THE INFLUENCE OF HYDRODYNAMIC FORCES ON THE TRANSPORT AND RETENTION OF COLLOIDS IN SINGLE, SATURATED, DOLOMITIC LIMESTONE FRACTURES

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TITLE: The Influence of Hydrodynamic Forces on the Transport and Retention of Colloids in Single, Saturated, Dolomitic Limestone Fractures

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ABSTRACT

Approximately 30% of Canadians and 50% of Americans rely on groundwater for their domestic water supplies. A significant portion of this groundwater originates from fractured rock aquifers, as they are ubiquitous throughout North America. In comparison to unconsolidated porous media aquifers, relatively little is understood about biocolloid transport in fractures. A mechanistic understanding of the transport and retention of biocolloids in fractures is important towards determining the risk of biocolloid contamination to these sources, which can have a significant impact on human health. It has been well documented in the interfacial science literature that micro-scale hydrodynamics play a significant role in the transport of particles greater than approximately one micron in diameter, but do not significantly affect the transport of smaller particles. This phenomenon, however, has never been investigated in fractures, where the larger-scale hydrodynamics are complex, and must also be considered. To bridge this knowledge gap, this research was conducted to elucidate the effects of hydrodynamics on the transport and retention of *E. coli* RS2GFP and carboxylate modified yellow-green polystyrene (CMP) microspheres (0.05 μm diameter) in single, saturated, fractures at the laboratory scale.

To achieve this goal, dolomitic limestone samples were acquired from a quarry in Guelph, Ontario, and were fractured under a uniaxial force. The hydrologic properties of each fracture sample were characterized using hydraulic and solute tracer tests. Using a factorial design approach, a known number of either *E. coli* RS2-GFP or CMP microspheres was released into the fracture under a range of specific discharges (30, 10 and 5 m/day). The resulting effluent

concentration profiles were compared to isolate the effects of hydrodynamics on particle transport.

Comparing and contrasting the effluent concentration profiles from these experiments revealed that hydrodynamic forces strongly influence the retention of particles larger than 1 μm in diameter in saturated, fractured media. Additionally, the mechanisms that dominate transport and retention are dependent on, and therefore vary with both specific discharge and particle size.

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