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Archaeometallurgical residues from Clonfad 3, Co. Westmeath (A001: 036 E2723)

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Abstract

Clonfad yielded a large collection of archaeometallurgical residues including 1.5 tonne of iron slag, one of the largest assemblages of Early Christian age from Ireland. The assemblage is almost entirely of residues from iron working, with only a tiny proportion of material from iron smelting or from non-ferrous metalworking.

The assemblage is dominated by smithing hearth cakes (SHCs), many of exceptionally large size. The SHCs present one of the widest ranges of weight observed in any similar assemblage. The extensive analysis of the Clonfad assemblage represents a major contribution to the investigation of plano-convex slag cakes. Some of the large slag cakes described in this report are of a form hitherto assumed to have been produced during iron smelting. Evidence is presented here that the large cakes form a textural and chemical continuum with smaller, more conventional smithing hearth cakes, and it is suggested that their approach to the chemical composition of smelting slags is mainly due an origin during bloom refining.

The presence of a large volume of tuyère debris (over 300 sherds totalling 14.7kg) but no other vitrified hearth material, suggests the use of a wide hearth, with the air blast fed from the bellows to the central part of the hearth through an elongate tuyère. A further previously undescribed distinctive form of slag associated with use of such tuyères is described here as the pro-tuyère tongue.

A wide variety of SHC morphology indicates a diversity of metallurgical practice. The SHCs vary from forms with a thick dense slag puddle to forms with a highly porous, sometimes extremely friable, charcoal-rich texture. The interpretation of this diversity is discussed.

The recognition of pieces of vitrified clay coating (shroud) from the brazing of wrought iron handbells is of enormous significance. Such handbells formed an important symbol in the Celtic church, and were made from the seventh (and probably the sixth) century through to the ninth. Although widely distributed across the area of influence of the Celtic church (particularly Wales, Scotland and Ireland), they are most common in the Irish South Midlands. The thin non-ferrous coating on the iron bells has not been studied in detail, but the Clonfad evidence suggests for the first time that it was applied by brazing. The forging of handbells, one of the largest iron artefacts of their period, may be the reason for the production of the large blooms suggested by the exceptionally large SHCs.

Although there is little evidence for iron smelting, the evidence for bloom refining suggests that smelting was being undertaken locally, perhaps in the parts of the monastic estate closer to the bogs which would have been the source of the iron ore, rather than within the monastic settlement.

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1. Methods

All materials were examined visually with a low powered binocular microscope as part of the evaluation (Young 2006a) and a database of all materials produced. The evaluation identified the assemblage as being dominated by residues produced during iron working. A follow-up programme of analysis was designed to investigate the residues in more detail. A particular focus of the campaign of analysis was the investigation of the smithing hearth cakes (SHCs), since the interpretation of these has been controversial. A revised catalogue of the macroresidues and associated materials is presented in Appendix 1. A brief description of the metallurgical residues obtained from the processing of bulk samples is given in Table 7.

Electron microscopy was undertaken on the LEO S360 analytical electron microscope in the School of Earth, Ocean and Planetary Sciences, Cardiff University. Microanalysis was undertaken using the system's Oxford Instruments INCA ENERGY energy-dispersive x-ray analysis system (EDX). All images of microstructures presented in this report are backscattered electron (BSEM) photomicrographs. The polished blocks for investigation on the SEM were prepared in the Earth Science Department, The Open University.

Chemical analysis was undertaken using two techniques. The major elements (Si, Al, Fe, Mn, Mg, Ca, Na, K, Ti, and P) were determined by X-Ray Fluorescence using fused beads, on the Open University Earth Science Department's Wavelength-Dispersive X-Ray Fluorescence (WD-XRF) system.

Whole-specimen chemical analysis for minor and trace elements (Sc, Ti, V, Cr, Mn, Fe, Co, Zn, Ga, Rb, Sr, Y, Zr, Nb, Mo, Sn, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, Pb, Th and U) was undertaken using samples in solution on the ThermoElemental X-series Inductively-Coupled Plasma Mass Spectrometer (ICP-MS) in the School of Earth, Ocean and Planetary Sciences, Cardiff University. All sample batches for chemical analysis are run with internationally certified standards.

Energy dispersive X-Ray Fluorescence was undertaken using the Eagle II ED-XRF system at English Heritage's laboratories at Fort Cumberland, Portsmouth, England.

Sample details are given in Table 1, with sampling locations within the slag cakes shown in Figures 1-4. The slag samples are illustrated before cutting in Plates 1-26, with the cut blocks shown in Plates 27-30. Bulk analytical results are presented in Tables 2-4. Microanalytical results are presented in Appendix 2 and listed by mineral phase in Appendix 3 . Sample locations for microanalysis are indicated in the relevant BSEM images (Plates 31-60).

The database of samples examined for fines is given in Table 9.

2. Results

2.1 Nature of the assemblage

The total collection recovered from Clonfad for further investigation weighed 4.05 tonne. Much of this material (approximately 2.9 tonne) was a naturally-cemented calcareous ferricrete, in part cementing deposits of the streamside slag dumps c478 and C479. The archaeometallurgical residues from other contexts totalled some 990kg, and representative sampling of the dump contexts suggests that the ferricrete contained a further 460kg. This encrusted material was not suitable for detailed investigation, but examination of the representative sample suggested it was of a similar nature to the materials recovered from the remainder of the site.

The archaeometallurgical residue assemblage is dominated by plano-convex slag cakes with a wide variety of form (smithing hearth cakes, or parts thereof, comprise 774kg, 78%, out of the 990kg of residues available for study). 2% of the assemblage is other forms of smithing slag. 18% of the assemblage comprises indeterminate iron slags, but which are likely to be from smithing. Less than 0.1% of the assemblage comprises slags that are of a form suggestive of a possible origin in iron smelting, and even these are not certainly indicative of that origin.

A tiny proportion of the material is associated with the use of non-ferrous metals.

2.2 Iron smelting residues

2.2a Morphology

Only two piece of slag were identified as possibly being residues from iron smelting. Both were pieces from the side of large bowl-shaped slag blocks with indications of flow lobes. In neither case is the identification of the slag as being from smelting certain. Despite the clearly extremely low level of evidence for iron smelting, that evidence is discussed in detail here since it is important for the understanding of the large slag cakes.

