petrographers can use this variable to reconstruct proximal firing temperatures (Quinn 2013, 94) as sintering and eventual vitrification of the clay matrix leads to a change in birefringence (expression of colour in XP) of its constituent clay minerals (Quinn 2013, 190). When clay particles fuse together and melt, the optical activity of the matrix, seen during stage rotation, is reduced and can be completely anisotropic (opaque) and glassy looking if completely vitrified. Earthenware pottery typically loses its birefringence and optical activity between 800-850°C (Quinn 2013, 191). These values can contribute to a proximal understanding of the firing technological styles between various paste groups and complement oxidation analysis.

4.4: Oxidation Analysis

Step-based oxidation analysis on archaeological sherds can be used to understand changes and continuities in firing technology at the Christianson and Hamilton sites (Beck 2006; Rice 1987). The appearance of shell temper at Neutral sites makes firing temperatures an important attribute to consider in this study, as the risk of limespalling at temperatures above 650°C presents a unique technological aspect of this paste. A low firing temperature (<650°C) can be a method by past potters to accommodate the limespalling issue (Shepard 1985, 83-86).[26] This particular technical knowledge may correlate with a unique firing technology. Therefore, the coalescence or diversity of firing technologies can speak to the possible presence of different learning communities that may or may not exist within and between Christianson and Hamilton sites.

Refiring Ceramics and Temperature

Archaeologists have utilized detailed analytical techniques to understand firing temperatures. These include, but are not limited to, the step-firing approach of magnetic susceptibility (Goodwin and Hollenback 2016; Rasmussen et al. 2012), and long used approaches such as x-ray diffraction, electron spin resonance, and thermal gravimetric analysis (Rice 1987, 426-433). Based on the availability, required expertise, and expense of such techniques, I instead employed the low-cost and destructive approaches of oxidation analysis (Rice 1987, 427) and petrography to provide proximal temperature values in a relativist scale.

Oxidation analysis rests on research that suggests clay colours develop from their chemical and inclusion composition when fired in an oxidizing atmosphere. Colours are largely a result of the iron oxide content and organic matter but colour can also be influenced by the soil mineral constituents, and calcium carbonate material in the clay body (Beck 2006, 97-98). The state of iron oxidation and organic burn off are frozen at the maximum temperature of its initial firing until the ceramic is heated to higher temperatures. This then

[26] Herbert's (2008) experimental construction and firing of shell-tempered pots demonstrated that a low firing temperature (<650°C) ensured a pot's integrity and subsequent serviceability. Similarly, Holterman (2007) found in her experimental study that the majority (11/13) of her shell-tempered test tiles made from Southern Ontario clay remained intact after a low temperature (500°C) kiln firing.

alters the clay's properties further (Rice 1987, 427). These chemical changes can be tracked through changes in colour (specifically hue and chroma) by use of a Munsell colour chart. Experimental studies that fired clay samples and refired archaeological sherds have shown the proximal reliability for colours to change, in an originally oxidized assemblage, beyond the point of the original firing temperature (Mirti 1998). Archaeologists have applied these approaches to approximate the firing temperature of archaeological assemblages (Goodwin and Hollenback 2016; Matson 1971). Although, some archaeologists highlight the proximal nature of step-based firing oxidation analysis and caution about its accuracy for assessing temperature (Goodwin and Hollenback 2016; Rice 1987, 426-428). These cautions are based on the fact that oxidation analysis can be imprecise at measuring initial firing temperature if the sherds were fired in reducing atmospheres, and varying levels of organic matter can mask various iron oxides until the organics are completely eliminated around 750-800°C (Beck 2006, 98; Goodwin and Hollenback 2016, 183; Rice 1987, 427-428).

Refiring Method and Samples

I selected 42 sherds for the refiring test. I previously thin-sectioned 27 of these samples while 15 new samples were chosen for refiring after I collected their attribute data. Half (21) sherds came from the Christianson assemblage and the other half from Hamilton. I selected sherds that were likely constituents of different vessels, and I distinguished this based on their excavation context and paste. McMaster undergraduate student Nicholas Williams fired the sherds to 600°C, and 700°C. He fired the sherds in an electric kiln with an oxidizing atmosphere where the kiln was raised to the desired temperature and let to soak for 45 minutes. After each firing, he took the sherds out to cool and recorded their Munsell colour under natural-light before refiring them at 700°C.

4.5: Methods Summary

In this chapter I provided a set of methodologies and variables of analysis that provide a window into tracking the changes and continuities in technical style through space and time. Iroquoian archaeologists are increasingly utilizing an attribute or micro-variable analysis approach, and this can be more suitable than traditional typological frameworks in certain research circumstances. As such, I can understand the ways socio-demographic processes impact the materialization of communities of practice in the archaeological record at each site. I suggested that sherd refiring tests, fine-grained analysis of motor skills, and ceramic paste analysis provide relevant fine-grained data to this project. In the next chapter, I present the data that these methodologies produced and highlight the key patterns of ceramic production that I observed with the Christianson and Hamilton samples.

Chapter 5: Data and Results

In this chapter, I will analyse pottery production practices, examine how technical styles throughout the operational sequence intertwine or diverge and explore the skill-level of potters. These data allow me to address my three sets of research questions concerning demographic loss, re-arrangements in potting member constituency, and situated contexts of learning. 1) What technical styles defined the communities of practice at each site? How were potting communities impacted by socio-demographic turbulence? How were technical styles rearranged, altered, or maintained through time? 2) Were communities of practice at each village reconfigured and/or reproduced by historical contingencies that acted upon smaller social units of production? As such, is there a spatial patterning to technical styles, are they consistent across each site? How does change and continuity play out at intra-community scales? 3) Did the broader turbulent conditions of the 17th century lead to alterations in embodied skills and technical knowledge of Neutral communities of practice? How does skill vary within and between Christianson and Hamilton?

I employ my entire data-set of attributes, petrography, and sherd refiring data to investigate the entire manufacturing sequence at both sites for my first question. I prioritize my paste findings to contextualize the distinct emergence of shell-temper within the broader repertoire of local potting communities. I follow with an examination and comparison of forming techniques, vessel forms, surface finishing, decoration, and firing. I then explore the spatial and temporal trends of particular practices within each site to explore my second question. Due to previous excavation strategies, site-level assessments, artifact cataloguing by past archaeologists, and the general patterns of deposition in Iroquoian villages, I cannot explore intra-site temporal patterns other than with two small middens at Christianson. With a limited cross-site sample of diagnostic vessels, I prioritized paste data and surface body finish attributes. The spatial patterning of these attributes can underscore the potential historical contingencies that altered technical styles amongst communities of potters at each village. For my third question, I draw upon multiple attributes and decorative width coefficients of variation to score 'skillfulness' in embodied knowledge along with technical expertise. I conclude the chapter with a summary of my findings and their significance for understanding the ways ceramic operational chains may have been reconfigured and the ways learning conditions changed amongst Neutral communities of potters during the turbulent 17th century.

5.1: Production Styles

5.1.1: Raw Material Choices

Lennox and Fitzgerald (1990) identify the shift towards shell-tempered pastes as one of the most profound changes in potting practice in the Proto-Early Contact-era across the Neutral Iroquoian Confederacy. I utilize this patterning as a point of entry to develop our archaeological understanding of what constitutes these paste typologies such as "grit" and "shell," and to investigate the variability within each category. I utilize macroscopic and petrographic analyses to define paste types, compare their frequencies at each site, and provide a proximal connection of paste styles to features on the landscape. In my analysis I assume that the physical proximity of the sites to each other (5km away) afforded similar sets of raw materials to potters in each village based on a shared geology (Barnett et al. 1991; Chapman and Putnam 1973; Marich 2010).

I distinguished two different classes of inclusions based on their size. These included the 'coarse fraction' and 'fine-fraction.' I distinguished these classes at 0.25mm, where I categorized inclusions larger than this size as part of the "coarse fraction."[27] I prioritized the

[27] Petrographers generally distinguish these two classes of inclusions based on their size, with the fine-fraction composed of a silt-sized (<60 µm) "groundmass" (Whitbread 1995, 365-395) but I extended the observed homogeneity of mineral types from the silt groundmass to rounded and equant fine sands (<0.25mm; Stoltman 1991).

examination of this latter inclusion class as I could investigate its constituency with macroscopic and petrographic analyses while the fine fraction is limited to microscopy. I can use the coarse-fraction to define the technical styles of temper selection and processing as this class of constituencies in the ceramic body is generally added as temper, while the smaller fine-fraction inclusions are usually natural to the clay (Stoltman 1991, 109-110).[28] These two classes would thus likely have independent geologic origins.[29] As such, I can couple these findings with the geological literature to provide a preliminary assessment on the materialization of these communities of practice in relation to their choices of deposit-types on the landscape.

In this section I utilized paste groupings for both sites based on colour, texture, and broad inclusion type (as I outlined in section 4.3.1). I defined colour as felsic (light), intermediate (medium), or mafic (dark) and texture as sand (<2mm) or gravel (>2mm). I defined shell as its own category for its distinct inclusion type. I distinguished grit (mineral)-based pastes as Felsic Sand, Felsic Gravel, Intermediate Sand, Intermediate Gravel, Mafic Sand, or Mafic Gravel. I distinguished the mixed (shell & mineral) categories as Mixed 1 (Shell and Felsic Sand) and Mixed 2 (Shell and Intermediate Gravel).[30] I found these higher order groupings showed more meaningful patterning in the ceramic dataset compared to my

[28] Potters are generally unable to separate the silt-sized inclusions from the clay matrix as they can suspend in water with clay particles during levigation (Braun 2015, 78-79), making these aplastic inclusions natural constituents of the clay. Levigation is a clay processing technique that involves "mixing the clay with water and allowing coarse particles to wash and settle out of the suspension" (Rice 1987, 118). I also identify clay pellets as natural phenomena in the clay body. They are likely to be present in the clay even after sieving or levigation due to their clay minerals constituency (Quinn 2013, 156, 171).
[29] Alternatively, the perceivable 'added' temper can be part of a deliberate choice of 'self-tempered' boulder clays (sedimentary clay deposits left by actions of glaciers).
[30] See Appendix A Figure series A.7 & A.8 for macroscopic assignments and reference examples of each colour and texture paste grouping at each site. See Appendix A Figure A.9 for petrographic summary and reference examples of each colour and texture paste grouping.

finer paste categories (seen in Figure 4.2).[31] This lumping not only serves to represent my identification of broader mineralogical constituencies (e.g. Table 4.2) but it might also be the discriminating factor in Iroquoian potters choosing raw materials, as colour might have been their proxy for perceived qualities of cobbles, gravels, or sands (section 4.3.1).

Christianson Pastes

Christianson pastes included Felsic Gravel, Felsic Sand, Intermediate Gravel, Intermediate Sand, Mafic Gravel, Shell, and Mixed 1. My petrographic assessment of all pastes showed an inclusion volume between 15-50%. Felsic Gravel represents the lowest inclusion volume consistently around 10-35%. Pastes with high inclusion densities were the sandy pastes (Felsic Sand and Intermediate Sand) which had densities around 25-50%. The texture of grit pastes ranged from very coarse (e.g. Intermediate Gravel and Mafic Gravel) to fine (commonly Felsic Sand). Felsic Gravel and Intermediate Sand scored along medium and coarse textures. The Shell-temper paste ranged in textures from fine (e.g. max shell size 2.9mm) to coarse (max shell size 3.5mm), indicating a range between fine to minimal crushing actions. The largest shell inclusion I found in all of the macroscopic samples at Christianson was 9mm long. Mixed 1 was generally coarse to very coarse with a larger constituency of shell and maximum shell inclusions were around 4.8mm. A small number of Shell-tempered sherds had laminar pot markings on the surface or within the cores, indicating that shell occasionally leeched or fell out during use or deposition (Appendix A Figure A.14).[32]

[31] Appendix A Figure A.7 and A.8 provide macroscopic representations and definitions of each. Appendix A Table A.3 and A.4 provides the frequency for these finer paste groupings.

[32] Shell leeching appears to be common across cultural contexts. Boulanger and Hill (2015, 522) note shell leeching from a mid-17th century Western New Hampshire village and J. Graves (1984, 180) notes a similar finding at the contemporary Sandusky Tradition Indian Hills site.

Here I define the inclusion texture of Christianson coarse-fraction values, those inclusions larger than silt and likely to be temper. I distinguished sands by their texture from gravels but both size-classes often contained similar minerals to their colour-class counterparts. Inclusions in sand pastes were more weathered, having a higher frequency of rounded and equant inclusions, a greater level of sorting, and contained a higher percentage of monocrystalline inclusions. However, not all sands were highly rounded, and this can be accounted for by their potential glacial origins. Thus, potters potentially added sand deposits to the clay with some to no grinding. This distinguishes sands from gravels as, from all colour classes, gravels were poorly sorted, irregular in shape, had sub-angular to angular edges. This indicates potters crushed medium-coarse grained rocks or selected these gravels from angular and poorly sorted glacially derived granule (<4mm) deposits.

Here I define the inclusion constituency of Christianson coarse-fraction values. Macroscopically, grit recipes are dominated by mixtures of pinks, translucents, opaques, gold (mica), and blacks/browns. My petrographic assessment of the paste groups (Table 5.1) revealed the mineralogy and texture of the patterning behind my macroscopic findings. Broadly, all the mineral-based pastes category represented a routinized choice of medium to coarse-grained plutonic igneous and metamorphic rocks and sands. I classified the mineralogy of most rocks according to plutonic definitions (Appendix B Figure B.7), but this should not rule out the possibility that I underrepresented their metamorphic counterparts.[33]

[33] For example, it was difficult to identify the difference between metamorphic gneiss and their coarse-grained plutonic counterparts due to the small lithic sizes under thin-section. Gneisses tend to have a weak and uneven distribution of foliated streaks of hornblende or micas (Reedy 2008, 85) and this grain orientation quality is useful for distinguishing gneisses from similar plutonic rocks. A coarse-grained rock that is generally less than 4mm in thin-section may have a limited number of minerals available to identify these characteristic patterns. Coarse-grained rocks are defined by having crystals >5mm while minerals of medium grained rocks are 1-5mm (MacKenzie et al. 1984).

Paste	Largest Grain[a]	Volume %	Angularity	Shape[b]	Primary Inclusion	Secondary Inclusion	Tertiary Inclusion	Clay Pellet[c]	Calcite/ Carbonate, %[d]	Sorting
Felsic Sand	2.23	20	a-sa	eq & el	Quartz	Syeno-Monzogranite	Microcline	CP1; CP3	-	Moderate
	1.41	15-20	sa-sr	eq & el	syeno-monzo granite	Quartz	Microcline	CP2	Carb.; 0.5-2	Moderate
	2.62	35-40	a-sr	eq & el	Quartz	Pyroxene gneiss/schist	Biotite Granite	CP2	-	Poor
	1.57	30-40	sa-sr	eq & el	Medium grained Quartz syenite	Orthoclase	Microcline	CP2	-	Moderate
	1.71	25	sa-r	eq	Medium grained gneiss	Quartz	Orthoclase	CP 2	-	Moderate
	3.61	20	a	el & eq	Alkali feldspar granite - Syeno granite	Orthoclase	Quartz	CP1; CP2	-	Poor
	1.59	45-50	sa-sr	eq & el	Biotite quartz syenite	Orthoclase	Quatz	CP1	-	Strong
Felsic Gravel	3.08	20	a-sa	eq & el	Granite	Biotite	Plagioclase	CP3	Carb.: <1	Poor
	3.92	25-35	a-sa	el & eq	Orthoclase	Biotite alkali feldspar syenite - syenite	Quartz	CP2	-	V. Poor
	2.93	15	a-sa	eq & el	Quartz syenite-syeno granite	Orthoclase	Plagioclase	CP2; CP3	-	Moderate
	2.89	15	a-sa	eq & el	Syenite	Biotite	Plagioclase	CP2	Carb; 0.5-2	Strong
	3.11	10-15	a-sa	el	Syeno-granite	Orthoclase	biotite	-	-	Poor
	2.07	20-25	a-sa	eq & el	Monzonite-Quartz Monzonite	Biotite	Grog	CP1; CP2; CP3	-	Poor
Intermediate Sand	2.07	25	a-r	eq & el	Biotite syeno-granite	Biotite	Quartz	CP1; CP2	-	Strong
	1.45	35	a-sr	eq & el	Quartz	Granite/Gneiss	Biotite	CP2	-	Poor
Intermediate Gravel	3.17	15	a-sr	eq & el	Biotite quartz syenite - quartz monzonite	Biotite	Orthoclase	CP1	-	V. Poor
	3.4	30	a-sr	eq & el	Olivine biotite monzonite	Orthoclase	Biotite	CP1	-	Poor
	3	30	a-sa	eq & el	Hornblende granite	Quartz	Biotite	CP1	-	V. Poor
	4.49	15-20	a-sa	eq & el	Biotite and amphibole quartz monzonite	Biotite	Microcline	CP1	-	V. Poor
	3.02	35-40	a-sa	eq & el	Hornblende alkali feldspar granite	Quartz	Hornblende	CP2	Carb.; 0.5-2	Poor
	4.5	20-30	a-sr	el & eq	Schistose sillimanite biotite gneiss	Biotite	Plagioclase	CP2; CP3	-	V. Poor
	2.3	15-20	a-sr	eq & el	Orthoclase	Syeno-granite	Quartz	CP2; CP3; Poss grog	Carb.; 0.5-2	Poor
	2.12	35	a-sr	eq & el	Medium grained biotite syenite	Biotite	Orthoclase	CP2	-	Poor
	3.05	35-40	a-sa	el & el	Biotite alkali feldspar granite	Orthoclase	Quartz	CP2	-	V. Poor
Mafic Gravel	2.7	30-35	a-sa	el & eq	Hornblende quartz monzodiorite	Hornblende	Plagioclase	CP1	-	Poor
	3.95	30	a-sa	eq & el	Amphibolite facies schist / amphibolite	Syeno-granite gneiss	Plagioclase	CP2	-	V. Poor
	3.94	35-40	a-sr	eq & el	Intermediate syeno-granite	Orthoclase	Amphibolite	CP1	-	V. Poor
	3.77	20-25	a-sa	eq & el	Biotite Quartz alkali feldspar syenite	Orthoclase	Quartz	CP2	-	Poor
	3.54	40	a-sa	eq	Amphibolite	Hornblende/Amphibole	Plagioclase	CP1	Carb.; 0.5-2	Poor
	2.6	25	a-sa	el & eq	Hornblende alkali feldspar granite	Orthoclase	Quartz	CP2 CP2/grog	-	Poor
Shell	2.234	30-35	a-r	el & eq	Shell	Quartz	Plagioclase	CP1; CP2	Bleb: 0.5-2	Poor
	3.49	25-35	a-sr	el & eq	Shell	Quartz	Siltstone	CP1	Carb. 0.5-2	Poor
	2.9	20-25	sa-r	el & eq	Shell	Grog	Quartz	CP1; CP2	Calcite; 0.5-2	Moderate
	3.45	40-45	sa-sr	el & eq	Shell	Quartz	Orthoclase	CP2; CP3	Carb/calcite; 2-5	V. Poor
Shell & Felsic Sand: Mixed 1	4.59	25-35	a-sr	el & eq	Shell	Quartz	Alkali feldspars	CP1; CP2; CP3	-	Poor
	4.24	35-40	a-sa	eq & el	Shell	Quartz syenite	Alkali feldspars	CP1; CP2	-	Poor
	4.84	30-35	a-sr	el & eq	Shell	Alkali feldspars	Quartz-alkali feldspar syenite	CP2; CP3/grog	-	V. Poor

Table 5.1: Summary of Christianson petrographic analysis of paste groups. N=37
(a): Value in millimetres; (b): eq=equant, el=elongated, arranged as predominant shape first; (c): Clay pellet types, refer to Appendix A Figure A.13; (d): carb=carbonate

Feldspars were the most abundant felsic mineral type (in monocrystalline form or as mineral constituents of lithics) among Felsic Sand, Felsic Gravel, Intermediate Sand, and Intermediate Gravel. This included orthoclase, with lesser amounts of microcline followed by plagioclase. Quartz was common but not as abundant as orthoclase. On the mineralogical tri-plot heuristic (Appendix B Figure B.7), most of the medium-coarse grained plutonic igneous rocks plotted near the potassium (K) feldspar bottom left and the majority of rocks were below 50% constitution of plagioclase or quartz. This regimental use of high K-feldspar rock types, with the occasional higher quartz selections (moving into granitic categories) and the lack of plagioclase-rich rock tempers can indicate either a deliberate selection strategy as part of broader routinization in rock-temper choices, a consistency in using certain sediment deposits, or the availability of certain rocks on the landscape. I found that variation between felsic and intermediate pastes (in either texture class, sand vs. gravel) in the assemblages are based on the frequency of mafic inclusions.

Intermediate Gravel and Intermediate Sand contained a higher abundance of platy and dark-coloured minerals than their felsic counterparts (Table 5.1). These dark minerals were dominated by biotite, hornblende, amphibole, with the occasional presence of olivine and chlorite. However, their mineral constituencies along the quartz to feldspar triplot placed them along similar rock-type definitions to felsic pastes that are only differentiated through these mafic minerals. Christianson's Intermediate Gravel and Felsic Gravel provide a cursory example as Intermediate Gravel contained biotite syenites-monzonites while Felsic Gravel also contained syenites-monzonites which were not rich in biotite or other mafic minerals. This creates some "blurring" between intermediate and felsic categories that are not always clear in parsing out the difference between potter choices or the natural heterogeneity in sediments/rocks. Some sections of a deposit may contain more mafic grains, or there can be an uneven distribution of minerals within a crushed rock, where the potter ends up using the more mafic grained rich section (making it intermediate) yet it still comes from same parent rock. Christianson's Mafic Gravel was more distinguishable in mineral constituencies. They generally contained higher concentrations of plagioclase, amphibole, and biotite, often constituted by amphibolite, a mafic metamorphic rock (Table 5.1).

Shell-temper appears as platy (long, thin, and sheet-like) greyish inclusions in thin-section (Appendix A Figure A.5). Shell is very poorly sorted as in all thin-sections where the smallest fraction of shell includes very fine sand and coarse silt sizes (0.125-0.031mm). Although I defined the Shell paste by a single deliberately added inclusion type, this recipe also includes small amounts of well-rounded fine sand-sized quartz. These background inclusions are likely natural constituents of the clay body. The Mixed 1 paste contains the same platy shell inclusions as well as felsic sands. I observed macroscopically that they contain an abundance of pinks (usually K-feldspars, occasional quartz) which congruently patterns out petrographically with microcline and orthoclase. Shell remains the dominant coarse-grained constituent (50-70%) of this paste, with quartz syenites, quartz, and alkali feldspars taking up to 30% of the coarse-grained volume. These rocks and minerals are a similar constituency of Felsic Sand (Table 5.1), and they similarly range from round to angular, indicating a partial grinding of sands or the selection of sands from a glacially formed deposit.

My petrographic analysis also discovered grog (crushed ceramic) in four Christianson samples (e.g. Appendix A Figure A.10). This means that 10.8% of my samples contained grog. I cannot accurately extrapolate this pattern to my macroscopic observations as grog looks analogous to clay pellets, which are present in a significant number of samples. The similarities between grog and the clay can also easily obscure macroscopic observations.[34] As such, I did not identify grog macroscopically and did not include them in paste categories. I found grog in samples of Christianson's Felsic Gravel, Intermediate Gravel (Appendix A Figure A.12) and two of my Shell paste samples (Appendix A Figure A.11). The density of grog appeared within 5-20% of the coarse fraction volume while one sample had a minimal presence of around 2%. Therefore, grog does not appear to have been considered suitable as a sole tempering agent.

[34] Grog appears to come from similarly coloured clay-types and were likely made in low-temperature firing conditions with a mix of firing atmospheres typical of Iroquoian ceramics (see section 5.2.6). Pieces of grog initially fired in reducing conditions can be macroscopically indistinguishable in a reduced core (e.g. Appendix A Figure A.11, A.12). However, grog can be identified microscopically by their irregular and angular shapes and by surrounding voids, that form when the plastic clay matrix dries and pulls away from the aplastic grog inclusions.

Archaeologists found grog in only one other sample of Ontario Iroquoian ceramics (a pipe) and examples are generally rare across the Northeast (Braun 2015). The rare example consists of Rieth and Horton's (2010) study where they macroscopically identified grog-only tempered vessels represented 13.9% of the ceramic vessel assemblage at an Iroquoian village in Onondaga County, New York dating within A.D. 1300-1450. The practice was common in the Mississippi Valley during the Middle Woodland - Early Mississippian (A.D. 0-1200) and the Mississippianized period (e.g. 1050-1550 Moundville) of the Southeast (Feathers 2006; Steponaitis 1983). The rarity of grog in Iroquoian contexts is interesting as it is easily accessible, with broken pieces of pottery common in middens or hearths. Moreover, there are functional advantages, as the angularity of grog adds strength to the vessel and grog has the most comparable coefficient of thermal expansion to the clay body (being composed of fired clay), providing thermal stress resistance (Rice 1987, 75, 229; Rye 1976).

Hamilton Pastes

Hamilton pastes included Felsic Gravel, Felsic Sand, Intermediate Gravel, Intermediate Sand, Mafic Gravel, Mafic Sand, Shell, Mixed 1 and Mixed 2. My petrographic assessment (Table 5.2) of Hamilton samples shows an inclusion volume range of 15-60%. Pastes with the highest density were generally sand-based and this includes the Felsic Sand and Mafic Sand pastes. Their volumes were around 20-60%. The texture of pastes ranged from very coarse (e.g. Mafic Gravel) to fine (e.g. Intermediate Sand and Felsic Sand). The majority of pastes had medium to coarse textures (e.g. Felsic Gravel, Intermediate Gravel, occasionally Mafic Sand and Felsic Sand). Shell showed a range from a very coarse to medium texture. Shell ranges in size based on the amount of crushing, with maximum inclusion sizes ranging from 2-4.3mm in the thin-sectioned samples, and the largest shell inclusion I observed macroscopically was 10.6mm long. Mixed 1 and Mixed 2 pastes are slightly coarser than Shell with a higher maximum grain size and higher density ranging from 20-40%.

Paste	Largest Grain[a]	Volume %	Angularity	Shape[b]	Primary Inclusion	Secondary Inclusion	Tertiary Inclusion	Clay Pellet[C]	Calcite/ Carbonate, %[d]	Sorting
Felsic Sand	1.66	30-35	sa-sr	eq	Medium grained biotite syenite	Microcline	Orthoclase	CP2/Poss grog	-	Moderate
	1.78	45-60	a-sr	eq & el	Quartz monzonite/gneiss	Biotitic quartz alkali feldspar syenite	Microcline	CP1; CP3	-	Moderate
	1.56	15	a-sr	eq & el	Felsic syeno-granite	Orthoclase	Quartz	CP2; CP3	-	Moderate
	2.54	20-25	a-sr	eq & el	Felsic alkali feldspar granite	Orthoclase	Quartz	CP2; Poss grog	-	Moderate
Felsic Gravel	2.9	30-40	a-sa	eq & el	Syeno-granite/gneiss	Orthoclase	Quartz	CP1	-	V. Poor
	3.05	20-35	a-sr	eq & el	Amphibole granite/gneiss	Orthoclase	Quartz	CP2; Poss grog	-	Poor
	2.7	25-30	a-sa	eq & el	Biotite Syeno-monzo granite	Orthoclase	Plagioclase	CP1; CP2	-	Moderate
	2.7	25	a-sa	el & eq	Felsic quartz syenite-quartz monzonite/gneiss	Plagioclase	Orthoclase	CP1; CP3	-	Moderate
Intermediate Sands	2.07	15-20	a-sa	eq & el	Hornblende syeno-granite	Schist	Microcline	CP1; CP2; CP3	-	Poor
	2.47	30	a-sa	eq & el	Biotite monzo-granite	Quartz	Orthoclase	CP1	-	Poor
Intermediate Gravel	2.5	25-30	a-sr	eq & el	Quartz alkali feldspar syenite - syeno granite	Biotite	Hornblende	CP3	-	Moderate
	3.2	35	a-sr	eq & el	Amphibolite	Hornblende	Plagioclase	CP2	-	Poor
	3.1	25-30	a-sr	eq & el	Hornblende syeno-granite/gneiss	Orthoclase	Quartz	CP2	-	Poor
Mafic Sand	1.63	30-40	sa-sr	eq & el	Medium grain amphibolite	Hornblende	Quartz	CP2	-	Strong
Mafic Gravel	3.64	30-40	a-sr	eq & el	Biotitic quartz syenite gneiss	Biotite	Orthoclase	CP1; CP3/ Poss grog	-	Poor
	3.13	25-35	a	el & eq	Biotitic quartz monzo-diorite	Plagioclase	Orthoclase	CP1; CP3; Poss grog	-	Poor
Shell	2.04	20-30	sa-r	el & eq	Shell	Orthoclase	Quartz	CP2; CP3	Calcite; 0.5-2	Moderate
	4.24	20-30	sa-r	el & eq	Shell	Quartz	Orthoclase	CP2; CP3	-	V. Poor
	4.3	25-30	sa	el	Shell	Quartz	Orthoclase	CP1; CP3/Poss grog	Calcite; 1-4	Poor
Shell & Felsic Sand: Mixed 1	3.67	30-40	a-sa	el & eq	Shell	Orthoclase	Plagioclase	CP1; CP2; CP3	-	Poor
	3.44	20-25	a-sa	el & eq	Shell	Quartz	Orthoclase	CP2; CP3	-	Poor
Shell & Intermediate gravel: Mixed 2	1.8	25	a-sa	el & eq	Hornblende quartz syenite	Shell	Hornblende	CP2; CP3	Carb. 0.5-2	Poor
	3.53	25-35	a-r	el & eq	Biotite schist	Shell	Orthoclase	CP2; CP3: 2-5	Carb. 0.5-2	Poor
	3.83	30-35	a-sr	el & eq	Shell	Biotite alkali feldspar granite	Biotite	CP2; CP3	Carb. 0.5-2; calcite: 0.5-2	Poor

Table 5.2: Summary of Hamilton petrographic analysis of paste groups. n=24 (a): Value in millimetres; (b): eq=equant, el=elongated, arranged as predominant shape first; (c): Clay pellet types, refer to Appendix A Figure A.13; (d): carb=carbonate

Here I define the inclusion types of Hamilton sherds' coarse-fraction values. I found in my macroscopic observations of minerals in 'grit-only' pastes and in shell & grit (mixed) pastes that there were pinks, translucents, opaques, golds (mica), and blacks/browns inclusions, just like in Christianson pastes. In my petrographic assessment of Hamilton sherds (Table 5.2) I also found that each broad class (grit, shell, grit & shell) contained a similar set of inclusion constituencies to the Christianson samples. Grit also includes medium to coarse-grained plutonic igneous and metamorphic rocks, as well as sands. Alkali feldspars (e.g. orthoclase and microcline) with lesser amounts (always below 50%) of quartz similarly dominated rock types and monocrystalline inclusions. Plagioclase-rich rocks are also uncommon in these tempers, but there is a slight increased presence of plagioclase with a higher frequency of monzo-granites, quartz monzonites, and monzonites in comparison to Christianson (Table 5.1). Sands and gravels were also distinguished by their textures, as they contained similar mineralogies to gravels. For example, felsic grit pastes such as the Felsic Sand and Felsic Gravel both are constituted by granites, syenites, or gneisses with sand textures possessing a higher presence of these rock's mineral types but as monocrystalline constituents. Thus, I distinguished sands from gravels by their size, higher representation of monocrystalline inclusions, a higher percentage of equant shapes, more rounded edges, and greater levels of sorting. I found the mineralogical distinctions of Hamilton's Intermediate Gravel, Intermediate Sand, Mafic Gravel, and Mafic Sand followed along the same patterning as I described in my overview of Christianson pastes.

Shell & grit categories represent a mix of minerals used in grit pastes and of the same (or similar) type of crushed shell used in the Shell paste. I suggest the two mixed pastes are meaningfully separated as they contain distinctive grit inclusions. Macroscopically, Mixed 1's mineral inclusions are dominated by medium-sized, equant shaped pinks and translucents that I defined as felsic sand. With ceramic petrography, I found that Mixed 1's mineral inclusions consisted of monocrystalline alkali feldspars and quartz.[35] Macroscopically, Mixed 2 is dominated by coarse, angular and irregular shaped micas, pinks and blacks that I defined as intermediate gravels. With my petrographic analysis, I found that Mixed 2's mineral inclusions consisted of schist, granite, or quartz syenites rich in biotite and/or hornblende. I did not identify this combination of minerals in a 'mixed' paste at Christianson. This mineralogy of the grit component in Mixed 2 is identical to recipes I defined as Intermediate Gravel at Christianson and Hamilton. The angularity, irregular shapes, and poor sorting of

[35] The macroscopic similarities between Hamilton's and Christianson's Mixed 1 can be seen between Appendix A Figure A.7 Paste 11 and Figure A.8 Paste 2.

mineral and rock inclusions in Mixed 2 (Table 5.2) suggest potters crushed the inclusions or that gravel sources were naturally angular and poorly sorted. I did not identify grog at Hamilton. Six thin-sections appeared to have plastic (clay-derived) inclusion types that were potentially grog but did not meet the entire suite of requirements to distinguish them from the clay matrix or from argillaceous inclusions.

Raw Material Production Styles and Paste Frequencies at Christianson and Hamilton

I suggest that the mineralogical differences between the coarse and fine fractions, the general angularity of the coarse fraction, and the irregular shapes of the coarse fraction (Table 5.1, 5.2) demonstrate that potters fabricated the majority of paste groups at both sites through the deliberate addition of temper. Crushed shell-temper from Christianson to Hamilton remained rather consistent with its range of textures (outline above) and its platy laminated composition under thin-section. Bivalve clams of the genus *Elliptio* represent most of the invertebrates in Christianson's, and Hamilton's faunal assemblage (Stewart 2000, 105) and environmental researchers state the genus *Elliptio* (particularly the species *dilatate*) is one of the most common freshwater mussels in Southern Ontario.[36] Although I cannot make a direct connection between availability and use, there are physical features that show comparable visual qualities with shell-temper and the freshwater mussels found at Christianson and Hamilton (See Appendix A Figure A.4). I would require alternative techniques to accurately and precisely identify species.[37]

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[36] Invertebrates (mostly bivalves) represent 14.5% and 3.2% of the faunal assemblages respectively at the Christianson and Hamilton sites (Stewart 2000, 94).

[37] Michelaki (2007, 148-149) proposed marine shell (e.g. whelk shell from the Atlantic coast) as a possible alternative source as part of the emergent interior trade routes (Section 1.3). This would be an expensive use of cultural capital, and likely insufficient to produce the number of ceramics needed in a year but may be symbolically and ritually powerful for the few vessels that incorporated marine shell (Hamell 1987, 1992).

The frequencies of paste types at each site can speak to the degree of variability versus regimentation of paste choices within a community of practice's existence at each site and define the distinctions or continuities in technical choices of these Neutral potting communities through socio-demographic turbulence. Christianson pastes were dominated by mineral (grit) inclusion types at 83.68%, followed by Shell at 14.14%, and Mixed 1 at 2.18%. Figure 5.1 provides a distribution along the colour-texture heuristic categories for grit pastes. I found felsic inclusions broadly represented 44.2%, intermediate at 42.1%, and mafic at 13.7% of the Christianson samples. The frequency of Hamilton pastes changes in several ways. Shell represents a significant percentage with 53.4% of the sample's total. The umbrella grit pastes constituted 33.86%, Mixed 1 was 6.14%, and Mixed 2 was 6.82%. Figure 5.2 provides a distribution along the colour-texture heuristic categories for grit pastes. Broadly, I found felsic inclusions composed 49.7%, intermediate pastes were 31.3%, and mafic paste were 19%.

At both sites, Felsic Sand and Felsic Gravel, together as felsic-coloured minerals, were dominant among grit paste types. Intermediate Gravel changed the most (-11.3%) from Christianson to Hamilton and Hamilton possessed the additional colour-textural paste, Mafic Sand. While there may be a symbolic reason for such shifts towards lighter colours (Braun 2015, Hamell 1992), such connections require additional contexts and other lines of evidence we currently lack at these sites. Otherwise, there is a slight change within a general continuity in the mineral-based pastes potters used through time. As such, these frequencies coupled with the utilization of coarse-medium grained plutonic and metamorphic rocks and sands suggests a routinization within a conceptual "grit" category for communities of practice at both sites, that these raw materials were considered as useful or even "legitimate" for recipes, and that potters continued to utilize similar sediment types through time. However, there were profound changes in paste choices with the significant adoption of shell temper at Hamilton (+39.3% more than CHR).

