

APPENDIX xx METALWORKING REMAINS – PAUL RONDELEZ

INTRODUCTION

In Area 2, two furnace pits were uncovered, while Area 3, about 150m to the north, yielded a further furnace pit and a likely ore roasting pit. Furnace pits are the remains of so-called slag-pit furnaces. The installations from both Area 2 and 3 returned radiocarbon dates overlapping in the first centuries BC and AD but they would have had greatly differing outputs of iron.

DESCRIPTION OF THE REMAINS

In Area 2, two pits were located in close proximity to each other. The first, C252, measured 0.65m by 0.56m and was 0.49m deep, had steep sides and a flat base. Its main basal fill C247 contained just under 40kg of slag, 66g of white to orangey-pink heat-affected clay with no inclusions and small fragments of likely bog iron ore. The slag consists mainly (25,695g) of rather dense to dense pieces with flow structure and cavities after timber fragments (Fig. 1), up to 115mm long and 47mm wide. Other slag fragments (8816g) have adhering grey, heat-affected clay with frequent inclusions of pebbles and small stones. A small amount of the slag (257g) is noticeably lighter with very frequent charcoal inclusions (Fig. 2). The remaining slag (5197g) has no defining characteristics. Upper fill C253 had no slag and radiocarbon analysis of oak charcoal from this fill returned a date of 50 BC-AD 88, AD 103-121 (2 Sigma).

The second pit, C256, was located about 1m to the east of C252, was 0.76m long, 0.56m wide and 0.39m deep. It had vertical sides and had a flat to concave base. Its only fill, C248, yielded 31.3kg of slag, the majority of which was either rather dense material with adhering grey-heat-affected clay with inclusions of pebbles and small stones (10,678g) (Fig. 3) and material without defining characteristics (11,634g). Other slag had cavities after timber fragments, up to 68mm by 27mm (6330g). Fragments of lighter slag (2687g) had frequent charcoal inclusions with one piece showing a V-shaped tool mark next to a rusty patch (Fig. 4). Among the twelve orangey-pink inclusion-free clay fragments (595g) is one piece with likely part of a blow-hole (Fig. 5) with an estimated original diameter of 20mm.

In Area 3, a pit C318 measuring 0.45m by 0.35m and 0.15m deep with gently sloping sides and a concave base was found. Its lower fill C309 contained about 9.6kg of slag most of which (9397g) consisted of rather dense to dense material with flow structure and cavities after timber, up to 105mm by 33mm (Fig. 6). The remaining slag (232g) was lighter with frequent charcoal inclusions. The same fill also contained two fitting pieces of heat-affected clay with adhering slag (705g) which is possibly furnace wall (Fig. 7). Its upper part was oxidized (orange-pink) while the bottom part was reduced (grey). A further fragment of orange pink heat-affected clay (104g) was also recovered. This fill

was covered by C314 consisting of oxidized clay, most likely representing fragments of furnace wall.

Just over 7m to the north of C318, pit C311 was uncovered. It measured 1.48m by 0.91m and was 0.4m deep. There was evidence of in-situ burning and the pit had an oxidized basal fill C313. A sample from mid-fill C305 (21g) consisted of heat-affected likely bog iron ore. Radiocarbon analysis on a charred hazelnut shell returned a date of 152-143 BC, 111 BC-AD 28, AD 39-48 (2 Sigma).

INTERPRETATION

While up till recently, it was assumed thought that early iron smelting in Ireland took place in so-called 'bowl furnaces' it is now clear that there is no evidence for this furnace type in Ireland and that during the Iron Age and Early Medieval periods iron was reduced from its ores in 'slag-pit furnaces' (Rondelez 2018). These slag-pit furnaces consisted of clay shafts built above a pit which was filled with organic material, mainly pieces of split timber. The shaft was filled with iron ore and charcoal and as the slag descended into the pit it replaced the timber fragments. The bloom of wrought iron formed at the base of the clay shaft. Archaeologically, the remains of these furnaces consist of pits, often with steep to vertical sides and flat bases. The slag can vary from droplets and drippy pieces to larger block showing flow structure. Typical are the imprints of the timber fragments, or grass/straw if this was used.

Pits C252, C256 and C318 can be confirmed as being furnace pits belonging to slag-pit furnaces but there are substantial differences between the furnace pits from Area 2 and that from Area 3. The pits from the former area are both substantially larger and contain much more slag. While the amount of slag contained in C318 in Area 3, which was sealed by furnace wall debris, was about 10kg, the furnaces in Area 2 contained between 30kg and 40kg of waste each. Slag volumes for early Irish furnaces generally varies between 7kg and 20kg. Highly depending on the iron-content of the ore and the technology used, but 10kg of waste represents between 5kg and 7kg of wrought iron made.

The white to pink (oxidised) clay represents both fragments of the furnace superstructure and, together with the grey (reduced) clay, the natural clay at the sides of the furnace pits. The slag with flow structure and/or impressions after timber fragments is the slag solidified inside the pit while the lighter, charcoal-rich slag is interpreted as fragments of 'furnace cake' (Rondelez 2018: 112). Of interest are the fragment of a blowhole and the tool mark preserved in slag, the result of removing the bloom at the end of the smelt, both from furnace C256 in Area 2. Pit C311 in Area 3 is a rare example in Ireland of a roasting pit, most likely for bog iron ore, probable fragments of which were found within this pit and furnace pit C252.

It is unclear if the two furnaces in Area 2 can be considered as 'paired' or if they ended up close to each other unintendedly. Slag-pit furnaces interpreted as, possibly, paired

have been found in Ireland at Clonrud 4, Co. Laois (8th to 7th centuries BC) (Young 2009a), Derrymorrigan 1, Co. Laois (4th century BC to 1st century AD) (Young 2009b) and Knockbrack, Co. Kerry (6th to 7th centuries AD) (Hull 2005). Similar twinned furnaces are known from continental Europe where they are dated from the Early Iron Age to the Late Medieval period and interpreted as representing the work of two smelting teams working simultaneously (Pleiner 2000: 77-79).