One piece (CFD27, probably from C137, but contained in disturbed packing and therefore excluded from the main catalogue) was in the form of a deep slag bowl, formed of vesicular slag, reaching approximately 100mm in thickness in the centre. One side of the lower face of the bowl is almost planar and lies at a high angle to the other faces. At the margin of the planar face there is a smooth slag surface, apparently blown, approximately perpendicular to the planar surface. The original orientation is very difficult to reconstruct, but one possibility is that the blown surface was originally horizontal and that the slag "bowl" formed not in the bottom of a hollow, but at the foot of a vertical wall. Three features differentiate this piece from most other large slag cakes on the sites – the presence of thin flow lobes on the margin of the cake, the presence of possible straw impressions on the lower surface, and the irregularly vesicular nature of the slag within the deep bowl.

Slag which accumulates in a block in the pit below a non-slag tapping iron smelting furnace may show rather similar features: it may occur as coalesced flow lobes, it may bear indications of an organic filler in the pit prior to smelting (usually in Irish slagpit furnaces

this is wood, although straw is known in Europe, Pleiner 2000, and in examples from the British Iron Age) and the slag may have entrained charcoal, giving it a rather different texture to the rounded and/or tubular vesicles seen in SHCs. The presence of thin layers of flowed material on the lower surfaces of the cake does not, however, appear to reflect a deeper structure to the slag; the lobes appear to be only superficial. Thin flowed slag sheets, possibly formed down the hearth wall below the tuyère, are known, for instance from samples 364 and 223 (Table 9) in circumstances where they are not associated with smelting. The textural arguments for CFD27 being a smelting slag are, at best, ambiguous. To add to the uncertainty surrounding the interpretation of this piece of slag, it is of uncertain origin, being of disturbed packing, although probably from C137, a fill of undated pit C145, which may well be of post-medieval date.

The second piece (from C538, a fill of pit C536) is more securely early medieval in age, but is a small fragment of coalesced flow lobes. Although resembling a smelting slag, there are also broadly similar textures to be found in many of the more prilly slag cakes on the site. This piece is more likely to be a true smelting slag, but again considerable doubt is associated with this interpretation.

The material classed as indeterminate iron slag in the catalogue contains many small fragments of flowed slag which could be smelting slag. However, since dense fayalitic flow slags have been found in many instances at Clonfad to be associated with small flows in the area around, and particularly immediately below, the tip of the tuyère there is no particular reason to suspect a smelting origin for these materials.

2.2b Microstructure and mineralogy

General

The microstructure and mineralogy of CFD27 was examined to enable comparison with the smithing slags from the site. The slag texture was broadly similar to pieces interpreted as smithing slags (see below). The slag shows a high level of manganese in the olivine (up to 19% substitution of Mn into the fayalite in the main generation of olivine), a feature which although often associated with smelting slags is capable of other interpretation (see discussion of the smithing slag compositions below).

Details

CFD27 (plates 26, 30b, 59, 60)

The two samples from his slag cake show very similar microstructures. There is a variable, patchy, distribution of wustite dendrites, flowed by a main phase of olivine in elongate crystals up to several mm in length. The main olivine shows cores of Fa97Fo 3 with 6% Ca and 19% Mn substitution which grade outwards to thin marginal zones of Fa100 with 27% Ca and 11% Mn substitution. The secondary interstitial olivine shows compositions of Fa100 with 20-36% Ca substitution and Mn substitution of 8-11%.

2.2c Chemistry

The analyses of CFD27 show a cake of broadly fayalitic composition, but with a low iron content (50-57w% FeO) in conjunction iwth a very high Mn content (11 wt% MnO). Most other major elements are in rather low concentrations, apart from calcium which reaches 6.4 wt% CaO. Phosphorus is low at 0.35-0.40 wt% P_2O_5.

2.3 Iron working residues

2.3a Morphology

SHC general morphology

The residues interpreted to be from iron working comprise a wide range of approximately plano-convex slag cakes. In this report all of these cakes are described as ***smithing hearth cakes*** (SHCs), despite their sizes ranging up into the range conventionally described as ***furnace bottoms*** (FBs; Scott 1990). The established English language nomenclature for such plano-convex slag cakes (Crew 1995, 1996) was developed in Britain, but has also been applied widely elsewhere. No such subdivision can be recognised on textural or chemical criteria within the Clonfad assemblage, a feature of Irish material already noted by Scott (1990).

Some of the smaller slag cakes (typically less than 300g) do have a distinctive morphology; they form as irregularly tabular cakes, with an approximately planar upper surface with a glassy composition, often blue or green on colour, with a low iron content. In contrast the lower surface comprises short lobate prills, almost stalactitic in form, of a much more iron-rich slag, often with a rusty surface to the dark crystalline slag. These cakes have sometimes been observed to show proximal attachments to the lower parts of the faces of tuyères. They show compositional similarity to the slabs of strongly ceramic-influenced slag found as the uppermost slabs of some the large complex SHCs. These cakes are here termed ***pro-tuyère tongues*** and have been excluded from calculations of SHC size statistics. The tongues range from about 140 to 300g, and some were found attached to the tips of tuyères. Other slag masses were also found attached to tuyères; these were typically prilly, somewhat amorphous masses, ranging up to about 500g. These too were excluded from calculations of SHC size.

The more conventionally-shaped plano-convex slag cakes are very variable in detailed morphology and internal texture. In hand specimen, during assessment, it was found useful to differentiate between SHCs of three main intergradational morphologies and this terminology is employed in the catalogue (Appendix 1):

a. conventional, with a vesicular slag filling the bowl-shaped part of the cake, often with either a charcoal-rich upper part, or a smooth glassy top,

b. thick crust, with the bowl comprising a thick accumulation of dense slag, often very coarsely crystalline, indicative of the former existence of a substantial molten slag puddle,

c. thin crust, with the bowl section of the cake formed by only a thin, concavo-convex dense slag layer (typically less than 15mm thick), with the interior of the bowl filled with a carious or charcoal-rich slag.