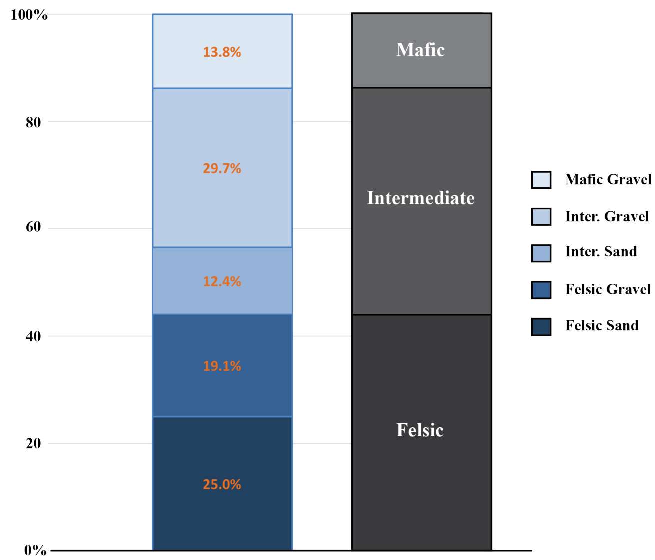

Figure 5.1: Christianson grit paste percentages and colour class percentages. N=805

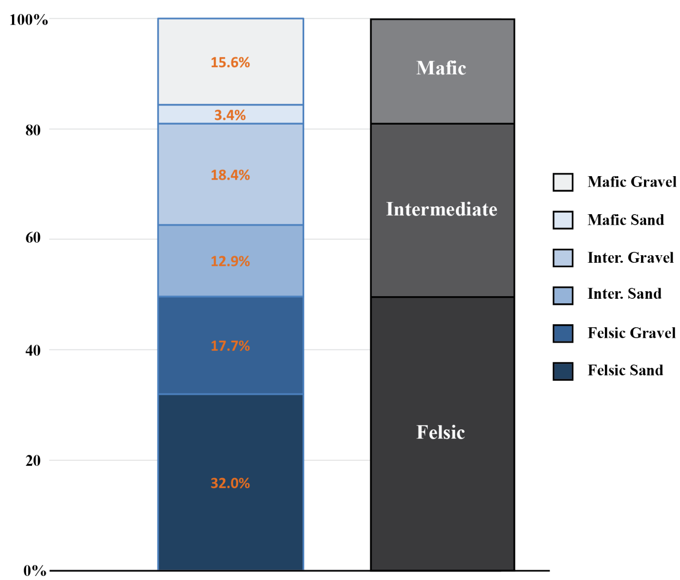

Figure 5.2: Hamilton paste percentages and grit colour class percentages. N=147

Fine Fraction

My petrographic samples of Christianson and Hamilton sherds all contained a similar set of boundaries within the fine-fraction constituency. Potters used similar types of clays across all pastes. The groundmass constituted between 5-50% of the total volume taken by aplastic inclusions. This wide range indicated some clays were quite silty while others were fine textured and clay-rich. The groundmass of both sites contains quartz or orthoclase that are mostly silt sized but also include a few a grains of rounded and equant fine sand.

Groundmass Class	Christianson		Hamilton	
5-15%	n=13	40.6%	n=8	33.3%
16-25%	n=10	31.3%	n=9	37.5%
26-35%	n=4	12.5%	n=4	16.7%
36-50%	n=5	15.6%	n=3	12.5%
Total	32		24	

Table 5.3: Silt inclusion percentages.

I created four different inclusion percentage classes for groundmass volume for comparison between the two sites. Table 5.3 shows most samples had a small percentage of silt (>25% silt). This might mean that potters utilized high clay-mineral content clays and/or may have used techniques such as sieving and levigation to remove larger non-clay inclusions and in the processes led to a small loss in the silt-fraction. These silt percentages also remained relatively consistent through time. The small percentage differences (<8%) within each class between the two sites is likely insignificant due to the small sample size and the qualitative nature of the analysis.

5.1.2: Raw Materials and the Landscape

This study does not attempt to characterize particular raw material deposits, but there are proximal indicators for the general geological contexts used by potter at these sites. Choices in ceramic raw materials can be tracked to types of features on the Flamborough landscape to understated initial stages of the operational sequence and define the boundaries of production styles. In addition, tracking the connection of technological styles to the landscape can help archaeologists understand the continuities and discontinuities of communities of practice through their socio-technical relationship to available sets of deposits (Gosselain and Livingstone Smith 2005; Roddick and Klarich 2013).

Coarse Fraction: Sand, Gravels, Shell, and Glacial Physiography

The lithic constituency of the coarse fraction at both sites is incongruent with the local bedrock, which includes dolostone and limestone. Limestone rocks are also interspersed as clasts in each site's surrounding Wentworth and Halton Till (Figure 3.1; Karrow 1987, 38, 42). Limestone and dolostone would have been available around the exposed bedrock (Figure 3.1; Chapman and Putnam 1973, 203) or even available in some glacial gravels that dragged down carbonate bedrock formations south of the Precambrian Canadian Shield. Neither was recovered in my samples, despite its potential for pottery.[38] Calcium carbonate rocks are peculiarly absent from Iroquoian sites more broadly.[39]This might indicate a proscription away from carbonate rocks or a greater weight of legitimacy towards other temper types.

The mineral and rock types composing the coarse fraction grit pastes at both sites suggest a strong association to a glacially formed physiography. Glacial deposits in Flamborough would contain Precambrian felsic, intermediate, and mafic plutonic, migmatite, and metamorphic rocks that were dragged down from glacial events in the late Pleistocene (Chapman and Putnam 1973; Ontario Geological Survey 1991). Pastes with a 'sand' texture could have come from glaciolacustrine deposits that form much of the centre and South-West of the Norfolk Sand plain (Figure 3.1, 3.3). As these deposits experienced greater weathering

[38] For instance, potters throughout the central United States during the Late Woodland (ca. A.D. 400-1000) utilized limestone temper (Church and Nass 2002; Hoard et al. 1995, 823-824). Based on this wide usage, Hoard et al. (1995) applied experimental work on a variety of tempers and found limestone had a high degree of thermal shock resistance because calcite (the mineral constituent of limestone) has a low thermal expansion coefficient and has a better fracture strength than quartz. These benefits come from a vessel fired around or below 600ºC, to avoid limespalling.

[39] I note this absence of carbonate rocks from macroscopic (Chilton 1998; Holterman 2007; Martelle 2002; Schumacher 2013) and petrographic studies (Braun 2012, 2015; Holterman 2007 Appendix 3 Petrographic Report by Gregory Braun). Although, Striker et al. (2017) found the rare occurrence of limestone temper at the 16th century Mantle site.

from their geologic history, they would possess a similar minerology to ‘sand-textured’ pastes and have a similar texture of rounded equant inclusions (Karrow 1987; Marich 2010, 10-11). Potters could have created pastes with ‘gravel-textures’ from glaciofluvial deposits concentrated to the east and northeast of these Neutral sites (Figure 3.1; Marich 2010). The coarse, angular, and poorly sorted nature of these glaciofluvial deposits (Karrow 1987; Marich 2010, 10-11) can correlate the similar set of textures I found in ‘gravel-textured’ pastes (of all colour classes; Table 5.1, 5.2). Among the glaciofluvial deposits, eskers and kames would be distinct and accessible raw material sources on the landscape. Respectively, they present as sinuous discontinuous ridges or as a set of mounds and linear ridges (Karrow 1987, 21; Marich 2010, 23).[40]

Without species identification, I cannot extrapolate patterns in shell-temper beyond broad associations. Shell-temper may have involved different patterns of material acquisition due to its association with stream and riverine systems. Although there is a general continuity in faunal usage at Neutral sites from the mid 16th to mid 17th centuries, the Hamilton site’s contemporaneous satellite hamlet, Bogle II, contained a high percentage of invertebrates at 20.8% of the faunal assemblage (Lennox 1984a; Stewart 2000, 111-113). To Stewart (2000, 113), the Bogle II hamlet may have been used to collect shell from the adjacent Bronte Creek as a main supplemental activity and the site is only a few hundred metres east of Hamilton. Hydrological variability and climate can affect the particular species makeup of a water system (Di Maio and Corkum 1995; Metcalfe-Smith et al. 2000; Minke-Martin et al. 2012) providing potential avenues for future provenance assessments.

Fine Fraction and Matrix

[40] Outwash gravels are also scattered across the central Norfolk Sand plan and lesser amounts in Wentworth Till and could be exposed along the extensive drainage system (Karrow 1987, Figure 3.1).

I found clay pellets to be natural constituents (Quinn 2013, 156, 171) in sherd samples from the two sites (Appendix A Figure A.13). Iron-rich clay pellets are present in all the sherd samples, suggesting they are natural across various sediment contexts. The distribution of calcareous clay pellets with 6/37 (16%) at Christianson and 14/24 (58%) at Hamilton may suggest some overlap and divergence in clay sources.[41] A significant number of thin-sectioned sherds contain trace amounts of plagioclase, chlorite, small iron opaque minerals in their groundmass (<15%). Calcium carbonates such as calcite, were rare in the thin-section samples. When present, I found they exhibited no greater than 2% of the aplastic constituency in either the fine or coarse fraction. As such, potters likely did not use residual clays from the carbonate bedrock or from subsoil clays of the highly calcareous Wentworth and Halton Tills (Barnett 1991; Chapman and Putnam 1973). This means potters could have also used residual clays from the Queenston shale formation[42] or from glacially formed clays (Chapman and Putnam 1973; Karrow 1987; Rutka and Vos 1993).[43]

Summary of Raw Materials

The technical styles of mineral-based recipes did not change considerably through time and are rather regimented along a set of paste heuristic types (e.g. Felsic Sand, Intermediate Gravel etc.). There appears to be a strong continuity in the constituency of my colour-texture paste types for grit-based recipes and only a slight change in paste type frequency from the Christianson to Hamilton site. Potters seem to have exploited glacially

[41] However, post-depositional processes in calcareous soils and the redistribution of calcite within and into the clay, particularly with shell-tempered sherds, may alter this frequency and reliability of calcareous clay pellets as a natural constituency of the raw clay source (Quinn 2013, 204-210).
[42] Studies on Queenston formation shale for brick, tile and sewer pipe industries show these clays possess little to no carbonates. In an assessment of Queenston formation residual clay in Aldershot, Hamilton, Guillet's (1977, 57) found that among his 9 samples, carbonate minerals composed less that 5% of aplastics in most of his samples and 3 samples contained 0% carbonates.
[43] Glaciolacustrine deposits contain stratified to varved clays and silts (Chapman and Putnam 1973; Marich 2010). These deposits are scattered to the South-East and East of Christianson (Karrow 1987; Figure 3.1). Although geologists did not examine their mineral composition, these deep-water deposits of glacial lakes might contain less local bedrock mineral types due to their geological history.

derived sediments on the landscape for tempers and perhaps occasionally for clays. The Shell paste also appears to be consistent through time but the relationship to shell species and the landscape are not entirely clear. Mixed 1, Mixed 2, and the rare thin-sections with grog appear to have a mixture of grit and shell patterning. With the general continuity of mineral-based recipes, I lump the colour-texture paste types into an overarching "grit" category in the rest of this chapter to provide meaningful correlations with other attribute expressions in comparison to the distinct Shell, Mixed 1, and Mixed 2 pastes.

5.1.3: Forming Techniques

After potters create their paste, the next step in their operational sequence would be to form the vessel. Potters can employ primary forming techniques such as pinching, slab building, and coil building that can be worked further with secondary forming techniques such as paddle and anvil (Shepard 1987, 54-64). Establishing these techniques through particular variables can be crucial in determining varying production styles. In this section I examine forming techniques through breakage and fracture patterns, inclusion and void orientation, and surface markings (Rice 1987, 124-144; Rye 1981, 68-84). This assessment is limited, as some of these variables overlap between forming techniques and can be obliterated by secondary forming actions.

Compressional Forces in Forming

Here I examine the shape and orientation of voids (in thin-section) and the orientation of coarse-fraction inclusions (macroscopically and in thin-section) to assess the types of force potters applied to the clay body. This variable can indicate a set of potential forming techniques but can be ambiguous with some overlap in orientation expression (Rice 1987;

Rye 1981; Shepard 1985). I apply this patterning in the ceramic data to assess the possible presence of techniques such as coiling, paddle and anvil, and pinching/slab building.[44]

With my petrographic data, I found that 88.9% of voids in my Christianson samples contained a moderate to strong orientation to the margins of the vessel walls, suggesting a paddle and anvil secondary technique, and/or slab building (Quinn 2013, 177) for the majority of sherds. This is compared to 11.1% of samples that shows slight to no alignment, suggesting a possible use of pinching and drawing, or of a weak use of force with other techniques (Quinn 2013, 177). The slight to no orientation included three Grit and one Shell sample while the moderate to strong included all paste groups. In my Hamilton samples, I identified all void alignments to be within moderate to strong. In addition, out of all of my samples (both sites), the thin-sections all include elongate shaped voids which were dominated by planar voids.[45] These voids come from drying stress and/or compressional forces (Quinn 2013, 176-177, 188-189).

Shell, Mixed 1, and Mixed 2 thin-sections at both sites contained a moderate to strong inclusion orientation. In my macroscopic analysis, Christianson's Mixed 1 paste had 70% of its inclusions aligned in a moderate-strong pattern, Shell had 90.7% in this orientation, while Grit pastes had 32.9% at a slight orientation and the rest (61.9%) was 'random.' I found a similar pattern at Hamilton, with the Shell paste at 87.8% moderate to strong orientation, Mixed 2 at 33.3% moderate to strong, 60% slight and 6.7% random, Mixed 1 at 66.7% moderate to strong, 33.3% slight, and Grit with 2.8% moderate, 40.6% slight, and 56.6% random. I connect the higher incidence of weak or random alignment of Grit inclusions to their occasional equant shapes that lack a long-axes, as this feature impedes a visual

[44] Iroquoian ceramics are suitable for identifying compressional forces due to coarse and occasionally elongate inclusion shapes along with an abundance of voids (Quinn 2013, 176).
[45] Planar voids are elongate in shape with parallel walls and end in a point (Quinn 2013, 97-99).

observation and any visual quality of "alignment" (Quinn 2013, 176). The orientation of sherds within their original vessel's context was also not always clear. The strong pattern of alignment of inclusions with a long axis further suggest these communities of practice produced pottery with paddle and anvil, and/or slab building techniques, while the presence of 'random' alignment can represent pinching. However, distinct orientations in some sherds and distinct breakage patterns in the next three sections suggest potters likely did not use slab building and that additional evidence for pinching is ambiguous.

Coiling

The majority of my macroscopic observations were of 'unknown' forming type, partially a product of the unclear orientation of body sherds. I did identify 39 samples at Christianson that contained proximal diagnostic traits of a forming technique and at Hamilton I identified 81. The first identification involved concentric inclusions clearly indicating relic coils. At Christianson I found 4/38 possessed relic coils and were all located on the shoulder to rim section of the vessel. This is similar to Hamilton where I identified seven coil samples and four were on the shoulder to rim. At Christianson, coiling was evenly distributed between Grit (n=2) and Shell (n=2) paste samples. At Hamilton, relic coils were present with Grit (n=3/39), Mixed 1 (n=1), Mixed 2 (n= 2), and Shell (n=6). It is possible that these delicate parts of the vessel, with specific contours and flaring angles, may have made it difficult for potters to obliterate coiling with secondary forming techniques and/or surface finishing.

I petrographically analyzed a few of these sherds with macroscopically identified relic coils and also found distinctive relic coil patterns under the light-polarizing microscope in additional samples. These patterns involved a concentric ring of inclusions or voids around the centre of the matrix, illustrating the force applied while rolling the clay. Relic coils also represent joining points, where potters blend the coils. I found these points of reference through inclusions and voids that were aligned in two diametric diagonal orientations, one going towards the exterior and the other towards the interior (Rice 1987, 67, 128; Quinn 2013, 177). I identified relic coils in the neck and shoulder areas (three at Christianson, one at Hamilton), around the rim (two at Hamilton and one at Christianson) and at the body (one at Christianson and one at Hamilton).

Paddle and Anvil

The rest of the macroscopic indicators of forming techniques involved laminar fractures or cracking (Appendix B Figure B.10). At Christianson this represented 34 samples. For Grit pastes, 20 exhibited laminar fracturing, three for Mixed 1, and 11 for Shell. At Hamilton 21 Grit sherds exhibited laminar fracturing, 5 for Mixed 1, one for Mixed 2, and 39 for Shell. This laminar splitting is typical of coil manufacturing combined with the paddle and anvil (Rye 1981, 84-85). Rice (1987, 137) suggests paddle and anvil is commonly associated with coil manufacturing in various cultures. The laminal fractures and relic coils suggest paddle and anvil was used over coil or 'slabbed coil' pots and this appears to be equally applied to all paste types. However, there is a possible overrepresentation of shell in laminar fracturing patterns as ceramic bodies of platy flat inclusions pastes are weakest along the orientation in which the inclusions align, leading to a pattern of sherds crumbling in layers (Rice 1987, 74).

Pinching/Slab Building

Identifying pinching or slab building during my analysis was difficult. Although the unpredictable and jagged ways in which slab built or pinching vessels break can act as a proximal diagnostic (Rye 1981, 70), it is possible that intensive and effective use of secondary techniques can obliterate coils and slab fillets in such a way to create similar breakage patterns (Shepard 1985, 184). In whichever primary forming technique was more widely used by these potters, the compressional forces and laminar fractures suggest these communities of potters routinely used paddle and anvil as the dominant secondary forming technique at each site and across all paste types. Paddle and anvil is generally congruent with broad understandings of the Late Ontario Iroquoian period (ca. Post 1400), where most vessel forming included a paddle and anvil (Ferris and Spence 1995, 91).

5.1.4: Surface Finishing Practices

After forming the vessel, potters tend to finish the surface in some manner when the clay is still plastic or when it has dried to a leather hard state (Shepard 1985, 65) and different technical styles can be employed at this stage. This finishing can be done to obliterate indications of forming features (e.g. smooth over coils), can make a vessel more suitable for an intended use (Rice 1987, 231-232), or for the aesthetic qualities of the surface (Shepard 1985, 66-67). Implementation of a particular surface finishing can involve preferred tool types and a shared set tools is one 'way of doing' that can align potters in a mutual set of values and identity (Gosselain 2000, 189, 2008, 75-76; Roddick 2016, 138). This can be added through the gestures and motions of surface finish application, reflecting the embodiment of particular motions when learning these practices (Roddick 2016, 137-138). Archaeologists have employed surface finishings as indicators of, and degrees of, 'foreign influences' in Neutral Iroquoian sites (Lennox and Fitzgerald 1990, 417-419; Poulton et al. 1996, 42-43); in other words, distinct production styles.

I identified eight different surface finishing techniques at the two sites. These include plain/smooth, burnish, wiped, cord roughened, smoothed/burnished over cord, ribbed paddle, smoothed/burnished over ribbed paddle, and scarified. Cord roughened represents the application of pressure from a cord-wrapped-paddle which leaves parallel 'twine-like' impressions (Lennox 1977, 66). Ribbed paddle represents the application of pressure into the clay body with either a grooved paddle or by a thong-wrapped paddle which leaves distinct parallel grooves (Fitzgerald 1981, 102). Smoothed-over-cord and smoothed-over-ribbed involves some smoothing work afterwards but is defined on a broad and rather consistent application of smoothing across the surface, indicating it was likely an intentional act rather than an unintentional smoothing from handling or being set down while the clay is plastic (Lennox 1977, 66). Some sherds display some attempt at smoothing over the cord or ribbed impressions from either wiping the clay with hands, a smooth soft fabric, or with minimal compressive force from a flat paddle while other surfaces exhibit a 'shiny' appearance from partial burnishing actions (likely from a polished stone) when the clay is leather-hard or dryer. The differences between these levels of additional smoothing or burnishing are not entirely clear but, in each case, potters did not obliterate the remnants of the corded or paddled appearance. Plain/smoothed refers to a consistent regular texture on the surface with a matte appearance which was made either by potters wiping the clay with their hands or a soft smooth fabric (Holterman 2007, 198). While wiping appears to be the use of a coarser fabric or material, leaving striations across the surface. Burnishing involves the use of a hard and smooth tool such as a smooth stone on the clays surface with repeated strokes, aligning the clay in a particular direction and creating a lustrous appearance (Roddick 2009, 194). Plain/smoothed, wiped, and burnish may potentially obliterate previous treatments such as cording, but their classification represents no signs of these earlier applications (Fitzgerald 1981, 102). Scarified represents a "roughly scratched surface" that was "scraped with a handful of twigs or reeds" (Holterman 2007, 198).

I found that the vast majority of sherd interiors were smoothed or burnished at the Christianson (n=883 interior surfaces) and Hamilton (n=396) sites, with less than 0.75% at each site representing combination of either wiped, cord roughened, and scarified. This pattern might result from potters making vessels for cooking, storage, water holding, or broad container usage in Iroquoian societies (Braun 2012), with the likely addition of resin or fat layers in the interior after firing the vessel to reduce permeability (Arnold 1985, 140; Braun 2015, 145, 151-159). At both sites, most necks and rims/collars of the vessel were either smoothed or burnished, with only two sherds at Hamilton showing corded applications on the neck. Table 5.4 shows that most diagnostic sections of the vessel at both sites were burnished or smoothed with horizontal motions. The percentages show a strong continuity in bodily movements in these exterior surface finishing practices. Table 5.4 shows there was greater variability in finishing the interior, likely as potters may have a different positioning when finishing the interior but horizontal directions still predominate with a general continuity between the sites as well. At both sites, cord-based finishes tended to be vertically applied with lesser frequencies of diagonal applications.[46] Ribbed applications tended to be horizontal, analogous to Lennox's (1977, 81) observations for the Hamilton site. However, I could not discern the orientation of most body sherds and could only account for it if a portion of the body was still attached or articulated to a diagnostic (e.g. shoulder, neck, rim).

Site	Exterior Direction Finish			Interior Direction Finish		
	Horizontal	Horizontal & vertical	Vertical	Horizontal	Horizontal & vertical	Vertical
Christianson	94.5%	4%	1.5%	88.1%	9.1%	2.8%
Hamilton	93.8%	4.3%	1.9%	91.5%	7.8%	0.7%

Table 5.4: Percentages of surface finish orientation on the shoulder to rim. Sample, CHR n=200; HAM n=161

Plain/smooth and burnishing were the most common techniques found on body sherds at Christianson with a lesser amount of corded paddle and a small fraction of ribbed paddle (Table 5.5). Hamilton represents a significant decrease in plain/smooth techniques with a significant increase of cording and a small increase of ribbed paddle. At both sites, the

[46] For images of a vertical cord application, see Figure 5.7 drawing (a) and 5.8 drawing (a). For a diagonal application see Figure 5.8 drawing (k).

smoothed-over-cord variation is dominant within the two cord-paddle based finishes, representing 70% of all corded exterior surfaces at Hamilton and 75% at Christianson. Skibo (2013, 49-52) suggests that roughening a vessel's surface creates greater thermal shock resistance, making a more successful cooking pot. However, these smoothing-over techniques for corded and ribbed paddle reduce this rough texture and may diminish these proposed benefits, highlighting the possibility that technical functionality may not be the sole variable driving this practice.

Finishing Technique	**Christianson**		**Hamilton**	
	Sherd count	**%**	**Sherd Count**	**%**
Plain/smooth	422	60.5%	55	21.6
wiped	9	1.3	-	-
Cord rough	30	4.3	41	16.1
Smoothed/burnish over cord	89	12.8	95	37.2
Ribbed paddle	10	1.4	11	4.3
Smoothed/burnished over ribbed	9	1.3	15	5.9
Scarified	7	1	3	1.2
Burnish	121	17.4	35	13.7
Total	**697**	**100%**	**255**	**100%**

Table 5.5: Body surface finishing. Eroded samples include 37 at CHR and 6 at HAM.

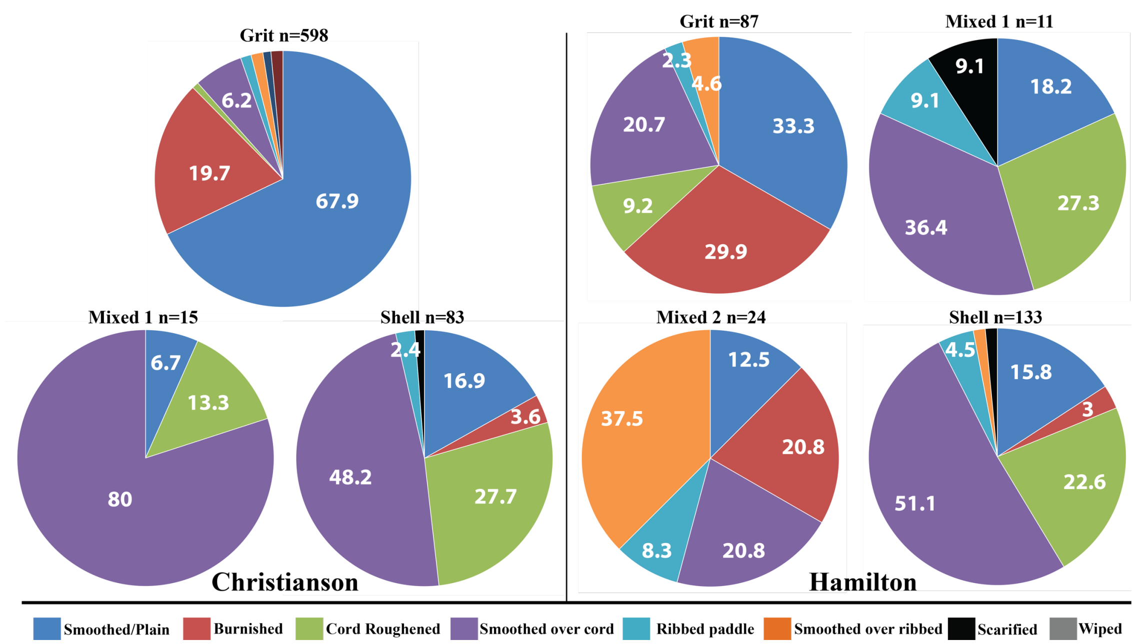

Figure 5.3: Paste to exterior body finish. Values as percentages of total paste class.

Figure 5.3 shows that there is a strong correlation of surface finishing types to paste types at both sites. Smoothing and burnishing are strongly associated with Grit recipes, taking up a combined 87.6% at Christianson and 63.2% at Hamilton. Potters predominately finished Shell paste pots with corded-based techniques, showing the same dominance of smoothed-over-cord and occasional use smoothed and burnishing finishes at Christianson and Hamilton. This strong pattern of connecting Grit to smoothing or burnishing and Shell to cording is congruent with the correlation identified by Fitzgerald (1981, 103-111) and Lennox (1977, 67) in their studies of the sites.

Figure 5.3 also illustrates a broader variability in surface treatments for certain pastes through time. The Grit category diversified in surface finishes at Hamilton, indicating greater variability in choices associated with these pastes. There is also some overlap at both sites, where smoothing and burnishing do appear as >18% in the Shell paste, suggesting that these recipes did not necessarily always define or constrain the next steps in production. Paste Mixed 2 at Hamilton shows the highest value of ribbed paddle techniques, representing a combined 45.8% of the paste. The general heterogeneity in finishes for the Mixed 2 paste suggests the potters experimenting with this paste may have also had a diversified preference in tool and or aesthetics in the creation of these vessels. Mixed 1 has a similar breakdown of cord-roughening treatments, plain/smoothing, and burnishing techniques with their shell-only counterparts at both sites. The addition of felsic sands to create this paste did not define these vessel types as distinct at this stage of the operation sequence from Shell in contrast to paste Mixed 2.

<u>5.1.5: Vessel Forms and Microstyles</u>

In the following section, I examine the vessel forms potters made at the sites. I explore whether communities of practice created a set of distinct forms or where there might be a general variability in micro-styles. These findings allow me to consider innovation and exchange in salient styles and consider potential influences brought in by newcomers. I could not identify all the forms outlined in Section 1.3 (Figure 1.4) as certain specialty styles such as jars and double mouthed vessels can be mistaken for the more common vessel types. The assemblage was also fragmentary, making form identification difficult. However, some previous archaeologists and students working on these assemblages articulated and glued many sherds together, providing a select but valuable insight into some forms present at these sites.

The majority of vessels appear to come from globular squat vessels with constricting necks, round or elliptical mouths, are either collared or collarless, and occasionally have rim projections called castellations. I found that variability amongst these globular vessels was based on the vessel size (diameter and correlating volume), the height of the neck, the rim profiles, and patterns of collars. Some specialty forms were also present at these sites.

Diameter

Some researchers employed ethno-historical texts to suggest Iroquoian societies conceptualized pottery into at least two distinct use-size classes (Engelbrecht 2003, 84) and in the 18th century Iroquoians had different nouns for each class (Allen 1992, 139).[47] This pattern underscores the socio-technical quality of this attribute, which I will define at both sites. I can then assess the possible transformations in size class values in communities of potters into the more turbulent conditions of Hamilton's occupation.

Based on the distribution of diameter sizes, I divided vessels into four size classes. There was a significant overlap and spread of frequencies on a continuum across most of the diameters between twelve to forty centimeters (Figure 5.4). Therefore, the class division was

[47] Researchers suggest there was a small size class for individual usage while a larger class was for communal usage (Martelle 2002, 185). While ethno-historic accounts suggest the presence of these two (or more) classes, Braun (2010) suggests there were 3 size-use classes at the mid-13th century Antrex site, while Martelle (2002) suggests there are four in Proto-Contact and Contact-era Wendat communities.

partially arbitrary, but I based the divisions near the 3rd quartile of diameters, where 50% of diameter measurements clustered around 17-30cm at both sites. I also based these divisions on Iroquoian research from other temporal phases and socio-political units (e.g. Wendat, Haudenosaunee) that define 2-5 size and use classes (Allen 1992; Braun 2012, Engelbrecht 2003, 84-85; Martelle 2002, 214-246, 747).

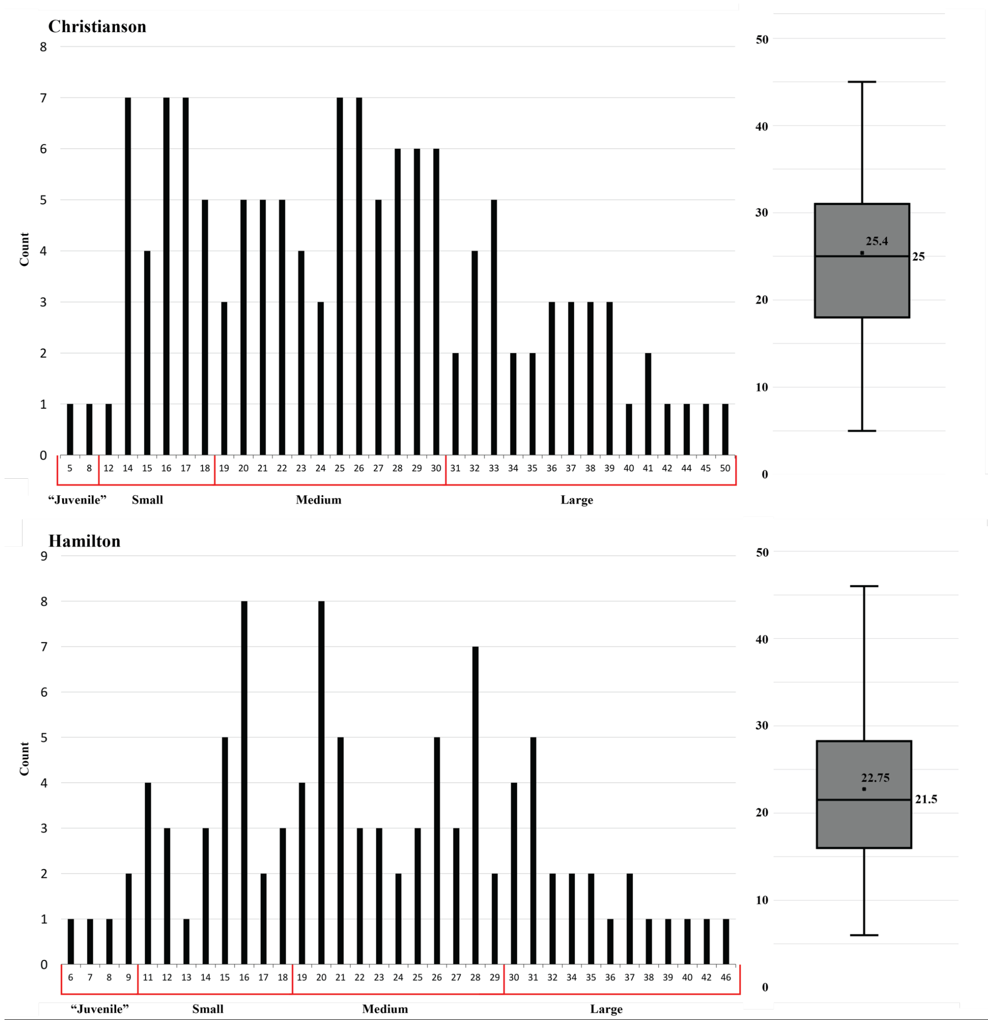

Figure 5.4: Diameter frequencies. Sample, CHR n=129; Ham n=102.

I defined the first size class as a very small (<10cm) class of irregularly shaped vessels that Iroquoian archaeologists define as “juvenile vessels” or as Martelle (2002) defined as ‘cups’ for Wendat assemblages (Figure 5.6). At Christianson, this vessel class constituted 1.6% of the assemblage and 4.9% at Hamilton. I defined the next vessel type as a 'small vessel' and this class has a diameter of 11-17cm (Figure 5.7). At Christianson the small vessel class constituted 24% of the assemblage and 28.4% at Hamilton. I defined the medium vessel class as 18-29/30cm (Figure 5.8). This was the most abundant class at 48.1% of Christianson's sample and 44.1% for Hamilton's. The 'large' class, with a diameter >30cm (Figure 5.9), represented 26.3% of Christianson's assemblage and 22.5% of Hamilton's. There is significant overlap between the two sites and no size category is distinguished by an increase or decrease of greater than 5% of its proportional frequency. The average diameter was also similar (Figure 5.4) with Hamilton having a slighter smaller average diameter at 22.75 cm, but this might be accounted for by the higher sample number of 'Juvenile' vessels at the site. This broader pattern suggests that size and possible use classes were somewhat consistent between the sites, and not a point of variance across space and time.

Neck Heights and Collar Heights

I examine the neck heights[48] and collar heights to further define ceramic practices at each site as these attributes represent a point of variance in vessel morphology for Iroquoian societies through space and time (Finlayson 1998; Fitzgerald 2007; Martelle 2002). Neck heights can constitute distinct shapes in vessel form (e.g. examples in Figure 1.4). Collar heights can represent distinct technical styles in a community of practice as they are a stylistic element added to pottery that archaeologists generally agree is not tied to function or use (Hart and Engelbrecht 2012, 330-332).

At Christianson, neck heights (n=66) ranged from 7.8-75.4mm, 3rd quartile ranged from 16-33.7mm and had an average of 27.1mm. At Hamilton, neck heights (n=59) ranged from 11-80mm, 3rd quartile ranged from 19-44mm and averaged at 33.1mm. Neck heights did

[48] Neck height represents the distance between the point of inflection (the part that connects the rim to the body) and the top of the rim.

correspond with vessel sizes, with the average height rising with size class at both sites.[49] The increase of neck heights among all paste groups in Table 5.6 reflects the slight stylistic change from Christianson to Hamilton as they created more elongated forms above the shoulder. Shell-tempered vessels at both sites are, on average, made with higher and more elongated neck forms than their Grit counterparts. Christianson exhibits a distinctly higher height in its Shell paste vessels and Figure 5.8 (medium) ceramic drawing (i) illustrates an example. Hamilton Mixed 2 pastes have the highest neck heights, but the small sample size (n=7) for this category might account for its discrepancy.

Paste	**Christianson**		**Hamilton**	
	Average	3rd quartile	Average	3rd quartile
Grit	26.3mm	16-29.85	29.9	17-34.4
Shell	30.94	16-41.5	31.6	19.6-41.3
Mixed 1	-	-	27.8	16.5-42.9
Mixed 2	-	-	37.6	21.6-46.7

Table 5.6: Neck heights to paste. Values in millimetres (mm). Shell neck heights are higher on average and heights increase at the Hamilton site.

Archaeologists typically employed the presence of collars to define ceramics as 'Iroquoian' (Hart and Engelbrecht 2012, 324, 330; MacNeish 1952) but collars at these sites do not take up a majority share of vessel rims. At Christianson (n=155), 53.6% of rim sherds were collarless and 46.4% collared. While at Hamilton (n=114), 45.6% of rims did not have collars and 54.4% of rims did. Table 5.7 shows that Grit tempered vessels were relatively split in the application or absence of collaring at Christianson while at Hamilton Grit tempered sherds had a greater percentage of collars. Shell tempered vessels were almost all collarless at Christianson, highlighting a clustering of attributes. While at Hamilton, Shell pastes were relatively split. This means the presence and absence of collars appear to

[49] Neck height averages per vessel size category: Christians first, Hamilton second: Juvenile, 16.7mm and 17mm. Small, 18.8mm and 23.3mm. Medium 27.8mm and 34.2mm. Large, 38.1mm and 54.8mm.

inconsistently coalesce through time as Grit in Hamilton appears to go towards 'traditional' Iroquoian connections between Grit and collars while Shell appears to go towards a brokering in of forming collars at the rim.

Collar	Christianson			Hamilton			
	Grit	Mixed	Shell	Grit	Mixed 1	Mixed 2	Shell
Absent	45.4%	100%	95.8%	20.6%	55.6%	-	53.25%
Present	54.6%	-	4.2%	79.4%	44.4%	100%	46.75%
Percent	100%	100%	100%	100%	100%	100%	100%
Sample	130	1	24	34	9	3	77

Table 5.7: Collar presence frequencies to paste.

The thickness of collars at Christianson range from 5.6-15.5mm with an average of 9.3mm while at Hamilton collar thicknesses range from 3.3-20mm with an average of 8.4mm. Hamilton collars are on average thinner than those at Christianson. I also measured the collar heights. At Christianson (n=71), collars ranged from 4.8-33mm with a 3rd quartile range of 7.84-14.5mm and an average height at 11.7mm. At Hamilton (n=66), collars ranged from 4.5-73.5mm with a 3rd quartile range of 11.3-24.8mm and an average height at 22.5mm. As such, potters at Hamilton created vessels with taller collars on average, with an almost 100% increase in average height in comparison to Christianson.

Rim Type	Range	3rd quartile	Average	Sample
Convex Rim	11-73.2mm	21.5-53.4mm	39.3mm	18
Other Rim Types	4.5-67.8mm	9.5-20mm	17.4mm	46

Table 5.8: Hamilton site collar heights to rim category. Juvenile vessels are not included

Table 5.8 illustrates the connection between collar heights and rim profile classes (outlined in next section) at the Hamilton site. Convex rim types have a strong connection to high collars and may influence the overall increase of collar height between Christianson and Hamilton. Convex rim vessels were composed of Grit (8.3%), Shell (79.2%), Mixed 1 (8.3%) and Mixed 2 (4.2%). While the rest of Hamilton's rim types combined breakdown in paste as

Grit (31.4%), Shell (60.8%), Mixed 1 (5.9%) and Mixed 2 (2%). Therefore, convex rims with high collars appear to be an additional stylistic component of the Hamilton site that is closely associated with Shell temper practices but does show some overlap in operational sequences with smaller proportions of Grit and the mixed categories.

