Proposal

When material science meet ceramic sociology: an archaeometallurgical study of crucibles and domestic pottery from Mapungubwe, South Africa

Shadreck Chirikure and Simon Hall

1. Introduction

The enchantment with Mapungubwe gold has marginalised mundane artefacts such as crucibles, which basically are domestic pottery used in metallurgical operations. The only distinction is that crucibles contain occluded slag in the interior, with occasional cuprous prills. In the ethnography, metallurgy and pottery making are characterised by gender exclusivity – men are metalworkers while women are potters. Taboos prohibit men from potting while a set of cultural restrictions also prevented women from metalworking. The presence of typical female material culture pottery in a male domain (metalworking) at Mapungubwe therefore requires further investigation to shed new light on gender relations in southern African pre-colonial metallurgy. For example, were the crucibles and pottery made of the same clay? Furthermore, is the technology of production similar or different? Who made crucibles and who made pottery? Also, what metals were worked and processed in the crucibles? Answers to these questions require a dedicated inter-disciplinary study crucible and domestic pottery fabric to explore technological and decision making choices invested by the manufacturers of these macroscopically identical material culture items. This proposal seeks to study ten samples of crucible fragments and ten samples of domestic pottery from Mapungubwe that are currently in the UCT collection. After study, the materials will be returned to the Mapungubwe Museum in Pretoria. It is hoped that a paper will be produced for a top journal such as the Journal of Anthropological Archaeology.

2. Background

Mapungubwe, the capital of one of southern Africa's early Shona states, is located in the Limpopo Depression near the border between the modern countries of Botswana, South Africa, and Zimbabwe (Pikirayi 2001). The Archaeological Committee of the University of Pretoria appointed Fouche (1937) to instigate large scale excavations on the summit of Mapungubwe Hill. Basically, there are two excavation phases at the site. The first stretches from the 1930s to the 1960s (Fouche 1937; Gardiner 1963) while the second started in the 1970s and lasted until the 1990s (Meyer 1998). The famous Mapungubwe burials were exposed in the 1930s together with the significant amounts of accompanying gold objects. It is the glitter from this gold which has given the site some of its glamour.

Two archaeological cardinal sins were however committed during the first phase. Firstly, cursory attention was paid to the stratigraphic relationship between different layers and secondly the provenience of artefacts was hardly recorded. In a move with antiquarian overtones, artefact collecting focussed on spectacular objects with the consequence that the more mundane objects ended up in the

excavation spoil heaps. Calabrese (2007) reverse excavated one of the dumps from the hill excavations and recovered just over 105 crucible fragments. Because the contexts of discovery were not recorded during the initial excavations, it is difficult to establish relationships in the chaine operatoire of metal working at Mapungubwe. As such, the link between different stages in the metal production cycle at the site is by historical circumstances a matter of conjecture. The ceramics from Mapungubwe which were used for day to day purposes like cooking, as well as for specialised functions such as metallurgy (Fig 1), present an opportunity to explore the material properties and sociological attributes of this material culture.

Basically, crucibles are free-standing vessels, used for high-temperature operations such as metal smelting, melting and casting (Freestone 1989). In Europe's later prehistory, crucibles were also used for assaying (Martinon-Torres et al. 2008). A diachronic study of the typology of crucibles used in Eurasia demonstrated the multiplicity of shapes and designs that they come in (Bayley and Rehren 2007). Regardless of shape and design, crucibles were supposed to meet essential performance characteristics such as heat retention and stability at high temperatures. Alongside other technical paraphernalia, crucibles occupied a crucial role in metal processing across the ages because not only did they act as combustion chambers that maintained suitable temperatures and thermodynamic conditions critical for melting or smelting but they also functioned as receptacles for the molten metal (Tite et al. 1985; Thornton and Rehren 2009; Konig and Serneels 2012).

A literature survey revealed a staggeringly limited inventory of work dedicated to archaeological crucibles in southern Africa (e.g. Maggs and Miler 1995; Miller and Hall 2008; Thondhlana 2012). In comparison to other areas of the Old World such as Europe and South Western Asia, where there is a long archaeometallurgical encounter with crucibles (see Tite et al. 1985; Freestone 1989; Bayley and Rehren 2007; Konig and Serneels 2012), in Africa there is a paucity of similar work. Perhaps, these contrasting disparities reflect on the general lack of archaeometallurgical studies on the pyrotechnology of copper and its alloys (Miller and Killick 2004; Severin et al. 2011), with the result that only snippets of information are available on the technology and social significance of crucibles in sub-Saharan Africa.