This classification was modified on the basis of observations of the sectioned examples of the SHCs,

in which several distinct, but intergrading, morphotypes were recognised (for assignation of these types to the samples see Table 1):

Type 1: the conventionally-textured SHC as described above

Type 2: as the conventional type 1, but the dense slag bowl is strongly differentiated from the upper charcoal-rich slag.

Type 3: as type 2, but the basal slag bowl shows vertically-oriented tubular vesicles

Type 4: as type 3, but the upper slag layer is separated from the bowl by a void. The upper surface of the slags of the bowl (in the base of this void) show large protruding crystals, generated by the drawing-down of the remaining melt during crystallisation.

Type 5: dense slag cakes of rather inhomogeneous internal textures, often in rather steep-sided slag cakes

Type 6: low density slag cakes with a porous meshwork of large crystals, associated with a thin basal crust.

Types 1 and 2 are broadly equivalent to the hand specimen class (a). Class (b) in hand specimen corresponds to types 4, 5 and sometimes 3. Type 6 and sometimes type 4 correspond to the thin crust class (c) in hand specimen.

In general the "conventional" cakes are typically the smaller examples, with the larger SHCs including both thin- and thick- crusted examples.

SHC size and weight

The early medieval plano-convex slag cakes are very variable in size, with a maximum size of 11kg. The catalogue contains 381 individually described SHCs for which a total cake size could be measured or estimated, representing a total original weight of 496kg and an average weight of 1.30kg. This is rather fewer than initially reported in the assessment report, in part because of the exclusion of tongues and other irregular slag masses attached to tuyères from the corpus of SHCs, and also because the current list excludes SHCs from post-early medieval contexts.

The distribution by weight for those SHCs apparently stratified in early medieval contexts is given in Figure 5. It remains uncertain how representative this distribution is, for there is a greater degree of fragmentation among some of the larger cakes (much of the material from which is therefore too small to be able to estimate the original cake size), but on the other-hand some of the smaller apparent SHCs may just be the upper layer of quite complex cakes. It was also not possible to determine cases in which multiple fragments from the same cake may be present in the collection. None-the-less the distribution is indicative of the rather large size of the SHCs from Clonfad, even in comparison with other assemblages from Early Christian sites (Table 6), but exhibited here rather spectacularly.

There was evidence from Clonfad that there was some post-medieval ironworking on the site. It is not possible to discriminate later SHCs with any degree of certainty. SHCs from late contexts were excluded from the description of the assemblage above, but it is unclear whether these SHCs in these contexts are indeed post-medieval or simply residual. 24 SHCs were recovered from such contexts, with an average weight of 770g and a similar range of morphology to the early medieval examples.

SHCs from smithing are typically less than 2kg in weight and most from blacksmithing are between 200 and 500g (Crew 1996). The larger ones are often ascribed to production during bloomsmithing. In contrast, the main class at Clonfad is from 200-1200g, with 346 examples in this interval (67%), forming 36% of the interpreted SHCs by weight. Only 71 SHCs exceed 2kg (14% of the collection), but these weigh 250kg, or 42% of the interpreted SHC assemblage by weight.

The overall size distribution of SHCs is very similar (Table 3) to two other sites currently under investigation, Clonmacnoise (material from the water treatment plant; Young 2005b) and Ballykilmore 6 (Young 2006b). At Clonmacnoise the assemblage includes smelting slags as well as the SHCs, so the collection appears likely to be the result of production from raw blooms to bar iron or to artefacts.

As well as typically being of large size than on conventional blacksmithing sites, the larger Clonfad SHCs show a divergent development. One group shows a large, porous slag cake, often with a concentric internal structure, and with little development of a basal crust. A second group shows a thick basal crust, often clearly having formed a substantial slag puddle.

Tuyères

As well as, and in association with, the SHC material, the assemblage includes a large number of pieces of tuyère, with 300 sherds weighing 14.7kg identified.

The tuyère material mainly shows outside diameters apparently ranged from 110-200mm. The smallest measured tuyère had a bore of just 18mm and the largest 40mm diameter. Typical material probably has an outside tip diameter of 140mm and a bore of about 26mm.

The presence of tuyères on Early Christian iron-working sites has long been recognised, but a probably erroneous association between tuyères and smelting has been claimed. Instead, the tuyères should be recognised as an essential component of an iron-working technology that also produced the abnormally large SHCs.

The collection contains some important specimens showing the linkage between the tuyère and main slag cake. A characteristic slag morphology of flowage up along the underside of the tuyère tube was noted, as was a particular class of slag mass in front of the tuyère at a high level above the main slag cake (the ***pro-tuyère tongue***, see above). The melting of the tuyère must have been one of the main sources of silicate for slag generation.

Evidence was found for the use of stones to help reduce erosion of the pit wall below the tuyère tip during retreat of the tuyère face due to melting. No evidence (*contra* Ballykilmore, Young 2006b) was found for lateral tuyère supports.

Of the two specimens with evidence for very large diameters (200mm), the smaller, less clear fragment was found in an early medieval context, but the other,

comprising several fragments from the same block, was found in the same undated, but probably late pit (C145) as the possible smelting slag block CFD27. It may be significant that the evidence from Ballykilmore (Young 2006b) suggests the use of very large tuyères in the area in the late medieval or early post medieval period.

2.3b Microstructure and mineralogy

General

Most of the SHCs show a relatively small proportion of primary dendritic wustite.

CFD6 showed large pieces of what was probably secondarily-oxidised iron. CFD16 contained complex droplets probably of oxidised metallic iron. CFD21 showed tiny iron blebs within olivine crystals. CFD23 showed large pieces of oxidised iron resting on the base of the bowl. Native iron was recorded in CFD24 as both fine blebs and larger iron particles, apparently forming points of nucleation for blocky olivine crystals.

CFD13 shows inclusions of angularly polycrystalline wustite with a texture similar that of the oxidised iron in hammerscale. The wustite in this specimen in Mn-rich, a feature also noted with the oxidised in CFD6.

In all samples the main phase was of olivine with a composition close to fayalite. In the following descriptions the substitutions of Mg, Ca and Mn into the end-member fayalite are described by assigning the olivine a position on the fayalite-forsterite continuum, to which is ascribed a percentage of Mn and Ca substitution. The degree of Mn and Ca substitution is very variable (reflecting the bulk chemical composition), but there is very little Mg substitution.