Profiles

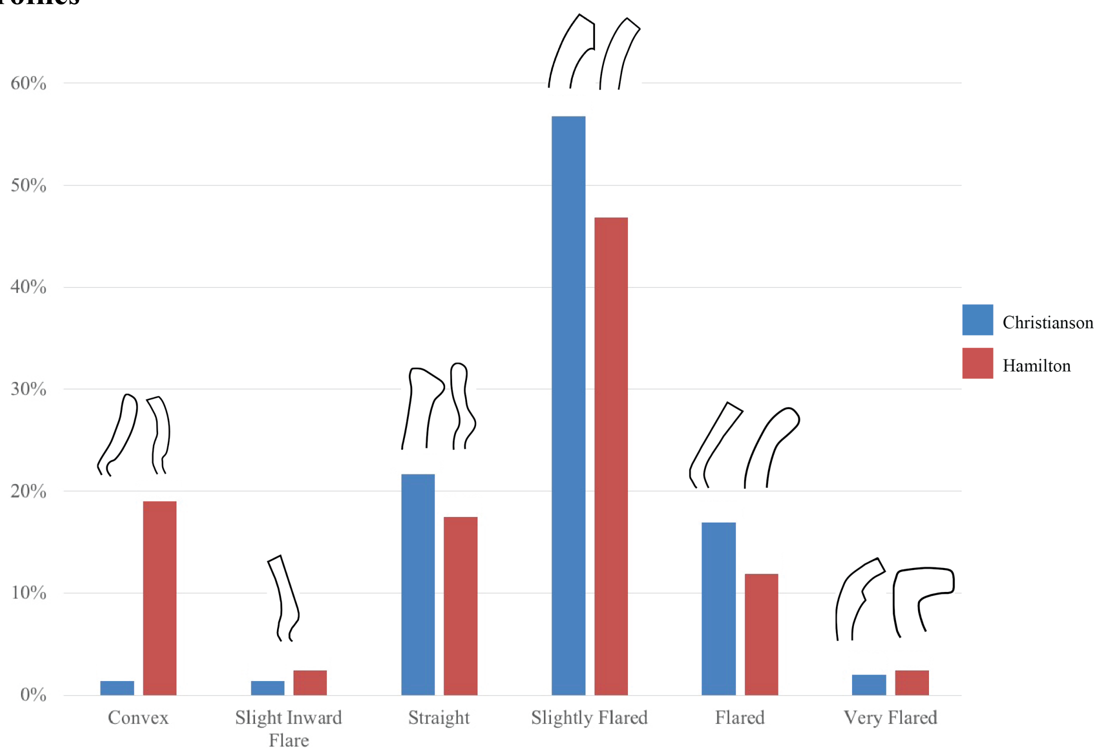

Figure 5.5: Rim angle percentages of site's assemblage, with select examples. Refer to Appendix B Table B.19-20 for full examples. Christianson n=148; Hamilton n=126.

I found there was a significant diversity of rim profiles at both sites. This was a product of potters mixing rim angles, collars, collarless, and the fattening, expansion, or eversion of lips. I identified a total of 28 different profiles (Appendix B Table B.19) with potters creating 20 of these profiles at Christianson and 24 at Hamilton. This shows a slight increase in the variability at the upper portion of vessel but there is a significant diversity at both sites. To differentiate these profiles into meaningful classes, I defined new categories on the angle of rim expressions whereby I assume that collaring or lip modifications are secondary alterations. I lumped rim profiles together by prioritizing the angle from which the rim meets the neck. This included straight (80-94º), slightly flared (79-65º), flared (65-46º), very flared (<45º), and slightly inward flare (>94º). I also included another rim category that was defined by its unique convex rim shape on the exterior that included straight to slightly flared angles. Figure 5.5 and Table 5.9 show that slightly flared rims dominate both sites among all paste types but the collection of straight to flared rims constituted a significant majority at 95.3% of Christianson's assemblage (n=148) and 76.2% of Hamilton's (n=126).

Profile Type	Christianson			Hamilton			
	Grit	Mixed 1	Shell	Grit	Mixed 1	Mixed 2	Shell
Convex	1.6%	-	-	5.9%	25%	33.3%	23.5%
Slight inward flare	1.6%	-	-	2.9%	-	-	2.5%
Straight	24.6%	-	8%	11.8%	-	-	22.2%
Slightly Flared	58.2%	-	52%	52.9%	75%	66.7%	40.7%
Flared	13.1%	100%	32%	20.6%	-	-	9.9%
Very Flared	0.8%	-	8%	5.9%	-	-	1.2%
Sample	122	1	25	34	8	3	81

Table 5.9: Frequency of rim profile among each paste type. Shell at CHR has a closer connection to flared & very flared while Girt has this connection at Hamilton.

Profile Type	Juvenile		Small		Medium		Large	
	CHR	**HAM**	**CHR**	**HAM**	**CHR**	**HAM**	**CHR**	**HAM**
Convex	-	-	7.7	15.4	-	18	-	38.9
Slight inward flare	-	-	-	3.85	3.1	2	-	-
Straight	-	20	11.5	15.4	21.9	12	27.3	22.2
Slightly flared	50	40	50	50	64.1	54	63.6	27.8
Flared	50	40	23.1	11.5	10.9	10	9.1	11.1
Very Flared	-	-	7.7	3.85	-	4	-	-
Sample	2	5	26	26	64	50	33	18

Table 5.10: Rim categories to vessel size classes at Christianson and Hamilton. Note the greater variation within most size classes at Hamilton.

Table 5.9 shows that Shell has a greater frequency of flared to very flared profiles and Grit is slightly more variable at Christianson while at Hamilton Shell is more variable and Grit has a greater frequency of flared to very flared. This pattern provides an additional differentiation between Shell and Grit composed vessels at Christianson as seen in an example of Figure 5.7 drawing (a).

Table 5.10 shows that I found a broad expression of rim angle classes across the vessel size categories at both sites. This suggests that potters generally manufactured rim profiles of various sizes (e.g. see Figures 5.6, 5.7, 5.8 and 5.9). Some size classes expressed greater variability than others. For example, Christianson's small-size vessels possessed greater rim variation within that site and Hamilton's small and medium-sized vessels were the most diverse. However, larger vessels (Figure 5.9) were generally more consistent with a smaller range of rim type at both sites, but Hamilton still possessed a greater distribution of rim angle types than Christianson.

Many vessels also contained accessory attributes and forms which I defined as "specialty." These include handles, pegs/feet, and stemmed/chalice vessels (Figure 5.10) that occasionally occur in rare frequencies at Contact-era Neutral sites (section 1.3). I did not identify handles at Christianson but Fitzgerald (1981, 94), in his initial study of the site, found seven unattached handles. He identified three strip handles and four hollow handles, with strip handles tempered with shell and hollow ones with grit (Fitzgerald 1981, 123- 124). At Hamilton I identified three handles that were attached to sherds. Two were hollow (e.g. Figure 5.8 vessel k) and ones was strip applied.[50] Two were composed of Felsic Sand while potters made one hollow handle using the Shell paste. Hamilton also contained three feet and three stemmed vessels (Figure 5.10) each with a distinct shape. Potters made one of the stemmed vessels with Mafic Sand, another with Felsic Sand and the last with Shell. Two of the feet were composed of the Shell paste while the last was Mixed 1. One peg was highly burnished and the other two were smoothed. The distinctive form of each peg suggests they came from different vessels and might indicate that pegs were variable in their form, shape, and mixture with other attributes. As such, Hamilton possesses not only a greater frequency

[50] See Appendix A Figure A.3 vessels i-k for examples of free handle and appliqué handles.

but also greater diversity in speciality and alternate forms that additionally exhibit diversity in recipes.

Figure 5.6: Juvenile vessel forms. Christianson = a, b; Hamilton = c, d

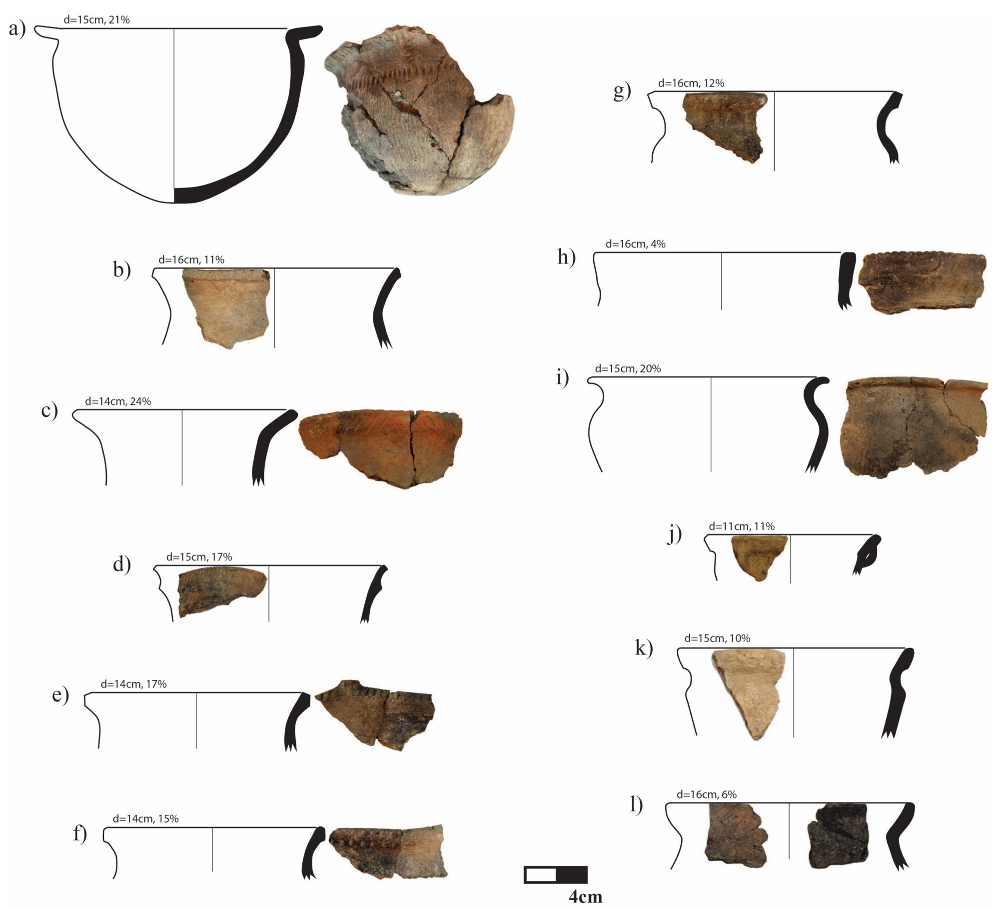

Figure 5.7: Small vessel forms. Christianson =a-g; Hamilton=h-l. Very flared = a,i; Flared = b-d; Slightly flared =e, f, j, k; Straight = h, Convex = g, l

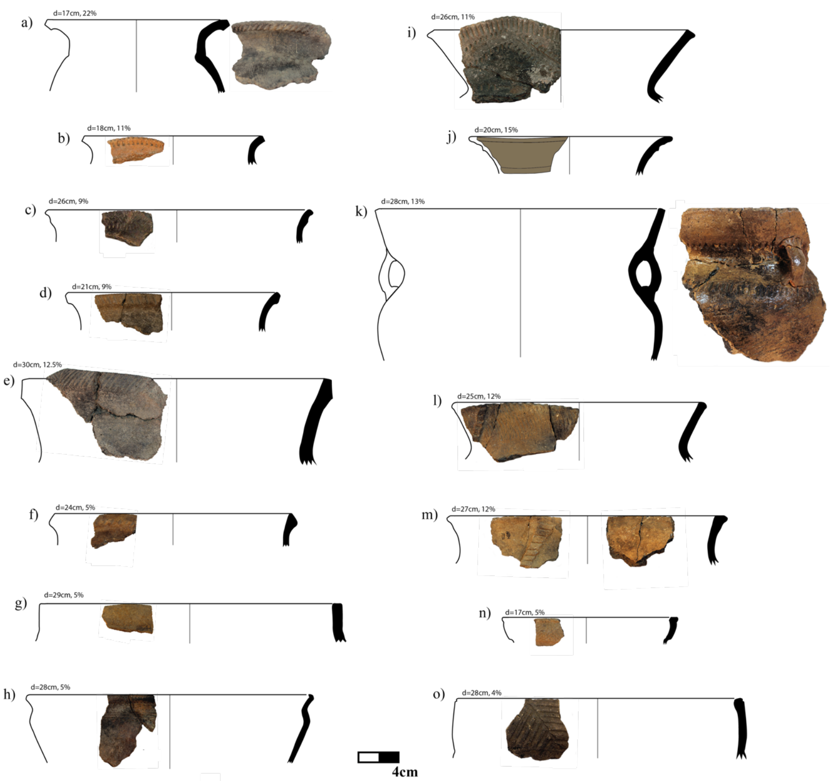

Figure 5.8: Medium vessel forms. Christianson = a-i; Hamilton = i-n; Very flared = a, j; Flared = b, c, i; Slightly flared = d-f, l; Straight = g, m; Convex = k, n, o; Slight inward flare = h. High neck vessel I, l

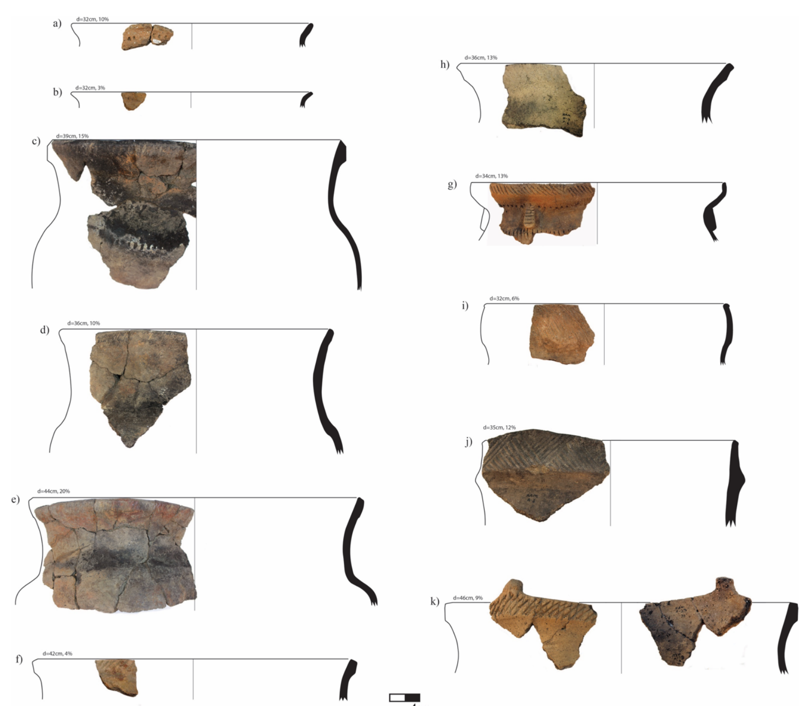

Figure 5.9: Large vessel forms. Christianson = a-f; Hamilton = h-k; Flared = a, b, h; Slightly flared = c-f, k; Straight = j; Convex = g, i

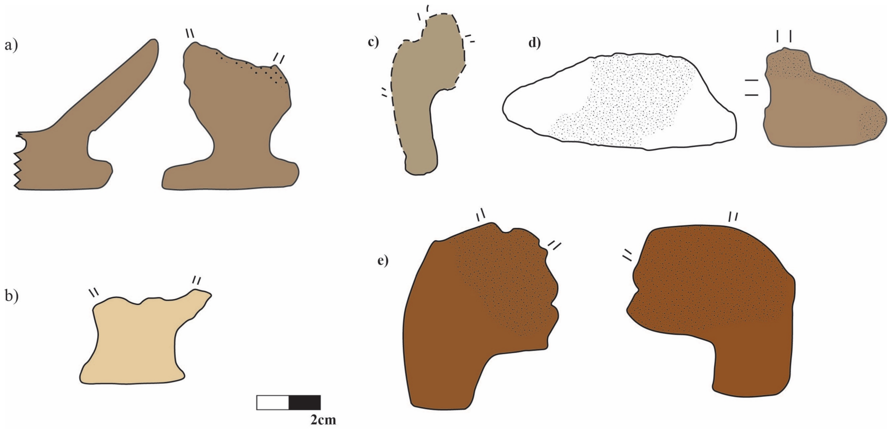

Figure 5.10: Specialty vessel forms. Hamilton site. 'Chalice'/Stemmed vessel = a, b; Peg/foot = c-e

Castellations

Castellations are useful for considering production practices as they are occasional stylistic elements of Iroquoian vessels. I found a small sample of castellations[51] at Christianson (n=17) and Hamilton (n=4). Christianson potters created incipient turret (n=5), pointed (n=5), rounded pointed (n=4), and incipient rounded types (n=3).[52] While Hamilton potters created rounded point castellation (n=1), incipient rounded (n=2), and turret castellation (n=1). [53] Therefore, Christianson has a slightly more diversified expression in castellation-type and these potters fabricated more castellations. At Christianson, castellations are dominated by Grit (n=15) and Shell was only used on incipient rounded castellation types. The pattern is similar at Hamilton where half of the castellations are Grit and Shell pastes are only used to create vessels with incipient rounded castellations. This represents a general continuity in the ways these stylized additions to vessel forms diverge among paste categories, but there is some mixture, as one out of the three incipient rounded castellation sherds from Christianson was made with a Grit paste.

[51] See Appendix B Table B.10 for castellation types.
[52] See Figure 5.7 vessel (e) for an example of an incipient turret castellation. See Figure 5.8 vessel (e) for an example of a pointed castellation.
[53] See Figure 5.9 vessel (j) for the rounded point castellation and vessel (k) for the turret castellation.

5.1.6: Decoration

When the clay is still in a plastic state or dried to a leather-hard texture, potters at these sites often applied decorative elements to the rim, lip, neck, and shoulder. In this study, I did not prioritize decorative attributes, but I am considering it as part of the operational sequence. I consider the regimentation versus diversity in motif classes and decorative methods (e.g. incised), while considering the ways motifs might be correlated with other attributes such as the rim type and paste. These traits reflect tool choices and clarify the difference between more regimented decorative practices versus ones that reflect additions of new or alternative styles present at each site. Therefore, we can consider changes and continuities in values of aesthetics (which may include social signaling) and of tool-type use among communities of potters as another point of investigation of local socio-demographic turbulence.

Decoration Location	Site	Decorated	Plain	Sample	Total Number motifs
Exterior Rim	CHR	82%	18%	167	36
	HAM	71.85%	28.15%	135	
Interior Rim	CHR	17.1%	82.9%	158	8
	HAM	12.5%	87.5%	128	
Lip	CHR	53.9%	46.1%	165	20
	HAM	51.9%	48.1%	131	
Shoulder	CHR	72.6%	27.4%	73	20
	HAM	66.7%	33.3%	72	
Neck	CHR	16.3%	83.7%	141	14
	HAM	17%	83%	153	

Table 5.11: Percentages of decoration along sections of the vessel.

Table 5.11 shows the distribution of decorative versus plain elements at both sites across various parts of the vessel. I found that potters at both sites did not decorate body sherds. Rims were generally the most decorated vessel location at both sites. Potters rarely decorated necks and interior rims. When potters decorated vessel necks, they predominately used appliqué elements. The application of decorations to a certain element on the vessel was proportionally consistent across both sites, indicating a general continuity in values and rules of aesthetics in what elements are considered acceptable for decoration. Table 5.11 does show that there was a slight increase in plain elements across areas of the vessel at Hamilton in comparison to Christianson, with the 10% rise of plain exterior rims. The number of motifs were diverse across most locations, with exterior rims having the most variety.[54]

I found that decorations can exhibit similar motifs (e.g. rows of diagonal parallel lines) but the tools and execution of the decoration can vary. Finlayson's (1998) diachronic analysis of Iroquoian sites in Halton County, Ontario illustrates this component is sensitive to time in Iroquoian societies. Figure 5.11 provides the distribution of decoration application techniques across vessel locations.[55] I found a broad pattern that most motifs on vessel elements are created by a single technique, with a 'combination' of techniques only being present at the shoulder (<27%), neck (<22%), or exterior rim (<12%). This suggests that at both sites potters usually did not mix decorative tools and techniques at a single location on a vessel, and the percentage of this 'combination' trait declines into the Hamilton site. There is also a broad generalized continuity across all locations (other than the neck) that the dominant types of applying decoration included linear impressions. However, certain locations do have dominant styles in conjunction with linear impressed. This includes the interior rim being notched, exterior rims being trailed, incised, or punctated, lips being incised, punctated, or notched, shoulders having punctates or combinations, and necks having appliqués or trailed motifs. Across most vessel locations, Hamilton potters had a greater diversity of decoration techniques, with most techniques taking less than 36% of their location's percentage. This greater spread of techniques, in comparison to Christianson, is the result of potters at

54 See Appendix B Table B.11-15, B.17-18 for full range and representative images of motifs present in this study.
55 See Appendix B Table B.23 for a description of these decoration technique types.

Hamilton using alternative techniques in certain locations and employing 'unconventional' techniques such as cording on the rim, lip, and neck.

To investigate the greater application of decorations on the rim (Table 5.11) and investigate the diversity of techniques along the rim (Figure 5.11), I lumped the exterior rim motifs into broad classes of simples, combined, complex, dentate stamp, punctate, notching, corded, and fingernail impressed.[56] Simples are defined as obliques or vertical lines and complex refers to a combination of lines and angles in a geometric design. Both involve either incised, linear impressed, or trailing techniques. The other motif classes align with the decoration technique.

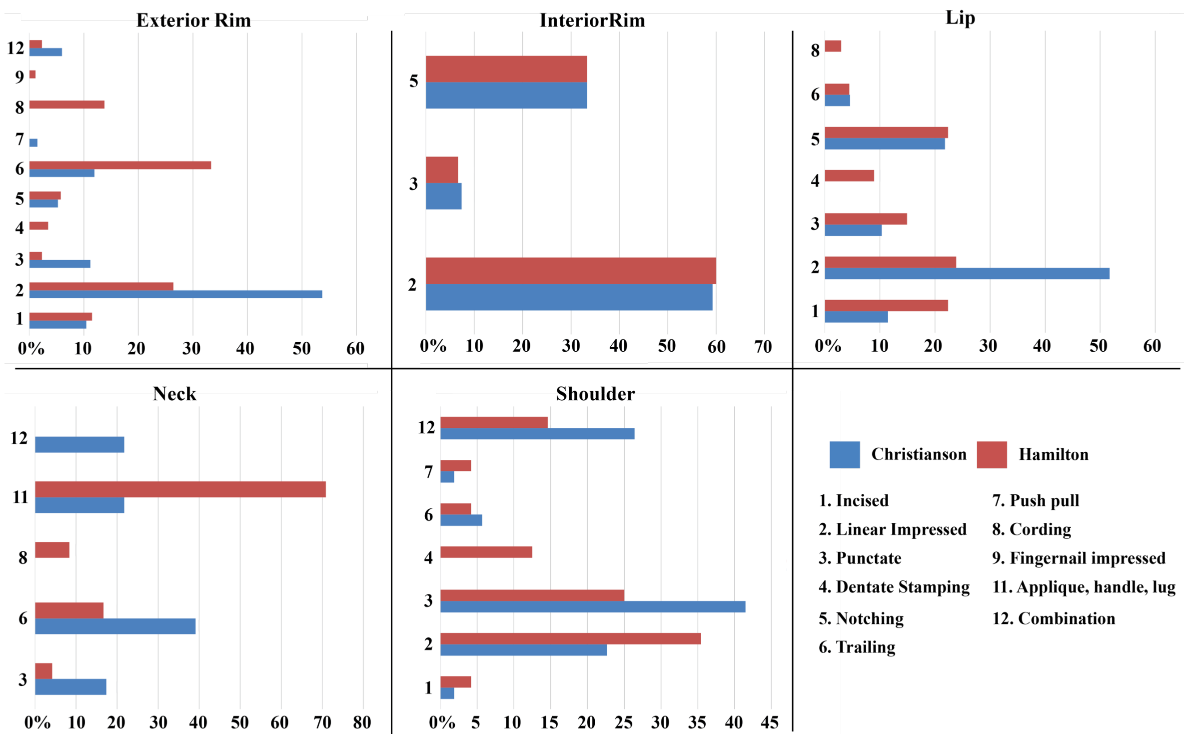

Figure 5.11: Decoration techniques to vessel location. Note slight de-regimentation of dominate decorative techniques at each location into the Hamilton site. Exterior Rim: CHR n=134, HAM n=87; Interior Rim: CHR n=27, HAM n=15; Lip: CHR n=87, HAM n=67; Neck CHR n=23, HAM n=24; Shoulder: CHR n=53, HAM n=48.

[56] See Appendix B Table B.11 for a visual representation of motifs that are included under each broader class.

Figure 5.12 shows that simple motifs were dominant at both sites and that this prevalence exhibits a proximal continuity through time. This signals that a recurrent set of motifs were an important component of ceramic manufacture. However, Hamilton potters created 19% less of the 'simple' motifs and that was proportionally distributed to some alternative motifs such as 'complex' motifs and the new decorative methods of cording and fingernail impressions.

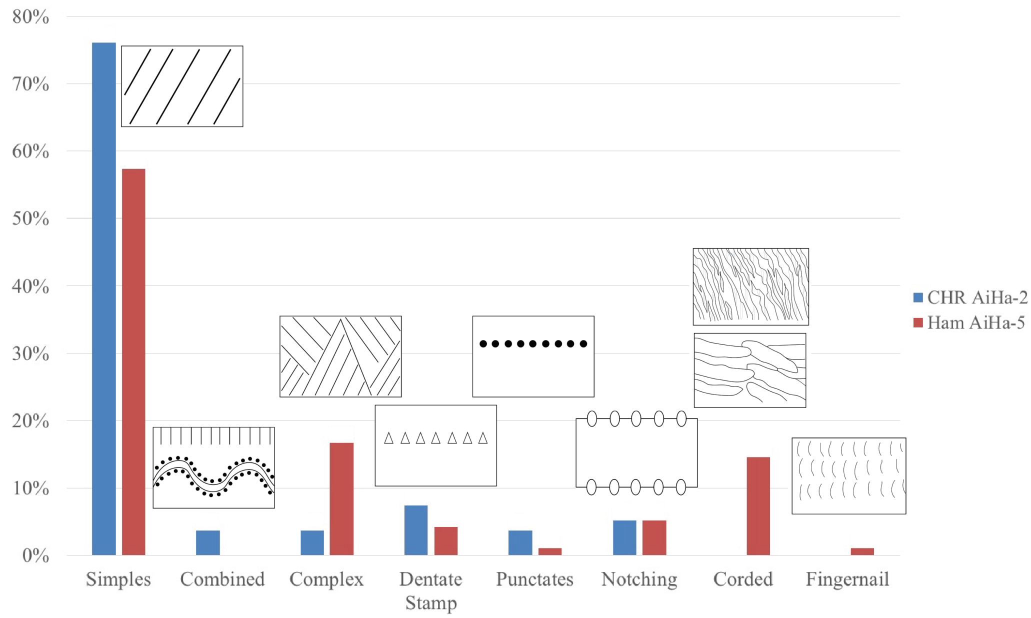

Figure 5.12: Motif class percentages at Christianson and Hamilton. Select examples of each category. CHR n=134; HAM n=96.

When decoration (and lack thereof) is tracked by pastes (Figure 5.13), I found a significant overlap of plain rim wares with Grit and Shell pastes. A similar pattern is present for simple motifs across all paste groups except Mixed 1 at Christianson. The small sample of mixed pastes (Mixed 1 & 2) might make their correlations less conclusive. The alternate motifs that cluster with Grit at Christianson include notching (100% notched vessels composed of Grit pastes), complex designs (100%), and punctates (80%) while the motifs that cluster with shell included the combined motif (80% composed of the Shell paste), and dentate stamping (40% Mixed 1, 40% Shell). The alternative motifs at Hamilton that cluster with Grit pastes included notching (60%, with 40% as Shell), fingernail impression (100%), and punctates (100%), while the motifs that cluster with Shell included complex (81.25%, 6.25% with Mixed 1, 6.25% Mixed 2), corded (85.7%), and dentate stamp (100%). These patterns illustrate some continuity in the alternative motifs and paste but they slightly drift towards higher proportional representation of Shell or mixed (1 & 2) categories into the Hamilton site.

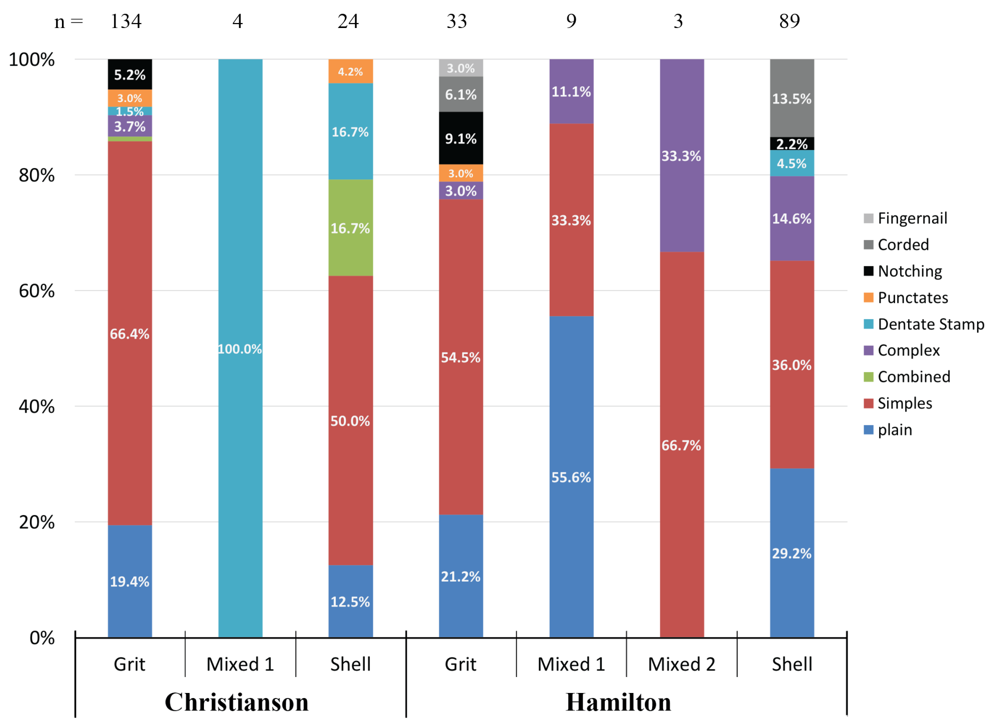

Figure 5.13: Paste to rim decoration type

The 'combined' rim motif at Christianson and the 'complex' motif at Hamilton also appear to cluster with other attributes. This pattern differentiates them from other continua of variability in other attributes. Potters at Christianson placed the combined motif on collarless vessels, these vessels had an average neck height of 45.3mm in comparison to the site’s overall average of 27.1mm and the majority are Shell tempered. This represents a unique form that is illustrated in Figure 5.8, drawing (i) and may be analogous to the “parker festoon” typology described by Tim Abel (1999). This is a small sample that represents a minimum of three vessels. At Hamilton, complex rim decorations correlate with Shell, Mixed 1 & 2 categories, they generally have high collars with a 36.8mm height average (Hamilton overall average is 22.5mm) and are correlated with convex rim shapes at 64.3% with lesser amounts as slightly flared (28.57%). This vessel type is drawn in Figure 5.8 illustration (o) and it might be analogous to the form Lennox and Fitzgerald (1990, 416-417) identified as 17th century 'high-collared, shell tempered vessel' of 'triangular plat motifs on high-collared vessels.

Accessory Decorative Elements

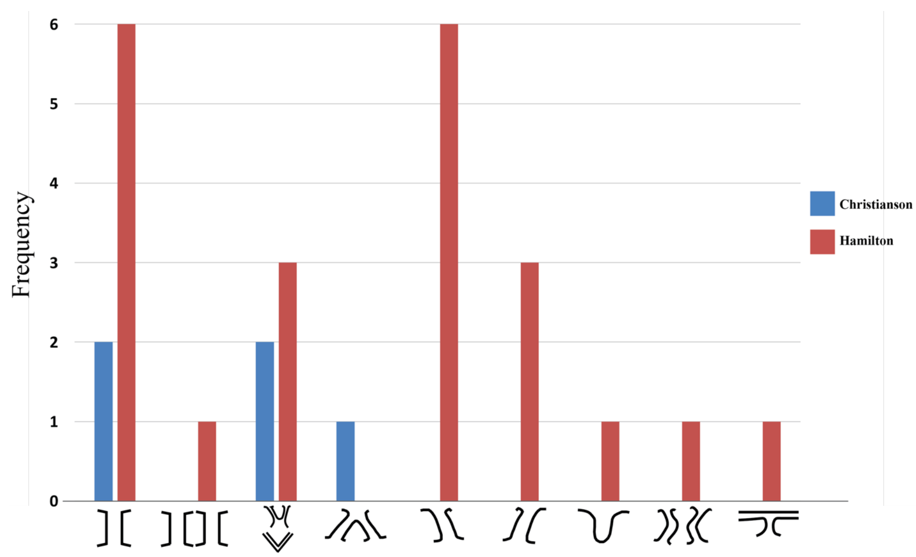

Figure 5.14: Orientation of appliqued elements at Christianson and Hamilton. CHR n=5; HAM n=22.

Both sites contained the occasional added clay elements located on the neck of vessels. These involved appliqué strips and lugs (See Appendix A Figure A.3). I found five appliqué strips at Christianson, 22 at Hamilton and two lugs at Hamilton. All the appliqués at Christianson were made from the Shell paste. At Hamilton one appliqué was made with a Grit paste, one with Mixed 1, two with Mixed 2, and 18 with the Shell paste. Figure 5.14 shows that there was a greater degree of variability in the application of these accessory decorative elements at Hamilton in comparison to Christianson.

5.1.7: Firing Technology

Firing represents one of the most important steps of the operational sequence as firing losses can cost potters several days or even months of work. Livingstone Smith's (2001) ethnoarchaeological study of firing conditions show that the firing temperature regime can be quite variable in open pit firing, but it focuses our attention of firing temperatures along the firing profile, which is primarily concerned with maximum temperatures, heating rates, and soaking time. Firing technology can constitute a technical style as potters can attempt to have controls over atmosphere, fuel, duration, and temperature (Livingstone Smith 2001; Rice 1987, 152-166). The use of shell-temper at both sites and its substantial increase at Hamilton warrants a consideration if potters utilized distinct firing regimes to mitigate the limespalling risk of shell-tempered pots (section 4.1.1). A divergence or convergence of firing technology at either site can either indicate the presence of different learning communities or indicate communities of production shared firing practices. In this section, I evaluate the firing atmospheres and temperature profiles at both sites.

Atmosphere

Firing atmospheres were quite variable. I noted 27 different core types at Christianson (n=903) and 29 different core types at Hamilton (n=412).[57] No core type exhibited a greater share than 20% of each site's total assemblage and the majority was represented less than 10% of the sample. Surface exteriors often contained two colour shades, some occasionally darkened or blackened. A significant percentage of exterior sherd colours had lower values and scales of chroma on the Munsell soils colour chart.[58] Munsell values of less than five for the value and less than four for the chroma constituted 54.7% of exterior surface colours at

[57] See Appendix B Figure B.9 for complete set of firing cores.
[58] These Munsell observations might be biased towards lower chroma and values, as this broader sample was taken under fluorescent light at Sustainable Archaeology at McMaster Innovation Park rather than natural light.

Christianson (n=930) and 34.4% at Hamilton (n=407). Interior colours of these same qualifications predominate with 81.4% at Christianson (n=880) and 64.7% at Hamilton (n=374). This indicates a combination of incomplete and completely reduced atmospheres (Rice 1987, 345). The rest of the colours at either surface was around light brown, light pinkish grays, light brownish gray, light grays, and pale browns of the 5YR, 7.5YR and 10YR hues, representing incomplete to complete oxidation (Rice 1987, 345). There were less frequent amounts of reddish yellows, light reds, and light reddish browns of the 2.5YR, 5YR and 7.5YR hues, representing relatively more oxidized atmospheres (Rice 1987, 343-345). Colours with these dominant grayish tones, and variable core types represent high organic contents or more oxygen deficient atmospheres (Schulze et al. 1993, 73-75) with occasional fire clouding on the surface being common in Iroquoian ceramics (Braun 2012; Warrick 1983).

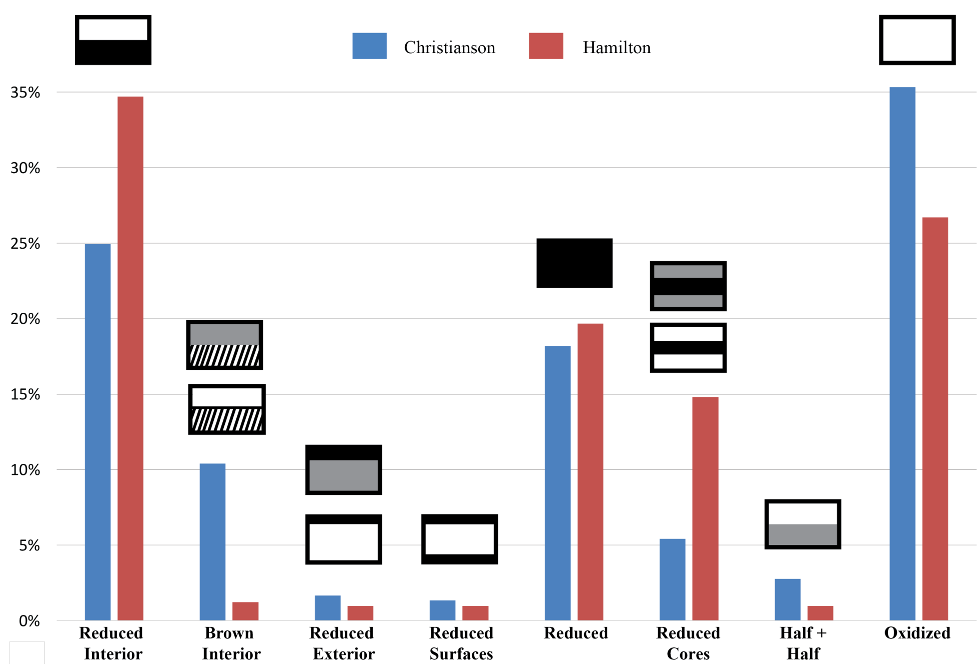

Figure 5.15: Firing atmosphere based on core cross-sections. Firing codes: black = black, white = red-brown, gray = light brown, diagonal hatch = brown. CHR n=903; HAM n=412.