The main indication from the Eurasian experience is that from the Early Chalcolithic to the Late Iron Age, melting and smelting crucibles were typically made from ceramic fabrics with low refractory qualities (Thornton and Rehren 2009). During this time, some crucibles particularly in Roman times resembled domestic pottery (Freestone 1989). In terms of operation, the charge which consisted of ore and charcoal in the case of crucible smelting was heated from the interior to cushion the vessel from thermal stress induced failure. Often, technological choices such as the addition of inorganic and organic temper, actions which greatly improved the heat retention properties of early crucibles, were selected by the crucible makers. On top of these technical interventions, some crucible manufacturers made multi-layered vessels to achieve optimum mechanical strength (Konig and Serneels 2012). This technological solution prevented total fabric failure given that the interior invariably was often exposed to high temperatures (Freestone 1989). From Medieval times onwards, custom made crucibles for assaying gradually emerged and these were fired from the exterior. Not surprisingly, their makers deliberately added highly refractory minerals such as mullite to the clay to confer additional thermal resistance capabilities on the crucibles (Martinon-Torres et al. 2008).

Given the glaring paucity of studies on metallurgical crucibles in southern Africa, geochemical and petrographic investigations of the crucibles from Mapungubwe are essential. Furthermore, the necessity of such work derives from the observation that often, southern African archaeologists have made significant interpretations about the organization of metal working on the basis of anthropological evidence but without any confirmatory archaeometallurgical work. For example, although variable amounts of metal working evidence were recovered at Mapungubwe, it has been maintained that on anthropological logic, smelting of iron and copper is unlikely to have been practiced at the site. In the recent past, metal reduction activities were located outside villages because of their association with metaphors of human reproduction and gestation (Childs 1991; Herbert 1993). Because it was less ritualised, smithing and metal melting were conducted in the homestead. Studies of the stages of metalworking represented by the crucibles are therefore essential.

3. Materials and their descriptions

The materials for study were recovered from the re-excavation of the spoil heaps from the early excavations that were carried on the north-western side of Mapungubwe Hill. Calabrese (2007) reverse excavated one dump and retrieved just over 105 crucible fragments. The crucibles resemble domestic pottery in terms of surface finish, decoration techniques, and vessel profiles (see Figs 2 and 3). The crucibles are however vitrified in the interior and contain vesicular slag with occasional metal prills. Superficial descriptions by Calabrese (2000) indicated the presence of a decorated crucible with both a profile and decoration motif typical of Mapungubwe beakers.

Macroscopic and stereo microscopic studies of the clay fabric of the pots and crucibles revealed identical clays for the two sets of material culture. While a significant amount of pots and crucibles had a dark core typical of firing in a reducing atmosphere, others were fully red indicating firing in a more oxidizing environment. Some pottery and crucible fragments had large quartz inclusions in a very fine clay matrix while others had smaller amounts of quartz inclusions in the same matrix. The only difference between the crucibles and the pottery is that the former are typically highly vitrified in the interior and often contain occluded cuprous prills in a black slag matrix. The main question therefore is are the clays also chemically identical? Only geochemical work can provide answers.

4. Research Aims

The Mapungubwe crucibles were recovered from the north-western part of the settlement believed by some archaeologists to be the royal wives' residency. The ensemble of metal processing remains from this part of Mapungubwe includes unreduced copper ore, vitrified tuyeres, slag and crucibles. Using results of combined optical and geochemical analyses, this contribution aims to achieve the following:

1. To identify metals worked in the crucibles,

2. To delineate the production chain stages represented by the crucible slag and finally

3. To compare the fabric of crucibles and domestic pottery

The outcomes of the study will afford an opportunity to explore the relationship between technical and sociological aspects of the crucibles, a variable which is hardly considered in anthropological literature.

5. Analytical Methods

In studying materials such as crucibles from the highly significant site of Mapungubwe, it is important to consider the issue of sampling seriously. As such, it is important to use methods that extract the maximum amount of information from a small sample size. We therefore propose to invasively sample ten samples of crucibles and ten samples of domestic pottery. In each case, pieces will be kept for reference purposes. In addition, no decorated crucibles will be sampled invasively.

A combination of optical and geochemical methods of study will be adopted, in a stepped approach that will commence with reflected and transmitted light plane polarised microscopy, followed by Scanning Electron Microscopy and ending with elemental analyses using WDXRF

Optical microscopic studies will be carried out in the Archaeological Materials Laboratory of the Department of Archaeology, University of Cape Town using a Reichert-Jung dual petrographic/metallurgical microscope. An FEI Nova NanoSEM Scanning Electron Microscope 50 attached with a Helix detector technology housed in the Electron Microscope Unit of the University of Cape Town will be utilised for further optical work. WDXRF analyses will be performed under the guidance of Professor David Reid using the Phillips X'Unique XRF spectrometer in the Department of Geological Sciences at the University of Cape Town.

Taken together, this analytical procedure will create a robust and reproducible geochemical and mineralogical data set essential for understanding the mineralogical and elemental composition of the materials under study.

6. Conclusion

Optical microscopic phase identification and compositional analyses of the crucible slag are aimed at identifying the metals that were worked in the crucibles. Comparative petrographic and geochemical work on individual crucible and domestic pottery fabrics will reveal the decision making processes and technological choices invested in raw material selection for pottery and crucibles. If the empirical work demonstrates that pottery and crucibles are one and the same, this will pass fascinating comments on the symbolic milieu in which metallurgy and potting were rooted.

7. References

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