Ceramic Evidence from Non-ferrous Metallurgy in the Mälaren Valley during the Viking Age

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Abstract: Studies of non-ferrous metallurgy in the Viking Age, predominantly from casting activities, have chiefly looked at specialised production contexts, while less specialised production has rarely been discussed in any detail. As a consequence, we know very little about the organisation and context of production outside larger pre-urban/trading sites. The purpose of this article is to discuss the evidence of non-ferrous craft production at a range of sites within region the Mälaren valley. It highlights that non-ferrous metallurgy was a widespread phenomenon during the Viking Age, but shows clear differences in the extent and context of the production.

Key words: The Mälaren valley – Craft organization – Technical ceramics

Introduction

Studies of non-ferrous metallurgy in the Viking Age, predominantly from casting of copper and silver alloys, have chiefly looked at specialised production contexts (e.g. at Birka) and linked this to the development of urbanisation and socioeconomic specialisation (Clark and Ambrosiani 1991; Callmer 2003). The presence of less specialised production is known (Callmer 1991; Ljungkvist 2012, p. 190-91), but this does not form part of the general narrative of production in the Viking Age. As a consequence, we know very little about the organisation and context of production outside larger pre-urban/trading sites.

The purpose of this article is to present some preliminary results from the ongoing project, Metalworking Crafts in Context, looking at the ceramic evidence of metallurgical production in the Mälaren valley during the Viking Age. Technical ceramics are the most reliable evidence of non-ferrous metallurgy (Bayley 1989; Martinon-Torres and Rehren 2014), while metallic waste products, hand-tools and furnace structures are ambiguous find categories which could relate to other craft activities or, in some cases, trade (Bayley 1991; Pedersen 2000). Phase one of Metalworking Crafts in Context was financed by Berit Wallenbergs Stiftelse and was an initial study to contextualise the production of non-ferrous metals in the Viking Age in two separate regions, Skåne and the Mälaren valley. This article discusses the material from one of these regions with the goals of defining different types of sites and characterising the ceramic material as a find category.

In this study, the Mälaren valley is defined as the area around the lake Mälaren in east central Sweden (Sporrong 2008), focusing on developments around Birka and Sigtuna. The chronological emphasis of the project falls on the Viking Age, loosely following the traditional chronology AD 800–1050, but includes sites with materials which are at least partly Viking Age in date.

Ceramic evidence of metallurgical production

Recent research has been able to identify an increasing number of non-specialised sites with evidence of non-ferrous production from different archaeological periods. This follows an increased interest in domestic contexts and the expansion of contract archaeology, but there is also an improved awareness of production processes and their material remains. Earlier research identified non-ferrous production mainly from the occurrence of moulds and crucibles, and the identification of a workshop building, but later research has indicated that non-ferrous production can leave a range of different materials and that the link to an actual workshop building is the exception rather than the norm (Armbruster 2004; Gustafsson 2012; Sahlén, forthcoming). The evidence discussed here derives from an extensive study of excavation reports and published sources, and materials published online in the National History Museum artefact database and The Swedish National Heritage Board database, Fornsök. Only sites classified as production sites by the excavators or in the publication of the material have been included since an independent classification of site activities was beyond the scope of the current work. As a consequence, there might be additional excavated sites where production was also carried out but currently not classified in this way.