To track the changes in firing regimens between the two sites and between paste groups, I put together related firing cores into overarching classes. Figure 5.15 shows the frequency of these firing core categories. The figure shows that reduced interiors, oxidized, and reduced were the most common firing conditions at both sites. Reduced interiors may suggest many pots were fired upside down while fully oxidized cores may represent ones that were fired upright. 'Brown interior' represented a very low value and chroma in the Munsell soil colour chart but was not black or gray enough to classify as reduced. This colour may still represent the interior position of the core was more reduced or incompletely oxidized in comparison to the exterior or its organics did not burn off to the same degree as the exterior (Rice 1987, 345). With that considered, there is a broad continuity between both sites in firing atmospheres.

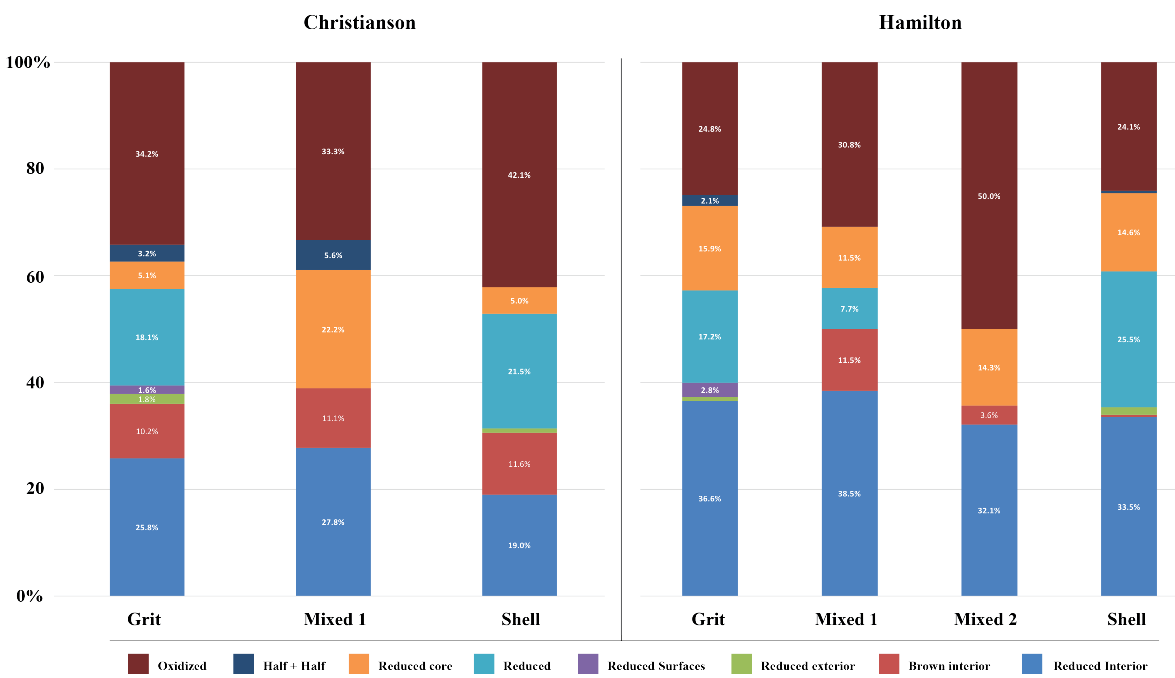

Figure 5.16: Firing atmosphere to sherd paste. CHR n=900. HAM n=411.

The 9.4% increase in reduced cores at Hamilton may suggest the occasional decrease in firing time for which oxygen can permeate the walls of the vessel or for the amount of time to burn off organics (Rice 1987, 334-335). This pattern may correlate with Hamilton's increase in reduced interiors in comparison to the partial oxidation of brown interiors, with occasionally shorter firing times or temperatures causing an oxygen and/or heat differential in upside down vessels. Alternatively, these patterns can mean a reduced atmosphere but cooled rapidly in the air as the reduced cores at both sites exhibit a roughly 50% split between diffuse and sharp boundaries (Orton and Hughes 2013, 154). These traits may suggest a decrease in the extent and perhaps control of the firing process, but this possibility must be set in broader understanding that these bonfire conditions were already heterogeneous.

I compared paste categories to firing atmosphere in Figure 5.16. I did not find a correlation of reduced atmospheres to shell-temper, a technique some archaeologists suggest potters can utilize to reduce the risk of limespalling (Herbert 2008; Rice 1987, 410). Shell, Mixed 1, and Mixed 2 pastes had slightly greater percentage of being oxidized or incompletely oxidized with reduced cores. The decrease of fully oxidized atmospheres (across all paste groups) and 'brown interiors' from Christianson to Hamilton either represents that 1) Christianson potters had more control over their firing, achieving greater time for soaking time due to knowledge of fuel and firing techniques or 2) the proportional increase of reduced interiors at Hamilton represent a slight shift in preference towards firing vessels upside down.

Temperature

Petrographic data on the birefringence and the optical activity of thin-sectioned samples provided one proximal indicator of the firing profile. I found that all of the thin-section samples contained some degree of optical activity and thus the clay matrix did not sinter.[59] This means that all vessels within this sample were fired below 800-850ºC for the

[59] See Appendix B Figure B.6 for optical activity differences under thin-section.

majority of the firing processes and did not soak at these temperatures for 1 hour (Quinn 2013, 190-191). The lack of any indication of sintering in any part of the vessel (e.g. contact exterior surfaces) also indicates that if these high temperatures occurred in the firing, they must have been very short in duration or did not raise the clay up to the fire's temperature. I found the degree of optical activity was predicated on the firing atmosphere and other variables that could mask birefringence colours. For example, darker matrix colours (possible high organic content, [Schulze et al. 1993]) and more oxygen deficient atmospheres could have resulted in lower optical activities (Quinn 2013, 191).

The pilot sherd refiring study also provided some proximal information on firing technology. Table 5.12 and 5.13 shows that along the core and the exterior, most sherds (when fired to 700ºC) exhibited an increase in value and chroma, with an occasional change in hue. Hue changes involved a change away from browner and grayish hues and values and towards redder ones, as yellowish red and reddish yellow ones (7.5YR and 5YR). Changes were most pronounced with the cores. Christianson (68.2%) and Hamilton (66.7%) samples showed a significant colour change that involved multiple numerical changes at value, chroma, and sometimes hues. Christianson (22.7%) and Hamilton (19%) samples also experienced slight colour changes that involved at most a single hue or a small number of chromas and values. Finally, 9.1% of samples at Christianson and 14.3% at Hamilton experienced no to negligible changes. There were no correlations with paste type. Thus, the change from lower chroma, values, and change in hues would suggest that refiring burnt off more organic matter and/or the iron within the clay body oxidized to higher degree than the original firing by local potters (Beck 2006, 98; Rice 1987, 345). These results can mean that vessels were fired at relatively low temperatures below 700ºC, or experienced short soaking times above 700ºC.[60] Temperatures also could have exceeded 700ºC and that colour changes in the refiring experiment represent the initial incomplete oxidizing atmosphere of potter open-pit firings as a small number of samples showed no to slight changes.

Paste	Core Original	Exterior Original	Core 700	Exterior 700
Felsic Sand	7.5YR7/4	2.5Y 5/2	7.5YR 6/6	7.5YR 7/3
	2.5YR 5/1	10YR 6/4	7.5YR 6/6	7.5YR 7/6
	GLEY 2 2.5/5PB	2.5Y 6/2	5YR5/8	5YR 6/6
Felsic Gravel	2.5YR 7/4	10YR 6/3	7.5YR 6/6	7.5YR 7/4
	7.5YR 5/6	7.5YR 4/1	5YR 6/8	7.5YR 6/6
	GLEY 2 2.5/5PB	5Y 2.5/1	7.5YR 6/6	GLEY 1 3/N (blotches of 7.5YR 6/4)
	GLEY 2 2.5/5PB	7.5YR 6/3	7.5YR 6/6	7.5YR 7/6
Intermediate Sand	2.5Y 5/6	2.5Y 5/2	7.5YR 6/6	7.5YR 6/4
	2.5Y6/2	10YR 5/2	7.5YR 6/6	7.5YR 7/5
Intermediate Gravel	GLEY 2 2.5/5PB	5YR 4/1	7.5YR7/6	7.5YR 6/4
	7.5YR 6/4	2.5Y 6/2	5YR 6/8	7.5YR 6/4 (spots of 5YR 4/6)
	2.5Y 5/2	10YR 5/3	7.5YR 7/6	7.5Y 7/4
Mafic Gravel	7.5YR 5/3	7.5YR 5/3	5YR 6/6/	7.5YR 6/6
	7.5YR 7/6	10YR 8/2	7.5YR 6/6	7.5YR 7/4
	7.5YR 6/4	7.5YR 5/1	5yr 6/6	7.5YR 6/4 (spots of 5YR 5/6)
	5YR 5/6	7.5YR 7/4	2.5 YR 6/8	7.5YR 7/4
Mixed 1	5YR 6/6	10YR 6/4	5YR 6/6	7.5YR 7/4
	10YR 5/2	10 YR 6/3	5YR5 6/6	7.5YR 6/6
Shell	2.5Y 6/3	2.5Y 6/3	5YR 6/6	5YR 5/6 (spots of 5YR 7/1)
	GLEY 2 2.5/5PB	7.5YR 6/4	5YR 6/6	5YR 6/4
	GLEY 2 2.5/5PB	2.5Y 4/1	7.5yr 6/6	7.5YR 7/2
	2.5Y 5/2	2.5Y 5/2	5YR 6/8	7.5YR 7/4

Table 5.12: Munsell colour table for refired Christianson sherds. Munsell data by Nicholas Williams n=22

[60] The Refiring experiment soaked the sherds at 700ºC for 45 minutes. Therefore, less than 45 minutes firing time at 700ºC, or simply less than 700ºC for the majority of sampled sherds.

Paste	Core Original	Exterior Original	Core 700	Exterior 700
Felsic Sand	Top Layer: 5YR 5/6 Bottom Layer: 2.5Y 6/2	10YR 6/3	Lower layer: 7.5YR 6/6top layer 5YR 6/6	7.5YR 6/4
	Top layer: 5YR 6/4 Bottom Layer 5Y 5/1	2.5Y 5/2	7.5YR 7/6	7.5YR 7/4
Felsic Gravel	Top Layer - 10YR 6/6 Bottom Layer- 10 YR 5/2	10 YR 5/2	5YR 6/6	5YR 6/6
	5YR 5/6	7.5YR 6/4	5YR 5/6	7.5YR 6/6
Intermediate Sand	7.5YR 6/6	7.5YR 7/3	5YR 5/4	7.5YR 7/4
	10YR 5/2	5YR 6/6	7.5YR 6/6	5YR 6/6
Intermediate Gravel	2.5Y 2.5/1	2.5Y 5/2	5YR 6/6	7.5YR 6/4
	10YR 6/3	10YR 4/1	5YR 6/6	5YR 6/6
Mafic Sand	7.5YR 6/6	7.5YR 6/4	5YR 6/6	7.5YR 6/6
	10YR 5/1	2.5Y 6/3	7.5YR 6/6	7.5YR 7/6
Mafic Gravel	10YR 7/3	10YR 7/4	7.5YR 7/3	7.5YR 7/4
Mixed 1	7.5YR 7/4	7.5YR 7/2	7.5YR 7/4	7.5YR 7/3
	2.5Y 5/1	7.5YR 4/6	5YR 7/3	5YR 7/6
Mixed 2	7.5YR 6/6	10YR 4/1	5YR 6/6	7.5YR 6/6
	5Y 3/1	10YR 6/3	7.5YR 6/6	7.5YR 7/4
	7.5YR 5/6	2.5Y 6/2	2.5YR 5/8	5YR 6/4
Shell	2.5YR 5/8	5YR 6/4	2.5YR 5/8	5YR 6/6
	2.5Y 2.5/1	10YR 6/4	7.5YR 6/6	7.5YR 7/4
	10YR 7/2	10YR 7/3	7.5YR 7/4	10 YR 8/3
	5Y 2.5/1	2.5Y 6/1	7.5YR 7/6	7.5YR 8/3
	GLEY 2 2.5/5PB	2.5Y 5/1	7.5YR 6/6	7.5YR 7/4

Table 5.13: Munsell colour table for refired Hamilton sherds. Munsell data by Nicholas Williams n=21. Munsell colour data by Nicholas Williams.

These possible low temperatures also are correlative with the visual qualities of shell under thin-section.[61] I found most shell inclusions under thin-section maintained their internal microstructures at both sites.[62] Of the seven shell-tempered samples at Christianson, two samples showed no signs of shell-calcite alteration, one sample showed less than 5% of shell

[61] Calcium carbonate inclusions (e.g. shell, limestone) undergo their chemical transformation from $CaCO_3$ (calcite) to CaO around 650-750ºC and, after cooling, recombines back into calcite (Section 4.1.1). From this process, the original material alters into fine-grained calcite and removes the original microstructures of shell (Quinn 2013, 191).

[62] See Appendix A Figure A.6 for an example of a shell with natural laminar patterns as their internal microstructures and an example of a shell inclusion that demonstrates a calcite alteration.

was altered, two samples showed <25%, and another two showed <30%. At Hamilton, three samples had <10% of the shell inclusions with calcite alteration, three samples were <20%, one was <30%, and one had a high percentage at less than 75%. The exact patterning is deceptive as many inclusions with the calcite alteration were on edges of the thin-section that were shaved down too thin (<30um), perhaps altering the optical activity. Shell could be pre-fired as Feather's (2006, 92) suspects occurred in American mid-continental Late Woodland and Mississippian period. However, pre-firing would have involved a short soaking time >650ºC as the majority of shell inclusions did not lose their microstructure. This pattern would also mean that the entire vessel did not often exceed 650ºC or had a short soaking time beyond these temperatures. This pattern of firing would have saved the vessels from limespalling.

5.2: 'Micro-histories' and Spatial Distribution

In this section, I explore these intra-community scales of technical styles to consider the historical contingencies of socio-demographic turbulence in migration, cultural interaction, and demographic loss that potters would have experienced in their daily lives within their village. With my focus on communities of production rather than consumption, I am, therefore, resting on the assumption of a strong socio-spatial connection between communities of production, communities of consumption, and depositional location (section 3.4).[63] Potters could have contributed beyond the household but archaeologists often tie consumption to a potter's (or pottery workgroup's) household, clans, or affiliated kin (section 1.3; Chilton 1998; Hart and Engelbrecht 2012; Martelle 2002; Ramsden 2016), where pots

[63] These earthenware pots likely cycled through a production-use-deposition life of 1-3 years (Allen 1992, 140; Warrick 1990, 261-265).

took a on use-life predominately in those household domestic contexts and occasional communal contexts (Allen 1992; Braun 2010).

As such, I present the spatial distribution of pastes and exterior surface finish within each site to address my second research question. I prioritized paste as one of the ceramic attributes for this section because paste was a variable of change and continuity within and between these sites (sections 1.2 and 5.1.1) and pastes can be assessed from every type of sherd, providing the most extensive dataset for spatial patterning analysis.[64] Similarly, surface finish provides information from most body sherds and also presents spatial and temporal patterning throughout proto-early Contact-era Neutral sites (section 4.1.1). Surface finish also changes not only its frequency of types of execution but also slightly changes in its correlations with other attributes from the Christianson to Hamilton sites (section 5.1.4; Table 5.5, Figure 5.3).

5.2.1: Paste Distribution

Grit, Shell, and Mixed recipes (1 & 2) are unevenly distributed across each site (Figure 5.17). For example, Christianson's House 1 shows the greatest diversity in pastes as it is the only locale to contain Mixed 1 and has a significant shell temper percentage at 28.4%. This might signify experimentation and is perhaps tied to a select number of potters operating in the household that utilized shell in their pastes as the sole or combined temper in their vessels. Midden A-1 and A-2 show the least amount of shell but their relative chronological sequence shows that the nearby households contributed a lower percentage of shell sherds through time. MA-2 is relatively earlier than MA-1 (See Sampling Chapter section 4.3) which

[64] This larger sample of recorded data from pastes and surface finishes accounts for sampling issues that other attributes would possess. Household contexts possess smaller concentrations of sherds which are also smaller in comparison to midden contexts (section 3.3.1 and 3.3.2). Whereby other attributes, such as rim profile, would be limited to a smaller dataset and not provide as meaningful a comparison.

meant shell declined in percentage from 13.3% to 6.7%. This can indicate that Shell pastes was not an 'inevitable' adoption through time.

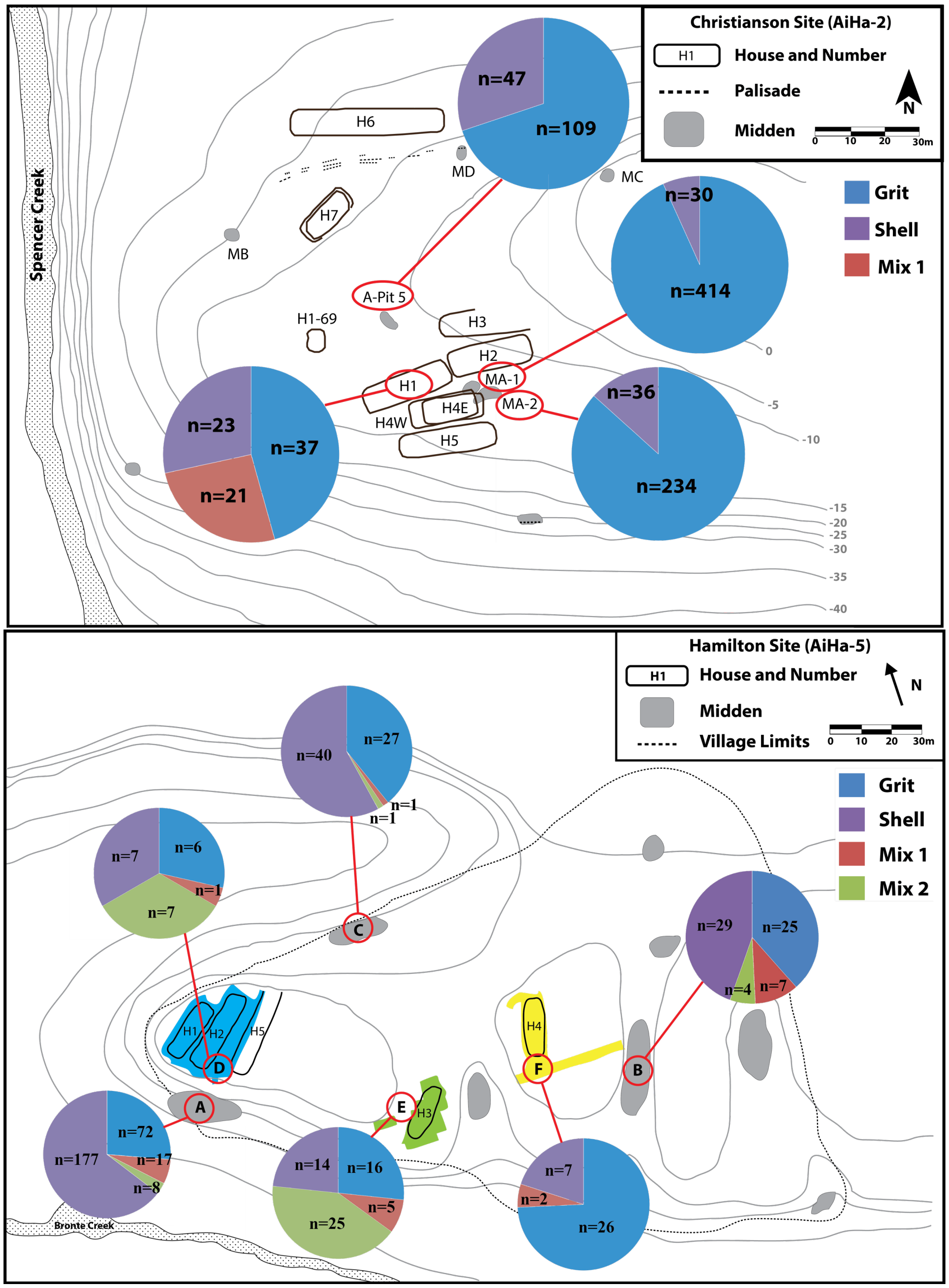

Figure 5.17: Spatial Distribution of pastes at Christianson and Hamilton. Overall site 83.68% grit, shell 14.14%, mixed one 2.18% breakdown. Overall site breakdown 'grit' category represents 33.86%, mixed one at 6.14%, and mixed two with 6.82%, and shell-temper at 53.4%.

Household deposits at Hamilton show the greatest variability between different contexts, differing from the amalgamated site paste percentage distribution (Figure 5.17). House 4 illustrates a strong continuity in utilizing Grit recipes as it constitutes 74.3% of the household's sherd refuse. House 3 and the collection of Houses in Area D illustrate a greater experimentation in recipes as they have a higher percentage of mixed pastes whereas at House 3, 41.7% of sherds are composed of Mixed 2. The middens show the greatest concordance with overall site frequencies.

5.2.2: Surface Finish Distribution

Section 5.1.3 showed patterns in finishing styles correlate with pastes but also exhibit a higher degree of mixing at Hamilton. Figure 5.18 also illustrates the uneven distribution of finishing styles through the site, with these spatial patterns coalescing with the paste data. For example, Christianson's House 1 had the highest Shell and Mixed 1 paste concentration and similarly exhibits the highest percentage of cord-based finishes, in comparison to MA-2, MA-1, and the Area A midden. As such, the percentage of cord-based finishes to burnishing or plain/smoothed is similar to the Grit to Shell distribution (Figure 5.17). As at the Christianson site, there is a strong correlation between these attributes (Section 5.1.3). However, Hamilton exhibits a wider variability and multiplicity of surface finishes. For example, the Area D household cluster context contains the least amount of cording and this is coupled with the approximately one-third splitting among of Grit, Shell and Mixed (1 & 2) categories (Figure 5.17). Hamilton's House 3 exhibits the highest percentage of ribbed paddle-based finishes, a practice that is infrequent within each site, but makes up a significant percentage of House 3. Therefore, paste groups and surface finish exhibit spatial trends at both the Christianson and Hamilton sites. Embedded in the spatial distribution of practices might be 'microhistories' of altered learning frameworks and a differing adoption of alternative tempering and finishing practices.

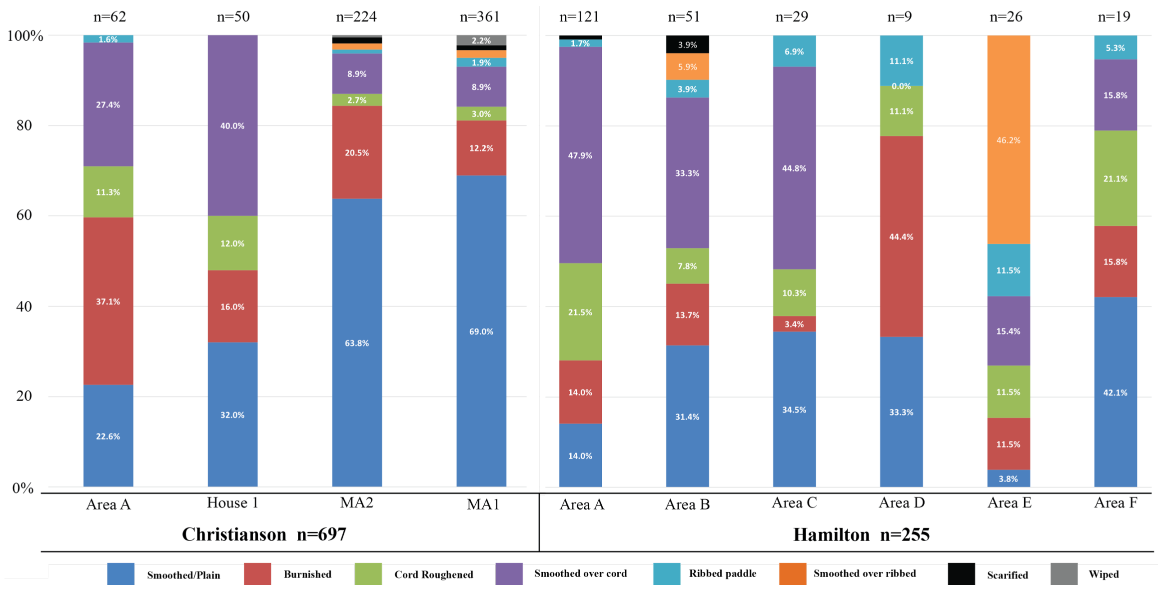

Figure 5.18: Spatial distribution of surface finish.

5.3: Skill

The epidemics and famines of the A.D. 1630's would have caused the death of Neutral potting community members, triggered the loss of skilled practitioners, and thus reconfigure the degrees of skill and knowledge among communities of practice. In the following section, I explore four attributes related to the motor-skills and technical knowledge of potters (Crown 2001; Longacre 1991) to understand the context of skillfulness amongst potters before, during, and after these profound demographic experiences. These measures include decorative element spacing and evenness, contour, thickness, rim undulation, and cracking. For the visual qualitative assessments, I rely on the assumption that the human eye and brain possess a strong capacity to recognize patterns, shapes, and angles that indicate the evenness of finishing and the degree of cracking on a sherd. Visual discernments are the primary way in which skilled potters distinguish levels of skill in pottery and, in some cases, allow them to identify the work of particular potters (Longacre 1999, 48-

49). With the limited sample size of diagnostic sherds, I compared these skill-related attributes between rather than within sites.

Table 5.14 shows the statistical data gathered from the distance between an applied decoration (e.g. width between obliques) from decorative elements on the rim, collar, neck, and shoulder of a single vessel or sizeable diagnostic sherd (combination of vessel elements). A lower coefficient of variation represents a higher skilled potter, as skilled potters utilize more efficient gestures and create a more standardized decorative element (Crown 2001, 452; Martelle 2002, 394).

	CHRISTIANSON	**HAMILTON**
Average CV	14.93	15.85
Standard Deviation	5.82	6.94
Range	4.4 - 34.8	3.65 - 38.7
n=	55	56

Table 5.14: Coefficients of variation for decorative element spacing on pottery. Includes the distances between elements (eq. oblique lines, punctuates, stamping etc.) on the rim/collar, neck, and shoulder.

The 14-16% averaged coefficient of variations at the two sites in Table 5.14 can be expected for part-time producers (DeBoer 1990, 88; Wiessner 1983). At Christianson, 85.5% of C.V.s were below 20% and 58.2% of C.V.s were below 15%. At Hamilton, 78.6% of C.V.s were below 20% while 51.8% of C.V.'s were below 15%. The wide ranges within each site indicate unskilled persons or learners engaged in pottery production while the clustering of values below the 20% and 15% C.V. suggest skilled persons created a majority of decorative elements on pots. This value and range contrast sharply with similar assessments on the decorative element C.V.s from earlier chronological phases where Braun (2012, 6-7) found pottery at the Iroquoian mid-13th century Antrex site had an averaged C.V. of 3.1%. However, Martelle (2002) employed the cutoff of around 15% among the contemporary

Wendat to highlight the seasonality of Iroquoian pottery production (few months a year) and standardize the results to ethnoarchaeology research.

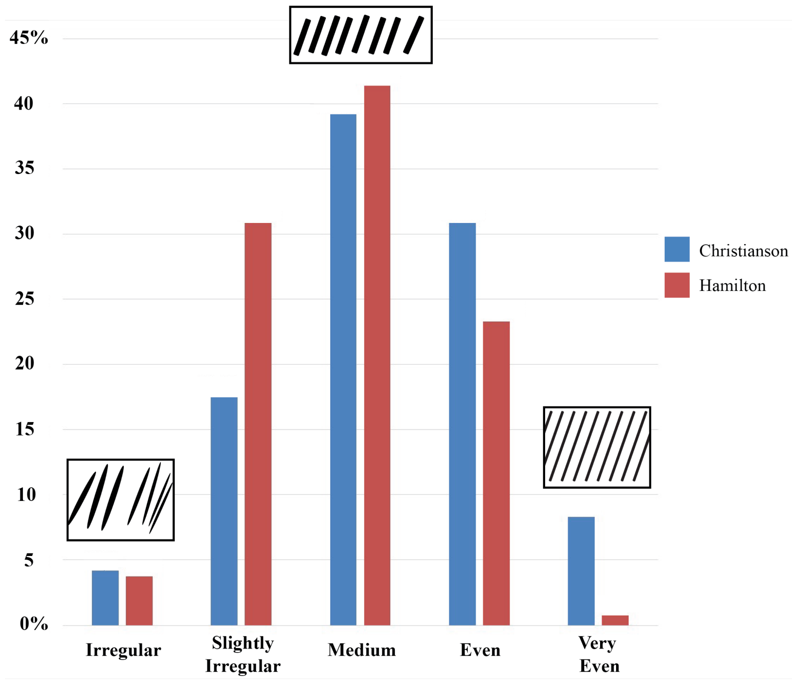

Figure 5.19: Qualitative assessment of decoration evenness. CHR n=120; HAM n=133.

Hamilton possesses a slightly greater range in coefficients (CHR: 4.4-34 and HAM: 3.65-38.7). This range combines with the higher standard deviation and greater proportion of C.V.s that lay above 15% or 20%. There was a slight decline in the average coefficient of variation (about 1%) between the two sites. This might be indicative of a slightly greater range of proficiencies between skilled and non-skilled persons at the Hamilton site along with a slight decline in skill. However, the difference between each site's averaged coefficients of variation is not likely to be statistically significant. Qualitative assessments on the quality of decorative applications are more revealing with Figure 5.19 showing a decline in skill. With the qualitative assessment I observed broad patterns of evenness in which I considered the consistency of width, length, and depth, clay lipping, and an overall holistic perspective. For decoration evenness, Christianson's combined 'very even' and 'even' frequency is 39.1%

while at Hamilton it declines to 24.1%. Christianson's combined 'slightly irregular' and 'irregular' frequency is 21.7% and at Hamilton it increases to 34.6% (Figure 5.19). Both sites possessed minimal irregular decorative elements that can speak to the unlikelihood that completely "green" novices made significant contributions to the decorative elements.

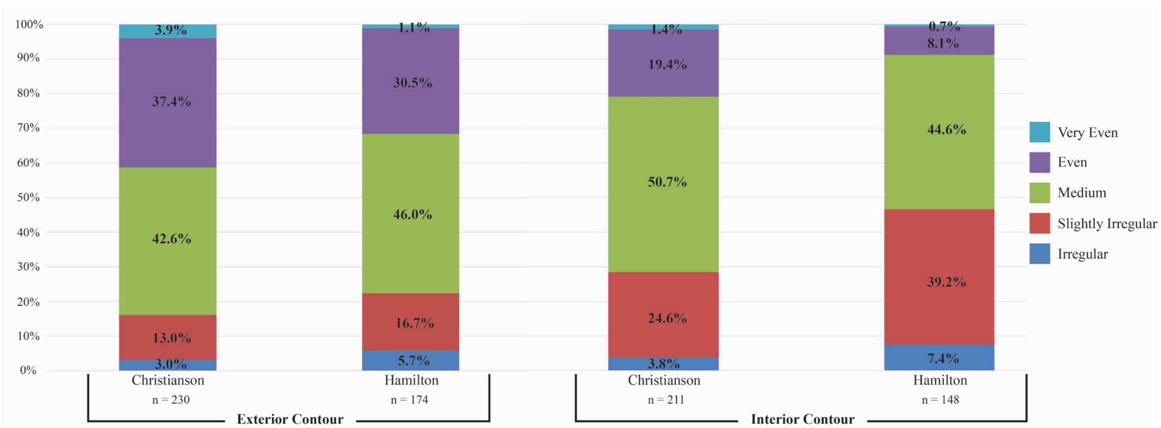

Figure 5.20: Contour percentages for interior and exterior observations on diagnostic sherds/reconstructed vessels from Christianson and Hamilton sites.

Additional attributes that analyse motor-related skills are also suitable to this study as Neutral potters did not decorate all vessels or all elements of vessels (Section 5.1.5, Table 5.10) Figure 5.20 shows the slight changes in contour between the two sites. The table does not demonstrate a profound change in surface evenness, but the differences are along a small gradient. Both the interior and the exterior show a change away from 'even' or 'very even' from Christianson to Hamilton, indicating a small shift away from skilled gestures. There was a decrease of the combined 'even' and 'very even' gestures on the exterior of sherds from a frequency of 41.3% at Christianson to 31.6% at Hamilton. Interiors have a significant increase in inefficient gestures with the combined 'slightly irregular' and 'irregular values' increasing in frequency from 20.8% at Christianson to 46.6% at Hamilton. Overall, interiors at both sites exhibit a lower degree of evenness, perhaps a product of their positioning during finishing and forming stages and the disparate amount of detail provided to a visually hidden part of the vessel.

Evenness and skill can also be tied to thickness, as it can be linked to a potter's ability to maintain even wall thickness, to be familiar with the pastes, and to employ efficient motions during forming. I split wall thickness assessments along broad temper classes (Grit, Shell, Mixed 1, Mixed 2) to accurately capture the possible intentions of potters, as generally potters use coarser temper and make thicker walls for larger vessels (Rice 1987; Appendix A Figures A.15 & A.16).[65] For Christianson, Grit's $\bar{x}$ = 7.28mm while at Hamilton $\bar{x}$ = 7.61mm, representing a 4.5% thickness increase. For Christianson' Shell paste $\bar{x}$ = 6.45mm and Hamilton $\bar{x}$ = 6.82mm, representing a 5.7% size increase. For Mixed 1 at Christianson, $\bar{x}$ = 7.69mm and Hamilton $\bar{x}$ = 7.68mm, representing a negligible change.[66] While Christianson did not possess the Mixed 2 paste, at Hamilton the thickness $\bar{x}$ = 7.63mm. These patterns show a general increase of around 5% in body sherd thickness with the most abundant paste categories (e.g. Grit, Shell). The statistical significance is questionable, but it may indicate a slight decrease in gesture skill.

Figure 5.21's assessment on rim undulations reinforces the pattern of potters slightly decreasing the quality of embodied skills as I also found a decrease in rim evenness. The values demonstrate a stronger shift than Figure 5.19 on decorative evenness and Figure 5.20 on contour. I observed a lower percentage of rim evenness at Hamilton than Christianson, where the combined 'very even' and 'even' values declined from 39.1% at Christianson to 24.1% at Hamilton, which stacked up on the combined 'slightly irregular' and 'irregular' values that composed 21.7% of the samples at Christianson and 34.6% at Hamilton. As with contour and decorative qualities, the sloppiest of constructions (represented through the irregular attribute) still sat below 10% of all samples. This may continue to indicate that

[65] Size classes also remained relatively the same between both sites (Section 5.1.4).
[66] I found the medians and 3rd quartile ranges coincided with these general patterns I presented in averages.

"green" novices did not construct most pots. Therefore, there was a range of experience and skill among the potters. The combined values for 'slightly irregular' and 'irregular' of rims at Christianson (17.8%) indicate that even before European disease epidemics, less skilled potters engaged in pottery production practices.

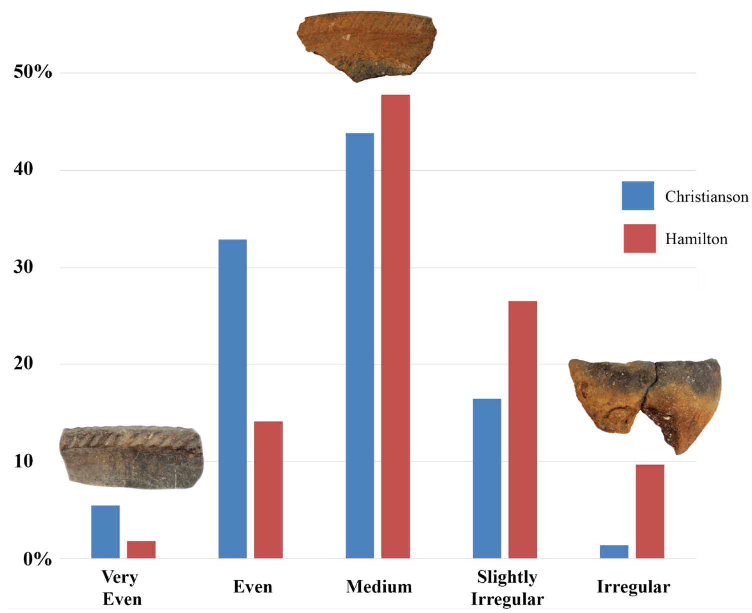

Figure 5.21: Qualitative rim undulation assessment. CHR n=73; Ham n=113.

