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Crucibles and moulds from Barrow-on-Humber

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The fragments of crucibles and moulds were found in a series of pits and ditches which are thought to be the fringe of a settlement of middle Saxon date.

The crucible sherds show some variation in fabric but all are made from a white or pale grey firing clay containing abundant quartz (sand) temper. Individual sherds show little variation in the size of the quartz grains they contain, though there are considerable variations from sherd to sherd. This sort of fabric is very suitable for use as crucibles because it is refractory, ie it will stand the high temperatures required to melt metals without softening itself. The high quartz and low iron contents of the clay both tend to increase its refractoriness when compared with ordinary clays.

Despite the nature of their fabrics, almost all the crucible sherds show some signs of vitrification produced by reaction with (alkali) fuel ash at high temperatures. In most cases there is just a thin glassy coating to the sherd but some show more extreme changes with the fabric affected to a considerable depth eg SF 72. In many cases the vitreous surface of the crucible sherd is coloured red by traces of copper.

Analysis of the deposits on a number of sherds were carried out by energy dispersive x-ray fluorescence (XRF). The results (see Appendix) show that most of the crucibles had been used to melt brasses or gunmetals, some of them containing significant amounts of lead. Two sherds (SF 66 and 82.3) contained silver-rich deposits which suggested the alloy being melted was base silver,

however no reliable estimate of fineness was possible. One further crucible sherd (SF 89.2) would appear to be part of a shallow dish. It contained a thick, dark glassy layer which gave strong XRF signals for silver, copper and lead. Both this and its form suggest it may be a fragment of a "heating tray" (Bayley 1982, 492).

The form of the metal melting crucibles is problematical though it can be said they were definitely hand made. There is only one which is complete enough for a reconstruction to be suggested (SF 58) and in this case there are three possibilities. First, it was an irregular thumb pot shape, roughly circular in plan and becoming wider towards its rim. Secondly, it could have been of a similar form but with a triangular plan, to produce lips out of which the molten metal could be poured. The final option is a half pear shape, similar to the lidded crucibles from Dinas Powys (Alcock 1963), which could be either open or covered. These last two options help explain the very variable curvatures seen on the smaller fragments which would otherwise suggest a considerable range of vessel sizes. Against this it should be noted that the sherds are of varying thickness (from under 4 to nearly 8mm) which tends to suggest a range of sizes, though some variation within individual vessels should be expected.

The moulds are all made of the same clay, a fine sandy fabric containing a fair amount of mica. It varies in colour from off white to dark grey, the parts nearest the metal being invariably darker than the outer surfaces of the mould. Where two valves have been luted together, the sealing clay appears to be the same as that of which the moulds were made.

There are no complete moulds but the larger fragments that survive all seem to come from 2-piece moulds. There is no evidence to suggest investment (lost wax) moulds were used although many of the pieces are too small to be diagnostic. By

considering all the fragments, the way the moulds were made and used can be pieced together.

First a lump of clay was laid down on a flat surface and roughly flattened, leaving a slightly convex upper surface. A model or copy of the object to be cast was then lightly pressed into the clay slab together with formers for the runners. In some cases nicks were made in the outer edges of the clay to act as keys for the upper half. A second clay lump was then applied to the first, over the top of the model. The two halves of the mould were then taken apart, the model removed and the valves reassembled and lightly luted together with a smear of the same clay round the join. The whole was then dried, fired and molten metal poured in with the mould held vertically rather than horizontally. The two halves could then be cracked apart, the casting removed and the mould reassembled for re-use. This method of manufacture means that the impression on the upper half of the mould tends to be deeper than that on the lower half and that most of the splaying out of the sprue cup is also on the upper half. Reconstructions of moulds of this type are illustrated by Lamm (1977, Figs 3 and 4), although the objects are more complex than most of those suggested by the fragments found at Barrow. The plano-convex form of the bottom halves and the concavo-convex form of the upper parts of the moulds are clearly shown.

One mould fragment (410 53.1) has a cylindrical hole running through it at right angles to the plane of the object being cast. This is probably not a runner as there is no splay where it reaches the outside of the mould. It may have held a peg (? of iron) round which the casting was being made.

The objects being cast, where they are recognisable, seem to be mainly rings, though they may just be ring-shaped ends of more complex objects. Some moulds have multiple runners, each going to an individual object (eg 404 59.1,

413 73.4) while other have a string of objects connected in a line (eg U/S 95.1).

One fragment (401 80.1) has definite lugs on the edge to ensure correct register of the two havles of the mould while a second piece (413 73.7) has a possible negative lug. The smooth surfaces on some of the upper mould pieces (eg 401 76.2, 414 90, 425 77) may represent the upper surface of a flat object or may just be the mating surface to the background on which an object has been placed.

References

Alcock L. (1963) Dinas Powys

Bayley J. (1982) Non-ferrous metal and glass working in Anglo-Scandinavian England: An interim statement PACT 7, 487-96

Lamm K. (1977) Early medieval metalworking on Helgö in Central Sweden in W.A.Oddy Aspects of Early Metallurgy 97-116

The metal traces on the moulds gave only very weak XRF signals (see Appendix) but the results were consistent with the use of copper alloys of similar compositions to those melted in the crucibles

Appendix : XRF results

The figures given are approximate XRF peak heights for K_{α} lines (copper, zinc, silver and tin) and the L_{α} line (lead). The numbers do not relate directly to the proportions of the various elements present but by comparison with standards of known composition give some indication of the nature of the alloys being melted. The zinc and lead levels on the crucibles are enhanced relative to the composition of the metal that was melted as both elements have high vapour pressures and so diffuse into the crucible fabric while also acting as glass forming elements, a factor which also increases their survival. These various factors have been taken into account in the discussion above.

Table 1 : Crucibles

		XRF peak heights				
Context	SF No	Copper	Zinc	Lead	Silver	Tin
409	85	433	214	?	-	-
410	72	4,833	1,572	200	-	130
412	58	1,117	121	485	-	190
412	64	2,133	3,646	1,769	-	299
412	66	422	2,100	149	603	-
413	73.1	992	1,501	210	-	70
413	82.2	407	176	99	-	-
413	82.3	626	1,068	92	418	-
416	65.2	291	229	180	-	133
417	89.2	29,086	903	5,386	3,858	-

Table 2 : Moulds

404	59.2 in	-	247	223	-	-
410	53 in	149	887	692	-	-
	out	-	-	453	-	-
413	73.4 in	85	117	123	-	-
	out	?	-	-	-	-
U/S	95.2 in	95	232	254	-	-