The term technical ceramics, or sometimes metalworking ceramics, includes various ceramic tools employed for the production and processing of metals and metal alloys (Freestone and Tite 1986; Martínón-Torres and Rehren 2014). The main categories are crucibles and moulds, but also include structural parts of furnaces and other specialised artefacts used for particular processes.
From a ceramic perspective, crucibles – vessels used for high temperature and chemical processes – have been the most discussed find variety in this category (Bayley and Rehren 2007; Sahlén 2013). The main type is the metal-melting crucible used in casting of non-ferrous metals, but other types of importance are scorifiers, cupels and heating trays used for the refining or purification of metals (Söderberg 2004; Bayley and Rehren 2007). Crucibles during prehistoric and early medieval contexts are typically made in ceramic materials, although crucibles made in stone are known from the Viking Age and the medieval period, but are rare. The dominating Viking Age shape is the small open crucible (Fig. 1), with or without a handle or a spout, which is known from diverse sites (Pedersen 2010; Lamm 2008; Sahlén 2012), but is chronologically non-diagnostic since this type was used also in earlier periods. The size varies from 3-7cm in height and around 5cm in diameter, but larger examples are also known. Other shapes are known, but a full study of Viking Age types is missing. The ceramic crucible is often described as sandy to course sandy, tempered with sand or crushed quartz (Sahlén 2013), but little work has been carried out to investigate the technology of Viking Age crucibles. Vince (2011, p. 305-307), comparing crucibles from Kaupang (Norway) and Birka, noted some petrographic similarities between the material from the two sites. He argued that this relationship at least indicated a shared technology between the two sites, but did not rule out the use of similar sources of clay.

Viking Age casting moulds were made from stone or clay, and a few moulds in metal are known. Moulds in stone – mainly soapstone, schist or sandstone – were particularly used for casting of ingots and simple forms, such as Thor hammers and crosses, but also for simple ornamental objects. In most cases these were used as open moulds, but in some cases were supplied with a cover. Ingot moulds of soapstone are a characteristic Viking Age artefact found mainly at larger trading sites, but also at minor sites in the North Atlantic. Two types of clay moulds were used during the Viking Age: two-part moulds and investment moulds (cire perdue). Clay moulds were used particularly for casting of personal ornaments, for example brooches or pins (Fig. 2). Investment moulds are made around a model of wax which is then heated up and poured out, and the metal is poured into the space within the clay package (Lønborg 1998, p. 16-17). Two-piece clay moulds are made in two halves and are held together with an outer layer of clay, mainly for the production of pins and brooches. Moulds of clay are typically made from sandy/fine sandy clays or are alternatively tempered with a large amount of fine sand/silt and organic matter (e.g. Vince 2008). Studies of materials from other periods have shown a difference in the fabric between two-part moulds and investment moulds (Sahlén 2011, 203), but this has not been assessed for Viking Age finds.

The other main types of technical ceramics are tuyères and clay used in the construction of the furnace and hearths. The bowl furnace was the main metallurgical furnace structure from the Iron Age and the early medieval period, but structures used for smithing and non-ferrous crafts were simpler hearths with an external air supply (McDonnell 2001). Little is often left of these structures, but it would have been a small open structure charged with charcoal, sometimes dug into the ground and lined with clay. A
tuyère connected to bellows could be used as an air supply to make it possible to reach higher temperatures.

There has been surprisingly little technological work on technical ceramics from the Viking Age. Most work on moulds has looked at their preparation and use (e.g. Zachrisson 1966; Brinch Madsen 1984) and, in relation to crucibles, on identifying their association to particular metals or metallurgical process (Söderberg 2004; Bayley and Rehren 2007). A few petrographic analyses of moulds and crucibles have been published (Vince 2006, 2008), but these are often part of larger studies and the main aspect has been to provenance the material, while the material’s technology has only been discussed in schematic terms.

The sites

In total 14 sites have been identified with evidence of casting during the Viking Age in the Mälaren valley. The context and size of these sites varies considerably and there is an even spread of sites throughout the area in focus (Table 1, Fig. 3). This demonstrates that non-ferrous metalwork was more common in the Mälaren valley than has previously been acknowledged and similar patterns can be observed in other areas in the Viking World (e.g. Callmer 1991; Gustafsson 2013).