In some cases, notably the bowls of thick crust SHCs such as CFD23, the olivine may comprise very close to 100% of the slag. In other textures rather more late stage interstitial materials may be present. As is typical in iron slags the interstitial materials fall into two main divisions, with “simple” interstices filled late stage fayalite, typically Ca-rich and often of a feathery dendritic texture. The proportion of glass in the interstices is generally low. Very fine-grained rhönite is a relatively common accessory phase and an apatite of uncertain composition also occurs locally, particularly in CFD14. Small leucite crystals were observed in the interstices of CFD24.

The second interstitial texture, with abundant leucite and probably indicative of liquid immiscibility, is much less commonly developed. Leucite-wustite cotectites are sporadically well-developed in CFD18. CFD21 shows a well developed texture of leucite and leucite-wustite vesicle margins.

Details

CFD1 (plates 1, 27a, 31, 32)

The microstructures are rather inhomogeneous, and comprise a dominant ,variably dense, dendritic wustite, followed by lath-like fayalite.

The microstructure is coarse grained with large olivine crystals constructed of blocky components. The whole crystals are up to several mm long. These large olivines are subsequent to the primary wustite. The main olivine grades from Fa96Fo4 with 7-11% Ca subs and <1%Mn subs in the cores, through to rims with Fa98-99 and 26-30% Ca subs in the margins. The interstitial areas bear small late olivine dendrites of similar composition to the margins.
Away from this typical texture there are pore-fills of wustite-free composition, often with olivine of a feathery appearance. Some of the open pores are associated with small areas of development of leucite-fayalite or leucite-wustite cotectics.
In summary, a classic SHC form, with well developed coarse grained textures, typical of SHCs.

CFD6 (plates 6, 27f, 33)

The microstructure includes what appear to be large piece of oxidised iron, plus all sorts of other strange wustite-rich patches. Away from the large primary wustite/fayalite patches there are zones of fayalite locally with a minor wustite cotectite.
Fayalite (with wustite cotectite) in a void inside an oxidised iron piece was Fa98Fo2 with 5-6% Ca subs and 2-3% Mn subs. Interestingly the wustite of the probable iron fragment was also around 1% Mn subs. A second generation of fayalite dendrites was much higher in Ca, possibly as much as 30%, although analyses elsewhere in the specimen gave late dendrites with only 10-20% Ca substitution.

CFD8 (plates 8, 27h, 34)

This SHC has well marked bowl with abundant tubular vesicles (from which B sample was taken). The A sample is a complete slab. The microstructure has typical variable wustite distribution of smithing slag, with late vesicles filled with low –wustite slag, sometimes with wustite as a cotectite, sometimes not. Olivine cores are typically around Fa97Fo3 with 4-7% Ca substitution. Margins range up to about 20% Ca subs, with the roots of the secondary interstitial olivine dendrites rising to 30% Ca substitution and Fa100. Nowhere does Mn substitution rise above 1%.

CFD10 (plates 10, 28b, 35)

The microstructure is another one of variable wustite distribution. Some large voids have very poorly preserved material which may have been extensive development of fayalite-leucite cotectite. More usual microstructure shows olivine with cores of Fa97Fo3 with 10% Ca substitution, grading towards a margin and interstitial fayalite of Fa100 Ca 20-30% substitution. Mn substitution is always less than 1%.

CFD13 (plates 13, 28e, 36, 37, 38)

This specimen shows a microstructure with a highly variable distribution of wustite, with the dendrites grading through dense clusters of blebs into polycrystalline wustite aggregates with polygonal grain boundaries (Plate 36 b, d) similar to those seen in hammerscale. The wustite appears to be uniformly high in Mn.

The olivine in the specimen forms a main phase of coarsely crystalline equant euhedral grains of 400-800μm with a secondary interstitial olivine in fine dendrites. The core of the main phase olivine is typically Fa97Fo3 with 5% Ca and 18% Mn substitution. This grades out to margins of Fa100 with 10% Ca and 13% Mn substitution. The bases of the dendritic overgrowths show rapidly increasing Ca

substitution, with the late dendrites reaching as much as 29% Ca substitution and 8%Mn substitution.

CFD14 (plates 14, 28f, 39, 40, 41)

This is a curiously shaped large slag cake with a bowl-shaped slag mass on one end, attached to a rather inclined curved slag sheet. The whole might represent an amalgamation of slag in partially cleared hearth, or it might represent accumulation in the base and against one side of a rather deep structure.

The microstructures are broadly similar in the three subsamples examined. The primary phase is a patchily-distributed dendritic wustite. This is followed by large complex elongate olivine crystals up to 1.5mm wide and at least 5mm (and probably much more) in length. The olivine has a typical composition of around Fa97Fo3 with 5% Ca and 10%Mn substitution in the core, grading to Fa99Fo1 with 10% Ca and 8% Mn substitution near the margins. The main phase is overgrown by a late stage more calcic olivine, which in the larger interstitial areas (particularly near the vesicles) may form fine elongate complex crystals and dendrites. These late stage olivines range up to Fa100 with 20% Ca substitution and 5% Mn substitution. The late dendrites often have a rounded shape and are intimately associated with dendritic crystals of apatite.

CFD16 (plates 16, 28h, 42)

This piece is a small fragment of an SHC, featuring an strongly curved coarsely crystalline crust forming a bowl filled with a rusty, charcoal-rich slag.

The microstructure comprises elongate blocky crystals of olivine of about 300µm width and up to several mm in length forming subsequent to a rather sparse, patchy development of wustite dendrites. Towards the lower margin of the crust there is very little wustite and the olivine is almost continuous (Plate 39f), but away from the cake margin there are interstitial areas, often bearing much of the wustite and a late stage development of fine olivine dendrites. The cores of the main phase olivines, particularly towards the base are about Fa96Fo4 with 3% Ca and 5% Mn substitution, with compositions with much higher Ca substitution. The late stage olivine dendrites are around Fa100, with 28% Ca and 2% Mn substitution.

In some places complex droplets (Plate 39c) were probably originally metallic iron, although now entirely oxidised.

