7.1.6.2 Tarbat crucible report
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1.0 INTRODUCTION

A total of 325 fragments of crucible and complete or near-complete crucibles and heating trays were recovered during excavation in Sector 1 and 2. The fragments were individually recorded and the results form the catalogue. The crucibles were categorised using Heald's crucible typology of Scottish Iron Age crucibles (Heald 2003, 47-59). The results of 59 EDXRF analyses of crucibles were also used (after Heald 2003 Appendix C). A further programme of EDXRF analysis was undertaken for the project by Dr Craig Kennedy, Senior Conservation Scientist, Historic Scotland on a further nine crucibles and trays and seven droplets of metal from hearths and working surfaces and the results are reported here.

2.0 TYPOLOGY

The following crucible types were identified: A1, A2, B2, G1, G2, G3 and I1 and I2 along with a variant form of Type I. Complete or near-complete crucibles (11) were easily assigned to type and a further 172 fragments were sufficiently diagnostic to also be assigned confidently to type. Where type could not be identified the fragment was recorded as body, base or rim and wall thickness was measured.

Crucible fabric was also visually recorded with notes taken on clay, temper, relining, vitrification, slag deposits and visible metallic residues.

2.1 Type A1, A2 and B2

Heald Type A crucibles are pyramidal or triangular crucibles being three-sided with a V-shaped profile with pointed or slightly rounded bases common throughout the Scottish Iron Age. They are also known from a range of Early Historic sites in Ireland, including Lagore, Cathedral Hill, Armagh, Garranes and Garryduff among others (Comber 2004). The type is subdivided by Heald based on height and wall thickness: Type A1 is most frequently recorded and forms a cohort of crucibles measuring between 35-45mm high in use throughout the Scottish Iron Age until the end of the 8th century; Type A2 are less common and larger measuring 60-70mm high.

Heald Type B crucibles are conical being circular in plan with a V-shaped profile. Like Type A, Type B crucibles are subdivided by size with Type B1 assigned to vessels measuring c.40mm high and Type B2 measuring over 70mm high.

Unless sherds are large the distinction between Type A1 and B1 and A2 and B2 is often not possible and the types are reported here together. A total of 87 Type A/B1 and A/B2 crucibles were identified in the assemblage and greater numbers of both types were probably represented in the assemblage.

Type A/B1

Twenty-four Type A1 crucibles and a possible Type A1 were recorded (Illus *). A further 18 fragments were assigned Type A/B1. Four of these belonged to a small A1 type crucible notable for their thin walls, small capacity and finely pinched spouts (Illus *). Wall thickness for Type A/B1 was recorded as up to 9mm but more frequently were considerably thinner often being recorded as 4 to 5mm and in some instances as thin as 2mm. Type A/B1 crucible fabric was commonly recorded as either fine with scarce mineral inclusions particularly in thin-walled examples or with mineral inclusions of rounded quartzose - presumably derived from a coarse-grained sand which may have been washed and sorted prior to inclusion in the fabric - or crushed quartz or quartzite.

Capacity of Type A/B1 crucibles could be judged in the complete or near-complete examples and appears to have been between c.10 and 15cc. The small Type A1 noted clearly had a much smaller capacity closer to c.3 or 4cc.

Type A/B 2

Six Type A2 crucibles were identified with a further possible example including a near-complete, smashed example (Illus *). A single Type B2 was identified and then only because it was almost complete (Illus *). A total of 30 Type A/B2 and 8 probable Type A/B2 were recorded but the fragments were not large enough to be more diagnostic. Wall thickness for these crucibles was recorded as slim as 8mm in a few examples, but generally thick walls were a characteristic of the type and were recorded as more than 10mm thick with many examples exceeding that and being up to 19mm thick (including re-linings).

Type A/B2 fabric was commonly recorded in cross-section as comparatively coarse with a frequent mineral temper of rounded quartzose, again probably a coarse, washed sand, or with crushed quartz or quartzite and notably with frequent voids. A large spall of a Type A/B2 crucible provided a section across rather than through the fabric where impressions of burnt-out vegetable matter possibly grass could be identified. The frequent voids noted in cross-section in many other examples are considered likely to represent burnt-out vegetable matter.