Table 1 summarises the ceramic evidence of non-ferrous production in the Mälaren valley during the Viking period, but note that the sites range from the early Viking Age to the early medieval period and many of the sites do not need to be contemporary. It is possible to define three categories of sites: Sites with extensive remains from metalworking suggesting a craft specialisation (site category 1); Sites with limited amounts of debris, but where the evidence for the production is clear, mainly through the presence of ceramic debris (site category 2); Sites with little or ambiguous remains and where the identification of an actual production is not certain (site category 3). This classification is not strictly a definition of site types since the characterisation of site categories 2 and 3 is mainly based on what was found, and this has to a large degree depended on how and to what extent each site was investigated. In addition, the sites’ production contexts have been noted in Table 1 (PC);

<table>
<thead>
<tr>
<th>No.</th>
<th>Site</th>
<th>Date</th>
<th>Site type</th>
<th>Cat</th>
<th>Ceramic debris and production context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Birka</td>
<td>VA</td>
<td>Pre-urban/trading place</td>
<td>E</td>
<td>Cbl: E; SC: S; TPM: E; StM: S; Misc: E; PC: W</td>
</tr>
<tr>
<td>2</td>
<td>Ekhammar</td>
<td>IA/VA</td>
<td>Settlement</td>
<td>3</td>
<td>Cbl: ---; SC: ---; TPM: ---; StM: ---; Misc: ---; PC: L</td>
</tr>
<tr>
<td>4</td>
<td>Fornsigtuna</td>
<td>VP-VA</td>
<td>Hall building</td>
<td>2</td>
<td>Cbl: S; SC: ---; TPM: ---; StM: S; Misc: W</td>
</tr>
<tr>
<td>5</td>
<td>Helgö</td>
<td>VP-VA</td>
<td>Large workshop area</td>
<td>2</td>
<td>Cbl: S; SC: ---; TPM: ---; StM: S; Misc: W</td>
</tr>
<tr>
<td>6</td>
<td>Hjulsta</td>
<td>VA</td>
<td>Settlement</td>
<td>2</td>
<td>Cbl: R; SC: ---; TPM: ---; StM: S; Misc: Mj</td>
</tr>
<tr>
<td>7</td>
<td>Mäby</td>
<td>VA-EM</td>
<td>Settlement</td>
<td>2</td>
<td>Cbl: ---; SC: ---; TPM: ---; StM: S; Misc: Mj</td>
</tr>
<tr>
<td>8</td>
<td>Pollista</td>
<td>VA</td>
<td>Settlement</td>
<td>2</td>
<td>Cbl: S; SC: ---; TPM: ---; StM: ---; Misc: M</td>
</tr>
<tr>
<td>9</td>
<td>Risse</td>
<td>VA</td>
<td>Settlement/grave</td>
<td>2</td>
<td>Cbl: E; SC: ---; TPM: ---; StM: ---; Misc: L</td>
</tr>
<tr>
<td>10</td>
<td>Säby gård</td>
<td>VA</td>
<td>Settlement and ritual complex</td>
<td>2</td>
<td>Cbl: R; SC: ---; TPM: ---; StM: S; Misc: Mj</td>
</tr>
<tr>
<td>11</td>
<td>Sandy gård</td>
<td>VA</td>
<td>Undefined</td>
<td>3</td>
<td>Cbl: ---; SC: ---; TPM: ---; StM: ---; Misc: L</td>
</tr>
<tr>
<td>12</td>
<td>Sigtuna</td>
<td>VA-EM</td>
<td>Urban</td>
<td>1</td>
<td>Cbl: E; SC: E; TPM: E; StM: E; Misc: W</td>
</tr>
<tr>
<td>13</td>
<td>Strömsnäs</td>
<td>VA</td>
<td>Without context</td>
<td>3</td>
<td>Cbl: R; SC: ---; TPM: ---; StM: ---; Misc: S</td>
</tr>
<tr>
<td>14</td>
<td>Valsta</td>
<td>VA</td>
<td>Grave complex</td>
<td>3</td>
<td>Cbl: ---; SC: ---; TPM: R; StM: ---; Misc: L</td>
</tr>
</tbody>
</table>