CONCLUSIONS

Area 2 contained two furnace pits with, for Irish standards, large amounts of waste (about 30kg and 40kg respectively). Their close proximity could suggest they were worked at the same time which would mean a total production of about 30kg to 60kg of wrought iron. A further furnace pit was uncovered in Area 3, which was sealed with a layer of furnace wall material, and containing about 10kg of waste, representing about 5kg to 7kg of iron made, next to a rare example of an ore roasting pit. The activities in both areas are broadly contemporary and likely present the need for varying quantities of iron at different but chronologically close times.

REFERENCES

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CATALOGUE (*material not related to metalworking in italics*)

CUT	FILL	SAMPLE	FEATURE TYPE	DESCRIPTION	WEIGHT (g)
C252	C247	S26	Furnace pit	c. 60 fragments of rather dense to dense slag with adhering grey, heat-affected clay. The clay has frequent inclusions of pebbles and small stones. A few pieces show flow structure. Many have charcoal inclusions or cavities after charcoal. Also inclusions of likely burnt clay.	8816
C252	C247	S26	Furnace pit	200+ fragments of rather dense to dense slag with clear flow structure and often cavities after timber fragments (max. 115mm by 35mm and 82mm by 47mm). With inclusions of likely burnt clay.	25,621
C252	C247	S26	Furnace pit	200+ rather light to dense slag fragments. Mostly small pieces, some with possible flow structure but generally no defining characteristics	5197
C252	C247	S26	Furnace pit	Four fragments of rather light, friable slag with very frequent charcoal inclusions and cavities after charcoal.	257
C252	C247	S26	Furnace pit	Three fragments of orangey pink heat-affected clay. The clay is homogenous without inclusions. Furnace wall	66
C252	C247	S27	Furnace pit	About 25 fragments of rather dense slag, several with clear drippy flow structure	74
C252	C247	S27	Furnace pit	Fine-grained material, a large part is magnetic. Most are small pieces of magnetic slag but some appear to be bog iron ore	18
C256	C248	S28	Furnace pit	300+ fragments of rather dense to dense slag with adhering grey, heat-affected clay. The clay has frequent inclusions of pebbles and small stones. A few pieces show flow structure. Many have charcoal inclusions or cavities after charcoal. Inclusions of likely burnt clay.	10,678
C256	C248	S28	Furnace pit	c. 80 fragments of rather dense to dense slag with clear flow structure and often cavities after timber fragments (max. 68mm by 27mm)	6330
C256	C248	S28	Furnace pit	Thirteen fragments of mostly rather light slag with very frequent charcoal inclusions and cavities after charcoal. The largest fragment (2288g) has a tool mark next to a rusty patch. The tool mark is a 58mm long V-shaped impression	2687
C256	C248	S28	Furnace pit	Several hundred rather light to dense slag fragments. Mostly small pieces, some with possible flow structure but generally no	11,634

				defining characteristics. Also inclusions of likely burnt clay.	
C256	C248	S28	Furnace pit	Twelve fragments of orangey pink heat-affected clay, some appear to have smoothed surfaces. The clay is homogenous without inclusions. One piece has a likely blow-hole fragment (estimated original diameter 20mm). Some have adhering slag. Furnace wall	595
<i>C261</i>	<i>C264</i>	<i>S30</i>	<i>Through</i>	<i>Heat-affected stones</i>	
<i>C263</i>	<i>C259</i>	<i>S31</i>	<i>Through</i>	<i>Heat-affected stones</i>	
C311	C305	S37	Ore roasting pit	Small fragments of probable bog iron ore, most magnetic. Some appear to be heat-affected. Ore roasting	21
<i>C311</i>	<i>C305</i>	<i>S37</i>	<i>Ore roasting pit</i>	<i>Heat-affected stone</i>	
<i>C317</i>	<i>C307</i>	<i>S34</i>	<i>Pit</i>	<i>Heat-affected stone</i>	
C318	C309	S35	Furnace pit	100+ fragments of rather dense to dense dark grey slag, most showing clear flow structure. Many show cavities after large timber fragments (max. 105mm by 33mm). Some of the larger pieces have a smoother, rusty coloured upper surface	9397
C318	C309	S35	Furnace pit	Three pieces of rather light rusty coloured slag with frequent charcoal inclusions	232
C318	C309	S35	Furnace pit	Two fitting fragments of heat-affected clay with a thin layer of adhering slag. The upper part of the clay is oxidized (orange-pink) while the lower part is reduced (grey). The upper part of the furnace pit wall opposite the tuyere	705
C318	C309	S35	Furnace pit	Fragment of orange pink heat-affected clay with adhering slag	104
<i>C322</i>	<i>C324</i>	<i>S41</i>	<i>Pit</i>	<i>Heat-affected clay, not related to metalworking</i>	

FIGURES



Fig. 1. Slag with impressions after timber fragments (fill C247 from furnace pit C252)



Fig. 2. Friable slag with frequent cavities after charcoal fragments (fill C247 from furnace pit C252)



Fig. 3. Grey clay with stone inclusions adhering to slag (fill C248 in furnace pit C256)



Fig. 4. V-shaped tool mark preserved in slag (fill C248 in furnace pit C256)



Fig. 5. Furnace wall fragment with partially preserved blow-hole (fill C248 in furnace pit C256)



Fig. 6. Slag with flow structure and impression of a large timber fragment (fill 309 furnace pit C318)



Fig. 7. Possible furnace wall fragment (fill 309 furnace pit C318)