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Investigating pottery vessel manufacturing techniques using radiographic imaging and computed tomography: Studies from the Late Archaic American Southeast

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ABSTRACT

Advances in image acquisition and processing, including the increasing availability of computed tomography (CT), have expanded the research potential for radiography. This paper employs recent radiographic advancements to investigate how hand-formed pottery was manufactured, with a focus on defining "micro-techniques" that may be isomorphic with past social groups. By creating and imaging experimental vessels, unique structural "fingerprints" are defined for a number of micro-techniques, which are then used to categorize assemblages from two contemporaneous and neighboring archaeological sites. Results suggest that the two sites were occupied by distinct potting communities and that radiographic imaging can be a powerful tool for determining the presence of past social groups.

1.1. Introduction

Although still uncommon, archaeologists are beginning to use radiography and computed tomography (CT) at increased rates, particularly to study the internal structures of objects. Recent radiographic studies have identified the advent and spread of novel technologies and investigated complex patterns of production and consumption in past societies (e.g. Abraham et al., 2014; Bettuzzi et al., 2015; Bugani et al., 2009; Lang and Middleton, 2005). The availability and applicability of radiography is steadily increasing as technological improvements reduce the price of analysis and increase the speed and accuracy of imaging. These improvements, coupled with the growing application of computer vision, photogrammetry, and image processing within archaeology have created a fertile field of study that threatens to revolutionize the study of past objects (e.g. Berg, 2008; Lang et al., 2005; O'Connor and Maher, 2001; O'Connor et al., 2002).

This paper incorporates advances in imaging and processing to reinvigorate one of the original topics for archaeologists using radiographic imaging – the study of ceramic vessel manufacture. In earlier radiographic studies, determining vessel manufacturing methods has proven useful in tracing the emergence and distribution of new technologies, such as the potter's wheel, and the development of particular practices, including standardized vessel manufacture (e.g. Carr, 1990; Rye, 1977). The present study expands beyond traditional radiographic studies by exploring how vessel manufacture data can assist in determining the presence of past potting communities. Ethnographic studies demonstrate that "primary formation" techniques (i.e. coiling, wheel-throwing) often pattern along societal lines and are relatively resistant to change over time, making them good indicators of past social groups (Gosselain, 1998; Leroi-Gourhan, 1993; Minar, 2001; Plog, 1980). Typically, primary formation techniques are some of the first skills learned by novice potters who mimic the actions of their instructors. As such, a shared pattern of primary formation techniques can be found among contemporary potters with a similar "teaching lineage" as well as across generational lines of novices and instructors. Primary formation techniques are particularly useful in studying the presence of past social groups when they are difficult to discern in the completed vessel. To the extent that smoothing, buffing, and other finishing techniques obfuscate the manner by which the vessel was formed, it is increasingly unlikely that techniques will be adopted by potters who encounter finished vessels yet reside outside of the community.

Recent research has refined the scale by which archaeologists can investigate the presence of past social groups by revealing a wealth of "micro-techniques" that often cluster among particular potting groups (e.g. Lindahl and Pikirayi, 2010; Thér, 2015). Although there are technological and functional factors that influence how potters fashion vessels, there are also practices, such as the manner by which coils are smoothed together, which are far more dependent on habitual actions. These

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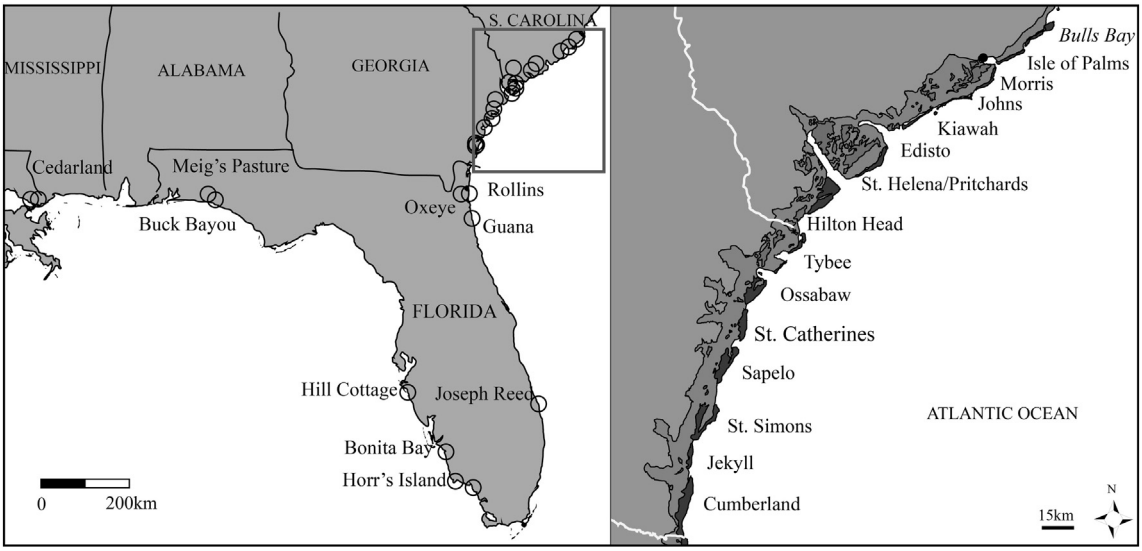