Key – Cat.: site category; IA: Iron Age; VP: Vendel period; VA: Viking Age; EM: early medieval; Cbl: crucibles; SC: specialised crucible; TPM: two-piece moulds; StM: stone mould; Misc: miscellaneous (mainly ceramic materials part of the furnace structure); E: extensive; R: rare; S: some; PC: Production context; W: workshop; L: limited; Mi: minor; Mj: Major; S: sporadic. The dates of most sites are uncertain, except for Birka and Sigtuna, why the periods have been listed rather than absolute dates.
this is a classification of the evidence of production at the different sites and includes an assessment of production debris and structural remains. This classification is preliminary and based on a system developed from the study of production contexts in late prehistoric Scotland (Sahlén, forthcoming). The quantity of crucibles, moulds and other ceramic materials (mainly furnace lining) has been defined using a descriptive nomenclature: rare, some and extensive to give an indication of the production intensity at the different sites.

There is obviously a clear difference between Birka and Sigtuna and the other sites listed in Table 1. Birka and Sigtuna were two early urban sites with extensive evidence of different specialised crafts and sporadic production in a workshop setting, while the other sites are mainly large farmsteads. The ceramic materials from site categories 1 and 2 are discussed briefly below, while the metallurgical material from all three categories and a full review of the sites will be presented in a future publication.

The ceramic materials

In most cases only limited amounts of ceramic debris are recorded, excluding the assemblages from Birka (Jakobsson 1996) and Sigtuna (Nordin 1990) where extensive amounts of moulds and crucibles were found. At Birka, the largest production site, around 25,000 mould fragments and 10,000 crucible sherds and solder packages were identified (Ambrosiani 2013, p. 237-38). This is two orders of magnitude larger than the 279 mould fragments found at Säby Gård, the site with most extensive ceramic assemblage in category 2 (Table 1). Crucibles are the chief material at the sites discussed here, but moulds and fragments of furnace lining are found at some places (Table 1). The number of crucible sherds can often be informative for an actual number of vessels since it can be possible to distinguish between different shapes and morphological features. In contrast, the number of mould fragments is not a good indicator of the number of actual moulds. Mould fragments are often much abraded and it is rarely possible to join individual fragments or to recreate a whole mould. This is due both to the fragile nature of moulds and that the mould is deliberately broken after use to remove the casted object. Still, a count of the number of mould fragments and identified mould patterns can give an indication of the extent of production and range of materials produced at the site. A crucible may very well have been used several times before it collapsed (cf. Eklöv Pettersson 2011) and does not give a clear idea of the extent of production.

The lack of moulds at excavated sites has led some researchers to discuss alternative moulding materials, particularly sand, but there is little evidence of such practices in the archaeological record. Clay moulds have been found at five sites (Birka, Helgö, Säby Gård, Sigtuna, and Valsta; Table 1), but the mould fragment found in the filling of a Viking Age grave at Valsta is probably intrusive and from the production in the Vendel period. Stone moulds are found at two sites, Birka and Sigtuna, and make up the largest portion of mould material at Sigtuna (Nordin 1990, p. 74). The casted objects are mainly decorative items such as brooches and pins, but metal ingots were also casted in the stone moulds from Birka and Sigtuna. The moulds from Säby Gård are interesting since they are for the casting of oval brooches (Dunér and Vinberg 2006), an artefact also manufactured at Birka (Ambrosiani 2013, p. 239-40). A petrographic analysis of the moulds from the two sites and pottery from the area around Säby Gård was carried out as part of the post-excavation assessment of the material from Säby Gård (Vince 2008). The purpose of the analysis was to assess if the clay was made from the same clay at the two sites and to test if the moulds were made at Birka and brought to Säby Gård. The petrographic analysis was unable to demonstrate if the moulds from Birka and Säby

Fig. 3: A, Map over Viking Age Scandinavia, including sites discussed in this article. The Mälaren valley is marked with a box; B, Map over the Mälaren valley, with site locations marked out (for site numbers see Table 1).
The main purpose of this article was to discuss the evidence of ferrous and non-ferrous production. A hearth structure was found in the west side of the terraced house at Farsta Gärde (structure A16, Andersson 2004, 13), which seems associated to smithing and possibly the working with copper alloys. The hearth measures approximately 3m in diameter and contains large amounts of fired cracked stones, charcoal, vitrified and glassy clay, slag and fragments and droplets of copper alloys, tin and lead. The position of the hearth within the building is unusual since the casting activities are often found outside a building or without connection to an actual building.