Relining was noted on several Type A/B2 crucibles and in one example more than once. Extensive vitrification of the fabric, rim and exterior was commonly noted with glassy crucible slags and oxides ranging in colour from red, grey, black and pale green.

Capacity of Type A/B2 crucibles was clearly much greater than Type A/B1 and where it could be judged using the largest sherds it appeared likely to have been c.20cc.

2.3 Type G

Heald Type G crucibles are identified as small, deep vessels formed around a thumb or finger with a handle modelled by pinching overlapping wall fabric into a small lug handle. Type G1 crucibles have handles horizontally pinched, Type G2 are vertically pinched and Type G3 has a handle pinched from the side to form a tear-shaped vessel. A total of 52 fragments could be identified as from Type G crucibles and a further 17 were probably from Type G crucibles.

Heald does not give a date for this type of crucible but Campbell and Lane suggest they are a 7th-century innovation with northern or western origins, being recorded at Dunadd in deposits of that date (Campbell and Lane 2000, 141). They have been recorded in quantity at the Brough of Birsay in 8th-century levels (Curle 1982, 40-1).

Type G1

Among this total of 69, nine complete or near-complete Type G crucibles were recorded as Type G1 and a further 23 Type G1 handles indicate a minimum of 32 examples in total (Illus *). Rim, base and body sherds of fragments recorded simply as G-type crucibles suggest many more examples are probably represented. Single possible examples of Type G2 and Type G3 were identified, although examples of both types are rare nationally and their significance is therefore difficult to assess (Illus *).

Wall thickness of Type G1 crucibles could be broadly grouped into thick-walled where crucible walls were measured as between 8 and 11mm thick and thin-walled crucibles which were recorded more commonly and generally between 3 to 5.5mm thick.

The handles of Type G1 were formed by pinching the clay of the walls into a small lug, but in several instances this resulted in a deep internal void and a likely point of weakness in the finished vessel. Small clay plugs moulded by hand and pushed into this void were noted in several examples often marked by part fingerprints (Illus *).

Six Type G1 crucibles were notably small including one complete example but other likely examples could be identified by the slightness of the handles (Illus *). These vessels were too small to have been formed around a thumb or finger and must have been formed over a fingertip or formed freehand. The complete small Type G1 is notably thick walled and appears to have been knife-trimmed producing a number of facets. Its use resulted in vitrification of the fabric and a covering of red cuprous oxides.

By contrast a notably large sub-rectangular lug handle measuring 27mm wide and 15mm thick was recovered with a body sherd which appears to have belonged to the vessel but does not conjoin (Illus *). The lug and body sherd appear to belong to the broader family of Type G crucibles and the handle appears likely to have been set close to the rim of the vessel. The fragment is unique and cannot be associated with further likely body sherds in the assemblage but clearly represents a notably large crucible.

Fabric of Type G crucibles was much the same as for Type A and B crucibles. The clay was often reduced to dark grey and mineral temper recorded as crushed quartz or quartzite or sand. A small group of crucible sherds were made in a white to pale grey-firing fabric. Vitrification over the exterior, rim and handle was noted in most examples and tended to be red, possibly cuprous, oxides with black, grey and pale green also noted. Internally, purple staining was noted in some examples and small droplets of copper alloy sometimes trapped in the fabric with one example from which the molten metal had not been poured quickly enough and much of its charge remained in the base and up to the pouring lip.

Capacity of most complete or near-complete Type G1 crucibles was calculated as between c.4.5 to 9cc while the capacity of the complete small Type G1 was as little as 1cc. A large body sherd and part handle of a Type G1 indicated a considerably larger example however and could conceivably have held up to 20cc of molten metal. The large lug handle is also generally indicative of a large capacity vessel.

2.4 Type I

Five Type I crucibles or trays were identified in the assemblage from nine fragments.