Fig. 1. Location of selected shell rings and close-up of the Georgia and South Carolina Sea Islands.

habitual practices often become rote, resulting in little change over time even as more reflexive actions, such as decorating or embellishing vessels, can change dramatically during the life of the potter (Gosselain, 1998; Minar, 2001).

Currently, the study of micro-techniques has depended on destructive analyses as they require thin-sectioning or polishing fresh breaks in vessels, and can even require the addition of polymers to enhance visibility. Radiographic studies obviously have the benefit of being non-destructive, yet have rarely engaged in the study of micro-techniques, partially because the structural features that define these techniques are difficult to discern using traditional radiographic methods.

Within this paper, I demonstrate how advances in radiographic technologies and imaging software have expanded analytical thresholds, making the study of micro-techniques increasingly possible. Specifically, with the advent and increasing availability of real-time imaging and CT-scanning, new methods of ceramic analyses are becoming possible (e.g. Sanger et al., 2013). These advances allow researchers to engage directly with samples by rotating, magnifying, and otherwise manipulating objects to allow visual inspection of internal structures otherwise difficult to see in static imagery (e.g. Kahl and Ramminger, 2012). Imaging data can now be investigated in increasingly robust manners as software allows the application of algorithmic analyses, pattern recognition, and enhancement parameters.

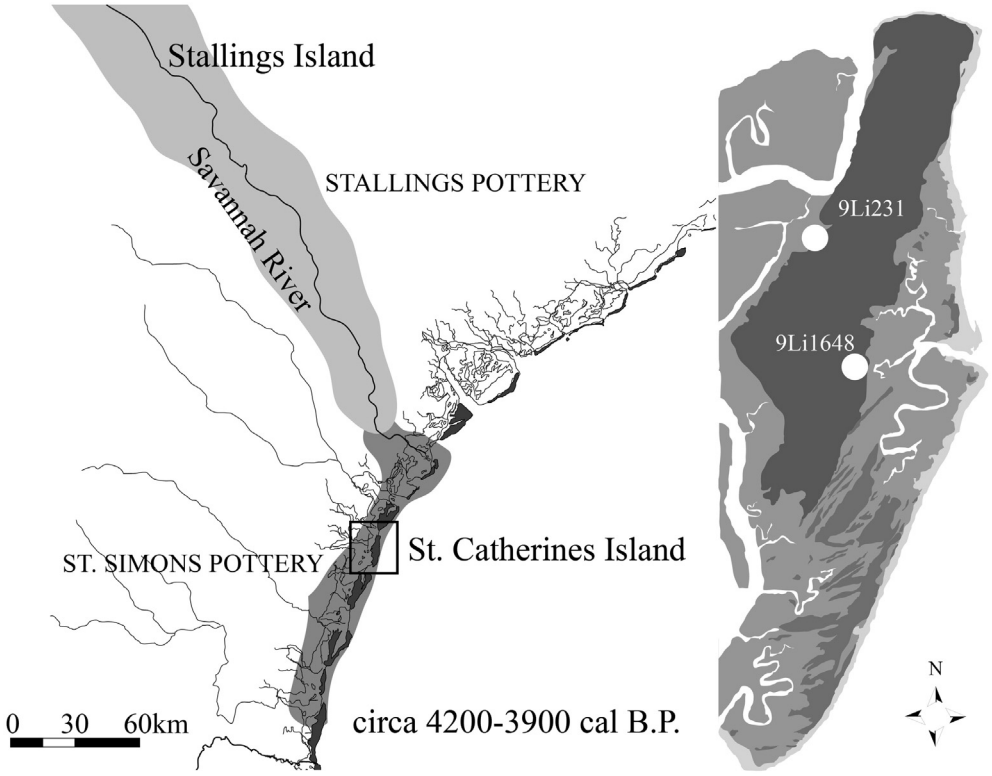

Fig. 2. Distribution of pottery types ca. 4200–3900 cal B.P. and close-up of St. Catherines Island with shell ring locations marked.