CFD18 (plates 18, 29b, 43, 44, 45)

This sample was a substantial SHC with a well formed bowl with a thick crust bearing large rounded vesicles. The bowl is filled with a charcoal-rich slag which rises well above the rim of the bowl and is capped by a slab of denser smooth slag.

The two samples from this piece both show a texture with a patchy development of primary wustite, followed by a generation of elongate olivine, with crystal width of 200-600µm and lengths of many mm.

The interstitial spaces are filled rather variably, with masses of often somewhat curvilinear olivine dendrites most common, but some areas show complex intergrowths involving leucite and wustite. These textures suggest development of liquid immiscibility.

The olivines are, in general, poor in both Mn and Mg, with main phase olivine ranging from cores of Fa99Fo1 with 5% Ca and 1%Mn substitution to margins of Fa100 with 10% Ca and 1%Mn substitution. The late dendrites are much more calcic locally reaching Fa100 with 38% Ca substitution.

CFD20 (plates 20, 29d, 46, 47)

This SHC is a steep-sided cake, with lots of evidence in hand specimen for reaction with the underlying sediment, suggestive of maintenance of a deep liquid slag puddle.

The microstructures show a very low level of primary wustite dendrites, which occur mainly in the subsequent interstitial areas. The secondary olivine is large and blocky, with individual angular crystals of about 1mm across. The olivine has a composition of about Fa96Fo4, with 3% Ca and 10%Mn substitution in the core, rising to Fa100 with 14%ca and 6% Mn substitution on the margins. Late stage fine interstitial olivine dendrites have compositions around Fa100 with 30% Ca and 4% Mn substitution.

The late interstitial olivine is associated with rhönite present in very small crystals, some in rosette-like clusters, fringing the interstitial pores.

CFD21 (plates 21, 29e, 48, 49, 50)

This is a very dense large cake with steep sides, indicative of a slag puddle. The slag appears internally inhomogeneous, but the sections show a considerable degree of weathering, which may account for some of this variability.

The B sample shows a weathered texture with blocky, coarse olivine (Fa97Fo3 with 3% Ca substitution in the core, with a rapid transition to marginal Fa100 with 33% Ca substitution), sparse wustite and complex fine olivine dendrites (Fa100, 29-33% Ca substitution) in the interstitial areas which is reminiscent of the better preserved texture in CFD20.

The C sample is very different. This shows evidence for contact with sediment (plate 46c), and shows vesicles with rims and earlier filled rims (filled with olivine dendrites of Fa100, 30% Ca substitution, glass and small needles of rhönite) of leucite overgrown with a leucite-wustite cotectite. In some areas the primary olivine is followed by an olivine-leucite cotectite (again approximately Fa100 with 30% Ca substitution). The main phase olivine is about Fa100 with 8% ca substitution rising to 36% Ca substitution on the margins; it is secondary to a very small amount of primary wustite dendrite.

The D sample is too highly weathered for useful interpretation.

CFD21 thus shares many features with the morphologically similar block CFD20.

CFD22 (plates 22, 29f, 51)

This specimen is a classic sample of a “thick crust” SHC. The crust is 50-60mm thick, with some vesicularity and an upper surface marked by protruding terminations of euhedral equant olivine.

The sample shows a tiny quantity of primary wustite dendrites, followed by angular olivine of 200-600µm, together with olivines with a carious quench texture and with sizes of well over 1mm. Interstitial to the large olivines are a wide variety of quench textured carious elongate olivine crystals and extremely fine, feathery,

olivine dendrites, set in a glass. Some of these late dendrites are associated with fine needles of rhönite.

The olivines show only a small range of composition, from Fa99Fo1 with 3% ca and 9% Mn substitution in the core, through to Fa100 with 5-6% Ca substitution and 7-9% Mn substitution on the margins. The late dendrites are similar to the margins but locally range up to Fa100 with 12% Ca substitution and 5% Mn substitution.

CFD23 (plates 23, 29g, 52)

The base of the bowl comprises a dense mass of olivine with inclusions of oxidised iron. The olivine has a composition of Fa96Fo4 with 6% Ca and up to 31%Mn substitution close to the iron and 25-27% more generally. Higher in the cake similar compositions are observed close to vesicles, but olivine margins facing interstitial areas show a rapid marginal zonation to compositions of Fa100 with 22% Ca and 17% Mn substitution. The interstitial areas include late dendrites Fa100 with 21-23% Ca and 13-14% Mn substitution. There is only tiny a small proportion of wustite dendrites. At these higher levels in the cake the main olivine shows a complex slightly carious texture with individual crystals of at least 2mm in length and 500µm in width.

CFD24 (plates 24, 29h, 49, 53, 54, 55, 56)

The B sample, taken from the proximal end of the cake, has a microstructure unlike all others in the project. In this area the bowl shows a sharp base, with a thin adhering layer of angular crystals facing outwards, with a composition corresponding to Fa96Fo4, with 14-21% Ca substitution and 13-15% Mn substitution.

Internally the lower part of the bowl comprises a tight mass of elongate olivine crystals which coarsen upwards slightly and resolve into sheaves of aligned dendrites. These dendrites appear to be of around Fa96 with 3-4% Ca substitution and 2% Mn substitution. Above this, lies a zone of equant, blocky olivines (Fa98Fo2 with 2% Ca substitution and 1% Mn substitution), which appear to be cored on small pieces of native iron. Higher in the cake, the slag because more highly weathered, but a similar texture of carious (although slightly more elongate?) olivine embedded in a mass of fine dendrites persists.

The C sample again shows a mass of aligned elongate crystals forming a background to a few larger complex elongate olivine crystals, here the substitutions are only slightly more significant, with olivines of Fa99, 3-6% Ca and 1-2% Mn the substitution.

Tiny blebs of native iron were observed inside some of the olivine crystals. In one area of the C sample small leucite crystals were observed on the surface of the main olivine phase.

CFD26 (plates 25, 30a, 57, 58)

This specimen is a small fragment from a thin-crust SHC, showing a external crust and an internal skeletal mesh of slag with a very large porosity. The A and C samples were taken from the crust whereas the B and D samples were taken from the internal slag.