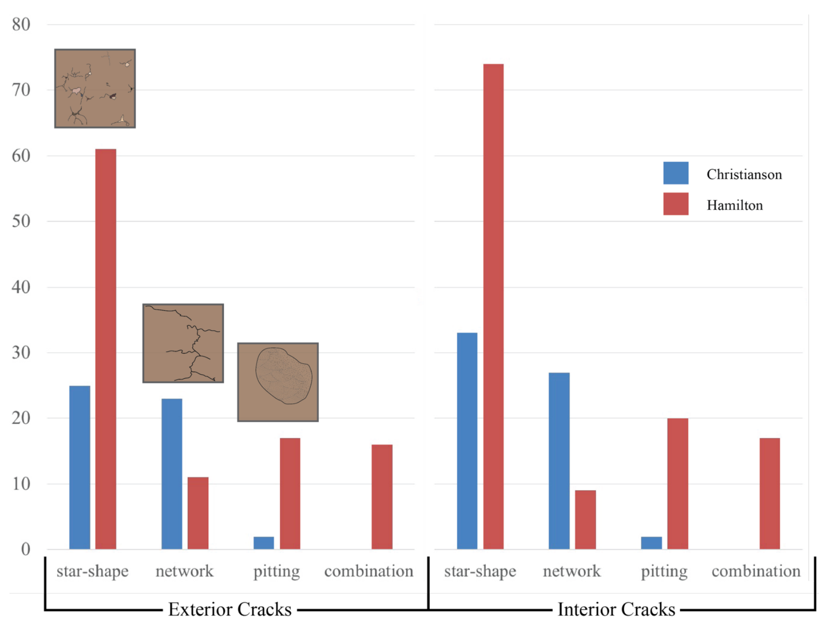

Figure 5.22: Frequency of cracks on sherd surfaces at Christianson and Hamilton. Sample counts, CHR exterior finish =924, Interior finish =885; HAM exterior finish = 426, Interior finish = 396.

Figure 5.22 provides data on levels of technical knowledge among Neutral potters. The Hamilton site exhibits a significantly higher count of cracking and pitting compared to Christianson. The high count of star-shaped cracks can result from uneven drying, where cracks form around an inclusion and these flaws can be accentuated during the firing process (Quinn 2013, 188). During drying, high shrinkage of fine clays can cause cracks and add stresses to the clay body (Rice 1987, 67-68). As such, cracking can also represent an unfamiliarity with clays and tempering materials. For example, the limespalling of calcareous materials can cause cracking (Rice 1987, 67, 98). Therefore, potters at Hamilton may not only be slightly less familiar with raw materials but also with drying processes.

5.4: Data Summary

In this chapter, I showed that the disparate datasets from decorative coefficients of variation, ceramic petrography, attribute analysis, and sherd refiring contributed to a succinct understanding of technical styles within the operational chains at the Christianson and Hamilton sites. I examined the constitution of pastes, the proximal types of clay and temper sources on the landscape, the possible forming techniques, surface finishes, vessel forms and rim profiles, decoration methods and motifs, the firing technology, the spatial distribution of pastes and surface finishes within each site, and finally skill-levels. I found a significant interplay between levels of skill, continuities versus discontinuities, and regimentations versus heterogeneity within and between the two sites. With these results, I can begin to address my research questions which I further elaborate on in the next chapter.

1. What technical styles defined the communities of practice at each site? How were potting communities impacted by socio-demographic turbulence? How were technical styles rearranged, altered, or maintained through time?

There appear to be at least two communities of practice at Christianson, but the boundaries are occasionally ambiguous. These difficult to qualify distinctions result from overlapping practices that suggest some histories of mutual engagement and mixing of traditions throughout the occupation of the village. I define one community of practice by the coalescence of some attributes around the Shell and Mixed 1 paste which include dentate stamping, appliqué decorations, corded body exterior, and more flared and collarless rims. One vessel-type distinction here might include the 'parker festoon' type (small sample of three vessels), that might have been introduced to Christianson with its Shell paste, high neck, and combined decorative motif.[67] The other learning community is defined around Grit pastes which include attributes such as plain/smoothed and burnished exterior bodies, simple or plain motifs, a variety of castellations, slightly shorter necks, and slightly flared or straight rims. At Hamilton, there might be more than one community of practice, but the boundaries are more ambiguous than Christianson. The Hamilton village possesses a greater degree of mixed operational sequences, emblematically evidenced with the higher presence of pastes that I defined on their 'mixed' inclusion-type constitution. However, the presence of a Shell paste, high-collared, convex rim, complex decorative motif, and corded body exterior type suggests a distinct community of practice introduced this form.

Between the two sites, there were many continuities in practice. This continuity included horizontal smoothing or burnishing motions from the neck to lip, vessel forms and size distribution, and slightly flared rims persist in significant frequencies (roughly 50% or more) across pastes. At both sites and across different pastes, potters seem to have used paddle and anvil as a secondary forming technique. The use of coils as a primary technique is present, but its frequency in comparison to other undernoted forming techniques is unclear. Potters at both sites appear to have a strong continuity in the constitution of Grit pastes. They utilized

[67] Number of vessels deduced from different neck heights, firing atmosphere, and surface colour from partially reconstruction sections of vessels.

coarse to medium grained igneous and metamorphic gravels and sands that were occasionally crushed and would all be tied to glacial rather than bedrock features on the landscape. The choice in minerology (felsic, intermediate, to mafic) and texture of these rocks also showed a general continuity. However, potters did adopt Shell at the Hamilton site in a significant way. This change was part and parcel of another significant presence of mixed recipes that contained the same Grit paste minerals with shell and, and in rare cases, mixed grog into either grit or shell-tempered pastes. In addition, all recipes show a preference towards similar types of clays. Although I cannot provide a true provenance for the clays, petrographic data suggest they avoided carbonate bedrock residual clays and subsurface till clays which would likely leave glacially derived clays and/or Queenston Shale deposits as possible sources. All recipes appeared to be part of a similar firing technology that were generally low-fired with low soaking times and put in a consistent mix of either oxygen-rich to reduced atmospheres, occasionally fired upside down.

There were discontinuities through time as Hamilton exhibits a declined routinization of operational chains and greater degrees of variability in practices. Vessels at Hamilton had higher collars and higher necks. At Christianson, plain and burnished surface finishings were predominate among Grit categories while cord-based finishes coalesced with Mixed 1 and Shell pastes. In contrast, Hamilton showed a greater share of cord-based finishings but the Grit, Mixed 1 and Mixed 2 categories possessed greater variability in body finish applications. The Shell paste was associated with a greater mixture of attributes at Hamilton, such as the significant presence of collars. While the presence of no motif applications (plain) elements increased from Christianson to Hamilton, decorative application techniques (e.g. punctate versus incised) seemed more heterogeneous across vessel locations at Hamilton, particularly with a distinctive cording on the exterior rim. Christianson showed a high regimentation of motifs, with oblique or vertical rows dominating the exterior rim application. While these simple motifs maintained a significant share at Hamilton, cording and fingernail impressed represented the introduction of distinctive alternatives, and complex motifs took a more significant share. Hamilton appliqués were also more diverse in their directional orientation. I also found specialty forms at Hamilton such as footed vessels, stemmed/chalice forms, and vessels with attached handles.

2. Were communities of practice at each village reconfigured and/or reproduced by historical contingencies that acted upon smaller social units of production? As such, is there a spatial patterning to technical styles, are they consistent across each site? How does change and continuity play out at intra-community scales?

There appears to be an inconsistent distribution of paste types and surface finish expressions within each site. Middens at both sites appear to have a more consistent variability in tempering and surface finish practices, while household contexts are the locus for significant heterogeneity. Middens may represent more centralized depositions across greater number of social units in each village while ceramic deposition in household contexts may tie production styles and communities of consumption closer together.

Certain households demonstrate alternative tempering and surface finishing techniques that have a minimal representation when taking a village-scale perspective. This can be quite indicative at Christianson's House 1 as it had the highest proportional frequency of Shell, Mixed 1, and corded body exterior at the site. At Hamilton the greater mixing of operational chains plays out through the example of Area D, where most of the pastes are Shell or mixed tempers (Mixed 1 & 2) but 77.7% had plain or burnished exterior surfaces, a pattern that contradicts the Shell and corded exterior correlation. Hamilton's Area E also has a significant proportion of alternative practices with the highest frequency of ribbed paddle applications. Some areas of each site had higher continuities of 'traditional' Iroquoian attributes (e.g. Grit paste at Christianson's MA-1 and MA-2). While Hamilton's House 4 showed the closest continuity to Christianson attributes with a high Grit percentage with plain or burnished exteriors. Therefore, variability in the broader village scale originates from histories at the scale of the household, lineage, or clan social units. These intra-village level scales highlight the discordance among potters within each site, tying change and continuities to different social units within the community.

3. Did the broader turbulent conditions of the 17th century lead to alterations in embodied skills and technical knowledge of Neutral communities of practice? How does skill vary within and between Christianson and Hamilton?

There seems to be slight discontinuity in skills levels from the Christianson and Hamilton sites. There were skilled potters at both sites based on the coefficient of variations in decorative width and their corresponding qualitative assessments. However, there is a greater variation in skillfulness, with a qualitative decline through time in skill. The skillfulness of bodily motions and gestures witnessed through contour and rim undulations suggest a similar pattern, with more potters at Hamilton showing deficient levels of embodied skill. There were decreases in 'very even' to 'even' executions towards increases in 'slightly irregular' and 'irregular' along with an average increase in wall thickness across various paste classes. The frequency of cracks increased through time, indicating a greater unfamiliarity with drying, inclusions types, and clays. These cracks can be congruent with the slight change in firing atmospheres towards reduced cores. This suggests firing times were occasionally shorter or potters had slightly less control over the firings, causing organics to remain in the cores. Therefore, the evidence suggests potting communities through time (from Christianson to Hamilton) experienced a slight reconstitution during socio-demographic turbulence towards a greater contribution from less experienced potters rather than a drastic disjuncture in potting skill. This indicates potters adapted to and managed the demographic trauma of European disease-epidemics and the additional turbulence arising from violence and migration.

Chapter 6: Discussion and Conclusion

6.1: Thesis Summary and Chapter Overview

In this thesis, I pursued an approach that situates the ceramic production of two villages in a Neutral site cluster within its macro and micro-scale contexts of cultural interaction, community reconstitution, and demographic trauma. Through this, I contextualized and re-situated Neutral potting practice within a situated learning theoretical frame that refocused the analytical gaze towards historical processes that not only constituted life histories of potters but reshaped their world of daily experience. I utilized a comparative and diachronic approach that leveraged a sound chronology from European trade beads (Fitzgerald 1990; Kenyon and Fitzgerald 1986; Kenyon and Kenyon 1983), the ethnohistoric record of demographic trauma and movement, the intra-site histories of residential changes in village and longhouse constructions, and a shared geologic landscape to understand changes in technical practices during the dynamic early to mid-17th century.

I suggest that there were material changes in production practices at these sites as the turbulent social and demographic conditions reconfigured values, knowledge, power, and practices among communities in the Spencer-Bronte creek cluster. These practices include the skill, technical styles, and the spatial distribution of these styles across each site. The fine-grained approach of attribute analysis, decorative width coefficients of variation, ceramic petrography, and sherd refiring show the choices potters made and their abilities at executing them skillfully. I found that skill slightly decreased between the two sites and that there was a mix of continuity and discontinuity in technical practices through time. I found that at least two possible communities of practice were present at the Christianson site and Hamilton site. While the boundaries of these communities of practice at both sites appeared slightly ambiguous, Hamilton's operational chains overall appeared more heterogeneous, indicating greater variability, innovation, and experimentation. Additionally, the intra-site patterning indicates conditions of variability and continuity could be the result of micro-histories within the household production unit.

In this chapter, I discuss my results and situate them within a situated learning frame. I propose plausible explanations for how particular sequences in the operational chain changed or continued through time. I argue the importance of fine-grained approaches to ceramic studies in Southern Ontario, and the benefits of re-contextualizing Iroquoian archaeological ceramic assemblages of the 17th century Lower Great Lakes within a historical frame that integrates the turbulence and social dynamism of such periods. Nevertheless, there are also challenges of fine-grained datasets and nuanced theoretical approaches, which I highlight here, and I outline possible future directions for Neutral Iroquoian research

6.2: Communities of Practice in Turbulent Times

Explaining Patterns of Continuity in Technical Styles

Diachronic and spatial variability in potting practices within and between the Christianson and Hamilton sites express a form of 'changing continuity' (Ferris 2009). For ceramic styles, the concept of 'changing continuity' can encapsulate a continuation in 'ceramic grammars' in aesthetics, forms, functional considerations and attributes while allowing for *degrees* of technical style changes and innovations rather than changes in *kind* (Chilton 1998). These continuities included diagnostic sherd surface finish directions, decoration locations, percentages of plain to decorated vessels, similar dominance of 'simple' motif types (obliques/vertical lines), size categories and their relative frequencies, the frequencies of rim angles, similar percentage of collars and their thickness, the use of paddle and anvil as a secondary forming technique, the likely use of coiling, and similar firing atmospheres and technology. I found continuity in pastes, with similar mineralogy, occasional grinding, and glacial origins of the coarse fraction in grit pastes, similar platy consistency of shell pastes, and a similar set of clay types devoid of calcium carbonate inclusions in the fine-fraction.

These broader continuities can be explained in part by peripheral and skilled participants continuing to participate in the learned practices of pre-epidemic communities of potters. These continuities can also be part of the communal or work-group nature of pottery production in Iroquoian societies (section 1.4), where more people participated in the processes of production and had some degree of access to information-flows from full community of practice members (Martelle 2002; Chilton 1998, 157). This would suggest a more 'open' learning system (Crown 2001; Wallaert-Pêtre 2001) that allowed for a greater percentage of the population to possess abstract technical knowledge (e.g. what are the best type of temper deposits) rather than exclusionary withholding of knowledge by potting 'masters' in closed learning systems (Crown 2001, 2016). Therefore, those on the periphery may have retained enough technical knowledge to take up the craft, albeit with minimal training, as might be indicative of the slight decline of skill into the Hamilton site. Surviving vessels, the curated pots or sherds, may have reified the prominent "ways of doing" by the pre-epidemic, and then deceased, former community of practice members. As such, old pots may have served as reference point for emulating ways of doing or (re)negotiating meanings for the emergent and reconstituted community of practice (Wenger 1998, 57-71).

Alternatively, the movement of potters from other localities into communities of production in the Spencer-Bronte creek cluster may have supported continuities if locals and migrants (e.g. captive, refugee, choice of residential relocation) were part of a shared constellation of practice (Wenger 1998, 126). Migrants and locals might have previously experienced diffuse connections through legacies of shared regional histories, and experienced occasional bridging through contributions of brokers and shared forms (Wenger

1998, 126-127). Thus, the movement of migrants from these more diffuse networks of interaction and historical legacies might share many commonalities in practice and make migrants methodologically "invisible" if their socialized ways of doing had many shared practices with the "native" community members.

Distinct Communities of Practice

It appears that there might be two (or more) different learning communities at each site as a few operational sequences were more clearly differentiated. These were difficult to identify as both sites have quite variable operational sequences. But at the Christianson site, grit and shell paste vessels appear to have a greater degree of difference compared to the boundaries I used to define the possibly distinct communities of practice at Hamilton. The exact materializations of alternative communities of practice was unique to each, suggesting separate movements (at least two different migrations) of different learning communities into each site. The introduction of alternative motifs such as the 'parker festooned combined decorative pattern' at Christianson and the 'triangular plat/complex motif' at Hamilton highlight different episodes of motif adoption, with their own potential set of meanings. These meanings that may have been internalized and interpreted within local traditions, values, and historical contexts.

Conditions of Variability in 'Changing Continuities'

Between the Christianson and Hamilton sites there were also discontinuities in technical styles. This included an increase in Shell and Mixed 1 pastes, cording (smoothed & roughened) body sherd exteriors, convex rim types, higher necks and collars, applications of alternative decorations (e.g. cording, fingernail impression) on the rim and lip, and plain rims. Hamilton also exhibited a greater diversity or a reduced degree of regimentation through the addition of Mixed 2 pastes, decoration application types across vessel locations, neck appliqué orientations, and of rim types across vessel size classes.

This diversity is part of additional patterns of mixing along operational sequences that start in Christianson but are more pronounced at Hamilton. The Mixed 1 paste and the presence of grog at Christianson exemplify a type of occasional experimentation with mixing 'standard' grit minerals and sources with alternative inclusions together. The frequency of Mixed 1 increased, and the additional presence of Mixed 2 occurs at Hamilton. Additional patterns show greater mixing, as Hamilton grit sherds are more variable in exterior surface finish compared to Christianson.

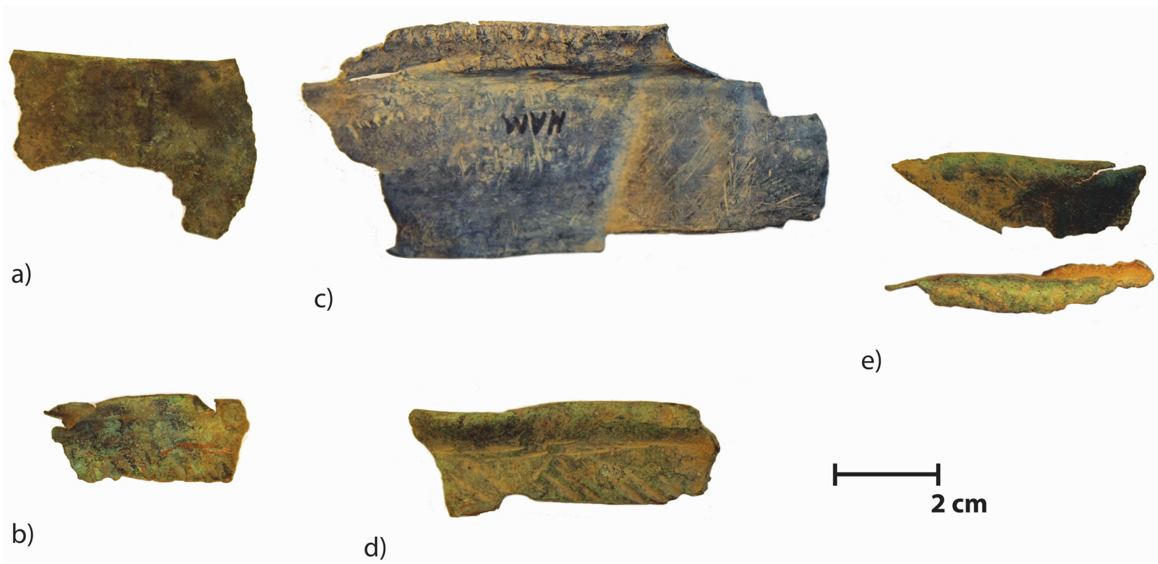

Figure 6.1: Decorated scrapped kettle rims. a, b = Christianson. c-e = Hamilton. Note the comparisons to ceramic decorative motifs: a, analogous to square dentate stamp seen in Appendix B Table B.12 code 36; b + d, right oblique analogous to Table B.12 code 3; c, analogous to vertical linear impressed Table B.12 code 1. e, lip right oblique analogous to Table B.13 code 4.

Hamilton also has a greater diversity of specialty forms such as stemmed/chalice vessels, and footed vessels. These vessels suggest emulations of or movement of vessels from the Ohio Valley (Drooker 1997; Griffin 1943). The stemmed/chalice vessels in particular, might also represent local ceramic copies of Jesuit Catholic chalices (Latta 1987, 1990). The presence of kettles at Christianson and Hamilton is evidence of a European trade connection in which Neutral Iroquoians integrated foreign forms and materials into local patterns of technical styles, functions, and values. Some kettles were altered with common local decorative elements on the traditional area for pots, such as the rim (Figure 6.1). These kettles and ceramic variations suggest potting choices might have been part of emergent communities of practice open to experimentation and alternatives to traditional forms, representations, and styles. With this affordability to utilize and produce alternatives, a potter's choice to deploy different ceramic styles might have been influenced by more than associated meanings, but also by consumption practices and foodways. As an example, metal kettles would have altered cooking and serving practices while imparting a different residual taste (Martelle 2004, 37-38). As such, the emergence in conditions of variability at Hamilton would be constructed in relation to a broader set of entanglements in practice that might have also gone through transformations in regimentation, variability, and alternatives.

6.3: Alterations and Continuities of Skill

My third question focuses on the impact of European-disease epidemics on the skill of pottery production. The techniques of hand-made pottery production, including coiling, require a significant period of time to learn forming motions and motor habits (Arnold 1985, 203-208). Clearly a dramatic demographic change from European-disease epidemics, which impact learning structures, would impact such motor habits. However, changes in skill can be difficult to interpret as there are no clear definitive boundaries of what a vessel should look like if it was made by a master potter versus a novice. Even life-long part-time specialists can have variability in their production (DeBoer 1990, 80). As such, skillfulness can rather fall on a relativist scale, on a continuum of what can be defined as more skillful versus less skillful in Iroquoian ceramics. The decorative width coefficients of variation, wall and rim evenness, sherd thickness, and frequency of cracking do indicate a slight decrease in embodied and technical knowledge from Christianson to Hamilton.

Hamilton communities of practice were likely constituted by some novice potters, and continuities in some technical styles suggest those on the periphery, such as members of the household or clan workgroup, were likely the ones to take up the craft.

Although Hamilton had a slight increase in unskilled executions across various stages, Christianson also had some unskilled or learning practitioners participate in the craft. This pre-epidemic site had occasional irregular and slightly irregularly formed vessels, and 14.5% of their decorative width C.Vs ranged from 21-34.8%. It seems learners and unskilled persons likely participated in some steps of production as well, representing some degree of open learning (Crown 2001, 463). Therefore, the select apprentices with a natural talent, and perhaps other types of peripheral participants (e.g. persons helping as part of a work-group), had some latitude in their creative expression while learning and engaging with the craft.

There was also some degree of continuity in skillfully made pottery between the two sites. A narrative of "collapse" from these socio-demographic processes is therefore inappropriate. Two scenarios may explain the continuity: 1) if there were demographic coalescence factors (post-epidemic coalescence of refugees and/or captives) then this might have led to a skill-pooling, where a similar pre-epidemic organization of production was maintained around a smaller set of potters for a greater number of consumption communities and/or 2) some skilled potters survived, continuing to produce pottery skillfully, perhaps accepting, as a community of practice, more "expedient" production, and worked with the next generation of unskilled workgroup members at the periphery. But these skilled potters that survived might have been disproportionately young adults rather than elders.[68]

[68] European-disease epidemics disproportionately increased infant and elderly mortality as the most immunologically vulnerable age groups of a population, but the overreactive immune responses of the least vulnerable (adolescents and young adults, 15-30) can coincidentally lead to their higher mortality rates as well (Warrick 2008, 235).

6.4: 'Interpretive Possibilities:' Explaining Patterns in Technical Styles

My findings suggest that the socio-demographic turbulence in the early Contact period led to an increasing movement away from regimentations in communities of practice. This perhaps indicates a reduction in the more structured social boundaries that had previously produced greater degrees of material homogeneity in potting communities. This process of heightened variability within operational chains appears more evident at Hamilton than Christianson, possibly indicative of the most turbulent years and greatest demographic reconstitutions. This is a difficult direct causal relationship to make from these ceramic patterns but considering the dynamics within communities of practice along with the ethnohistoric record (section 1), and settlement patterns (e.g. house/village expansions, section 3), provide some possibilities.

There likely was a greater number of brokering agents (Wenger 1998,10), through the movement of persons, connecting potters with different traditions. This possibility can draw an analogy to Steven Shackley's (2000) study on the individual history of learning (worked through stone-tool traces) and social identity of Ishi, a native from the Lassen foothills of California that arrived at the University of California in 1911. Shackley (2000, 709) concluded that Ishi was "a Wintu/Nomlaki-Yahi boy [who] learned to produce projectile points as a Wintu/Nomlaki but lived the life of a Yahi in the Lassen foothills [where he continued to produce stone-tools in the Wintu/Nomlaki tradition] until no more Yahi remained." Ishi's example can suggest that the movement of individuals includes the movement of learning histories that may provide affordances for brokering in different ways of doing into their host communities if they produce a craft in mutually engaging social spaces. These processes afford possibilities for experimentation and the mixing of traditions. For example, the presence of Fire-Nation captives would create unintended consequences of technical styles, where these 'foreign' potters could intertwine some of their alternative production practices with local operational chains or continue to produce pottery in their own ways of doing (Cameron 2011, 2013). Many vessels may very well be copies of what immigrants and/or captives produced in their homelands in spite of potential social pressures to conform to local potting traditions (Cameron 2011, 187; Gosselain 2008, 2016). This might be evidenced by the greater degree of separation in operational sequences between grit and shell vessels at the Christianson site. While the greater variability and mixing of production chains at Hamilton suggest a history integration and 'mixing' of formerly sequestered communities of practice, the occasional presence of two or more communities of practice at Hamilton still highlights the possibility for separate histories of population movement.

The loss of skilled practitioners and the wider continuum of skill and knowledge at Hamilton may not only lead to changes in how particular production practices are executed but their loss of old-timers in potting communities can be a compounded contributor to disruptions in learning contexts, playing a part in 'stylistic drifts' in which peripheral learners continue to experiment without regimented learning and structure (Hardin and Mills 2000). This would be part of a movement towards a greater "open" learning system as these systems are shaped to respond to unstable situations and to develop within unknown situations (Wallaert-Pêtre 2001, 482). As such, the continuities and discontinuities in technical styles parallel components of an increased "open" learning system that, by allowing greater access to production knowledge, also allows for variability during disruptive contexts.

These contexts of experimentation would also have played out at lower-social scales, such as household units. Some households and middens at each site exhibit greater percentages of alternative practices (e.g. Mixed 1 or 2 pastes), some had a greater degree of variability in the operational chain, while others have a strong consistency with 'traditional'

Iroquoian attributes (e.g. grit & smoothed body). These patterns might have formed through Iroquoian social practices that produce possibilities of brokering agents to act upon these household scales of daily life. This can include "assimilative" adoption which incorporate people into matrilineages and clans (Engelbrecht 2003; Peregrine 2008; Richter 1983), "associative" adoption (Lynch 1985) that allowed for communities or households to retain former identities, and additional forms of in-group residential mobility that may be present within nations and confederacies (Engelbrecht 2007). Experimentation with, or incorporation of alternative ways of doing can also be accepted or rejected at individual, family, or household levels (Ferris 2006, 44-45) or reflect household socio-political and economic ties to different places. The latter cause can be similar to Ramsden's (2016) conclusions on ceramic patterning at the 16th century Wendat Benson site. Greater regional networks meant greater access to alternative vessel morphologies, such as noted in the presence of specialty forms, and increased use of handles at Hamilton, reflecting greater regional ties to ways of doing by bridging to additional constellations of practice.

Shell-temper

The presence of mixed shell and grit pastes and the increasing frequency of shell-temper may be accounted for by the greater integration of shell-temper in local technological systems leading into the occupation of the Hamilton site. We might understand this pattern if we first take into account the special technical knowledge required for calcitic tempers, techniques that local Iroquoians would have had little experience with before the Proto-Contact period. Shell firing regimes and temperatures at both sites appear to be the same as firing technologies of other pastes. Potters might rely on a pot's colour during firing to determine when to pull a shell-tempered pot out of the bonfire (Rice 1987, 157).[69] This might

[69] The glow of a hot pot to a red heat hue is visible in daylight at 550-625ºC (Rice 1987, 157), which is below the temperature risk of limespalling. Modern Wyandot potter Richard Zane Smith has been working

be a product of migrants coming from a shared constellation of practice (as mentioned above) in which both 'native' and 'foreigner' employed similar firing technologies. This would also allow Neutral potters to adopt shell into local technical systems of production. Additionally, shell-temper would have been present in the region and locally produced since at least around A.D. 1600-1624/30 at the Christianson site, with a potential earlier history with the paste back to the mid-late 16th century in a possible ancestral community in the Southwestern edge of Ontario (Foster 1990; Lennox and Fitzgerald 1990, 418). This might have brought shell-temper into many different potters' daily set of experiences and histories of learning. With some vessels, mixing shell with grit, or using shell in a greater frequency might not represent a significant disjuncture in potting styles. Rather, it might reflect the blurring boundaries of practice, with potters drawing on their repertoire of knowledge and producing vessels with alternative arrangements in the production sequence.

Grit, Shell and the Landscape

My assessment of grit pastes did show that potters continued to utilize an almost identical minerology and set of rock types, with mixed recipes showing potters occasionally drawing on both traditions of temper types. Regimentation in rock types for grit recipes and their continuity of use through time suggests a shared knowledge of the glacially formed landscape and perhaps more recurrently visited sources. Potters likely accessed their shell-temper from along the extensive creek systems from which these villages collected mussels (Fitzgerald 1981; Lennox 1977; Stewart 2000). This represents a shift in raw material acquisition and knowledge in relation to the landscape, particularly at the Hamilton site. Raw material

at reviving ancestral Shawnee shell-tempered pottery. He similarly suggests that to fire shell-tempered pots he puts the vessel in a bonfire until it reaches a red heat temperature and then he lets the pot cool by the fire (Smith 2017, personal communication).

choices on the landscape involve a socialization with the local environs, that can be imprinted with cultural meaning and knowledge that is shared among a community of practice.[70]

An additional causal variable might concern changes in daily movement, a component of impacted lifestyles and responses to socio-demographic turbulence. Communities in the Spencer-Bronte Creek cluster might have circumscribed village activity from the risks of warfare and raiding, encouraging a localization in production and raw material acquisition [for such a case, see Stahl et al.'s (2008, 378) study of ceramic provenance and consumption in western Ghana]. Villagers in the Spencer-Bronte Creek would have been aware of potential violence initially from the Fire Nation and later from the Haudenosaunee. If captives were held at the sites, an ever-present risk would have been of captive escapes and thus loss of labour (Peregrine 2008, 229; Starna and Watkins 1991, 42-49). Indeed, the movements of these more subordinate village inhabitants may have been circumscribed under new conditions of power. Thus, a pressure of circumscription might occasionally encourage the collection and use of shell from nearby streams as a ceramic raw material, drawing upon their repertoire of possible action to accommodate these new circumstances. Without a broader study covering the variety of daily activities on the landscape from multiple lines of inquiry, then any accounting of circumscription is only an interpretive possibility

6.5: Future Directions & Contributions

Comparative Approaches and Alternative Collections

[70] This can involve specific place names that are tied to symbolic meanings, legend, history, or even mundane happenings (Roddick and Klarich 2013, 115-117). Although divorced by time and ethnolinguistic background, Augustus Jones' (Deputy Provincial Surveyor) survey of the Hamilton area in the 1780-90's illustrates a possible analogy for Neutral Iroquoian place-naming. He defined and translated Mississauga names of places and connected them to their Euro-Canadian place name. For example, *Mos squa waunh*, translated as, "salt lick where deer resort," was/is called 40 Mile Creek by Euro-Canadians. *Carry gusegunoceloning* which Jones translated as "place where a small kind of turtles laid their eggs," which Euro-Canadians now identify as the Red Hill Creek (Jones 1796).

In this thesis I applied fine-grained methods to understand ceramic manufacture, which is rare in proto- to contact-era Neutral archaeology. Future work comparing 16th and 17th century Neutral sites could address a wide range of research questions. For example, researchers might focus on shell-temper in other sites from the Spencer-Bronte cluster. Questions of captive migration could be addressed by comparing these findings with assemblages in Ohio, where some scholars suggest Indian Hills Phase Sandusky tradition ceramics are "indistinguishable from that observed on contemporary Spencer-Bronte Creeks sites" (Lennox and Fitzgerald 1990, 419). Such claims require detailed analysis into production practices, where archaeologists can identify a community's shared way of doing (Gosselain 2008).

One of the greatest difficulties in this thesis concerned vessel morphology. Rim profile angles are the usual indicator of form in fragmented assemblages but may provide only a partial understanding of the complete vessel. Moreover, specialty forms that archaeologists (Kenyon 1982; Ridley 1961) identify from ossuary and cemetery contexts (e.g. double mouthed vessels) may be obscured in village contexts due to the friability of Late Woodland ceramics. Nevertheless, I did find a range of neck heights and neck constrictions, flaring, and shoulder carination, suggesting forms beyond those depicted by Lennox and Fitzgerald (1990, 416). With the presence of such additional forms, future research into Neutral ceramics might benefit from a new regional synthesis of vessel morphology, one that describes the variability of vessel shapes and attribute expressions across 17th and 16th century contexts.

Complete diagnostic forms typically come from ossuary contexts (e.g. Grimsby cemetery, Kenyon 1982), contexts which deserve careful ethical considerations and consultation with descendent communities. Sustainable Archaeology houses some partially reconstructed vessels from village contexts.[71] Future studies may consider leveraging the ways collectors still engage with Neutral archaeological sites in the Hamilton region. Ontario's *Greenbelt Act* (2005) ensures that incompletely excavated and surveyed sites largely remain under active agricultural production in the Hamilton area (section 3.2). Four different property owners in Hamilton's Flamborough, Glanbrook, and Binbrook[72] communities have told me that collecting Neutral artifacts, and occasionally reconstructing ceramics, continues to be a biannual activity, at either end of the agricultural seasons. By engaging with this misguided, but interested, public (and reporting serious offences)[73] archaeologists can perhaps help maintain the integrity of these Neutral sites for the future and bring to light the assemblages that have been stored away in private homes. This process should involve a collaboration with descendent communities, such as the Six Nations of the Grand River, to establish appropriate frameworks for recording, preserving, and using these collections. As such, archaeologists should not encourage dubious and illegal (Ontario Heritage Act, R.S.O. 1990, c. 0.18) collecting practices, but these collections are continuously growing and should not be ignored.

Challenges in Operational Sequence Approaches and Fine-Grained Methodologies

In this study, I analysed assemblages associated with specific times and spaces, collections ideal for fine-grained approaches to socio-demographic processes of turbulence. Similarly, future approaches to Lower Great Lakes archaeology should be shaped by the questions and analytical scale of the project. Detailed methodologies may not suit all project designs. They can impede larger scales of analysis (in space and time) because they are costly

[71] These reconstructions were likely from the initial excavation work on these Neutral sites. A photo collection from the property owners of the Christianson site show students and researchers gluing together sherds on site in the 1960's and 1970's.
[72] This would be from the Upper Twenty Mile Creek site cluster (Figure 1.2).
[73] Serious offences might include mass looting, selling artifacts, and cemetery/ossuary desecration as these activities have meant legal ramifications for looters in the past (Fox 1985).

in research-hours. As such, researchers may use a less-detailed approach to address larger-scale questions while interpreting their finding through socio-theoretical frames. For example, I employed multi-attribute and operational chain approaches instead of a typological one. However, the analytical construction of certain vessel types does not necessarily conflict with relational and historical theoretical frames because, in certain circumstances, communities of potters can produce meaningful categories that are associated with particular socio-technical meanings and/or consumption practices (Eckert 2012; Roddick 2016, 131-132; Wenger 2002).[74] Thus archaeologists can recognize the potential existence of conceptual boundaries in ceramic forms and use, while understanding these boundaries may have been open to subtle adjustments. As such, archaeologists can deploy these distinct forms and types in analysis while selectively prioritizing additional attributes to be examined.

As I illustrated in this study, petrography provides data on paste preparation, forming, and firing temperature which complements additional attribute assessments, while the broader literature also stresses its usefulness for addressing provenance and exchange (Quinn 2013; Reedy 2008; Stoltman 1989). As a specialized methodology, petrography requires an intensive learning regimen and involves a significant amount of time to collect and process data. This can create a barrier for its research applications within a broader operational chain program of analysis. Alternatives to petrography can address similar questions on paste even with the challenge of precise inclusion-type identifications (e.g. rock types) in low-fired and mixed atmosphere Late Woodland ceramics. Handbooks for macroscopic observations (Orton and Hughes 2013 Appendix 1) and light reflective imagery of fresh-breaks (on sherds), such

[74] For example, researchers associate 16th and 17th century Wendat "canoe" vessel types (small globular squat double handled vessels with a single castellation) with transportation, as a travel vessel used to cook food while traversing long distances (Latta 1991, 379-381; Martelle 2004, 27-28).

as the Dino-Lite digital USB microscope, can be used to address broader strokes in paste choices such as dominant minerals and texture (Druc 2015).

Researchers have shown the benefits of macroscopic approaches in other contexts (e.g. Highland Bolivia [Rivas-Tello 2016]) and in Ontario (Mather 2015). Our understanding of Ontario's geological landscape (e.g. Barnett 1991; Chapman and Putnam 1973), coupled with petrographic findings in this study and others (Braun 2010, 2012, 2015; Holterman 2007 Appendix 3; Striker et al. 2017), suggests Late Woodland mineral-pastes typically consist of coarse-medium grained igneous and/or metamorphic rocks and sands. As I found the overarching grit and shell categories obscure finer sets of choices, my formulation of mineral colour-texture classes (section 4.3.1) can be a useful way to define broader strokes of paste data across a larger macroscopic assemblage in Ontario Late Woodland contexts. This may allow for higher scales of analysis while understanding paste types and their frequencies can be historically contingent. Future researchers using these macroscopic approaches might also examine for the possible presence of grog, and the rare presence of limestone temper that petrographic analysis revealed at the Wendat Mantle site (Striker et al. 2017, 60). Petrography is, therefore, pertinent to finer-grain questions and is revealing previously unrecognized/ underrepresented alternative practices (e.g. grog, mixed shell & grit pastes in this study). However, the use of macroscopic assessments can not only be more accessible to a wider number of non-specialists, but also aid in our understanding of historically sensitives changes and continuities in technical choices and help infer ceramic use (Rye 1976; Tite et al. 2001).

Alternative Perspectives and Methodologies

This thesis proposed a recontextualization of ceramic production within a demographic and social context of 'turbulence' that can define the 17th century Lower Great lakes. This historical reframing aligns with current research trends in Iroquoian archaeology where scholars are moving beyond culture-historic approaches (e.g. Braun 2015; Hart and

Engelbrecht 2012; Hart et al. 2016; Ramsden 2016). I have contributed to work into the "materiality" of the Iroquoian contact period (Martelle 2004, 24), a comparative research program to trace change and continuity in material practices through space and time. Specifically, I demonstrated the strength of petrography and a multi-attribute system to examine the dynamics of ceramic practices.