Discussion and conclusions

The main purpose of this article was to discuss the evidence of non-ferrous craft production in the Mälaren valley based on the ceramic debris and it presents preliminary results from the ongoing project Metalworking crafts in context at Stockholm University. The study has highlighted that non-ferrous metallurgy was widespread in the Mälaren valley during the Viking Age, but clear differences in the extent of the material remains from the different sites are apparent. Ceramic evidence for non-ferrous metallurgy was divided into four different categories (Table 1): melting crucibles, processing vessels (e.g. scorifiers, cupels and heating trays), clay moulds, and ceramic materials associated with furnace structures. The occurrence of stone moulds was also noted in Table 1. Non-ferrous production was identified at 14 sites (Table 1 but ceramic materials were only discovered at 12 sites and the amount of material discovered at the different sites varies considerably.

The material diversity at the different sites in the Mälaren valley is telling for the different types of production carried out. The extent of the material, the duration of the production and the range of different non-ferrous crafts carried out at Birka and Sigtuna indicate that the production at these two sites was both specialised and extensive following the main narrative of non-ferrous production in the Viking world. It is possible to identify different independent locations of production at both Birka and Sigtuna. Production at Birka has been discovered at several different locations (cf. Hedenstierna-Jonsson and Holmquist Olausson 2006; Ambrosiani 2013), suggesting different production contexts. The production at Sigtuna is located at several minor workshops (Wikström 2011), possibly an organisation typical of early medieval production. In contrast, the material seen at the other sites presented here show a more limited and shorter production; although part of the variability derives from differences in the excavation of the sites. This difference in production contexts is also seen in the variability of the material, where the material from Birka and Sigtuna appears more specialised with a wide range of crucibles for different purposes and different types of moulds. This suggests that at least two sets of production were established in the Mälaren valley during the Viking Age, one more specialised and one sporadic. Similar patterns have been seen in other areas, for example Skåne (Callmer 2003). This seems to indicate that non-ferrous production, and probably also other crafts, saw an increased specialisation during the Viking Age, though local non-specialised production continued outside the major sites.

This conclusion raises a number of questions concerning the consumption of metals and the presence of craft knowledge. For example: Were the crafts at these smaller sites linked to trade or local consumption? Were the crafts carried out by settled or itinerant craft workers? How common were skills in casting and forging of non-ferrous metals in the Viking Age society? It has not been possible to answer these questions from the present dataset, but these questions are explored in an ongoing project.

It is interesting that moulds and crucibles – the main types of ceramic evidence from casting production – are fairly sparse at most sites, excluding Birka, Sigtuna and to some extent Säby Gård. A similar pattern is noted by Callmer in his review of casting sites in southeast Skåne during the Viking Age (2003, p. 355). Callmer found seven sites with evidence of casting in his region of interest. Most of the sites showed only limited amounts of moulds and/or crucibles, while the material at Åhus II showed a considerable amount of material. This difference in materials quantities is partly related to the method of excavation, but the contrast between the large amount of material found at Birka and Sigtuna and the small amount or absence of materials at the other sites suggests that there were also different production practices and how the production was organised. Future analyses of the ceramic and metallurgical material at these sites are ongoing and will illuminate this relation further.

The patterns discussed in this article are tentative and more work is needed to test some of these conclusions. Comparison with similar distribution of production sites in other regions would clarify if the observations made in the Mälaren valley are representative of the Viking society or typical of socioeconomic central regions. Technical analysis of metal and ceramic debris has been initiated to assess the variability in the use of metal and craft techniques, which will be important to make assessments about the nature of the production at the different sites.

Bibliography


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