Both areas show that much of the framework is controlled by the disposition of the early wustite dendrites, with the voids in the framework only partly filled by the subsequent phases. The main phase olivine grades from cores of Fa97 with 2-3%Ca and 1% Mn substitution to margins of Fa99 with 5%Ca substitution and 1% Mn.

The secondary interstitial olivine dendrites show compositions of about Fa100 with 16-18% Ca substitution and 1% Mn substitution.

2.3c Chemical composition

General

The range of major element composition of the Clonfad slags is fairly limited. Silica contents vary from 15-28 wt% in general, apart from two particularly iron-rich SHCs (CFD4 and 5) with 10-11%. The variation of FeO with SiO2 is shown in Figure 6. The bulk compositions can be seen to cluster close to the composition of olivine in most cases. Almost all the Mn-rich cakes lie close to this composition, but a few low-Mn high-Fe cakes lie at higher iron contents.Most slags have between 20 and 28% silica and 55-75 wt% FeO, which gives the samples the dominantly fayalitic mineralogy described above.

Alumina is low, with almost all samples falling in the range of 0.5 - 2.8wt%. the silica:alumina ratio varies quite widely (from about 8 to 21 by weight), with most materials clustered around 8-15 (Figure 7)

Mn (calculated as MnO) varies up to about 12 wt% and shows a moderately strong correlation with the size of the SHC, in so far as of the small SHCs (<1500g) only two of the thirteen had bulk MnO contents of over 2wt%, whereas six of the ten SHCs over 1500g had MnO contents of >2wt% with 3 being >8wt% (Figure 8).

Mg contents are generally low (mainly <0.5wt% MgO), as are those of Na (<0.5wt% Na_2O), K (<1.4 wt% K_2O) and Ti (<0.5wt% TiO_2). Calcium is present in more significant quantities (1.6 - 7.4 wt%), with a slight correlation with SHC weight, particularly among the small SHCs.

Trace element compositions are generally quite low, with the exception of barium, which ranges up to over 6400 ppm. The barium shows a very strong correlation with Mn, athough the relationship is not quite linear, with the Mn:Ba ratio slightly higher for the very high Mn samples. This is illustrated in Figure 9 using the concentrations of Mn and Ba in the samples on a normalised iron-free basis.

Ba has been described from Scandinavian bog ores and smelting slags derived from those ores, at levels of 5-10% of those of manganese (e.g. Buchwald 2005). Equivalent data do not exist for Irish bog ores. The curved distribution of the analyses shown in Figure 9 suggests the mixing of two discrete components – one with a higher Ba:Mn ratio dominant in the low Mn samples and a component with lower Ba:Mn ratio present in the higher Mn samples.

Uranium and thorium are present in low levels and show a very variable U:Th ratio from 0.51 to 1.91 for the slags, with the ratio for the tuyère and subsoil samples being very low at 0.4-0.5 (Figures 7 and 10).

The U:Th ratio is plotted against the Ba:Mn ratio in Figure 10. Individual slag cakes may show subsamples with variable Ba:Mn ratio, but the U;Th ratio is almost constant for all such cakes except CFD20. The tuyères

and a sample of subsoil have low U:Th ratios and very low concentrations of Ba and Mn, but with a high Ba:Mn ratio. The datapoints on Figure 10 are differentiated by the MnO content calculated on an iron free basis. A systematic variation in these parameters with Mn content is shown, and is further discussed below.

The rare earth elements are shown in Figure 11 (bulk data; normalised to upper crust after Taylor & McLennan 1981) and Figure 12 (recalculated analyses on an iron-free basis, also normalised to upper crust). The analyses all show a very similar profile, with only very subtle differences in shape. The only significant detail is that the tuyère samples and CFD9, the strongly tuyère-influenced SHC, show slight positive Ce anomalies, whereas in most of the slags Ce is slightly depressed.

Discussion

Figure 10 shows the development of two distinct groups of slags on the basis of their Mn, Ba, U and Th contents. The tuyères and subsoil sample are characterised by a high concentration of Th and a low U:Th ratio (about 0.4). One group of slags (Group I) shows U:Th varying little from the values show by the subsoil and tuyères, but with a wide spread of Ba:Mn values dropping from 0.15 (with an outlier at 0.24) down to 0.02.

A second group of slags (Group II) shows an increased U:Th ratio (between 1.1 and 2.0), but with a fairly narrow range of Ba:Mn of 0.02 to 0.11. The samples show analyses with varying MnO contents (presented here on an iron-free basis) occupying quite discrete fields.

A rather more complicated picture emerges when the same variables are plotted with size of cake indicated (Figure 13; utilising bulk cake compositions only). Here the Group I can be seen to comprise almost entirely SHCs of below 2000g in weight (CFD 1, 2, 4, 5, 6, 8, 9, 10, 15, 16, 24) with the exception of CFD21 (9260g). In contrast Group II contains the cakes over 2000g (except CFD21; CFD 11, 12, 13, 14, 18, 19, 20, 22, 23, 26), together with three of the smaller cakes (CFD 3, 7, 17). The possible iron smelting slag, CFD27, also lies within the field of this group.

The three small slag cakes falling into Group are worthy of further discussion. Two of the three have modest Mn concentrations and are marginal to the group: CFD7 has 1.81% (4.67% on an iron-free basis) and CFD17 has 1.05 wt% MnO (3.30% on an ion-free basis). One of the samples however, CFD3, has bulk MnO of 6.14wt% (16.19% on an iron-free basis), which is a very high concentration. CFD3 (Plates 3, 27) is a very conventional-looking, small (460g) SHC.

A high Mn concentration in a slag has been generally assumed to be indicative of a smelting slag, since Mn concentrations are high in many iron ores, particularly some bog iron ores, and manganese is not reduced into the metal, but is concentrated in the slag phase. Thus transfer of manganese into a smithing slag can only be via the slag inclusions in the iron being worked, which should limit the amount of manganese incorporated into the slag.

With bloom-smithing (bloom refining) slags, however, the amount of trapped slag in the raw bloom can be quite considerable, depending on the quality of the bloom. Such slags may be lost to the smithing hearth both through mechanical loss and particularly through melting.

The evidence from the chemical composition of the slags, particularly the data for Mn and Ba presented here, suggest that there is a continuum of composition, with mixing of high U, high Mn, with materials in which the proportion of Ba compared with Mn is higher as is Th with respect to U.