The Neutral are an example of the community rearrangements and emergent power dynamics that accelerated through the mid to late 17th century (Starna and Watkins 1991; White 1991). This is most evident in the post-1650 A.D. Haudenosaunee conquests that created multi-ethic communities (and often contained captives) across the Lower Great Lakes who were immersed in an expanding regional and Atlantic exchange network (Engelbrecht 2003; White 1991).[75] These would be profound times when social boundaries and practice could be renegotiated in emergent social spaces. For example, Blau (1966) suggested the False Face Society, typically connected to the Haudenosaunee, may have originated among the Wendat during the 1630's epidemics which they shortly introduced afterwards as captives and refugees. Similarly, Engelbrecht (2003, 163) suggests Wendat captives in 1657 reintroduced pottery to the Mohawk (who previously ceased ceramic production), while Bradley (1987, 122-123) claims 'Wendat' and 'Neutral' material culture is visible in Onondaga territory from the mid-17th century. As such, my assessment of the Neutral ceramic changes and continuities underscore the possibilities with understanding the conditions of material production as the late 17th to early 18th century Iroquoian communities of the Lower

[75] These multi-community amalgams included resettlements of the North shore of Lake Ontario, around the South-West head of Lake Ontario and around the South-western edges of Lake Erie while also including an integration of populations into the communities and traditional territories of the Haudenosaunee in New York State (Ferris 2009, 118; Garrad et al. 2003; Lajeunesse 1960; White 1991).

Great Lakes increasingly experienced similar socio-demographic patterning within a centuries-long maintenance of settlement-subsistence lifestyles (Ferris 2009).

Understanding the conditions of daily life and the reconfigurations in values, knowledge, and power during the transformative demographic and socio-historical processes of the 17th century can benefit from fine-grained archaeological analyses. This study provided initial steps for understanding these conditions through a comparative approach. Since the first site syntheses several decades ago (e.g. Fitzgerald 1981; Lennox 1977, 1984a, 1984b; Noble 1972, 1980b; M.J. Wright 1977), very few scholars have used these proto-Contact to early-Contact-era Neutral ceramic collections other than the rare single-site study taken up over the years (e.g. Holterman 2007; Pawlowski 2005). These collections offer archaeologists the potential for fruitful research pursuits to establish a culture for sustainable archaeological practices in Ontario through the application of social archaeological frameworks and fine-grained methodologies.

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Appendix A

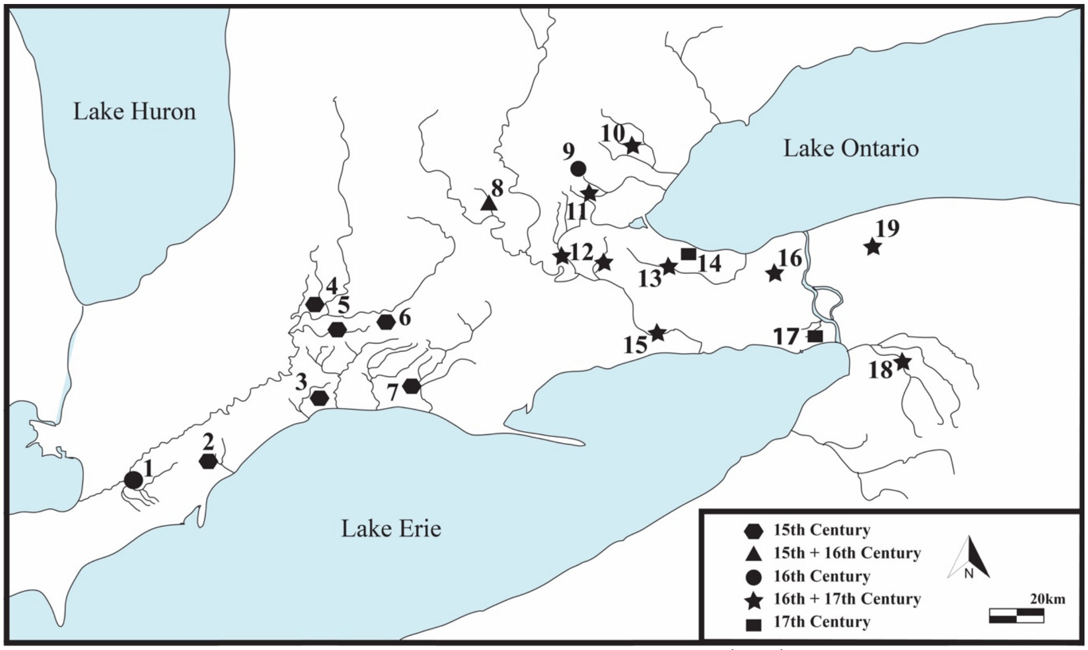


Figure A.1: Iroquoian site cluster locations South-Western Ontario, 15th-17th century. Redrawn from Lennox and Fitzgerald 1990, 406.
1, Central Chatham-Kent**;** 2, Clearville, East Chatham-Kent; 3, Southwold, Elgin County; 4, London cluster; 5, Dingman Creek cluster; 6, Harrietsville, Whittaker Lake community (Pearce 1996); 7, Catfish Creek Cluster; 8, Kitchener Cluster; 9, Upper Bronte Creek; 10, Milton cluster; 11, Spencer-Bronte Creek Cluster; 12, Fairchild-Big Creeks Cluster; 13, Upper Twenty Mile Creek Cluster; 14, Grimsby; 15, Lower Grand River; 16, Eastern Niagara; 17, Onondaga Escarpment; 18, Niagara Frontier, Buffalo; 19, Niagara Frontier-Huron Plain

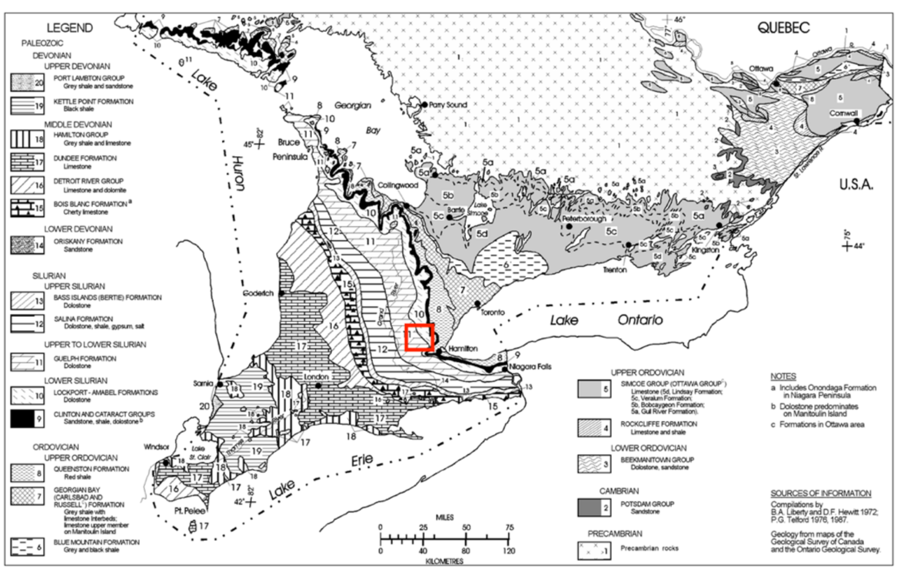


Figure A.2: Geologic bedrock of Southern Ontario. Study area is marked in red (From Marich 2010, 32).

Site	Cultural Association	Location	Time (A.D.)	Shell Temper %	Sample Count[a]	Site Type	Source
Raymond Reid	Ancestral Neutral	Spencer-Bronte Creek Cluster Flamborough, ON	early 16th cent.	0	min. 72 rims	Hamlet	Fitzgerald 1984
Wolfe Creek	Ancestral Neutral	Chatham-Kent, SW Ontario	16th cent.	16.8	3101 body	Village	Foster 1982, 1990
Buddy Boers	Ancestral Neutral	Spencer-Bronte Creek Cluster	c.a. 1500-1580	0	1439 sherds	Village	MPP 1989b, Fitzgerald 1990
Hanes / Zap	Ancestral Neutral	Spencer-Bronte Creek Cluster	16th cent.	0.3	695 sherds	Village	MPP 1989b, Fitzgerald 1990
Crawford Lake	Late Iroquoian	Milton, ON	15th-16th cent.	0	116 vessels	Village	D. Smith 1987
Antrex	Middle Ontario Iroquoian	Mississauga, ON	13th cent.	0	1299 sherd 87 vessels	Village/Hamlet	Braun 2010
Mantle	Ancestral Huron-Wendat	Stouffville, ON	c.a. 1500-1550	0	1992 vessels	Village/Town	ASI 2012
Holly	Ancestral Huron-Wendat	Barrie, ON	ca. 1290-1305	0	326 vessels	Village	Braun 2015
Serena	Middle Iroquoian	Hamilton, ON Red Hill Creek	ca. 1350	0	1764 sherds	Village	ASI 2004
Clearville	Ancestral Neutral	Chathem-Kent, SW ON	Post 1500	0	47 rims, 73 body	Village/town	Foster 1990
Southwold	Ancestral Neuttral	SW ON	ca. 1500	0	n/a	Village	D. Smith cited in Foster 1990
Lawson	Ancestral Neutral	London cluster	ca. 1500	<0.01	14000 sherds	Village	Wintemberg 1939 cited in Foster 1990
South Park	Late Whittlesey Tradition	North-Central Ohio	Late 15th - Early 17th cent.	21	29 rims	Village	Redmond and Ruhl 2002; Brose 2001
OEC 1 SITE (33CU462)	Late Whittlesey Tradition	North-Central Ohio	1476-1642*	71.2	708 sherds	Village	Redmond 2009
Muddy Creek	Sandusky - Fort Meigs & Indian Hills Phase	North-East Ohio	c.a. 1490 ± 80*	100	14 sherds, 5 vessels	Camp	Stothers & Abel 1991
Peterson	Sandusky - Indian Hills Phase	North-East Ohio	c.a. 1550-1643	100	n/a	Village	Stothers & Abel 1991; Abel 1999
Libby-Miller	Sandusky - Wolfe Phase	Wallaceburg, ON	late 15th - early 16th cent.*	31.6	n/a	Camp	Ferris, Fox, Murphy 1990
Liahn	Sandusky - Fort Meigs Phase	Dover, Chatham-Kent, ON	16th cent.	12.5	8 vessels	Camp	Kenyon 1988
Plus Site	Ancestral Cayuga	South-East Cayuga Lake, NY	late 14th cent.	0	176 sherds 5 vessels	Camp	Stothers & Abel 1991

Table A.1: Sites, dates, and shell-tempered assemblages within A.D. 1280-1580. Non-shell recipes include sand and rock-based pastes.

[a] Samples are of various descriptions. Sherds = undistinguished difference between sherd type. Vessels = treatment of paste type on a partially reconstructed vessel. * Radiocarbon dates. Occupation within date range. ON = Ontario; NY = New York State

Site	Cultural Association	Location	Time (A.D)	Shell Tempering %	Sample[a]	Site Type	Reference
Fonger	Neutral	Fairchild-Big; Brant + Ancaster, ON	1580-1610	3	876 sherds	Village	Warrick 1983; Holterman 2007
Walker	Neutral	Fairchild-Big	1626-1640	4	3991 sherds	Village	M.J. Wright 1977
Stratford/ Misner	Neutral	Fairchild-Big	ca. 1600-1650	5	n/a	Village	Fitzgerald 1990
Carlisle	Neutral	Spencer-Bronte Creek Cluster; Flamborough, ON	1580-1600	0	6+ sherds	Hamlet	Kenyon 1986
Christianson	Neutral	Spencer-Bronte Creek	1615-1632	14.9	6153 sherds	Village	Fitzgerald 1981, 1984
Bogle I	Neutral	Spencer-Bronte Creek	1630-1641	16.7	246 sherds	Hamlet	Lennox 1984b
Bogle II	Neutral	Spencer-Bronte Creek	1640-1651	63	216 sherds	Hamlet	Lennox 1984b
Freelton	Neutral	Spencer-Bronte Creek	c.a. 1640	32.2	769+ sherds	Village	Macdonald 1991
Hood	Neutral	Spencer-Bronte Creek	1630-1641	27.4	1655 sherds	Village	Lennox 1984a
Hamilton	Neutral	Spencer-Bronte Creek	1640-1651	64.2	4845 sherds	Village	Lennox 1977
Thorold	Neutral	Thorold, ON	1620-1640	1	n/a	Village	Noble 1980a
Borscok	Neutral	Lower Bronte Creek	ca. 1635-1650	7	n/a	Village	D.R. Poulton and Associates 1993
Fradenburg	Neutral	Lower Grand River	c.a. 1620-1630	2.9	315 sherds	Village	Poulton et al. 1996
Peterson	Sandusky - Indian Hills Phase	North-West Ohio	c.a. 1550-1643	100	min. 9 rims	Cabin	Stothers & Abel 1991
Indian Hills	Sandusky - Indian Hills Phase – Fire Nation	North-West Ohio	1600-1643/4	97.9	665 vessels	Village	J. Graves 1984
Ball	Huron-Wendat	Huronia; Simcoe County, ON	1580-1610	0	390 vessels, 787 sherds	Village	Martelle 2002
Auger	Huron-Wendat	Huronia	1615-1630	0	121 vessels, 285 sherds	Village	Martelle 2002
Ossossané (BeGx-25)	Huron-Wendat	Huronia	term. 1635	<1	262 vessels	Village	Hawkins 2001
Thomas-Walker	Huron-Wendat	Huronia	1624-1640	0	75 pots 121 sherds	Village	Martelle 2002
Sidey-Mackay	Petun	Nottawasaga Township, ON	1580-1600	1.2	424 rims	Village	Wintemberg 1946 in Garrad 2014
MacMurchy	Petun	Nottawasaga Township, ON	1595-1615	<0.1	1646 rims	Village	Bell 1953 in Garrad 2014

Table A.2 Sites, dates, and shell-tempered assemblages of Neutral and Lower Great Lakes contexts. Proto-Contact to early Contact-era (AD 1580-1650)

[a] Samples are of various descriptions. Sherds = undistinguished difference between sherd type. Vessels = treatment of paste type on a partially reconstructed vessel.

* Radiocarbon dates. Occupation within date range.

ON = Ontario

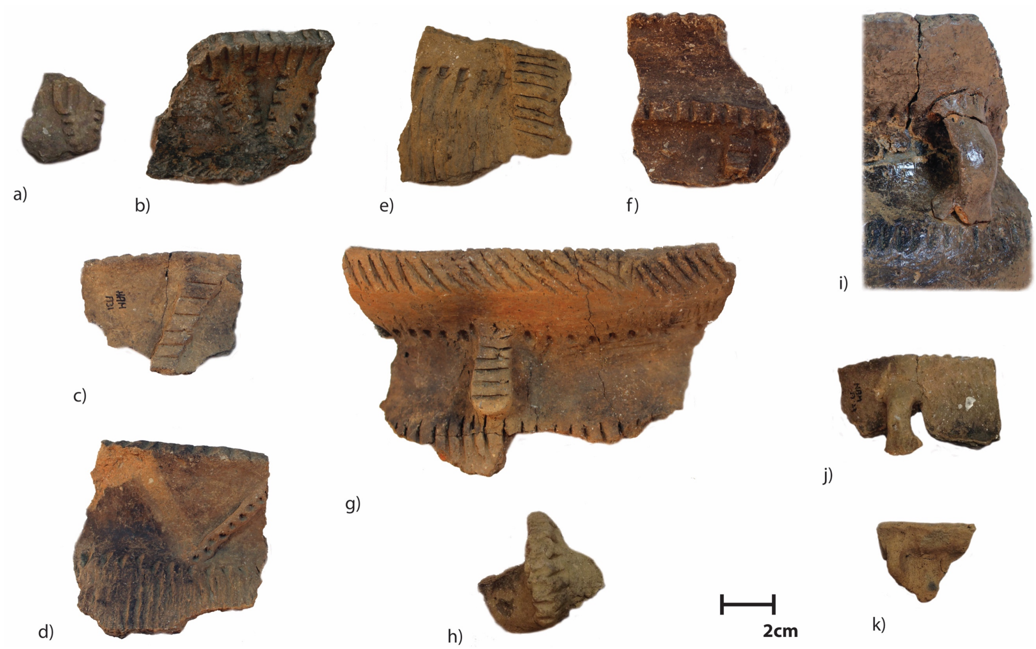


Figure A.3: Clay applied decoration and handle examples. a-b, Christianson; c-k, Hamilton. a-f, applied appliqué clay. d=applique scar, indicating the application of a clay band on top of the vessel surface. g-h, variety of lugs. i-k, handles. i-j, free hanging handle. k, attached handle.

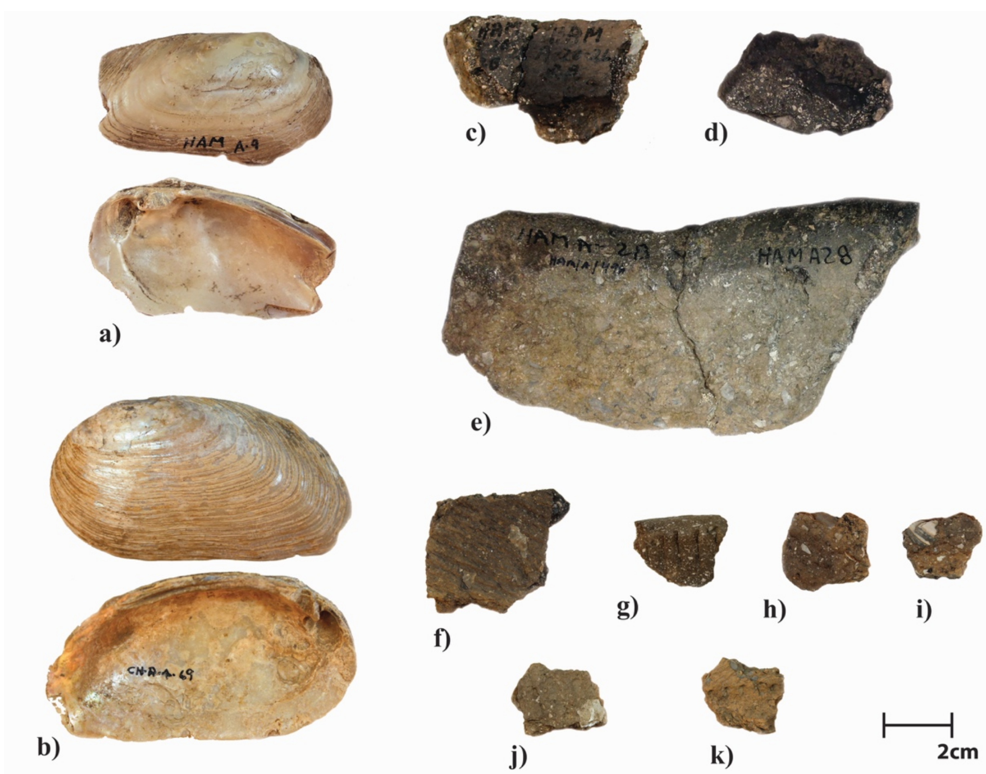


Figure A.4: Freshwater bivalves and shell-tempered sherds; a-b unionidae, genus elliptio shell (Identified by Fitzgerald 1981; Lennox 1977). c-k, shell tempered examples at Christianson and Hamilton that show visual affinities to freshwater bivalves. b, f-k, Christianson. a, c-e, Hamilton.

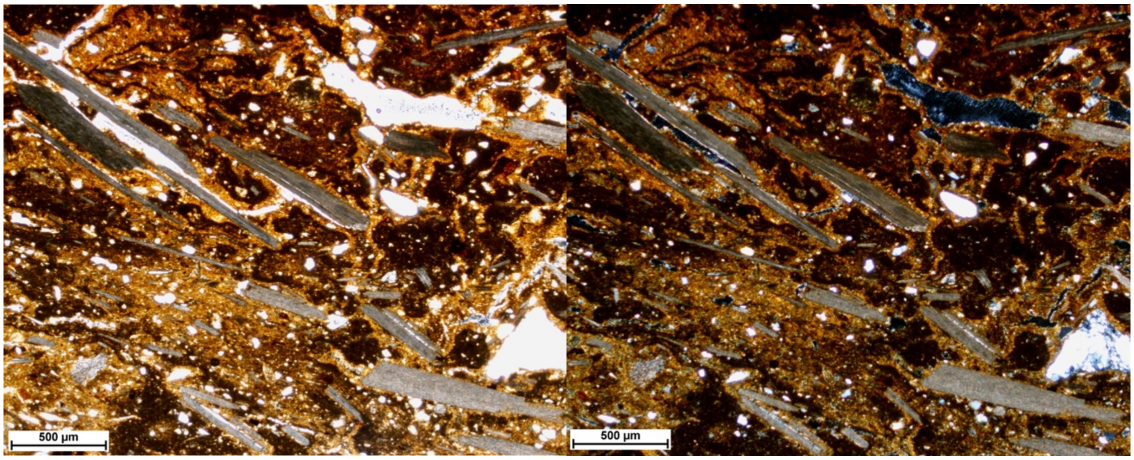


Figure A.5: Shell-temper, light polarizing microscope: Christianson site samples Left PPL, right XP.

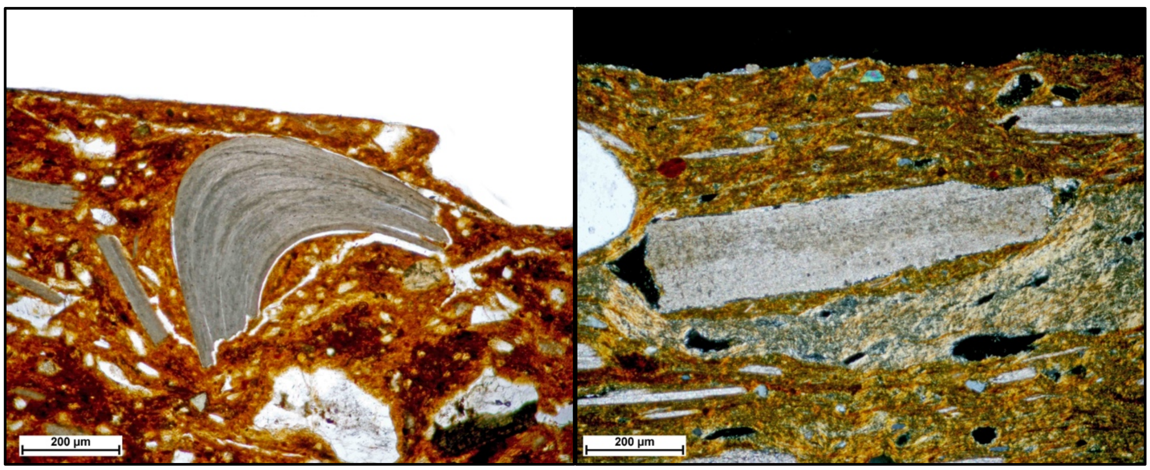
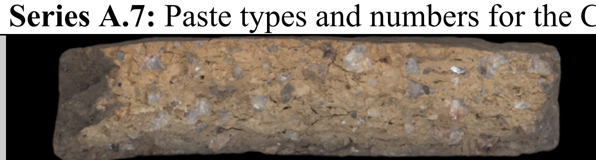
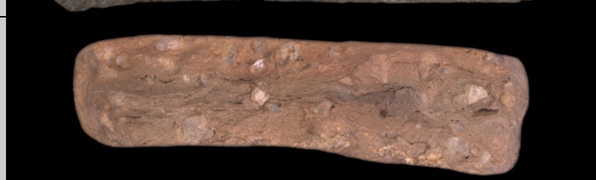
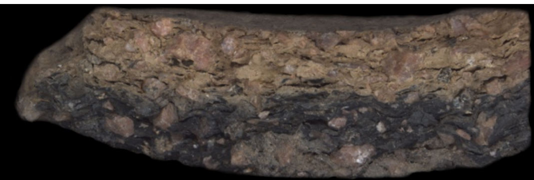
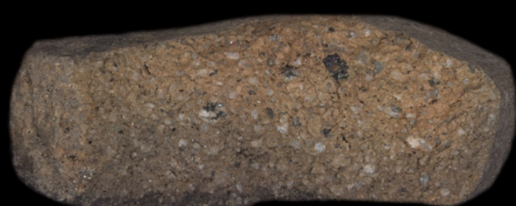
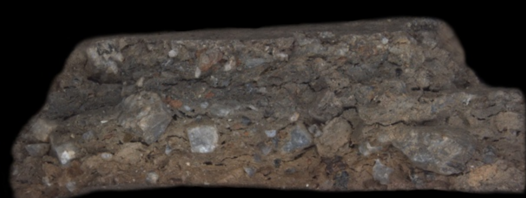
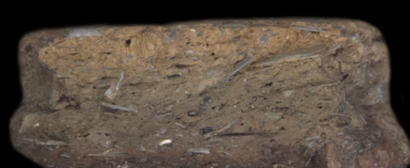
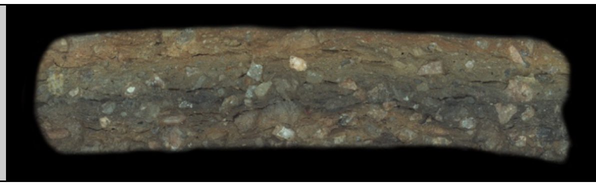


Figure A.6: Shell-temper from Hamilton samples, left (PPL) non-calcinated, right (XP) calcinated. Right with shell internal structure breaking into calcite. Left see the striations structure of shell.

Figure Series A.7: Paste types and numbers for the Christianson Site

1 Felsic Mineral		Medium texture, sub-compact. Medium-coarse translucents, pinks, occasional mica.
2 Felsic Mineral		Fine-medium texture, compact. Medium size, subrounded to subangular translucents, whites/opaques.
3 Interm. Mineral		Medium texture, , sub-compact, dense. Small-medium, sub-angular to sub-rounded, mica (abundant) and translucents.

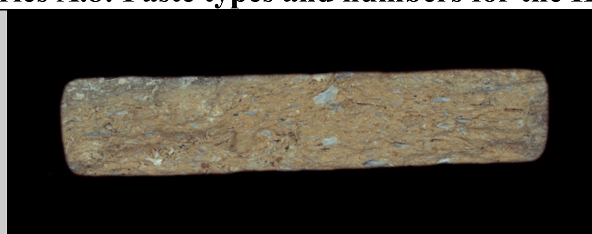
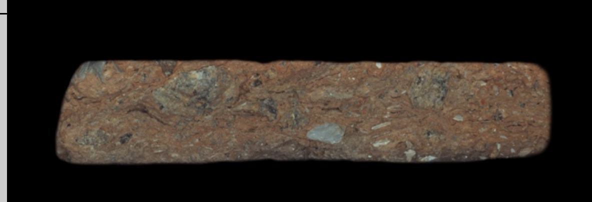
4 Interm. Mineral		Coarse texture, subcompact Large angular pinks, and mica.
5 Felsic Mineral		Fine-medium texture, subcompact, dense. Small-medium, subrounded, translucents, and opaques.
6 Mafic Mineral		Coarse-very coarse texture, subcompact. Large to chunky angular to subangular blacks/dark greens, pinks, mica, opaques, occasional translucents.
7 Felsic Mineral		Medium-coarse texture, compact. Medium-large angular to subangular pinks, mica, some translucents.
8 Felsic Mineral		Fine-medium texture, subcompact, dense. Small-medium subrounded translucents, mica, occasional pinks and opaques.
9 Interm. Mineral		Coarse-very coarse, subcompact, porous/crumbly. Angular to subangular, opaques, pinks, mica, occasional translucents.
10 Shell		Medium to very coarse texture, subcompact. Small-very large plates of shell, minimal (very fine) to no mineral inclusions. Occasional leeched shell voids.
11 Shell & Felsic Mineral: Mixed 1		Medium to very coarse texture, subcompact. Small-very large plates of shell, medium to large subangular pinks and whites.

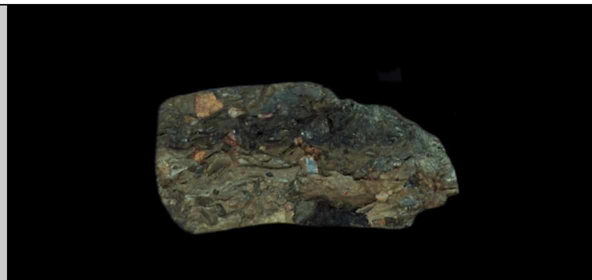
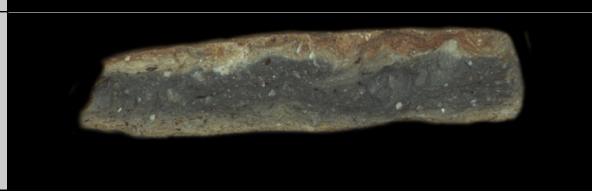
12 Inter. Mineral		Medium texture, subcompact. Medium-large pinks, mica, and occasional translucents.

Paste	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
Freq	65	20	100	70	25	110	89	147	86	136	21	83	952
%	6.8	3	10.4	7.3	2.6	11.4	9.3	15.3	8.9	14.2	2.2	8.6	100

Table A.3: Christianson paste frequency, from paste types and descriptions in Figure A.6

Figure Series A.8: Paste types and numbers for the Hamilton Site

1 Shell		Medium-very coarse texture, subcompact, occasionally crumbly, occasionally compact. Small-very large plates of shell (max. size noted at 10.6mm), minimal (very fine) to no mineral inclusions.
2 Shell & Felsic Mineral: Mixed 1		Medium-coarse texture, subcompact. Small-large plates of shell, subangular reds/pinks, occasional translucents and mica.
3 Shell & Interm. Mineral: Mixed 2		Medium-coarse texture, subcompact. Small-large plates of shell, large subangular to angular blacks and mica, medium sized subangular pinks and translucents.
4 Felsic Mineral		Fine-medium texture, subcompact, dense, occasionally porous. Small-medium subrounded translucents, mica, occasional small to medium subangular to subrounded pinks.
5 Felsic Mineral		Medium texture, subcompact, occasionally porous. Medium-large subangular to angular transclucents, opaques, mica, and pinks.
6 Mafic Mineral		Fine-medium texture, subcompact, dense. Small-medium subangular to subrounded, mica, pinks, and opaques.

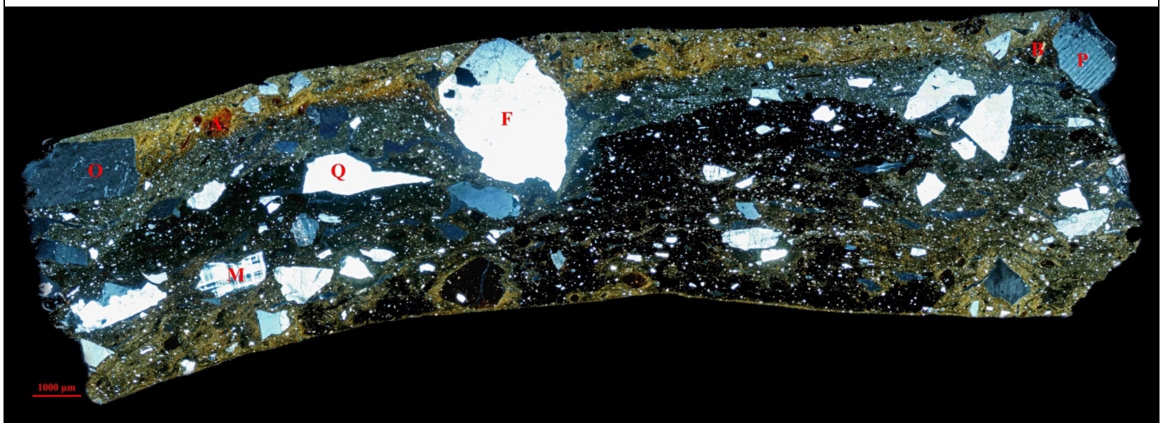
7 Mafic. Mineral		Coarse texture, subcompact. Large subangular, blacks, pinks, and occasional opaques.
8 Interm. Mineral		Fine-medium texture, compact-subcompact. Small and medium translucents, pinks, and mica.
9 Felsic/ Interm. Mineral		Coarse-very coarse texture, subcompact. Large-chunky angular to subangular pinks, mica, and occasional opaques.
10 Felsic Mineral		Fine texture, subcompact occasionally compact. Minimal inclusions, small-very small subrounded translucents, occasional pinks, and mica.

	Paste 1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Freq	234	27	30	18	26	5	27	19	23	29	438
%	53.4	6.2	6.8	4.1	5.9	1.1	6.2	4.3	5.3	6.6	100

Table A.4: Hamilton paste distribution, from paste types and descriptions in Figure A.7.

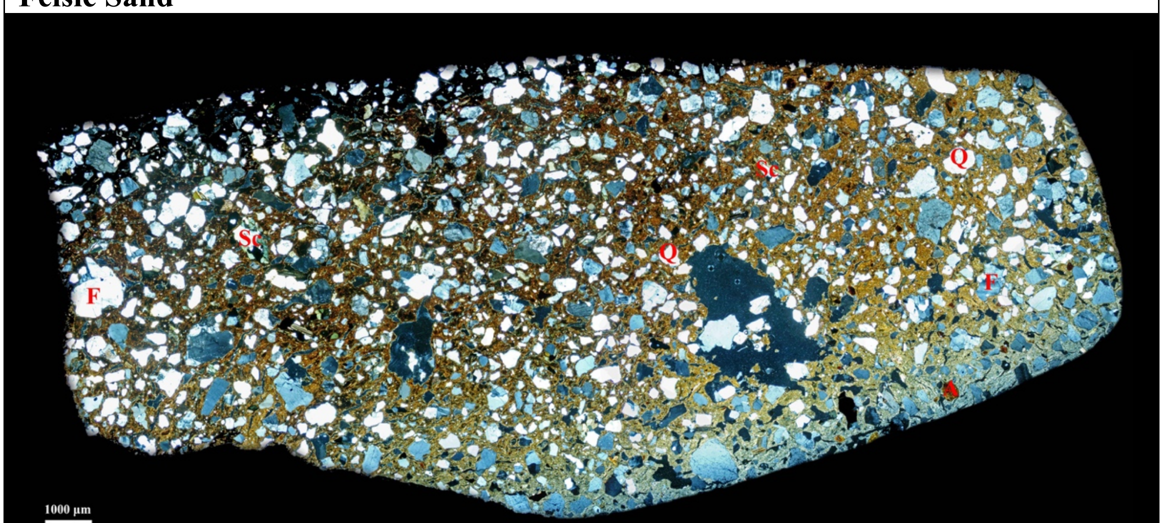
Figure Series A.9: Petrographic Paste Categories

Felsic Gravel

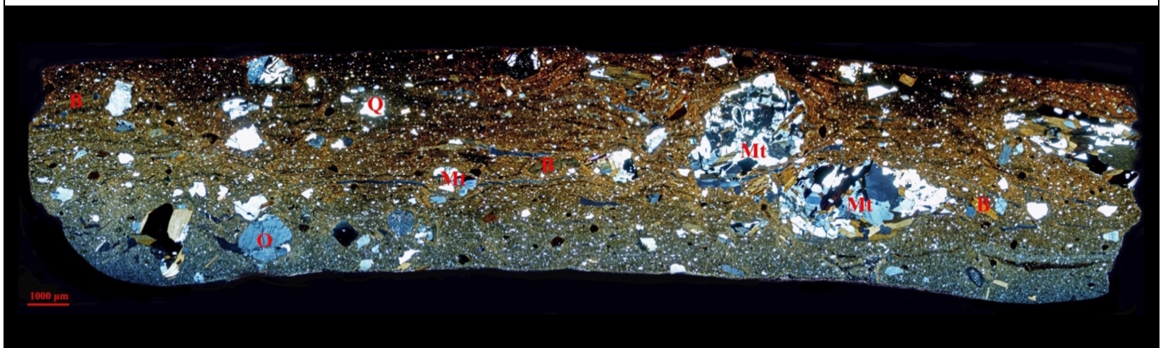


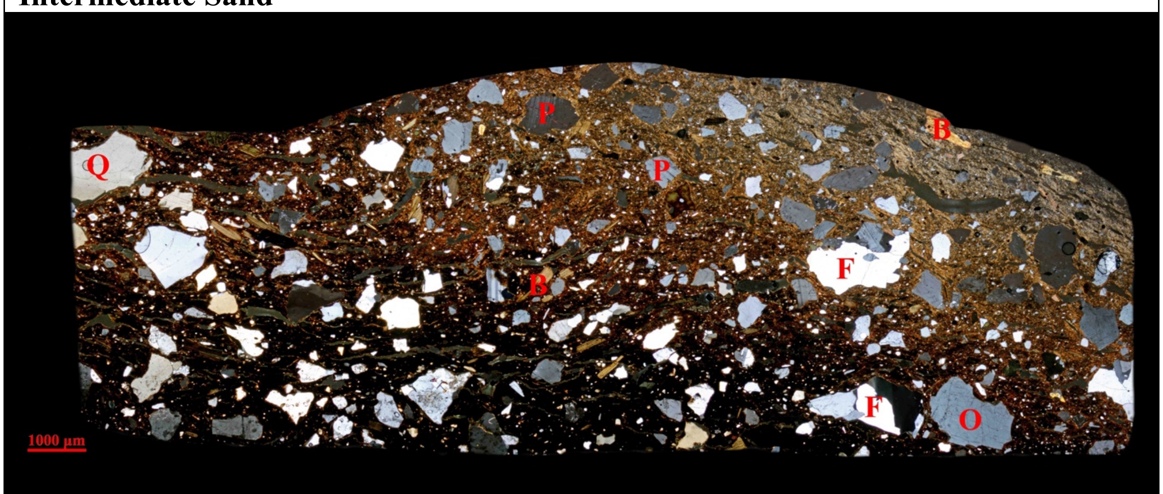
Label: F=felsic lithic, Q=quartz, A=argillaceous inclusion/clay pellet, P=plagioclase, O=Orthoclase, M=microcline, B=biotite.	- Largest inclusion variation 3.92-2.54mm - Angularity: angular-subangular - Sorting: very poor-moderate - Volume range: 10-40% - Elongated and equant shapes - Inclusions: alkali feldspar syenite, quartz monzonite, granites, felsic gneiss

Felsic Sand



Label: F=felsic lithic, Q=quartz, A=argillaceous inclusion/clay pellet, O=Orthoclase, Sc = Schist.	- Largest inclusion variation 2.62-1.41mm - Angularity: angular to rounded - Sorting: poor-strong - Volume range: 15-50% - Equant and some elongated shapes - Inclusions: Quartz, alkali feldspars

