Applications of Microscopy Paired with Thin Section Petrography in Iroquoian Ceramic Analysis

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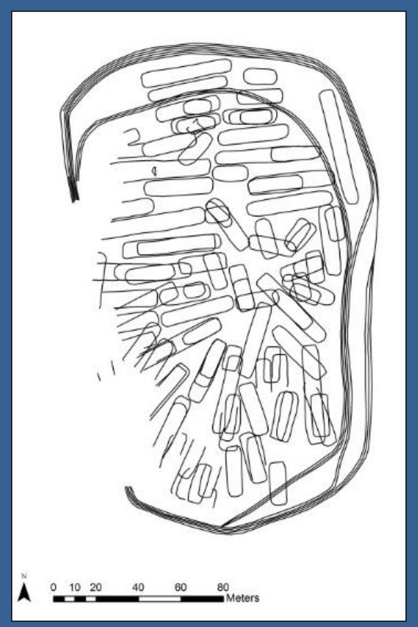
ABSTRACT

Iroquoian ceramic analysts typically focus on decorative style, in part because this approach maximizes the amount of information that can be obtained from an assemblage in a short amount of time. Decorative attributes can be rapidly identified and recorded, and a significant literature links patterns in decorative styles to social, temporal, and cultural trends. Characteristics of ceramic fabrics including clays and tempers are rarely examined, but adding these elements to the standard Iroquoian ceramic analysis would address important unanswered questions about Iroquoian ceramic production.

I present a methodology for the efficient and cost-effective analysis of Iroquoian ceramic fabrics applicable to ceramic pots and pipes. The attributes selected and methods for recording them are developed using insights from petrographic analysis of ceramic thin sections using a polarizing microscope following Whitbread's (1989) methodology. By focusing on characteristics diagnostic of specific technological and provenance related characteristics of ceramic fabrics that are evident using a standard binocular microscope, this methodology is designed to be used and refined in conjunction with selective petrographic analysis. I test my methodology by comparing this method with thin section petrography using ceramics from the Mantle site, an early fifteenth century Ancestral Wendat village located near Toronto, Ontario, Canada.



Top: Location of Mantle site
Right: Mantle plan map
(Redrawn from ASI 2012)

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References

ASI. 2012. *The Archaeology of the Mantle Site (Algt-334) Report on the Stage 3-4 Salvage Excavation of Part of Lot 33, Concession 9, Town of Whitchurch-Stouffville, Municipality of York, Ontario.* edited by Archaeological Services Inc. Report on file. Toronto: Ontario Ministry of Culture, Tourism and Sport.
Braun, Gregory V. 2102. "Petrography as a Technique for Investigating Iroquoian Ceramic Production and Smoking Rituals." *Journal of Archaeological Science* 39 (1): 1-10.
Braun, G. 2015. *Ritual, Materiality, and Memory in an Iroquoian Village*. Unpublished PhD Dissertation. University of Toronto, Toronto.
Howie, L. 2012. *Results of Petrographic Analysis of Pottery and Geological Samples from the Mantle Site (AlGt-334)*. HDAS.
Striker, Sarah, Linda Howie and Ron Williamson. Forming Pots and Community: Pottery Production and Potter Interaction in an Ancestral Wendat Village. In *Innovative Approaches and Explorations in Ceramic Studies* edited by Sandra L. López Varela. Archaeopress: Oxford.
Whitbread, I.K. 1989. "A proposal for the systematic description of thin sections towards the study of ancient ceramic technology." In *Proceedings of the Archaeometry: proceedings of the 25th international symposium*, edited by Y. Maniatis, 127-138. New York, Elsevier.

Introduction

Decorative style is the foundation of most Iroquoian ceramic analyses. With well established methodologies and interpretive frameworks, decoration on pots can inform about date of occupation, social interaction, and more, maximizing the amount of information that can be obtained from an assemblage in a short amount of time. However, very little information about ceramic clays and tempers is recorded in a standard analysis, so that we know comparatively about technological choices in Iroquoian pottery production. Those groundbreaking studies that do exist demonstrate how much we are missing in terms of provenance, production techniques, use, exchange, and learning in Iroquoian pottery production (e.g., Howie-Langs 1998; Howie 2012; Braun 2012, 2015).