Group I slags can be interpreted as those in which the U and Th contents are controlled by the influence of the technical ceramic (tuyère; although other similar inputs are possibly involved), but which show a variable influence of Mn inherited from inclusions in the iron being worked. The size range of the Group 1 SHCs is similar to that from sites on which only end use of iron, rather than iron production, is suspected (e.g. Coolamurry, Navan and Moneygall; Table 6).

Group II slags are interpreted as having their silicate material dominantly supplied by the slag from the workpiece. They show a composition trending towards a likely smelting slag composition (perhaps indicated by the composition of CFD27). Group II slags would thus be the products of bloom smithing rather than secondary smithing. It is conceivable that Group II includes some true smelting slags, but many members of the Group (e.g. CFD3 mentioned above) are firmly classifiable on textural grounds as SHCs. There are no firm criteria, textural, mineralogical or chemical, apart from size, which differentiate the large cakes from the smaller ones in this group. This leads to the conclusion that the large Group II cakes are also bloom-smithing slags.

Further refinement of the interpretation of the chemical composition of these slags will be possible through further interrogation of the analytical database in the future.

2.4 Non-ferrous metalworking

2.4a Crucibles

23 sherds of pyramidal crucibles were recovered from the outer enclosure ditch in area B. The collection appears to form a homogeneous collection of vessels of similar form and fabric, although it is unclear how many crucibles are actually represented. The crucibles appear to triangular in plan with only slightly curved sides and tight corners, the fabric is finely sandy, with abundant organic (hair?) temper. The sherds mainly show a pale grey thin external glaze, a slightly darker grey body and in an internal surface which is typically of an oxidised buff tinge. Both surfaces may show some cracking. None of these sherds shows any internal glazing or slagging.

This material, if used, would be indicative of non-ferrous metalworking, but the limited geographical and stratigraphic distribution of the material suggests that either non-ferrous metalwork was not a normal component of activities on the site, or that the main focus of that activity (or at least disposal of its residues) has not yet been located.

A single sherd (#229) derives from c290, the fill of a well, and is in a slightly coarser fabric, but with a shape suggestive of a similarly pyramidal form and with the same hair tempering. This sherd shows a white external vitrification that was sufficiently intense for the

ceramic to start to flow in places. Internally the piece shows a purplish glaze, suggestive of incorporation of copper alloy residues.

The interpretation of this material is rather uncertain. It seems unlikely that the collection of crucibles from c129 had been used for copper alloy working (the usual purpose of crucibles of this shape). The presence of slight oxidation of the internal surface of the crucible is extremely unusual and may be indicative that, despite the vitrification of the exterior, these crucibles were never used. They may be crucibles that were taken up to temperature empty, in order to prove them, but which failed, and were then discarded.

The form of the crucibles is a widespread one in early medieval Ireland (e.g. Comber 1997, 2004).

2.4b Brazing

The site has yielded a number of pieces of vitrified ceramic that can be interpreted as fragments of a clay coating or shroud, placed over a workpiece to be brazed. The brazing process involves production of a clay package, containing the iron object(s) to be coated and/or joined, together with pieces of copper alloy (sometimes bound with the iron object using cloth) all wrapped in clay. The package can then be fired in a hearth, during which process the copper alloy melts and tracks over the surface of the iron, providing a striking and corrosion-resistant finish as well as infilling any cracks between adjacent pieces of iron to form a strong join.

The largest collection of brazing shroud from Clonfad derives from c483, a fill of hearth c464. The largest of these pieces clearly show on the inside the characteristic impression of the side of a Type 1 wrought iron handbell, with upper flap, central seam and two of the original three widely-spaced round-headed rivets (Burke 1980, 1986). The fragments from c483 probably comprise around one half of the clay coating from a single bell, One piece shows much more iron contamination of the external glaze than the others, however. A collection from [c508] shows some different features including, apparently, binding of the workpiece in fabric, a feature seen in some Viking period brazing in Scandinavia (Söderberg and Holmquist Olausson 1997). Some of the material from the main assemblage [c464] may also possibly show slight fabric impression, but may be an artefact from cleaning.

This style of brazing, involving attaching of brazing metal to the iron object (perhaps as sheets or alternatively as filings, maybe attached to the binding cloth rather than directly to the workpiece), then wrapping in a protective clay coating before firing, was described by Theophilus (himself a metal-working monk) in the early 12th century, and is a common feature of Viking metalworking, particularly lock manufacture (Gustafsson 2005). The copper alloy coating on hand-bells has long been noted, but only two coatings appear to have been analysed: Anderson (1881) has provided an analysis of the coating on the Fortingall Bell (Perthshire) which recalculates (subtracting iron) as a 6.9% Sn bronze, and Smith (1881-2) gave three analyses of material from the Ednam Bell (Berwickshire) which were all of a 16% Sn-bronze.

The Ednam Bell, of broadly similar size to the example indicated by the brazing residues, weighs 13lbs 8 ounces (Smith 1881-2; equal to 6.12kg) overall and is 280mm tall (excluding the handle). Bourke (1980 p.62) commented on the bells as representing an unusual use of iron sheet at this period. The forging of iron into a sheet is a demanding process, requiring a good quality bloom, and it is likely that it would have been forged from a single bloom if possible, rather than welding several smaller pieces together. No evidence for welding of the iron sheet has been noted by any previous studies of the Type 1 bells.

The brazing process as represented at Clonfad is closely linked to more recent techniques for brazing animal bells (Björklund 1982, Jouffray 1993, Laurence 1991). Some of the modern techniques differ in detail, because they employ the volatility of the zinc in a zinc-containing copper ally as part of the mechanism of coating, but the essential process using clay packages remained the same in wrought iron bell manufacture through to recent decades (Laurence 1991).

Details

E2723:539-540, 543-544, 546-555, 557-566, 568-590, 683 (total 52 pieces), c483

The clay coatings are formed in a low density pale sandy fabric. The fabric contains abundant tabular primary voids, suggestive of the use of an organic material, presumably of plant origin. The inner face of the coatings shows a vesicular thin greenish glassy surficial coating in some areas. Externally there is a deeply dimpled dark green glaze, below which the ceramic is strongly vitrified and vesicular, resembling a “fuel ash” slag. The strong vesicularity rarely extends more than 10mm below the surface. The fabric is pale grey through most of its thickness, becoming paler into the vesicular zone. Pieces associated with what is probably the coating over the handle (upper) end of the bell are more darkly slagged, suggesting the bell was inverted in the hearth.