Intermediate Gravel	
	
Label: Mt = metamorphic rock (gneiss/schist), B=biotite, Q=quartz, O=Orthoclase	- Largest inclusion variation 4.5-2.5mm - Angularity: angular-subrounded - Sorting: very poor-moderate - Volume range: 15-40% - Equant and elongated shapes - Inclusions: amphibolite, schists, syenites

Intermediate Sand	
	
Label: B=biotite, Q=quartz, O=Orthoclase, F=felsic lithic	- Largest inclusion variation: 2.47-1.45mm - Angularity: angular-rounded - Sorting: poor-strong - Volume range: 15-35% - Equant and elongated shapes - Inclusions: Orthoclase, biotite, quartz, biotite and hornblende syeno-granite, biotite monzo-granite, schist, gneiss

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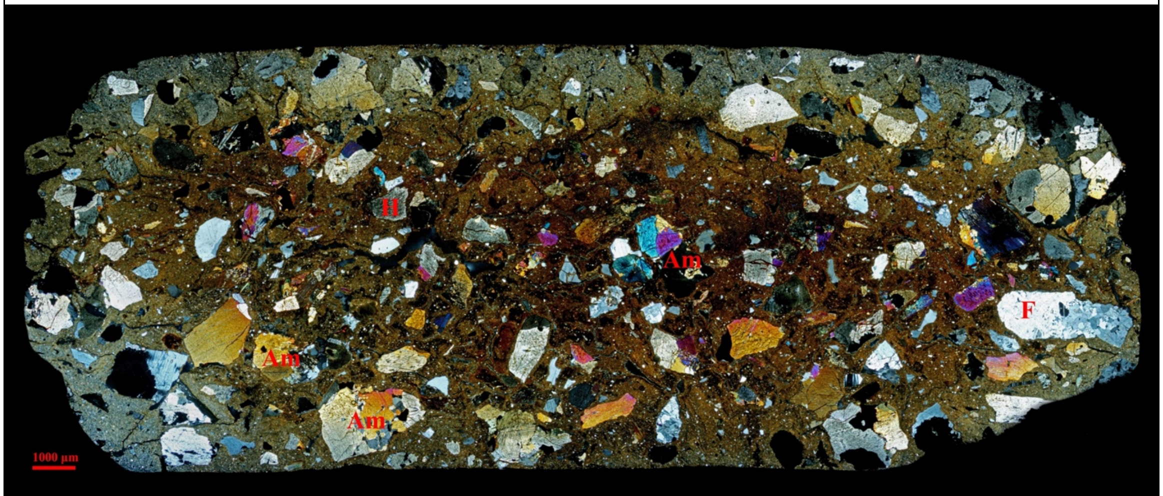
<tr><td colspan="2">
</td></tr>
<tr><td>Label:
Am=Amphibolite, H=hornblende.
F=felsic lithic.</td><td>- Largest inclusion variation: 2.6-3.95mm
- Angularity: angular-sa
- Sorting: very poor-poor
- Volume range: 20-40%
- Elongate and equant
- Inclusions: Hornblende/biotite monzodiorite, amphibolite, biotite/hornblende alkali feldspar syenite, biotite quartz gneiss</td></tr>
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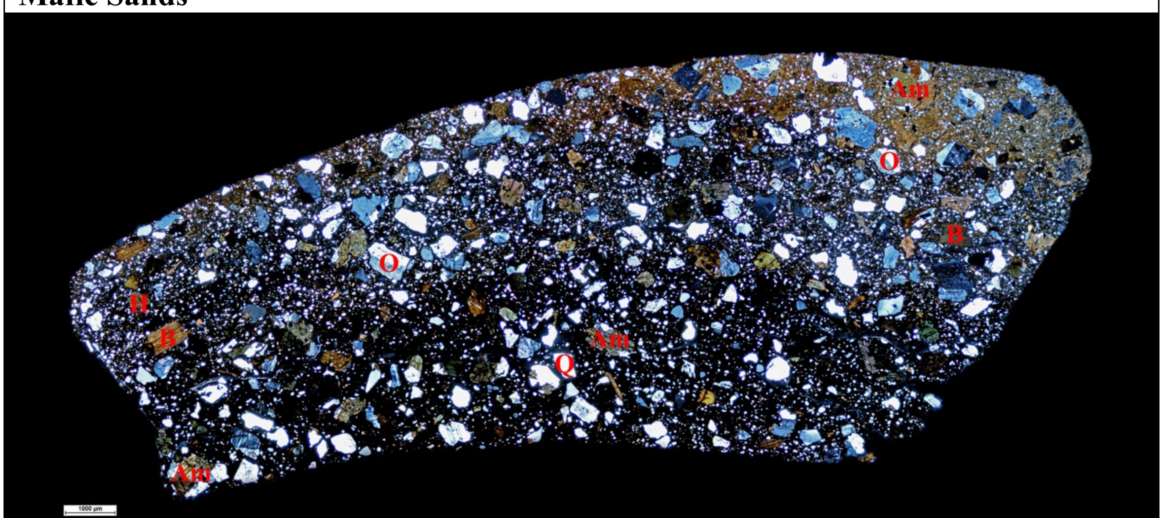
<tr><td colspan="2">
</td></tr>
<tr><td>Label:
Am=Amphibolite, H=hornblende,
B=biotite, Q=quartz, O=Orthoclase</td><td>- Largest inclusion variation: 1.63mm
- Angularity: subangular-subrounded
- Sorting: strong
- Volume range: 30-40%
- Equant
- Inclusions: Medium grained amphibolite, hornblende, quartz, biotite</td></tr>
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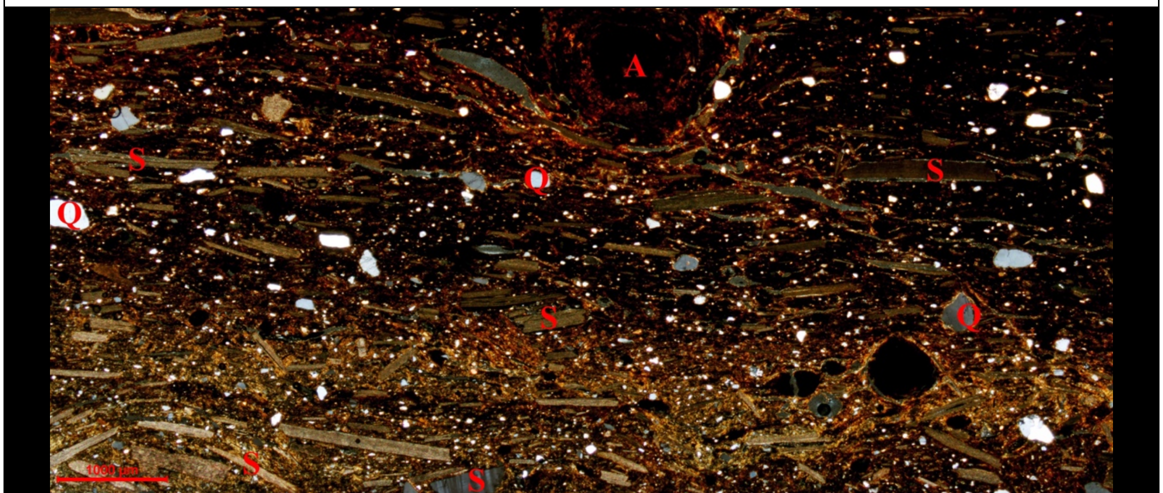
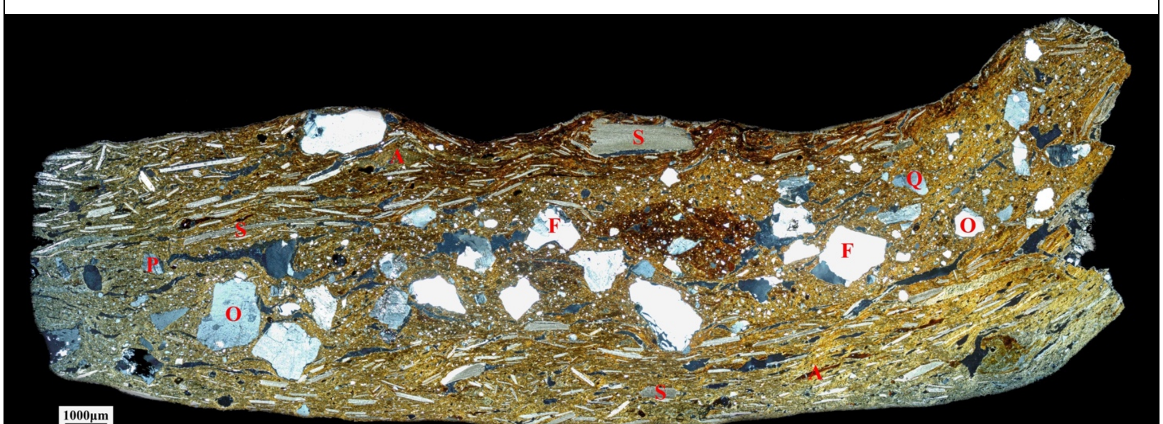
Shell	
	
Label: S=shell, Q=quartz, A=argillaceous inclusion	- Largest Inclusion variation 4.3-2.04mm - angular-subrounded - Sorting: very poor-moderate - Volume range: 20-45% - Elongated shape - Inclusions: Shell, fine sand quartz and orthoclase

Shell and Felsic Sand	
	
Label: S=shell, Q=quartz, O=Orthoclase, F=felsic lithic, A=Argillaceous inclusion clay pellets	- Largest inclusion variation: 4.84-3.44mm - angular-subangular - Sorting: very poor-moderate - Volume range: 20-40% - Elongated and equant shapes - Inclusions: Shell, alkali feldspars, quartz

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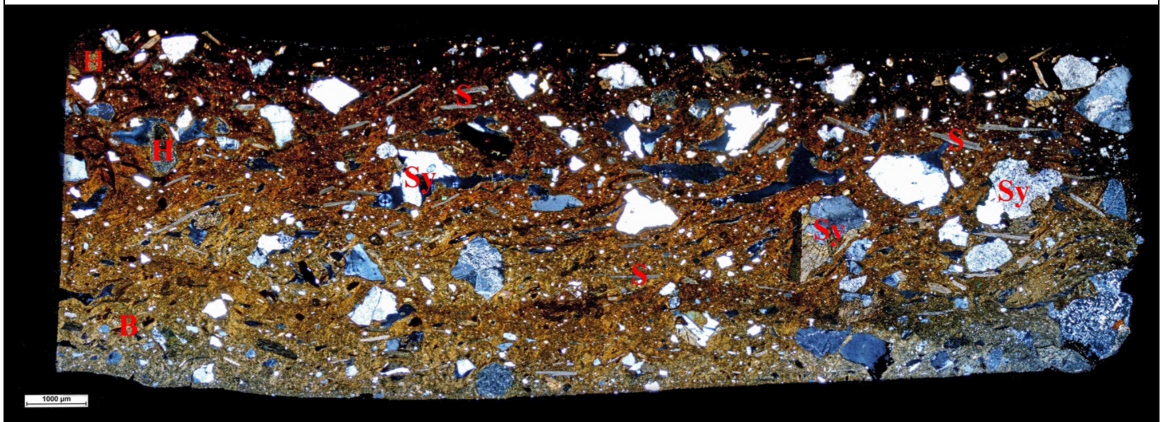
<tr><td colspan="2">
</td></tr>
<tr><td>Label:
Sy= hornblende quartz syenite,
S=Shell, H=hornblende, B=biotite</td><td>- Largest inclusion variation: 3.83-1.8mm
- Angular to subrounded
- Sorting: poor-moderate
- Volume range: 25-35%
- Elongated and equant shapes
- Inclusions: Shell, Mac lithics, syenites, amphibolite, schists, biotite, hornblende</td></tr>
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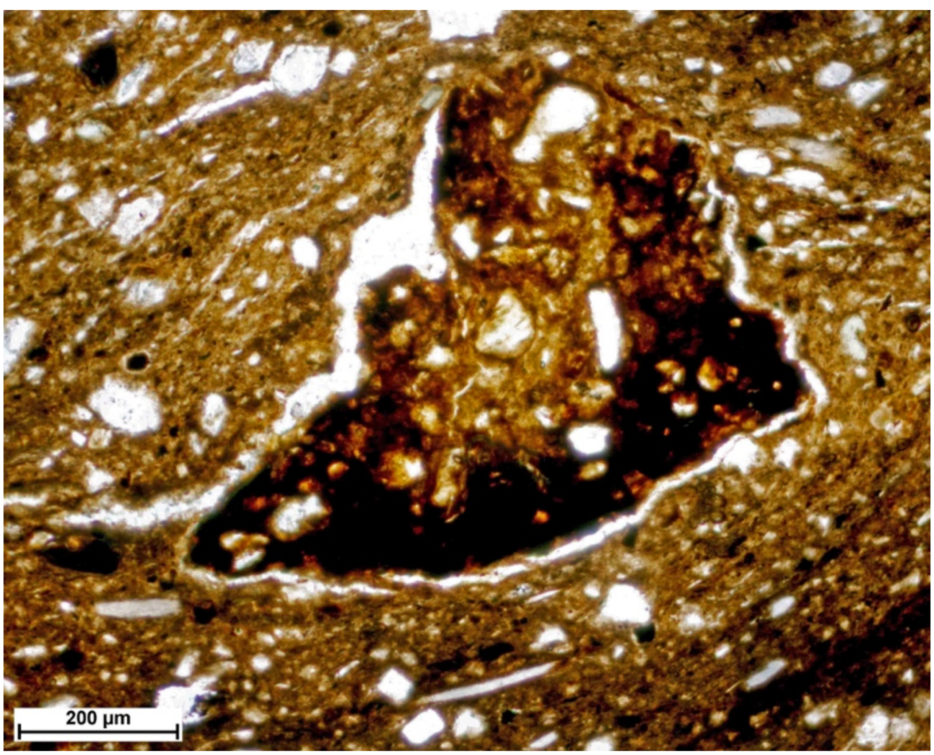


Figure A.10: Photomicrograph of Christianson grog, 10x, PPL.

Grog & Shell

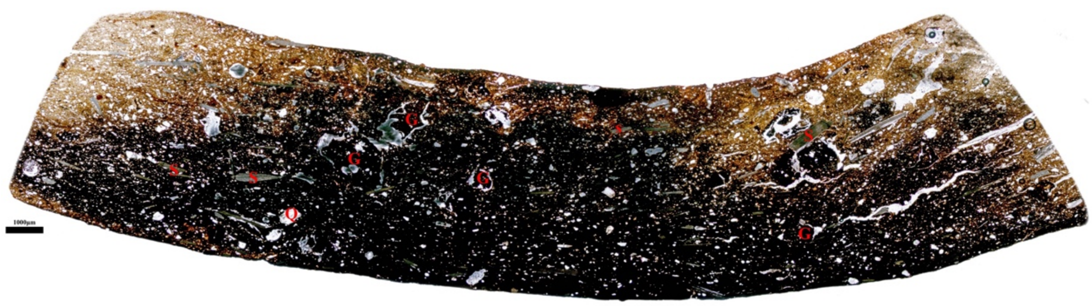
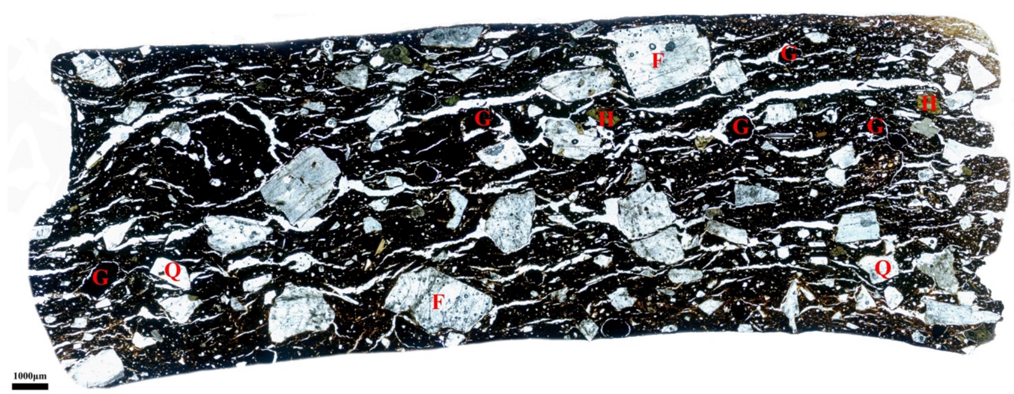


Figure A.11: Grog and shell observations in a Christianson site sherd. Top, Photomicrograph, PPL G=grog, S=shell.

Grog & Felsic igneous rock



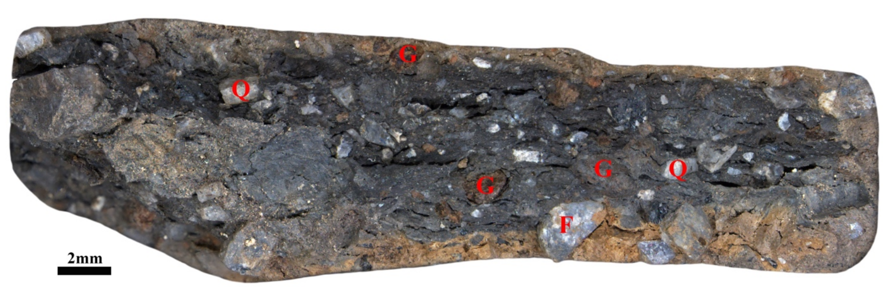


Figure A.12: Grog and grit observations in a Christianson site sherd
G=grog, F=felsic igneous rock, Q=quartz.

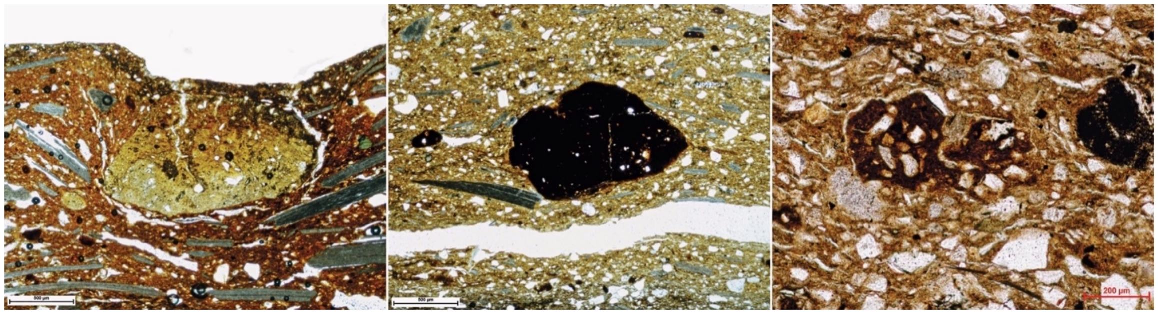


Figure A.13: Microphotographs of three clay pellet types, PPL. Left, calcareous (CP3). Centre, dense iron-rich (CP2). Right, dense to neutral iron-rich (CP1).

Figure A.14: Post-depositional leeching of shell-temper. Top, cross section of fresh break; Bottom, exterior surface.

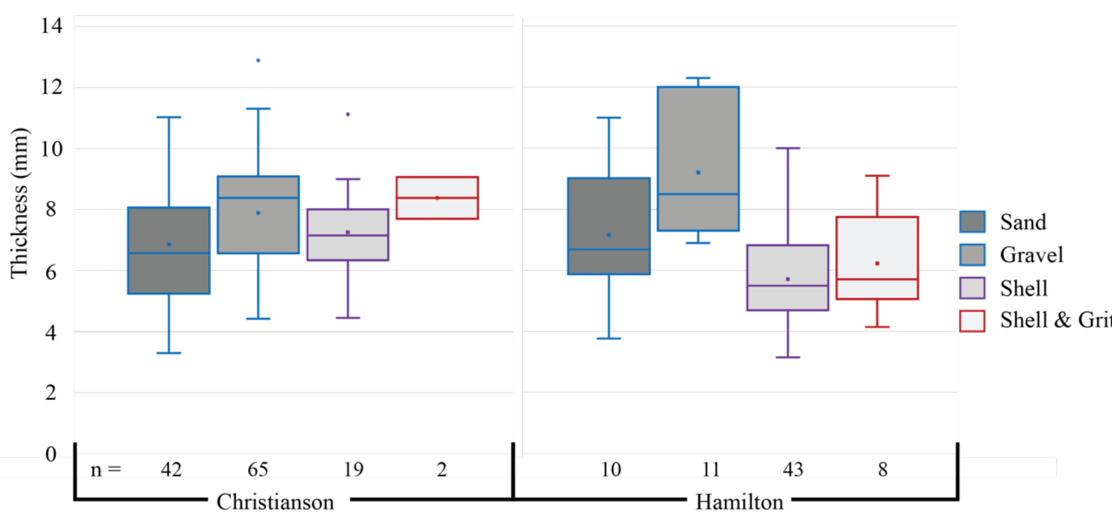


Figure A.15: Neck thickness to paste texture

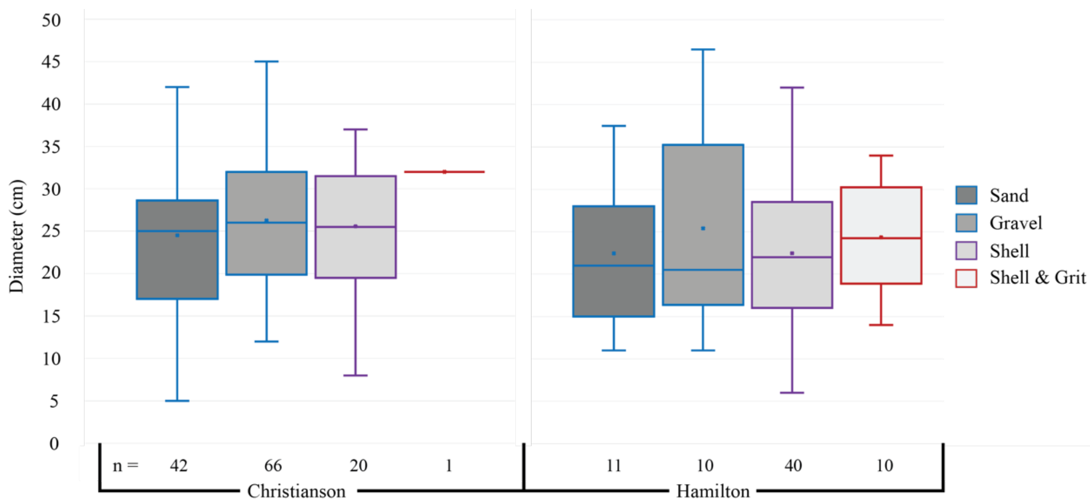


Figure A.16: Paste texture and diameter

Explaining Figure A.15 and A.16

To consider the justification in separating grit categories by texture, I lumped paste categories according to their size class. I examined neck thickness as larger vessels require thicker walls and coarser tempers for the structural support of the ceramic during forming and drying (Rice 1987, 227-228). Although wall thickness and tempers can be influenced by the intended use (e.g. thicker walls for storage, thinner walls for cooking; Rice 1987, 227-229) I did find a congruent pattern along neck thicknesses among both sites. This pattern was consistent along a comparison between these broad recipes and the vessel diameters and was comparably consistent between the two sites.[76] Potters generally used sands for smaller vessels than gravel, but there was significant overlap over their third quartile concentrations and with their overall frequency range. Shell appears to have more variability in size than the grit categories, particularly at Hamilton, and the generally thinner walls of shell appears to be congruent with my earlier finding that shell paste body sherds were thinner on average.

[76] Warrick (1983, 109) compiled Kenyon's (1982) ceramic vessel data on the 17th century Neutral Grimsby ossuary and found that diameter and volume increase in tandem.

Appendix B

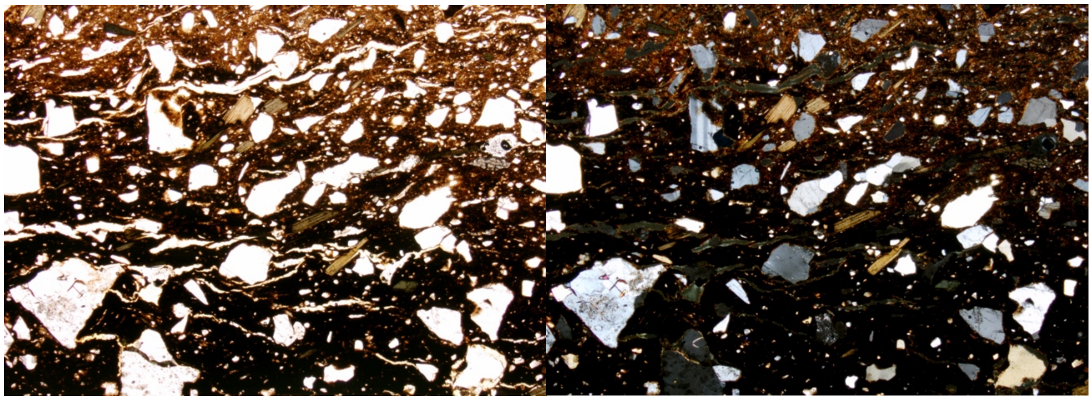


Figure B.1: Optical qualities under the light polarizing microscope. Plane polarized light (PPL) left; crossed polarized light (XPL) right.

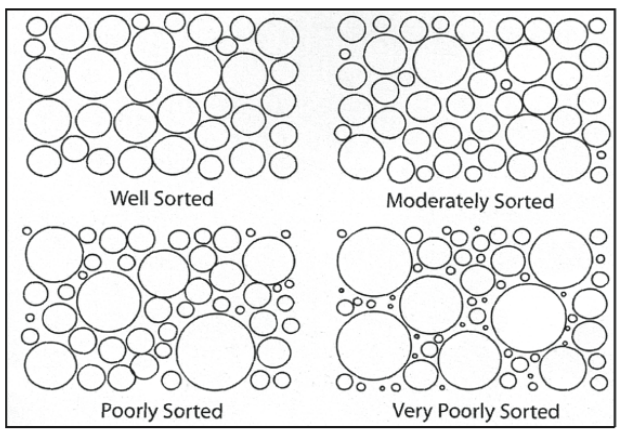


Figure B.2 Comparison Charts for Sorting and Sorting Classes. Derived from Quinn (2013, 87).

Millimeters (mm)		Micrometers (μm)	Phi (ϕ)	Wentworth size class		Rock type
	4096		-12.0	Boulder	Gravel	Conglomerate/ Breccia
	256		-8.0	Cobble	Gravel	Conglomerate/ Breccia
	64		-6.0	Pebble	Gravel	Conglomerate/ Breccia
	4		-2.0	Granule	Gravel	Conglomerate/ Breccia
	2.00		-1.0	Very coarse sand	Sand	Sandstone
	1.00		0.0	Coarse sand	Sand	Sandstone
1/2	0.50	500	1.0	Medium sand	Sand	Sandstone
1/4	0.25	250	2.0	Fine sand	Sand	Sandstone
1/8	0.125	125	3.0	Very fine sand	Sand	Sandstone
1/16	0.0625	63	4.0	Coarse silt	Silt	Siltstone
1/32	0.031	31	5.0	Medium silt	Silt	Siltstone
1/64	0.0156	15.6	6.0	Fine silt	Silt	Siltstone
1/128	0.0078	7.8	7.0	Very fine silt	Silt	Siltstone
1/256	0.0039	3.9	8.0	Clay	Mud	Claystone
	0.00006	0.06	14.0			

Table B.1: Udden-Wentworth Grain Size Classification Scheme. Derived from Wentworth (1922).

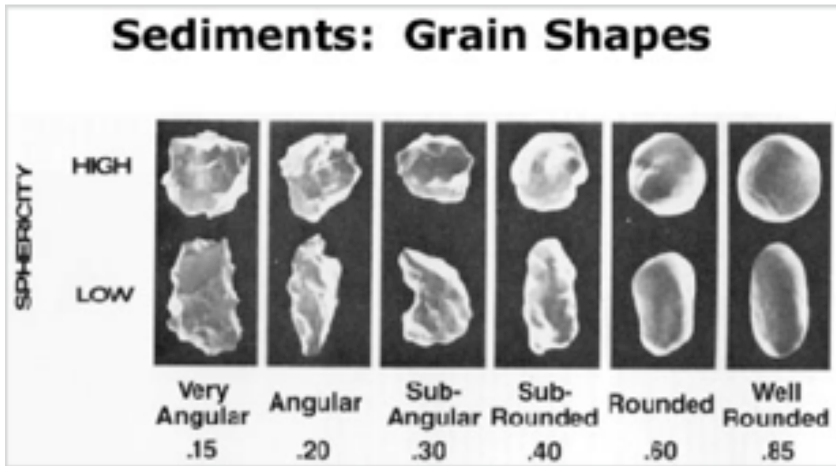


Figure B.3: Sediments: Grain Shapes Power's scale of grain roundness

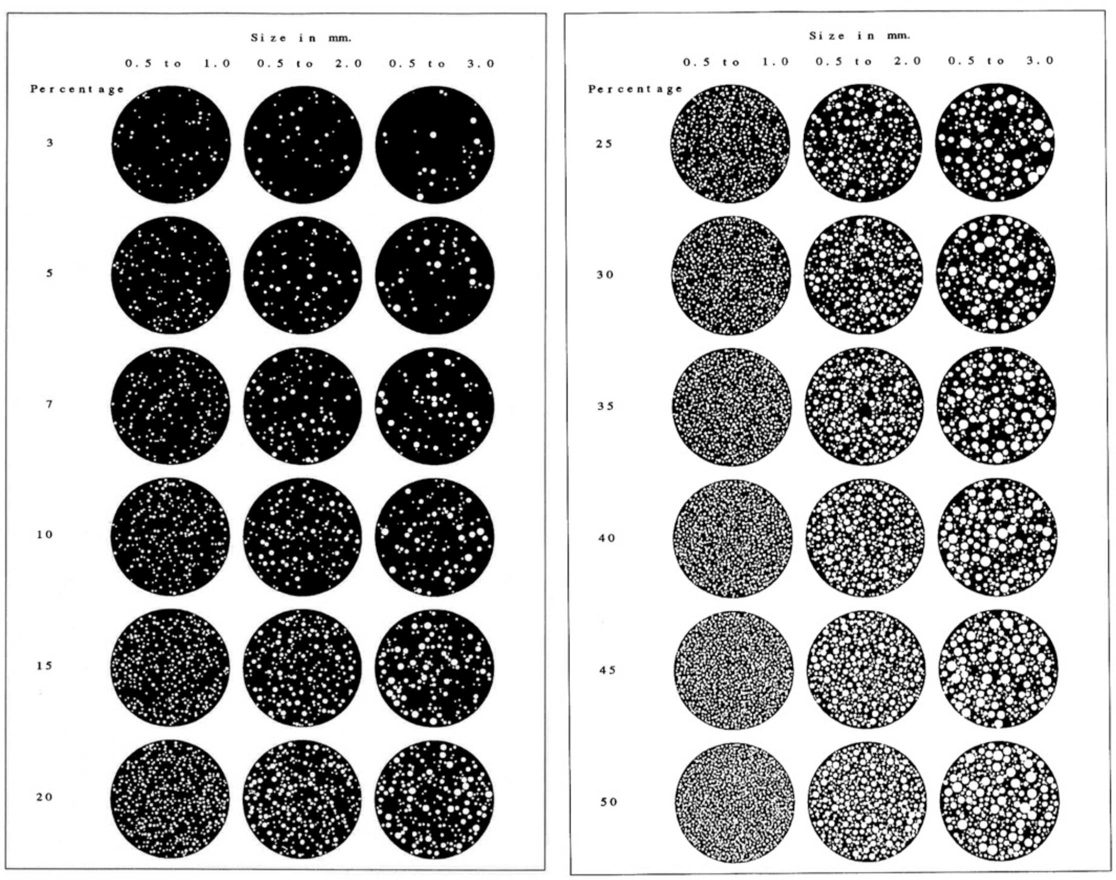


Figure B.4: Inclusion Estimation Chart

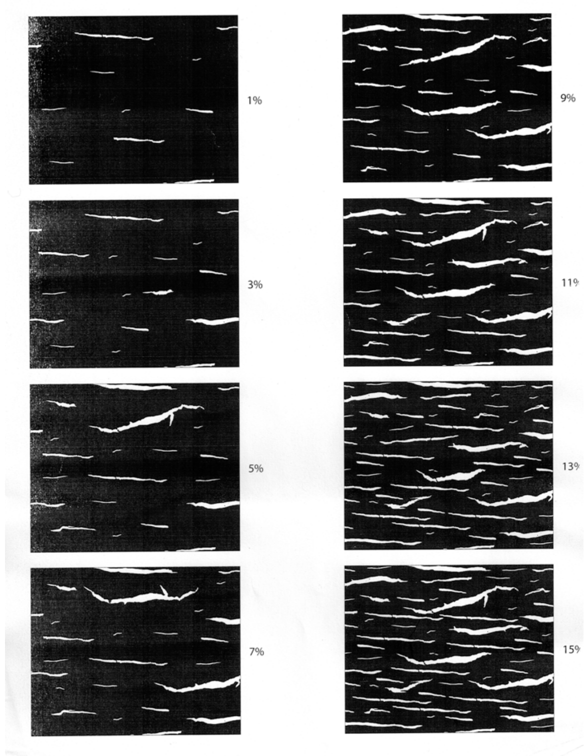


Figure B.5: Void Estimate Chart

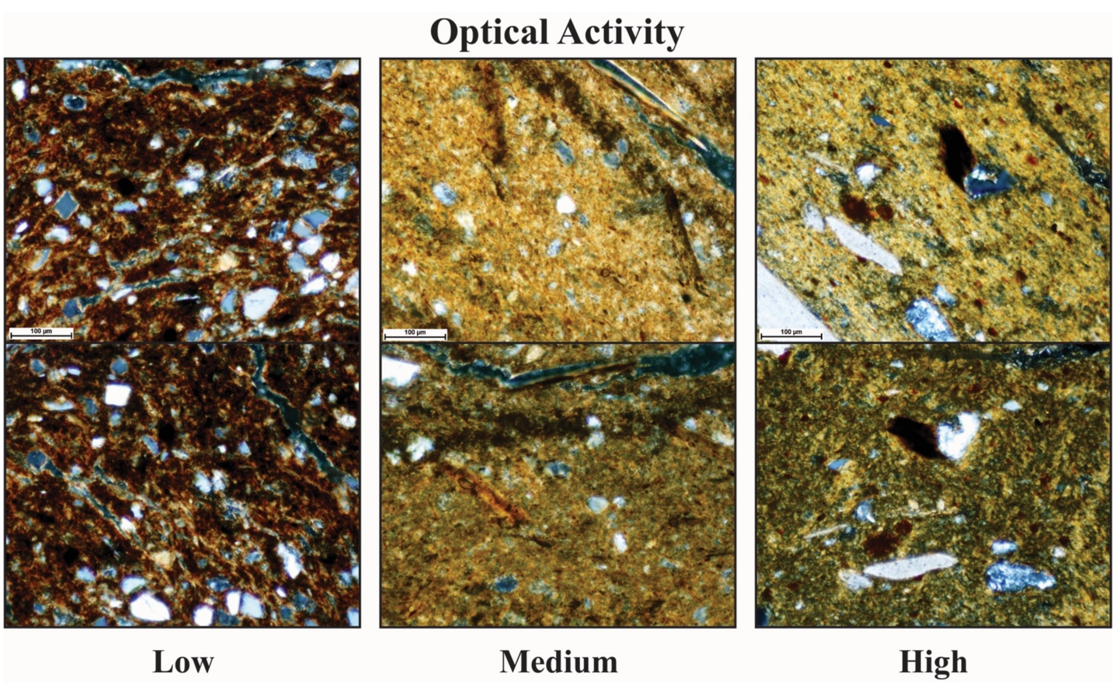


Figure B.6: Ranges of optical activity in XPL. Derived from CHR and HAM samples.

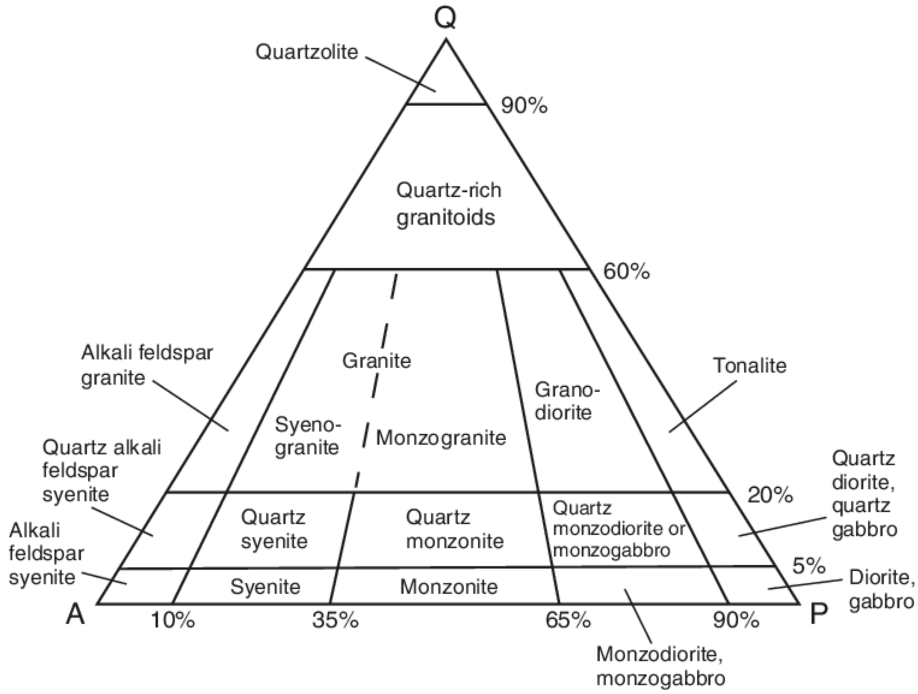


Figure B.7: Mineral triplot for defining igneous rocks. A= Alkali feldspar (eg. Orthoclase, microcline); P=Plagioclase; Q=Quartz.

