INTERPRETING SILENT ARTEFACTS

Petrographic Approaches to Archaeological Ceramics

Edited by

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Cover images

Thin sections of Late Prehistoric ceramics from southern California seen under the polarizing microscope

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FOREWORD

This volume presents a range of petrographic case studies as applied to archaeological problems, primarily in the field of pottery analysis, i.e. ceramic petrography. Petrographic analysis involves using polarising optical microscopy to examine microstructures and the compositions of rock and mineral inclusions in thin section, and has become a widely used technique within archaeological science. The results of these analyses are commonly embedded in regionally specific reports and research papers. In this volume, however, the analytical method takes centre stage and the common theme is its application in different archaeological contexts.

The volume was inspired by the meeting on *Petrography of Archaeological Materials*, co-hosted by the Department of Archaeology, University of Sheffield, UK and the Ceramic Petrology Group (www.ceramicpetrology.com), on 15-17 February 2008. It is a natural successor to two earlier volumes on petrographic studies produced by the British Museum. The Sheffield conference was attended by around 60 participants from Britain and other regions in Europe and from North America. As might be anticipated the participants, including specialists on pottery, plaster, mortar, mudbrick and other materials, also attended a microscope workshop in the Materials Science Laboratory in the Department of Archaeology. This maintains a tradition long established at Ceramic Petrology Group meetings of fostering 'hands-on' shared experience in materials identification and interpretation.

Petrographic analysis can be relatively easy to learn at a basic level because it is visual and descriptive, and relates to hand specimen properties and geological materials. Nevertheless, identification and interpretation of unusual inclusions and varied micromorphologies arising from choices in raw materials, processing, forming and firing can be demanding even for specialists. Shared experience is therefore a key resource for addressing these issues, but the major problem faced by all petrographers, is how to communicate complex visual and analytical information in a concise and effective manner. A photomicrograph helps, but it represents only a fraction of the sample area and poorly conveys microstructural diversity. Nor can a photomicrograph incorporate the range of optical properties necessary to identify inclusions accurately. This information needs to be communicated in reports via comprehensive description and interpretation to aid other petrographers in recognising technological properties and comparing results. Publication on the Internet offers opportunities to expand beyond the limitations of traditional paper reports, but face-to-face discussion over a polarising microscope remains an essential means of exchanging information.

Petrography pioneer Henry Clifton Sorby had begun to address archaeological questions as early as the 1860s, only a few years after his remarkable advances in developing the thin section analysis of rocks (Worley, this volume). It is not at all surprising that petrography was quickly recognised within archaeological research as a valuable tool for answering questions. Procedures for examining mineral and rock inclusions in composite materials were subsequently developed in the earth sciences, especially in the field of sedimentary petrology, but properties specific to the

anthropogenic manipulation of these materials also need to be addressed, and this can only be done within archaeology. Prime examples are the pioneering works of Anna Shepard in the USA and David Peacock in the UK, who established ceramic petrography as a specialist archaeological field.

Foremost amongst the archaeological issues to have exploited petrography is the study of ancient trade and exchange, which is the subject of several papers in this volume (Ixer and Vince; Montana *et al.*; Boileau *et al.*; Ownby and Bourriau; Heidke; Kelly *et al.*). The most basic question raised by many excavators is whether pottery at their site was locally produced or imported from nearby or remote sources. Ceramic petrography lends itself to such issues because inclusions in pottery can be compared with local and regional geology, as well as with fabrics of pottery from known sources. It may be suspected that excavators like to find that their site was integrated into regional exchange networks, since this indicates a wider social significance for the settlement under investigation. On the other hand, sites with limited evidence for such engagement have their own stories to interpret (Jorge; Maritan *et al.*; Pentedeka and Dimoula; Szilágyi and Szakmány; Kelly *et al.*) and are just as critical for gaining insight into social organisation at the regional scale. Dealing with large quantities of imported fabrics is as challenging as it is exciting because it takes considerable effort to identify remote source areas, especially where different regions of similar geological character present viable alternatives. This is where petrography benefits from the ability to build on previous research through re-analyse of thin sections from earlier studies (Ownby and Bourriau). We can see here that well archived (Worley) petrography projects can remain an active research resource long after the initial studies have been completed.