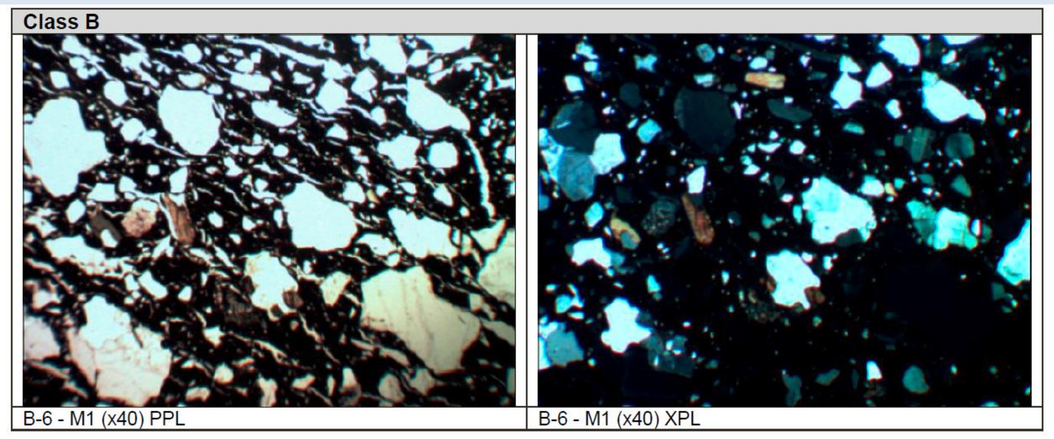
As part of my dissertation research, I set out to develop a method to quickly, accurately, and inexpensively characterize Iroquoian ceramic fabrics using a Dinolite USB microscope and selective thin section petrography. I developed this method working with ceramic vessels and pipes from the early fifteenth century Mantle site (see maps to left and right).

ASI 2012 p. 181-294

ASI 2012 p.138-139

Developing the Method

I began with descriptions of ceramic fabrics completed by Linda Howie (2012) using a modified version of Whitbread's (1989) descriptive technique. I used Howie's observations to determine what features to record. First I examined sherds previously characterized by Howie, checking my own observations against her descriptions. Working iteratively, I determined which characteristics of the ceramic fabrics that I could identify most accurately. After experimentation, I developed a set of attributes that I could record consistently and accurately using a USB microscope and set aside those that I could not.



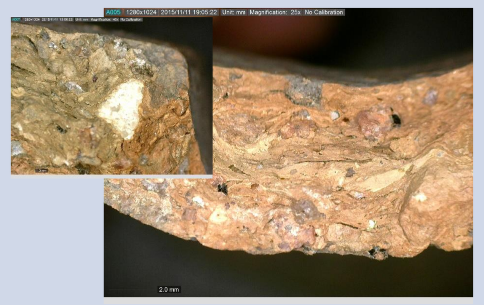
Photomicrographs (Howie 2012, p. 73) and a Dinolite photo of vessel CS45. Howie described this fabric group as well sorted clay with subrounded inclusions (predominantly quartz and feldspar) with crushed igneous rock temper. Both the rounded clay inclusions and the character of the temper are visible using the Dinolite.

What can you see with a USB microscope?

I used a Dinolite digital microscope to examine a freshly broken surface of each sample. I examined both the clay and temper with low (~50x) and moderate (~150x) magnification. Using Howie's detailed petrographic descriptions as a guide, I can distinguish major paste and temper groups and identify features that warrant further investigation. Howie's study included 62 vessel thin sections, and I have examined an additional 289 vessels and 92 pipes. Another 75 vessels and 15 pipes will be thin sectioned for descriptive petrographic analysis to test and refine my characterizations.

CS118511 Pipe: Smooth clay with sparse fine sand/silt. Rare fine temper or larger sand inclusions. Unusual voids.

CS101288 Vessel: Smooth clay. Moderate density of very coarse, poorly sorted, angular temper of crushed granite. Unusual green inclusion may be from temper or clay and will be positively identified via petrography.



CS9773 Vessel: Streaky clay, perhaps varved or with plastic inclusions that were worked during vessel shaping, Very coarse, moderate density, poorly sorted, angular granite temper. Large irregular channel voids. Large white calcitic inclusion reacts with HCl.

CS12315 Vessel: Mottled clay with semi plastic inclusions likely clay or silt lumps, and very fine/silt sized rounded, poorly sorted sand. Sparse temper is angular, poorly sorted crushed granite.