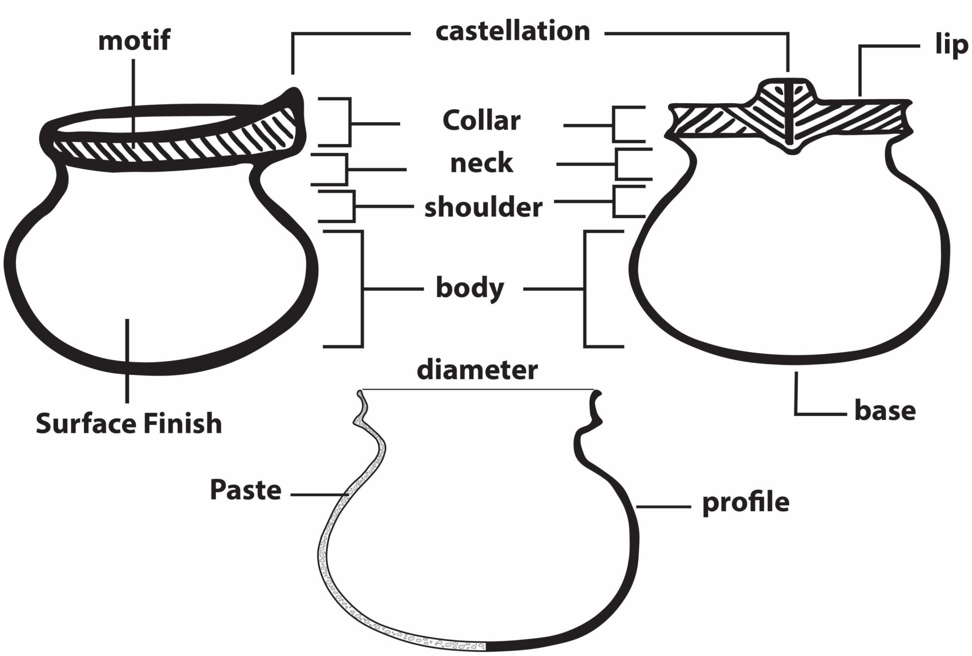
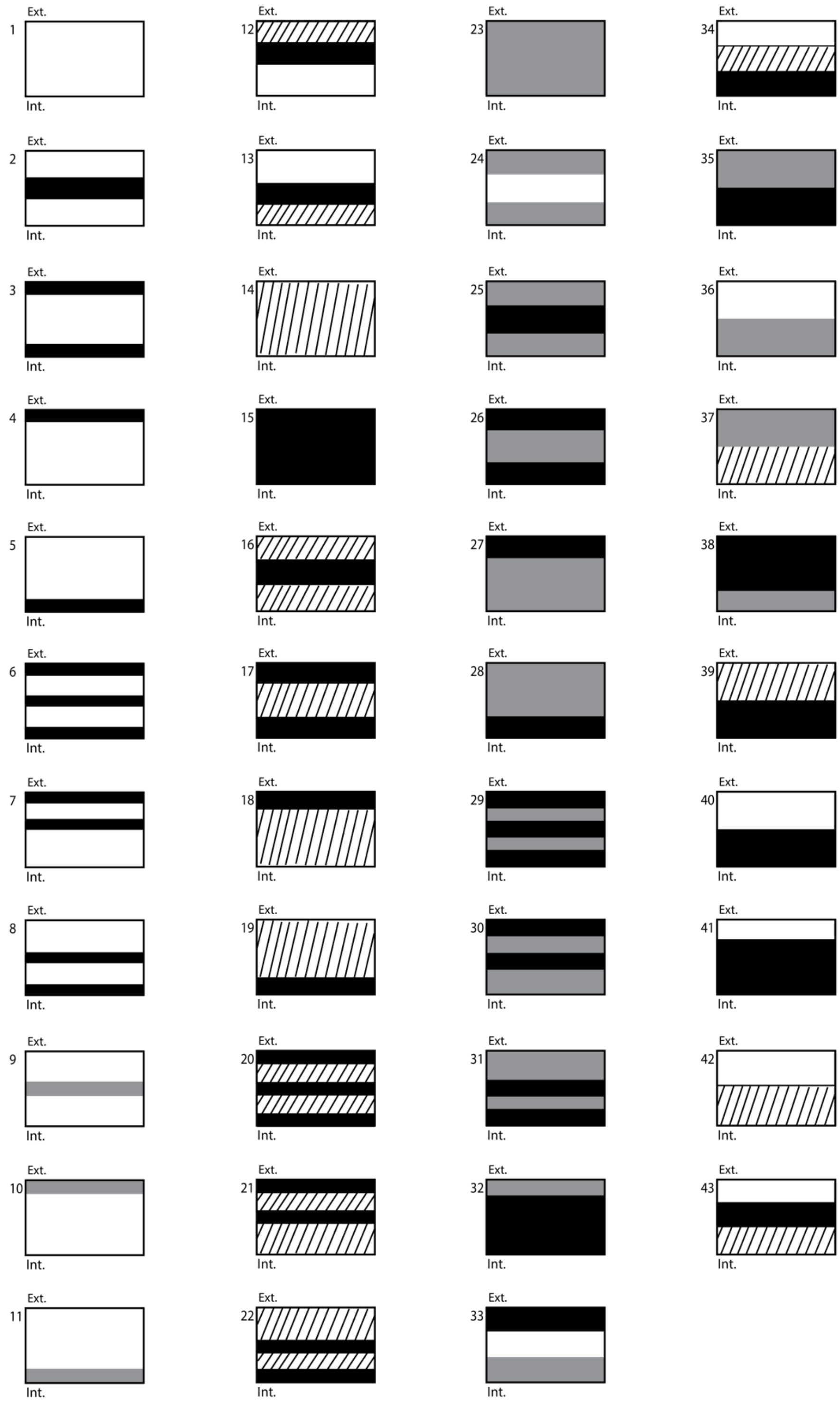


Figure B.8: Iroquoian Vessel Attributes. Modified from Martelle 2002, 531.

Attribute Analysis Forms, Codes and Tables

ID Code/Description			
1	Body	12a	lug
2	Too small b. sherd	13	Handle
3	Rim	13a	Rim and handle on neck
4	Shoulder	14	Juvenile
5	Collar	15	Feet (a - pedestal) (b - flaring) (c - peg)
6	Neck	16	Ceramic Waste
7	Castellation	17	Rim and neck (possible partial shoulder)
8	Base	18	Rim, neck, shoulder
9	Neck and shoulder (collarless)	19	Rim to base
10	Neck, collar, shoulder	20	Neck to base
11	Rim and castellation	21	Full vessel
12	Rim applique	22	unknown

Table B.2: Sherd identification codes.



Ceramic firing codes: black = black, white = red-brown, gray=light brown, diagonal hatch=brown

Figure B.9: Firing Core

Fully Oxidized	1, 9, 10, 11, 14, 23, 24	Partial Oxidized	3, 6, 17, 20, 26, 29, 32
Reduced	15	Reduced Cores	2, 7, 8, 12, 13, 16, 21, 22, 25, 30, 31, 43
Partial Reduced	4, 5, 18, 19, 27, 28, 33, 34	Half Reduced	35, 38, 39, 40, 44
Half + half	36, 37, 42		

Table B.3: Recategorized firing core classes from Figure B.9.

Firing Core Boundaries			
S	Sharp	D	Diffuse

Table B.4: Firing Core Boundaries.

Forming Techniques			
1	Coiling	4	unknown
2	pinching	5	Coil/fillet
3	Paddle + anvil		

Table B.5: Forming techniques.

Code/Ext Surface/Interior Surface Finish		
1	Wiped	Wiped
2	Wiped	Plain
3	Wiped	Smoothed
4	Wiped	Cord roughened
5	Wiped	Ribbed paddle
6	Wiped	Smoothed over cord
7	Wiped	Smoothed over ribbed
8	Wiped	Burnish
9	Wiped	Scarified
10	Plain	Plain
11	Plain	Wiped
12	Plain	Smoothed
13	Plain	Cord roughened
14	Plain	Ribbed paddle
15	Plain	Smoothed over cord
16	Plain	Smoothed over ribbed
17	Plain	Burnished
18	Plain	Scarified
19	Smoothed	Smoothed
20	Smoothed	Wiped
21	Smoothed	Plain
22	Smoothed	Cord roughened
23	Smoothed	Ribbed paddle
24	Smoothed	Smoothed over cord
25	Smoothed	Smoothed over ribbed
26	Smoothed	Burnished
27	Smoothed	Scarified

28	Cord roughened	Cord roughened
29	Cord roughened	Wiped
30	Cord roughened	Plain
31	Cord roughened	Smoothed
32	Cord roughened	Ribbed paddle
33	Cord roughened	Smoothed over cord
34	Cord roughened	Smoothed over ribbed
35	Cord roughened	Burnished
36	Cord roughened	Scarified
37	Ribbed paddle	Ribbed paddle
38	Ribbed paddle	Wiped
39	Ribbed paddle	Plain
40	Ribbed paddle	Smoothed
41	Ribbed paddle	Cord roughened
42	Ribbed paddle	Smoothed over cord
43	Ribbed paddle	Smoothed over ribbed
44	Ribbed paddle	Burnished
45	Ribbed paddle	Scarified
46	Smoothed over cord	Smoothed over cord
47	Smoothed over cord	Wiped
48	Smoothed over cord	Plain
49	Smoothed over cord	Smoothed
50	Smoothed over cord	Cord roughened
51	Smoothed over cord	Ribbed paddle
52	Smoothed over cord	Smoothed over ribbed
53	Smoothed over cord	Burnished
54	Smoothed over cord	Scarified
55	Smoothed over ribbed	Smoothed over ribbed
56	Smoothed over ribbed	Wiped
57	Smoothed over ribbed	Plain
58	Smoothed over ribbed	Smoothed
59	Smoothed over ribbed	Cord roughened
60	Smoothed over ribbed	Ribbed paddle
61	Smoothed over ribbed	Smoothed over cord
62	Smoothed over ribbed	Burnished
63	Smoothed over ribbed	Scarified
63a	Burnished over ribbed	Smoothed
64	Burnished	Burnished
65	Burnished	Wiped
66	Burnished	Plain
67	Burnished	Smoothed
68	Burnished	Cord roughened
69	Burnished	Ribbed paddle
70	Burnished	Smoothed over cord
71	Burnished	Smoothed over ribbed
72	Burnished	Scarified

72a	Burnished over Cord	Smoothed
73	Scarified	Scarified
74	Scarified	Wiped
75	Scarified	Plain
76	Scarified	Smoothed
77	Scarified	Cord roughened
78	Scarified	Ribbed paddle
79	Scarified	Smoothed over cord
80	Scarified	Burnished
81	Scarified	Scarified
82	Wiped	Eroded
83	Plain	Eroded
84	Smoothed	Eroded
85	Cord roughened	Eroded
86	Ribbed paddle	Eroded
87	Smoothed over cord	Eroded
88	Smoothed over ribbed	Eroded
89	Burnished	Eroded
90	Scarified	Eroded
91	Eroded	Wiped
92	Eroded	Plain
93	Eroded	Smoothed
94	Eroded	Cord roughened
95	Eroded	Ribbed paddle
96	Eroded	Smoothed over cord
97	Eroded	Smoothed over ribbed
98	Eroded	Burnished
99	Eroded	Scarified
100	Eroded	Eroded
101	Burnished over cord	Plain
101a	Burnished over cord	Burnished
101b	Burnished over cord	Smoothed
102	Burnished over cord	Eroded
103	Burnished over ribbed paddle	Burnished
104	Burnished over ribbed paddle	Plain
105	Burnished over ribbed paddle	Eroded

Table B.6: Surface finish codes.

Code/ Colour			
1	Red brown	6	Gray/ gray brown
2	Red/orange	7	Dark gray
3	Light brown	8	Fire clouded
4	Brown	9	Pale light brown
5	Black		

Table B.7: Colour categories.

Munsell/ Color Description					
5YR 5/3	Red brown	2.5YR 3/2	Brown	10YR 6/1	Gray/Gray Brown
5YR 5/4	Red brown	5YR 3/2	Brown	7.5YR 6/2	Gray/Gray Brown
5YR 5/6	Red brown	5YR 3/3	Brown	5YR 5/2	Light brown
5YR 6/6	Red brown	5YR 3/4	Brown	5YR 6/2	Light brown
5YR 4/3	Red brown	5YR 4/2	Brown	5YR 6/3	Light brown
5YR 4/4	Red brown	7.5YR 3/2	Brown	5YR 6/4	Light brown
5YR 4/6	Red brown	7.5YR 3/3	Brown	5YR 7/3	Light brown
2.5 YR 5/3	Red brown	7.5YR 3/4	Brown	5YR 7/4	Light brown
2.5 YR 5/4	Red brown	7.5YR 4/2	Brown	7.5YR 5/2	Light brown
2.5 YR 4/3	Red brown	7.5YR 4/3	Brown	7.5YR 5/3	Light brown
2.5 YR 4/4	Red brown	7.5YR 4/4	Brown	7.5YR 5/4	Light brown
2.5YR 3/4	Red brown	10YR 3/3	Brown	7.5YR 6/3	Light brown
2.5YR 3/6	Red brown	10YR 3/2	Brown	7.5YR 6/4	Light brown
2.5YR 4/4	Red brown	10YR 4/2	Brown	7.5YR 6/6	Light brown
2.5YR 4/6	Red brown	10YR 4/3	Brown	7.5YR 7/4	Light brown
2.5YR 6/4	Red brown	10YR 4/4	Brown	7.5YR 7/3	Light brown
5YR 3/1	Dark Gray	7.5YR 2/2	Gray/Gray Brown	10YR 5/2	Light brown
2.5YR 3/1	Dark Gray	7.5YR 5/1	Gray/Gray Brown	10YR 5/3	Light brown
7.5YR 3/1	Dark Gray	7.5YR 6/1	Gray/Gray Brown	10YR 6/2	Light brown
10YR 3/1	Dark Gray	10YR 7/1	Gray/Gray Brown	10YR 6/3	Light brown
2.5Y 3/1	Dark Gray	2.5Y 3/1	Gray/Gray Brown	10YR 6/4	Light Brown
2.5Y 3/2	Dark Gray	2.5Y 4/1	Gray/Gray Brown	10YR 7/2	Light Brown
7.5YR 4/1	Dark Gray	2.5Y 6/1	Gray/Gray Brown	10YR 7/3	Light Brown
10YR 4/1	Dark grey	2.5Y5/1	Gray/Gray Brown	10YR 7/4	Light Brown
2.5YR 4/6	Red/Orange	2.5Y 4/2	Gray/Gray Brown	7.5YR 7/2	Light Brown
2.5YR 5/6	Red/Orange	2.5Y 5/2	Gray/Gray Brown	10YR 8/3	Pale Light Brown
2.5YR 6/6	Red/Orange	2.5Y 6/2	Gray/Gray Brown		
10R 5/8	Red/Orange	10YR 5/1	Gray/Gray Brown		

Table B.8: Munsell colour classification.

Code	**Carbonization**
1	Light powder
2	Medium powder
3	Heavy powder
4	Light encrustation
5	Medium encrustation
6	Heavy encrustation
7	Light encrustation with yellow or white edges
8	Medium encrustation with yellow or white edges
9	Heavy encrustation with yellow or white edges
10	Scorched gray
11	Scorched white
12	Fire blackened
12a	Spotted blackened marks
13	Black all over/post breakage charring

Table B.9: Carbonization codes.

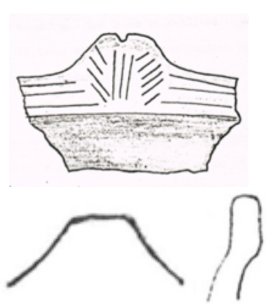
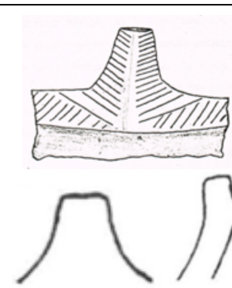
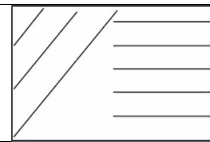
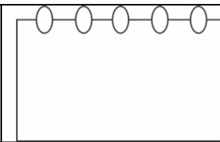
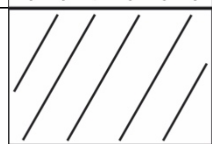
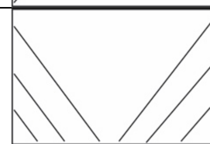
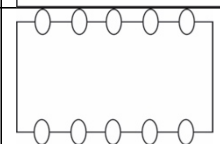
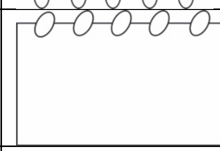
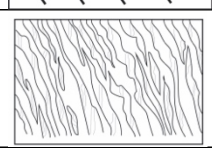
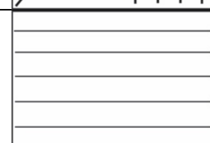
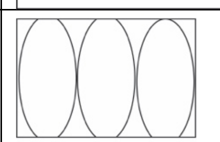
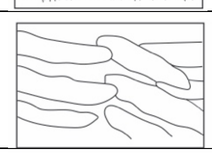
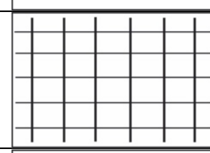
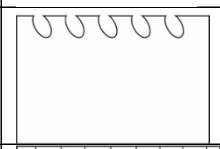
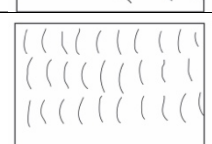
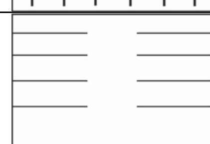
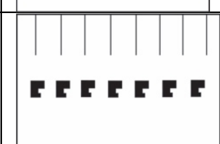
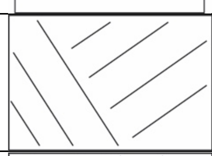
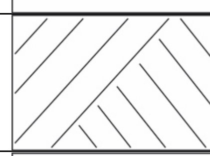
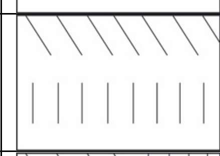
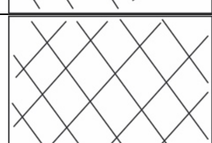
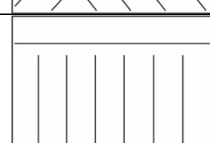
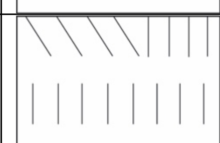
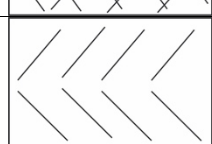
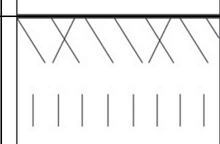
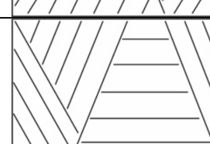
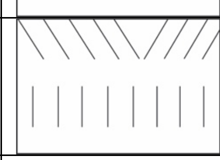
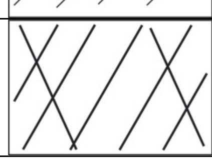
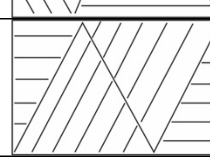
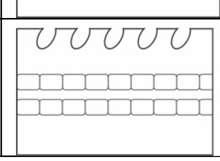
1	Incipient turret		**4**	Incipient rounded	
2	Pointed		**5**	Turret	
3	Rounded Point		**6**	multiple notch	

Table B.10: Castellation type codes. Images and profiles from Emerson (1954, 77, 79), Fitzgerald (1981, 150-151) and Lennox (1977, 102).

Exterior Rim/Collar Motif					
1 (S)		21 (Cx)		41	
2 (S)		22		42 (N)	
3 (S)		23		43 (N)	
4 (C/P)		24 (S)		44 (N)	
5 (C/P)		25 (Cx)		45 (N)	
6 (F)		26		46 (Cd)	
7 (S)		27 (Cx)		47	
8 (S)		28 (S)		48	
9 (S)		29		49	
10 (S)		30		50 (Cx)	
11		31		51 (Cd)	

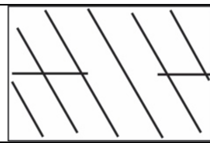
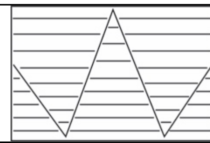
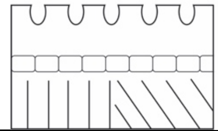
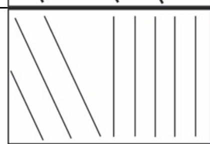
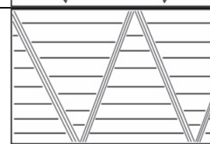
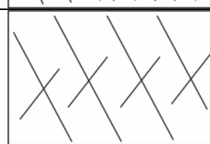
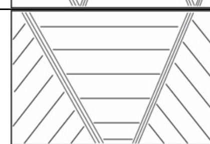
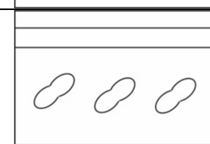
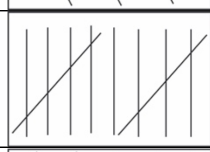
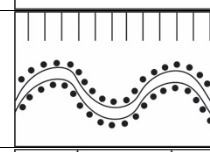
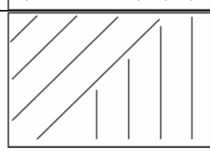
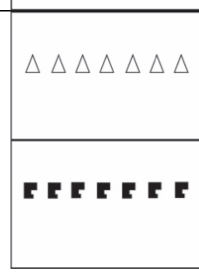
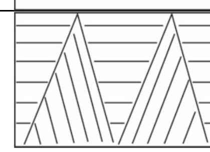
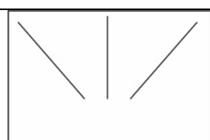
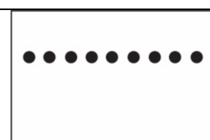
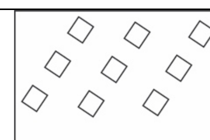
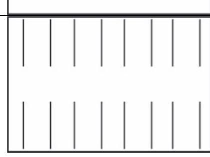
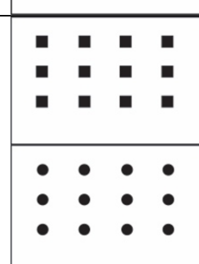
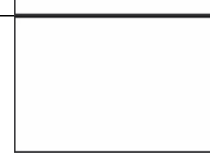
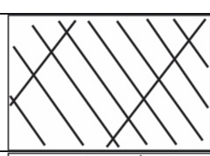
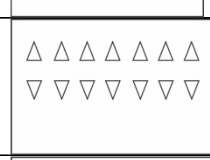
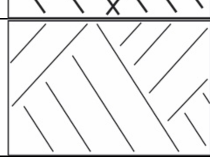
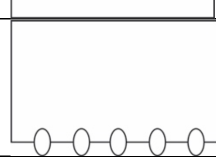
12		32 (Cx)		52 (Cd)	
13		33 (Cx)		53 (Cx)	
14 (S)		34 (Cx)		54	
15		35 (P)		55 (Cd)	
16		36 (DS)		56 (Cx)	
17		37 (P)		57 (DS)	
18 (S)		38 (P)		58 (Pn)	
19		39			
20 (Cx)		40 (N)			

Table B.11: Exterior rim/collar motif code. S=Simples; P=Punctates; DS=Dentate Stamp; N=Notching; Cx=Complex; Cd=Combined; C/P=Corded/Paddled; F=Fingernail; Pn=Plain.

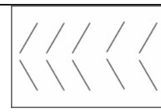
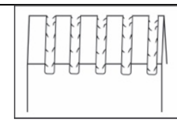
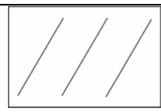
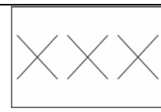
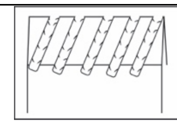
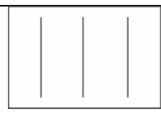
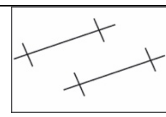
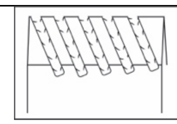
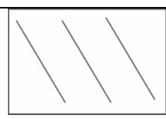
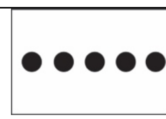
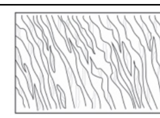
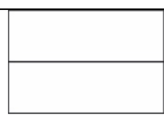
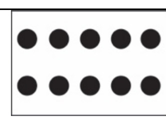
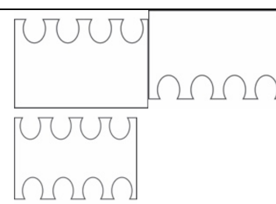
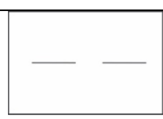
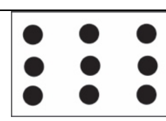
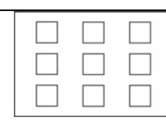
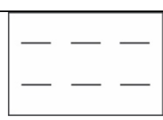
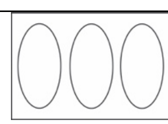
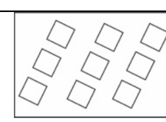
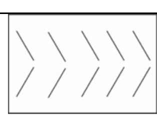
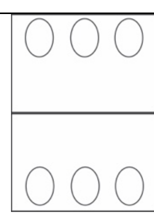
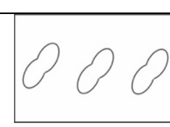
Lip Motif					
1		**9**		17	
2		**10**		18	
3		**11**		19	
4		**12**		20	
5		**13**		21	
6		**14**		22	
7		**15**		23	
8		**16**		24	

Table B.12: Lip motif code.

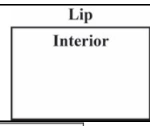
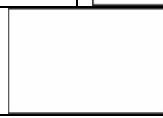
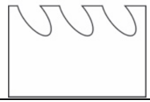
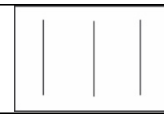
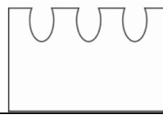
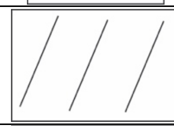
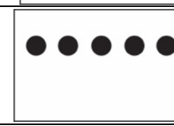
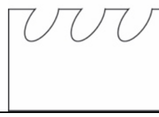
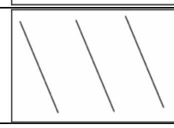
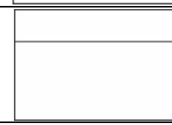
Interior Rim Decoration					
1		**4**		**7**	
2		**5**		**8**	
3		**6**		**9**	

Table B.13: Interior rim decoration motif code.

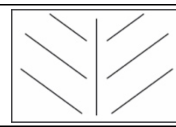
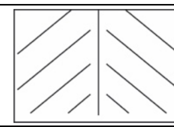
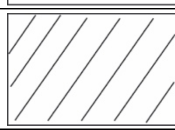
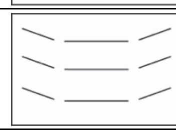
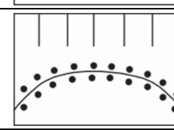
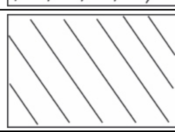
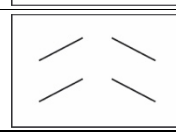
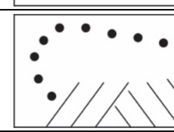
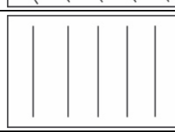
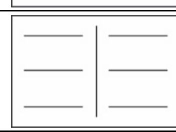
Dec Type Castellation					
1		**5**		**9**	
2		**6**		**10**	
3		**7**		**11**	
4		**8**			

Table B.14: Castellation decoration motif code.

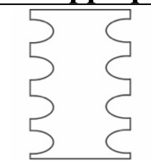
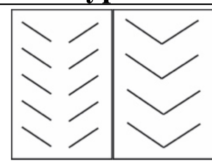
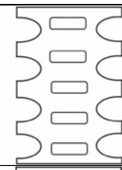
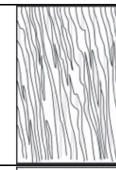
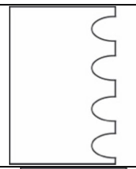
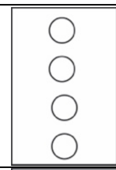
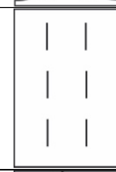
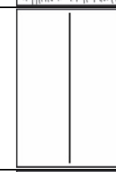
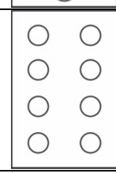
Vertical Applique decoration Type											
1		**4**		**7**		**10**	
2		**5**		**8**		**11**	
3		**6**		**9**		**12**	

Table B.15: Vertical appliqué decoration motif code.

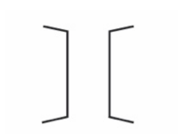
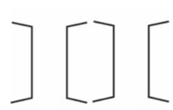
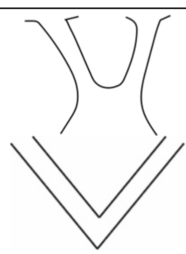
New Applique orientations					
1		4		7	
2		5		8	
3		6		9	

Table B.16: Vertical appliqué orientation.

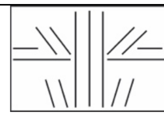
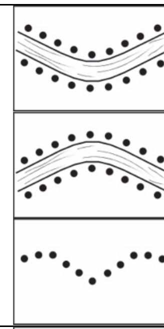
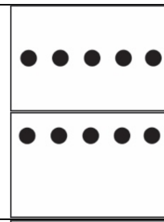
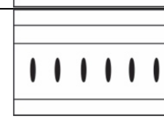
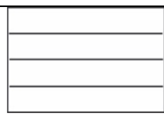
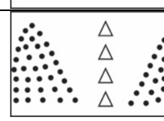
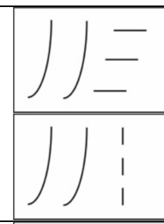
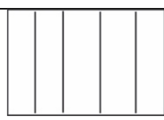
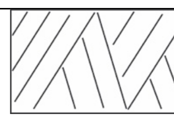
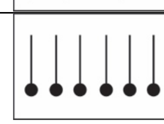
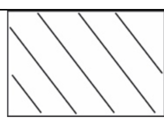
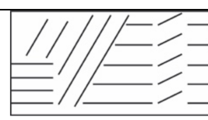
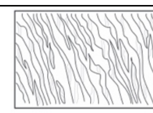
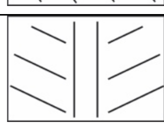
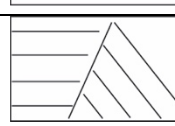
Neck motifs : New					
1	 **plain**	**7**		**13**	
2	**Plain with applique, applique scar, handle, or lug**	**8**		**14**	
3		**9**		**15**	
4		**10**		**16**	
5		**11**		**17**	
6		**12**			

Table B.17: Neck decoration motif codes.

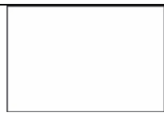
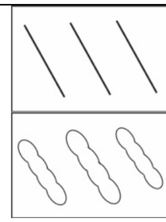
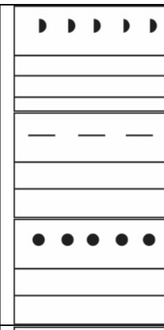
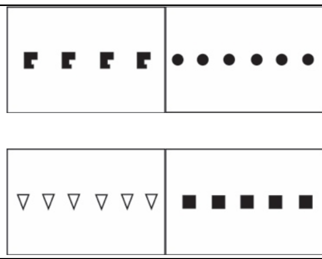
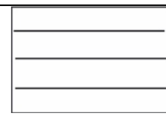
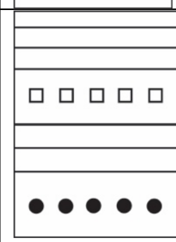
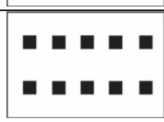
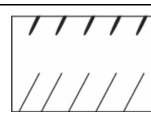
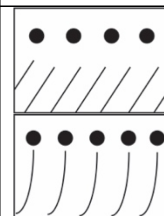
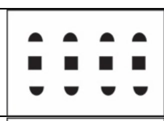
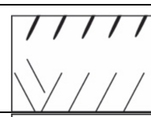
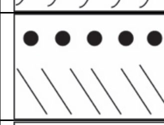
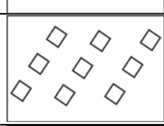
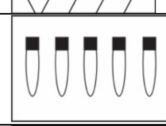
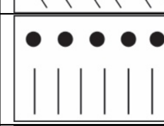
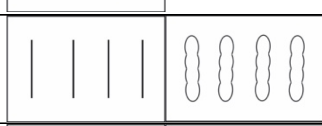
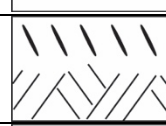
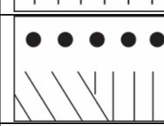
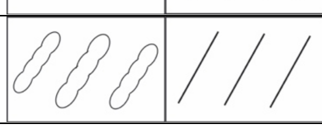
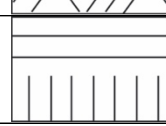
Shoulder Motifs: New					
1		**8**		**15**	
2		**9**		**16**	
3		**10**		**17**	
4		**11**		**18**	
5		**12**		**19**	
6		**13**		**20**	
7		**14**			

Table B.18: Shoulder decoration motif code.

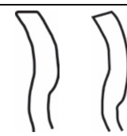
Rim Profiles:					
1		11		21	
2		12		22	
3		13		23	
4		14		24	
5		15		25	
6		16		26	
7		17		27	
8		18		28	
9		19		29	
10		20			

Table B.19: Rim profiles code.

Flaring Categories					
Straight	**80-94º**	7, 9, 16, 19, 23, 24, 26, 27, 28, 29	**Slightly flared**	**79-65 º**	1, 4, 6, 8, 11, 20, 21, 25
Very flared	**<45 º**	5, 12	**Convex straight + slightly flared**		13, 14
Flared	**65-46 º**	10, 17, 22	**Slightly inward flare**	**>94 º**	2, 15, 18

Table B.20: Rim profile flare categories and associated codes from Table B.19.

Decoration Type			
1	Incised	7	Push pull
2	Linear Impressed	8	Cord roughened and Smoothed over cord
3	Punctate	9	Fingernail impressed
4	Dentate stamping	10	drilling
5	Notching	11	Applique, handle, lug
6	Trailed	12	Combination

Table B.21: Method of decoration application codes.

Attributes on Forming	
Variable	Definition
Maximum Diameter	The maximum diameter of the vessel mouth. Measured on exterior surface with a Rim diameter chart is used (Rice 1987, 223)
Rim height	Vertical height from lip to base of rim. Use calipers.
Collar Height	Vertical height from lip to base of collar. Use calipers.
Neck Height	Vertical height from lip to neck inflection. Use calipers.
Lip Thickness	Thickness of vessel at point of max. thickness at edge of rim. Use calipers.
Collar Thickness	Thickness of vessel at point of max. collar diameter. Use calipers.
Neck Thickness	Thickness of vessel at point of inflection. Use calipers.
Rim Thickness	Thickness of vessel at 1 cm below lip. Measured on rims without collar only. Use calipers.
Body Thickness	Thickness of vessel anywhere below the shoulder's inflection and before a thickened base. Measurement taken from the thickest portion of the body sherd. Measured with calipers.
Inclusion orientation	Measured as parallel orientation to vessel walls R=random, W=weak, M=medium, S=strong
Shoulder Shape	R = Rounded C = Carinated

Table B.22: Forming attributes measurements and codes.

Figure B.10: Laminal fracture patterns. b, c, d, e = Christianson. a, f, g = Hamilton.

Incised	Dragging a narrow ended tool that produces a relatively deep and narrow v-shape incision.	Linear Impressed	The negative impression resulting from impressing a smooth-edged tool perpendicularly to the vessel wall, leaving a linear decoration at a variety of lengths (dependant on the tool). More shallow than notching, defined as linear if impression is longer than its width.
Trailing	Dragging a flat edged tool, producing wide, continuous shallow lines with slight bordering of clay along the edges	Push pull	Combination of dragging and impressing. Dragging a blunt tool while impressing it into the opposite direction of which the tool is being dragged
Notching	Removal of clay or deep impression into clay that leave deep markings. Often on the edge of collars or the lip	Cording	Impressed decoration from corded tool, leaving corded markings analogous to body cord impressions
Punctate	Deep impressions with of circular or angular shape. Shape dependent on tool. Impression are at oblique or vertical angles	Fingernail impressed	Deep, very narrow series of impressions, and crescent shaped. Suspected impression from potter fingernails.
Dentate Stamp	Impressions with a toothed/notched tool, usually produces square or rectangular impressions, alterations in shapes come from angle of application	Applique, lug	Clay additions pressed onto the surface of pots. Occassionally present as "scars," evidence of these clay appendages being dislodged.

Table B.23: Decoration types, tools. Definitions from Fitzgerald 1981; Holterman 2007; Ramsden 1977.

Attribute	Scoring		Attribute	Scoring
Rim undulation	VE = Very even, E = Even, M = Medium, SI = Slightly Irregular, I = Irregular		**Decoration Evenness**	VE = Very Even E = Even M = Medium SI = Slightly Irregular I = Irregular
Paste Orientation	R= Random Parallel – W = Weak, M-medium, S = strong		**Contour**	VE = Very Even E = Even M = Medium SI = Slightly Irregular I = Irregular
Mica	L = Large, M = Medium, S = Small, VS = Very Small		**Decoration Finish**	H = Horizontal V = Vertical H & V = Combination of horizontal and vertical
Shell Temper	L , M, S, VS		**Lip Form**	P = Pointed Flat = flat R = Rounded
Red ochre	Present = P		**Cracks**	a) star-shaped cracks, radiating from large inclusions or b) network of superficial cracks c) some pits
Lustre	MA = Matte L = Low M = Medium H = High			

Table B.24: Qualitative attribute codes.