Type I1 and I2

Five tray fragments consisted of rim fragments of apparently shallow circular or sub-circular/sub-oval vessels formed by hand. Three of these could certainly be a vessel family and have been assigned as Type I2 (Illus *). These possibly conjoining fragments describe a shallow tray sub-oval in plan perhaps up to 90mm long, flat bottomed and low walled. None of the sherds display any clear evidence for use in high-temperature processes. A fourth example has been identified as Type I1 being a rim sherd of a smaller dog-bowl type crucible and which is completely reduced with some vitrification.

Type I variants

A total of four fragments cannot be assigned to Type I as the typology is currently defined by Campbell's site typology for Dunadd where all examples were circular in plan form (equivalent to Dunadd Type B1 to B5). Nevertheless, the Tarbat examples are considered to belong within a broader group of mainly shallow, flat bottomed crucibles/trays despite the sub-rectangular plan.

Three such fragments are clearly a vessel family with two fragments conjoining and a third possibly conjoining (24/4585 and 24/1612). Notably the two definitely conjoining fragments show a close fit on the interior with a wide gap on the exterior suggesting the break was coincident with a large crack caused by distortion and stress under high temperature. The three fragments belong to a flat bottomed, sub-rectangular tray with rounded corners and straight-sided relatively shallow walls measuring c.48mm long x 42mm wide (Illus *).

3.0 CRUCIBLE TYPE AND METAL-WORKING PRACTICE

Some correlation between crucible type and different metal-working practices was identified by Heald in his survey of Scottish Iron Age crucibles (2003, 47-59). The results of EDXRF analyses undertaken towards this thesis have been transposed into the catalogue, in the form of major, minor and trace levels. However and most regrettably these results, and those from a subsequent programme to analyse all Tarbat crucibles ongoing in 2006, have not been made available to the project, nor was a description of EDXRF hardware and technique provided for the former making any quantitative statements impossible and comparison with new EDXRF data problematic. The results of a second programme of EDXRF undertaken for the project by Historic Scotland have also been used in the following discussion.

Table 1 presents EDXRF results from Heald's thesis, while Table 2 and 3 present the results of analysis undertaken by Dr Craig Kennedy, Senior Conservation Scientist, Historic Scotland.

Table 1

Period	Find	Type	Major	Minor	Trace	Casting
2	25/703	A/B1	Cu**, Sn, Pb	Sn;	Br; Ag	silver alloy
2	25/708	G1	Cu, Pb; Cu, Pb	Sn;		leaded bronze
2	25/709	G2	Pb**, Cu; Pb*, Cu			copper alloy
2	25/771	?G	Cu**, Zn*, Pb; Cu**, Pb, Zn	Ag, Sn; Ag		silver alloy
2	25/797		Zn, Cu, Pb, Ag, Sn; Cu**, Pb**, Sn, Ag, Zn			silver alloy
2	11/1137	G1	Cu; Cu	Sn, Pb; Sn, Pb		leaded bronze
2	11/3560			Cu; Cu; Zn, Cu	(Zn); (Pb)	copper alloy
2	11/3563	G1	Cu**, Ag**, Zn, Pb, Sn; Ag**, Br**, Cu, Sn	Zn		silver alloy
2	11/3572	E/G	Cu**;	Cu; Cu	Sn; Sn	bronze
2	11/3585		Cu**; Cu**	Cu; Sn; Sn		bronze