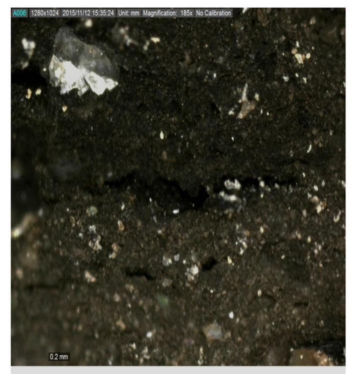
CS9649 Vessel: Typical of incompletely oxidized very dark fabric with few characteristics of the clay visible. Coarse, poorly sorted, angular granite temper.

Attributes to Complement Qualitative Description

Whitbread's descriptive approach uses thin section petrography to produce detailed descriptions of ceramic fabrics with individual samples grouped by shared characteristics. For my dissertation, I needed data on ceramic fabrics by sample, rather than by group to examine relationships between decorative styles, vessel provenance, and raw material selection and processing. To make this possible, I recorded variables in the same manner as one might for an attribute-based decorative analysis with sample-by-sample records for each variable. With detailed attribute data, I can group samples by shared criteria such as sherds fired in oxidizing conditions, pipes and sherds with mica comprising >10% of inclusions, or create groups that match existing petrographic descriptions. This allows flexibility to explore many research questions with one dataset.

What do you miss with a USB microscope?

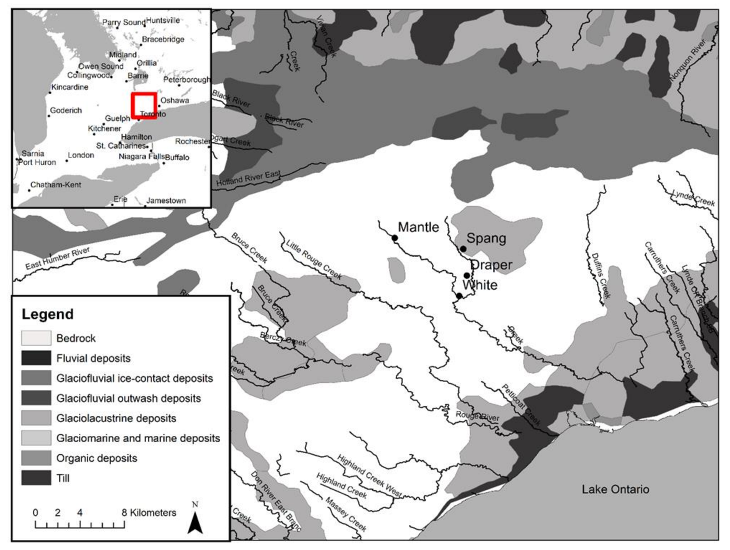
- Cannot distinguish calcareous vs. non-calcareous clays in the absence of calcitic inclusions >0.25mm even using HCl
- Can be hard to distinguish between natural clay and temper inclusions when the natural clay inclusions are angular
- Limited identification of rock and mineral inclusions
- Difficult to see any features of the clay or temper in very dark fabrics



Vessel CS45
Extremely dark fabric

Know your Geology

Understanding the local geology is essential because it provides context for interpreting the characteristics of the locally available clays and tempers. This context can also help you develop expectations for what you will find in the ceramics. For example, Mantle is located on a post-glacial landscape. Therefore, I would expect to find a lot of variability in the texture of local clays and a wide range of tempers would be available. I would not expect to find a significant amount of sedimentary rock used as temper, as there is not a lot of this on the local landscape. Vessels containing sedimentary rock were in fact rare at Mantle, and were selected for thin section petrography for further study.



South-central Ontario is a geologically complex landscape (Striker et al. 2017 p. 57)

Conclusions

My methods are specifically tailored for the geological and cultural setting I am investigating. I would recommend the following steps to develop a similar approach in another setting.

1) Create a geological profile of the region. What raw materials are available for making ceramics? Do you know what is commonly used?
2) Determine what specifically you would like to know about the pots (provenance, manufacturing steps, raw materials).
3) Use existing petrographic studies where available to determine how, if at all, these differences may appear in the finished vessel visible to the naked eye.
4) Develop a list of variables that you can code consistently. Wherever possible, focus on description rather than positive identification as this will make it easier to correct errors
5) **Test your findings** (paste groups, rock and mineral identifications, clay descriptions) using thin **section petrography**. Repeat! This method is intended to complement, not replace thin section petrography.