Analysis of composition and microstructure lends itself to investigations of ancient technology. Recent research has highlighted the socially embedded nature of technology and its role in identifying social identities and boundaries. Technology is therefore not just of interest to materials specialists, but is relevant to a wide range of archaeological research on social issues. Several papers in this volume focus on technological and social aspects of pottery production (Jorge; Piovesan *et al.*; Kreiter *et al.*; Klassen; Quinn and Burton). Raw materials prospection, sampling and processing are frequently used when interpreting local pottery fabrics. Moreover, this type of analysis can reveal something of the interaction between ancient craftspeople and their natural environment, as much in identifying materials that were not selected as those that might have been used. Several contributions to this volume employ this approach to assist in identifying processing technologies such as refining (e.g. sieving and levigation), intentional addition of materials as temper and clay mixing, which may characterise particular technological traditions. One type of temper in particular that excites petrographers is grog, or crushed pottery (Jorge; Maritan *et al.*; Piovesan et al.; Klassen; Quinn and Burton). Grog is material that clearly was added intentionally, but the reasons for incorporating fragments of old pottery within new products are varied and rarely identifiable with surety. There is potential for developing the identification of vessel forming techniques from ceramic microstructures (Pentedeka and Dimoula; Quinn and Burton), though challenges are encountered in the small areas covered by

thin sections and the disruption of traces during clay working. Finally, firing conditions can be estimated from the optical properties of fired clay and the condition of certain inclusions (Pentedeka and Dimoula; Quinn and Burton), but SEM studies have proved to be especially successful in this respect (Faber *et al.*).

Naturally, petrographic studies encounter problems where the technique is pushed to its limits. Taking on these problems is fundamental to advancing the role of the technique and to opening new and alternative avenues for addressing archaeological questions. Contributions to this volume illustrate some of these challenges. Ceramic petrography works best where there is regional diversity in rock types. While too much diversity compounds investigations with alternative potential sources (Kelly *et al.*), detailed analysis is necessary to discriminate sources in regions of overwhelmingly similar geology (Ixer and Vince; Jorge; Szilágyi and Szakmány; Kelly *et al.*; Quinn and Burton). Fabrics with relatively large and compositionally distinctive inclusions are especially sensitive to petrographic analysis, but chemical analysis is usually more effective for finer fabrics or those dominated by common minerals such as quartz. There are circumstances where petrography can be usefully applied to finer material, however, especially with the aid of associated techniques such as SEM (Faber *et al.*) and clustering routines to aid fabric classification (Montana *et al.*). Combining petrography and chemical analysis is especially productive (Maritan *et al.*; Kelly *et al.*). Familiar methods can also benefit from modification and application with well-targeted aims. Point counting, for example, has been successfully applied to pottery in Arizona (Heidke), showing that enhancements in technique and appropriate application can bring significant rewards.

Finally, there are some areas of future research not included in this volume that might be considered, such as digital image analysis, experimental petrography and the *chaîne opératoire*. The former has potential to generate valuable quantified petrographic data, but so far its application has been limited. This may be due in part to the complexity of optical properties and microstructures encountered in many thin sections, the relatively small area of many samples and the time needed to capture, process and interpret the data for large numbers of samples. Experimental petrography is an extension of the raw materials analysis referred to above, with the aim of generating specific microstructural properties in modern samples in order to better understand those found in ancient materials. This applies particularly to questions of clay mixing and the generation of distinctive void structures. The *chaîne opératoire*, or sequence of actions and choices in a technological process, is widely recognised as a means investigating technological traditions. Several papers in this volume touch on this area (Jorge; Kreiter *at al.*; Pentedeka and Dimoula; Klassen; Quinn and Burton). There is clearly an avenue of research in integrating more closely raw materials studies with those of forming, decorating and firing to better distinguish technological traditions and integrate them into broader studies of identity and social relations.

Such opportunities to develop petrographic methods and their application are encouraging. They encapsulate a flexibility that allows the technique to address wide-ranging problems and diverse archaeological assemblages, not just textbook case

studies, and further develop the work initiated in the mid-nineteenth century by pioneers such as Henry Clifton Sorby.

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