

**SPECIAL SECTION  
RESOLUTION AND REFINEMENT: RECENT ADVANCES  
IN ARCHAEOLOGICAL CHEMISTRY**

**INTRODUCTORY COMMENTS**

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Over the last century, methods developed in the analytical physical sciences have produced an astonishing impact on archaeologists' ability to glean information from the past. While debates concerning 'science' in archaeology linger, it is clear even from casually browsing the literature that archaeological chemistry enriches archaeological interpretations. Often though, there is still a divide across which natural scientist and archaeologist collaborate: one scholar with training in the analytical techniques and interpretation of the data produced, the other with the contextual knowledge of the archaeology and the inferences about the past that the data will address. Research must pointedly consider both perspectives. Multidisciplinary efforts falter when the relationship between analytical results and past social significance is not explicitly addressed (cf., Pollard and Heron 1996, 12–13). Recently, there has been a greater focus on integrating these perspectives, and increasing numbers of archaeologists with backgrounds in natural sciences are applying sophisticated analytical tools to help them answer broad questions about the past (e.g., Jakes 2002).

This special section examines two exciting, complementary and interconnected aspects of the current direction of archaeological chemistry. First, refinements in analytical instrumentation currently allow a wider variety of analyses than ever before, often with milligram-scale sample requirements. An obvious example is the impact of accelerator mass spectrometry (AMS)  $^{14}\text{C}$  dating, but with increases in the sensitivity of other techniques over the last 20 years more detailed sampling regimes and smaller samples are possible. For instance, light stable isotope studies of skeletal material provide a steady stream of data about past diet or environment (Fricke *et al.* 1995; Bocherens *et al.* 2001; Richards *et al.* 2001, 2003; Schulting and Richards 2001) and smaller sampling requirements now allow multiple measurements from a single specimen to evaluate mobility and seasonality (Balasse *et al.* 2002). Second, analytical techniques increasingly allow archaeologists to obtain greater resolution of our understanding of past societal dynamics, either by extracting more information per sample or by accumulating large comparable data sets. For example, early chemical characterization of obsidian in the prehistoric Mediterranean established hypotheses about the nature of trade (Renfrew and Dixon 1976); recent studies utilizing more sensitive techniques, novel methods and a significantly larger sample base have elaborated and substantially modified the understanding of obsidian circulation in the Mediterranean (Chataigner *et al.* 1998; Gratuze 1999; Tykot 2002). Similarly, organic residue analyses continue to extract more anthropogenic information from the lipid extracts of skeletal material and pottery (Evershed *et al.* 1999; Stott *et al.* 1999).

The papers in this special section had their genesis in a symposium at the 66th Annual Meeting of the Society for American Archaeology on 22 April 2001 in New Orleans, Louisiana, USA. Although they exemplify the trends of resolution and refinement in archaeological chemistry, they also implicitly focus on using multiple lines of archaeological evidence to complement the particular analysis, strengthening the bridge between chemical analyses of archaeological material remains and the production of meaningful inferences about the human past. These papers represent a collection of research thematically linked by greater resolution, refinement and integration in illuminating the past, though they do not necessarily represent a cross-section of new research in archaeological chemistry.

In the first paper by Knudson *et al.*, analysis of strontium isotopes ( $^{87}\text{Sr}/^{86}\text{Sr}$ ) in teeth and bone from the South Central Andes is used to evaluate competing hypotheses about the expansionist character of the Tiwanaku polity. Strontium isotope analysis shows the potential to refine our understanding of human patterns of movement in the past and to characterize the processes of cultural interaction, and has proven robust with samples from different environmental conditions and geological milieus (Price *et al.* 2002). This analysis provides a picture of human movement at the level of the individual, but eventually aggregate data could be used to revisit questions of the relationship between material culture, geographical origin and identity or ethnicity.

Reber and Evershed demonstrate the ability of new instrumental techniques to provide complementary information to isotopic studies of diet in North America and the introduction of maize. Identification of pottery used for the preparation of maize is utilized to consider interpretations of cultural change in the North American Eastern Woodlands. While studies of prehistoric organic residues are often hampered by diagenetic processes and by the destruction of anthropogenic signatures, this paper demonstrates that augmenting the data from individual samples can substantially contribute to useful lines of archaeological evidence.

In their study of Lapita ceramics from several islands in the Pacific, Kennett *et al.* investigate the nature of trade and production through elemental analyses using inductively coupled plasma–mass spectrometry (ICP–MS). Their research indicates the potential for ICP–MS analysis to document colonization or exchange in Oceania. And while there has been debate in the archaeological literature about the most appropriate way to define ceramic composition, the authors explicitly link human behaviour to the variability observed in the data. In their analysis, trade and exchange relationships can be discerned, and the potential to distinguish between individual potters is raised.

In his contribution, Middleton outlines a methodology for identifying past activity areas using soil chemistry. An explicit link is made between ethnoarchaeology, sampling considerations, site formation processes and archaeological inference. Two case studies illustrate how the combination of the multi-element characterization that is possible using inductively coupled plasma–atomic emission spectroscopy (ICP–AES) with ethnographically derived control samples can delineate activity areas in the absence of material evidence.

Finally, Wells applies ICP–AES to soil samples taken from plaza and midden contexts in a Classic Period (AD 600–1000) site in northwestern Honduras. In an alternative approach to that of Middleton, the author here considers correspondences between the chemical compositions of middens and spatially distinct areas of the plaza to propose activity areas. The difference in spatial scale between these last two papers well represents the utility of soil chemistry studies to provide resolution that is dramatically finer than that of site prospecting methods.

Instrumentation continues to become more sensitive, and new proxies for human behaviour and the environment are expanding the potential avenues of research into the human past. One

particularly exciting aspect of these directions, though, is that they are increasingly integrated into archaeology, remoulding the discipline. We hope that this series of papers shows the 'ways in which science can elaborate on the information available from archaeological data', and how the trends towards analytical refinement and resolution in archaeological chemistry strongly contribute to the 'attempt to *interpret and understand* the analytical results in social or cultural terms' (Knapp 2002, 141, emphasis in original).

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