Period	Find	Type	Major	Minor	Trace	Casting
3	14/2547	?G		Cu;	(Zn, Pb); (Cu, Zn); (Cu, Zn)	?copper alloy
3	14/2737	A/B2			(Cu, Zn); (Cu, Zn)	?copper alloy
3	14/2583	-	Cu**; Cu**, Sn; Cu**, Sn; Cu, Sn	Pb; Pb;	 Pb	leaded bronze
3	24/1175	A1	Cu**; Cu**; Cu**		Sn, Pb, Zn; Sn, Pb, Zn; Sn, Pb, Zn	copper alloy
3	24/1509	A/B1		 Cu, Sn	Cu; Pb, Zn	copper alloy
3	24/3477	-		Cu, Ag, Zn; Cu, Ag, Zn	Sn, Pb; Sn, Pb	silver alloy
3	24/3485	G variant	Cu		Sn, Ag, Zn, Pb	silver alloy
3	24/3913	G1	Cu**, Zn, Pb, Sn; Cu**, Pb, Sn, Ag; Cu, Pb; Cu**, Sn, Pb	Zn; Zn, Sn;	 Zn, Ag	silver alloy
3	24/4033	G	Cu**, Ag, Sn, Zn, Pb; Zn**, Br**, Cu, Ag, Sn; Cu**; Zn, Cu	Br, Pb; Pb		silver alloy
3	24/4548	?G	Cu; Cu**, Sn**, Pb**, Zn**; Cu*	 Ag; Sn		silver alloy
3	24/4569	G1	Br**, Ag**, Sn**, Cu, Zn, Pb; Br**, Ag**, Sn**, Cu;	Cu		silver alloy
3	24/4584	G1	Sn*, Cu*, Zn, Pb	Ag		silver alloy
3	24/4585	I variant	Pb**, Sn; Pb**, Sn; Pb**, Sn			?separating residue
3	24/4620	A2	Cu**; Cu**, Sn; Cu**, Sn, Ag	Sn;		silver alloy

Table 2

Period	Find	Type	Cu%	Zn%	Pb%	Ag%	Sn%	Other%	Casting
2	11/4102	A1	5.19	0.11	5.51	-	0.93	88.22	copper alloy
2	25/1459	I variant	1.79	-	26.30	-	44.81	27.00	?separating residue
3	24/3480	I2	1.40	0.05	0.30	-	-	97.94	copper alloy
3	24/4620	A2	6.72	0.85	2.39	2.58	8.28	78.56	silver alloy
3	24/8223	A/B2	1.53	-	0.02	-	-	98.42	?copper alloy
3	24/8227	A/B2	0.58	-	0.02	-	-	99.26	?copper alloy
3	24/8314	A1	6.31	1.08	4.73	-	5.99	81.89	leaded bronze
3	24/8360	I variant	17.59	-	17.65	-	0.23	64.42	copper alloy
3	24/8416	A1	17.00	0.09	10.63	-	7.61	64.48	leaded bronze

Table 3

Period	Find	Type	Cu%	Zn%	Pb%	Ag%	Sn%	Other%	Casting

Period	Find	Type	Cu%	Zn%	Pb%	Ag%	Sn%	Other%	Casting
3	24/5565	droplet	46.39	0.08	2.88	-	27.15	22.96	leaded bronze
3	24/5661	droplet	48.24	-	8.95	-	13.64	28.77	leaded bronze
3	24/5662	droplet	51.85	-	0.19	-	18.66	29.17	bronze
3	24/6585	droplet	47.86	0.15	1.91	-	9.13	40.64	leaded bronze
3	24/6606	droplet	47.13	0.15	5.15	-	27.37	20.04	leaded bronze
3	24/7131	droplet	48.04	0.05	2.98	-	10.31	38.50	leaded bronze
3	24/7132	droplet	44.18	0.09	5.23	-	24.26	26.10	leaded bronze

3.1 Type A and B

Analysis of Scottish and Irish Type A crucibles suggest they were used primarily for copper-alloy working although silver-alloy and silver-working with a single known example of use in gold-working have also been recorded (Heald 2003, 50). Type B crucibles are thought to be used for the working of copper alloys, possibly quarternary alloys (Heald 2003, 51).

EDXRF results for Type A crucibles from Tarbat support their use in working copper- and silver-alloys. Copper-alloys (possibly quarternary alloys) were detected in Type A/B 1 (1) and 2 (3) crucibles and in Type A1 (2) crucibles. Two Type A1 crucibles had also been used to work leaded bronzes. The casting of silver-alloys was recorded in Type A/B 1 (1) and Type A2 (2).

