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Selected with care? – the technology of crucibles in late prehistoric Scotland. A petrographic and chemical assessment

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ABSTRACT

Prehistoric crucibles and other metalworking ceramics are often described as highly specialised tools made from refractory materials, but little is known about regional trajectories and individual material developments. Hence, further analyses of materials from less studied regions are needed. The current study investigates the technological development of crucibles from late prehistoric Scotland and its relation to technological choices and specialisation. The examination, using ceramic petrography and Energy Dispersive X-Ray Spectroscopy, focuses on the selection of clays and additives for the manufacture of crucibles in contrast to moulds and pottery. It is demonstrated that the production of crucibles in the late prehistoric period predominantly used local resources. Late Bronze Age crucibles have a close relationship with other types of technical and domestic ceramics, while materials in the Iron Age indicate an increased material specialisation for the preparation of particular fabrics. This development is seen across Scotland and echoes trends seen in other areas of Europe, emphasising the role and importance of metallurgical and technological networks.

1. Introduction

Metalworking ceramics, including moulds, crucibles, tuyères, and furnace lining, are a group of tools used for the production and processing of metals and metal alloys. These materials are often classified as specialised technical tools demanding a high degree of technological skill, and said to indicate socio-economic status of a particular site or society (e.g. Howard, 1983; Levy, 1991: 68; Ehrenreich, 1991: 78). Technical studies have shown that these materials and practices are more nuanced. Early materials were simple, predominately made from local clays (e.g. Childs, 1989; Schneider, 1989; Evely et al. 2012); while technically advanced refractory materials were used first in post-Roman periods (e.g. Freestone and Tite, 1986; Bayley et al., 1991; Rehren, 2003). The technology of metalworking ceramics is well documented, but based on chronologically and geographically spread case studies; Bayley and Rehren (2007) and Freestone (1989) provide good summaries of previous literature. Little is known about regional trajectories and few studies have looked at the material in a diachronic perspective, hence more detailed studies from specific areas are needed to give a fuller understanding of this material.

This article discusses data for the manufacture of crucibles in late prehistoric Scotland, the period from the Late Bronze Age to the Early Historic period[1] (Table 1)(cf. Harding, 2004). The focus here will be on crucibles, vessels used for high temperature processes of various substances, for example metals, glass and pigments (Bayley and Rehren, 2007). Scottish late prehistoric crucibles were mainly used for casting of copper alloyed with lead and/or tin in varied amounts, but crucibles used for casting and processing precious metals, particularly silver, are known from the later part of the Iron Age (Hunter et al., 2007: 56). The goal is to investigate the technological development of crucibles in the context of material choices and specialisation. Other types of metalworking ceramics together with domestic pottery will be used to assess the material properties of crucibles. A central aim is to assess the technology of late prehistoric crucibles and test if the craftworkers selected particular clays different from those used for other groups of ceramics.

Recent decades have seen a development of our understanding of technology, from a static residue of human culture to an active

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[1] The period from ca. AD 400 to AD 800 is termed Early Historic for most of Scotland, while some scholars argue that this period is a final phase of an extended Iron Age (IA) in Atlantic Scotland and term it the Late Iron Age (Ralston and Armit, 2003: 218).

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Table 1
The late prehistoric period in Scotland, compared with SE England and continental chronology; Early Historic refers only to Scotland; periods marked in bold are discussed in this paper.

Period	Scotland, absolute chronology	SE England, [a]absolute chronology	Hallstatt/La Tène[a]
Late Bronze Age (LBA)	1000–700 BC	1150–800 BC	Hallstatt B/C
Early Iron Age (EIA)	700–200 BC	800–600 BC	Hallstatt C/D
		600–400/300 BC	
Middle Iron Age (MIA)	200 BC – AD 300/400	400/300–100/50 BC	La Tène I/II
Late Iron Age/Early Historic (LIA/EH period)	AD 300/400–800	100/50 BC – AD 43	La Tène II/III

[a] After Cunliffe (2005).

process constructing social meanings and processes (cf. Dobres, 2010). Studies of ceramics, particularly pottery, have increasingly looked at individual or social practices for the technological sequence, from material procurement to firing or use (Sillar and Tite, 2000) commonly in the context of *technological choices* – choices made by the potter during the manufacturing process. This research has shown that production is often embedded in daily life and a central part of traditions and social practices (e.g. Gosselain and Livingstone Smith, 2005). This article looks at the first two steps in the production sequence in the manufacture of metalworking ceramics, particularly crucibles in late prehistoric Scotland and views this in relation to material selection:

1. the selection of clays and tempering agents
2. the preparation of the ceramic fabric

Discussions of the use of clay sources have traditionally focused on the question of provenance with the goal to characterise material groups or point towards a geological or geographical origin (Wilson and Pollard, 2001), but an increasing theoretical literature has looked more in detail at why certain sources were selected. Several scholars have highlighted the difficulties in determining the exact provenance of a particular ceramic material following the often high variability of ceramic materials, due to both anthropogenic and natural causes (Blackman, 1992; Tite, 1999: 197; Rapp and Hill, 1998: 140–41). The issue of the provenance of the ceramic material is not a key-question in the current study, but the assessment of the use of local vs. non-local clays will be essential. Local is based in this context on Arnold's assessment of the use of clays in ethnographic contexts (1985; 2000). Arnold argued that a potter would usually collect clay and temper within a 1–3 km radius from the production site, and rarely go beyond 7 km. His conclusion is supported by later research (e.g. Gosselain and Livingstone Smith, 2005: 35; Sillar, 1997); but both Gosselain/Livingstone Smith and Sillar emphasised that social rather than economic mechanisms, as Arnold stressed, were central to the formation of particular selection processes.

Previous studies looking at the provenance of pottery from late prehistoric Scotland (e.g. Topping, 1985; MacSween, 1990, 2007) have highlighted that pottery was produced locally using local resources. This follows the main trend seen in late prehistoric Britain (Morris, 1996; Fig. 5.2), where there is little evidence that communities would travel beyond the local surroundings to collect clays, and likewise there was little evidence for the trade of pottery. Centralised production of pottery is first seen in southern England at the end of the prehistoric era (Morris, 1996: 49). Specialised production and trading of pottery was not seen in Scotland until the medieval period (cf. Jones et al., 2003), while large parts of Scotland have been described as aceramic during the late prehistoric period (see below).

The origin of clay and temper used for metalworking ceramics has not been as well studied as the provenance of pottery, and the understanding of practices during prehistoric periods of particularly north/northwest Europe is still sketchy. The ceramic technology of crucibles and metalworking ceramics from Scotland has never been assessed in detail. Most studies have instead focused on material morphology and its chronological potential (e.g. Heald, 2001; Campbell and Heald, 2007). Hilary Howard's (1983) thesis is the only comprehensive study of prehistoric materials from Britain. She concluded that LBA crucibles (Howard, 1983: 490) and moulds are made from carefully selected local clays. This is in contrast to other studies which have shown that predominantly local alluvial clays were used (Bayley and Rehren, 2007: 47; Evely et al., 2012:, 1833).

Howard made no assessment of the provenance for the clay or tempering materials used in the Iron Age, but stressed the presence of three distinct refractory crucible fabric groups: carbon-rich fabric; carbon/quartz-rich fabric; sand-rich fabric (Howard, 1983: 496). Other studies north of the Alps have shown a continuous use of local clays in the Iron Age, as for example the Celtic oppidum Kelheim in north Germany (Schäfer and Scharff, 2003) and the Viking Age city Birka in Sweden (Vince, 2005: 244). The use of refractory fireclays is first seen in the medieval period (Freestone and Tite, 1986: 48–53; Bayley et al. 1991).

2. Materials

Functional qualities of a prehistoric crucible depend on its shape and fabric (Bayley and Rehren, 2007: 46–49). A general trend in crucible morphology from thick-walled shallow vessels to thin-

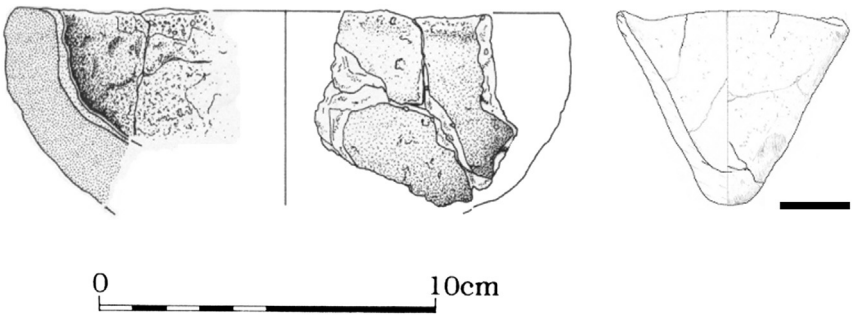

Fig. 1. Example of late prehistoric crucibles from Scotland, LBA crucible from Birnie (left, scale bar 10 cm) and MIA crucible from Traprain Law (right, scale bar 2 cm); from original drawings by Alan Braby.