3.2 Type E

A single example of Type E or G crucible was recorded by Heald and analysed but the fragment was absent on recording during 2011. EDXRF analysis detected the presence of copper and tin suggesting bronze casting.

3.2 Type G

Analysis of Type G crucibles from Dunadd, Tarbat and Birsay showed them to have been used for working with copper- and silver-alloys and gold (Heald 2003, 54). Bronze and leaded bronze has also been detected. Results from Type G1 crucibles from Tarbat indicate leaded bronze (2) and silver-alloy-working (2), with those only identifiable as Type G suggesting silver-alloy (6), bronze (1), copper-alloy (1) and leaded bronze (2) were melted in them. Results from the analysis of a single Type G2 crucible suggested copper-alloy casting.

3.3 Type I

Analysis of three Type I crucibles or trays was undertaken. Two Type I variants (sub-rectangular trays) reported comparatively high percentages of lead and tin which may represent enrichment of the fabric during refining of precious metals. Results from a further Type I variant and a Type I2 crucible/tray suggesting the working of copper-alloy.

3.6 Droplets

Seven metal droplets recovered from Period 3 metal-working hearths and working surfaces were also analysed using EDXRF. The droplets were mostly identified as leaded bronze with bronze also indicated.

4.0 DISCUSSION

The results of crucible recorded and EDXRF analysis allow some insight into metal-working processes for Period 2 and Period 3, although the fragmentation of crucibles from Period 2 was markedly higher, which makes a discussion of differences in metal-working practice a little problematic. Overall technology in terms of both crucible form and alloys worked remains broadly unchanged between these periods, nevertheless different emphases can be detected in the data.

A total of 30 crucible fragments from Period 2 deposits could be identified to type and a further 78 undiagnostic fragments were recorded. By contrast, a total of 143 fragments were identified to type from Period 3 deposits with a further 82 undiagnostic fragments recorded. Some of the difference in the number of identifiable examples relates to the contrasting depositional history of crucibles by period, but is so large it is also a measure of the intensity of activity. The incidence of crucibles identified to type from Period 3 is much greater than from Period 2,which given the fragmentation of Period 2 assemblages is likely to be significant.

4.1 Period 2

The most commonly identified crucible from Period 2 deposits was Type G or probably Type G (19) which may indicate an emphasis on silver-alloy working. Where Type G1 crucibles were clearly identifiable (7) the number included three notably small examples. Type A1 or A/B1 crucibles were also clearly in use during Period 2 (5) and likewise have associations with the working of silver and copper-alloys. The capacity of both these crucible types is generally small and correspondingly small objects must have been cast. The crucibles point to the working of small individual quantities of silver- and copper-alloys.

There is a notable absence of Type A/B2 crucibles in Period 2 deposits and this does not seem to be because the crucibles were so fragmented that none could be identified, but rather that they were not

in use. Type A/B2 crucibles are comparatively large capacity and suited for casting into correspondingly larger.

4.2 Period 3

Notwithstanding possible bias of the excavated sample at Tarbat, a real shift in intensity appears to be signalled in Period 3. Greater numbers of crucibles were in use with a total of 143 identified to type. A total of 34 A/B1 type (including probable examples of Type A1) and 46 A/B2 type (including probable examples, of both A2 and B2) were recorded. A further 50 Type G crucibles were represented along with the majority of Type I crucibles/trays.

Not only was the number of crucibles recorded greater, but the types identified tended to be those with greater capacity ie Type A/B2 and large G1-types. Analysis of both crucibles and droplets indicate that same range of alloys was being worked and castings clearly included silver-alloy, but bronze, copper alloys, leaded bronzes and probably quarternary alloys were also being cast, and apparently more commonly.

At Tarbat radio-carbon dating of a Period 3 metal-working hearth suggests the activity was taking place in the early to mid-9th century and this extends the chronology for Type A/B and Type G crucibles slightly.

References

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