The thickness of the coating is variable – ranging from about 30mm low on the bell, to about 12mm over the shoulder of the bell. One piece may show the side of the handle, and if so it suggests that the top of the handle may even have been exposed through the coating, though whether by accident or design is not clear.

The coating is coil built, with coils 20-25mm thick. There is little indication of how the copper alloy was placed in the coating. The preservation of the imprint of the rivets shows that the bell was not covered in copper sheet (the Swedish approach described by Björklund, 1982) and there are no obvious depressions in the coating suggesting the presence of lumps of brazing material as plates or wire. One sherd, probably from near the mouth of the bell appears to show an inclusion in the clay extending out at right angles to the side of the bell – so this could have been a piece of copper alloy perched on the rim of the bell.

ED-XRF examination of several coating sherds showed no detectable metal residues, although one (unanalysed) sherd does show a few specks of copper alloy corrosion on the inner surface. The detection of zinc in the fabric of the coating would be highly likely if the copper alloy had been zinc-containing, so it was probably a simple bronze.

The key fragments for the interpretation are:

A reconstructed block with #539, #549, #550 – shows the side of a bell with flap, seam and two rivets with a

surviving length of 215mm. The narrow side of the bell is about 80mm wide at themidpointof the piece and 70mm level with the upper rivet. The rivets have heads 15mm in diameter. The flap descends 20mm off the shoulder of the bell and has a rounded outline.
#584 shows a swollen convex area probably adjacent to the base of the handle, but it is not clear if this is inside or outside the handle. The base is seen over a width of 45mm, rising c. 8mm in centre in triangular area.
#575 is a fragment showing a shoulder flap.
#582 shows a length of seam and rivet head.
#581 shows a possible section of the handle with an 85 degree bend, both sides are only slightly concave moulds, but the angle is markedly so. The clay pinches out against one side. The probable handle is seen to width of 20mm, other side seen to half width of 15mm, with centre 6mm higher, suggestive of outside of handle base.

E2723:687. C561, s255, 62g.
Piece with an almost planar brazing surface, 50x40mm, with very slight concave form around a single axis. Coating is 30mm thick, heavily overgrown with iron oxides (which increase weight as well as obscure details). The exterior has green glaze and deep dimples. This is possibly from the long side of a bell.

E2723:686. C508, s315, 116g, 3 pieces.
#1. This is a very important piece of shroud for it shows several features not shown by other pieces. The piece shows an outer convex (longitudinally) vitrified pale surface which is planar to slightly concave laterally, ending in a bulbous, but almost straight "rim", which curves round into an inner depression. The depression has an acute angle with a planar inner face which has a rather imperfect surface. There are two depressions on the inner face. The one nearer the "rim" is irregular and may be either a join between coils or possibly a cloth fold impression. The outer is a smooth, right-angled re-entrant about 7mm across. The fabric is only hard fired to about 15mm below the surface, below which the ceramic is darker grey with a strong parallel fabric. Reconstruction of this piece is difficult, but it may represent the coating on the mouth of the bell. The poorly-fired rim in this model would lie internal to the mouth of the bell, with the smooth groove being either the mouth of the bell, or associated with the emplacement of the brazing metal.

#2. This piece has the typical dark green outer glaze of most of the shroud fragments. The internal surface is approximately 35x25mm, with the coating 20-23mm thick. The inner surface appears to have been fractured during use, has a slight groove across one end, and is slightly concave. The surface appears to have a cloth impression.

#3. This piece has a very low degree of external glaze, like piece #1 above. The inner face shows a triangular area about 40x30mm, strongly concave and with a marked cloth impression. The thickness of the shroud varies from about 25mm to only 5mm as it swings through about 45 degrees. The strong curvatures, thickness changes and low of vitrification may link this piece to #1, but it does not appear to conjoin it directly.

E2723:683 c298, s222, 28g.
This piece has a dark opaque outer slaggy glaze. The internal surface has a marked out-turn at one-turn about 3mm wide at one end and several wide hollows roughly orthogonal to the out-turn. The surface has probable cloth impression and these hollows may be creases in the cloth. The ceramic varies from 20mm to 15m in thickness around the curve, thinnest over the out-turn, and is vitrified and vesicular through the complete thickness. The inner face of the ceramic shows some very fine voids, reminiscent of the possible hair moulds in the Clonfad crucibles. If from a bell, this is probably from near the shoulder, but this is far from certain. If the out-turn is part of the object, then hard to reconcile with a bell, but the out-turn could possibly be cloth or brazing material.

E2723:682. C135 s200, 11g.
This is a fragment of shroud 35mm thick, with an outer surface with good green clear glaze. The outer part of thickness is strongly vesicular – including one vesicle 17mm across. The inner face small and obscured.

E2723:683. C426, S204, 120g.
This is a thick shroud fragment, 27-30mm thick. The outer surface has a fuel-dimpled dark slaggy surface. The curve of outer face increases towards the area with deeper dimples. Internal face 40x25mm, whole block 80x60mm. The internal face is gently concave. Overall form suggests location just below shoulder on long face of bell. Slaggy layer to 3mm, overlies pale vitrified zone 5mm thick, above pale grey dense zone 10mm thick. Inwards of this the ceramic has a rather "pelleted" appearance distinct from all other brazing shroud sherds. The inner face is pale and smooth but covered with moulds of possible hair. This is the only large sherd not showing coiling.

2.5 Distribution of residues

The distribution of archaeometallurgical residues is given in Tables 7 and 8. The vast majority of the archaeometallurgical residues from the site occur in early medieval contexts, particularly within the ditches. Detailed discussion of the significance of this distribution will require coordination with the final stratigraphic report in due course.

Very few of the residues were associated with metalworking hearths, but detailed stratigraphic evaluation of the examples recognised should be undertaken, with recognition of the interpretation of the hearth style given in this report.

Contexts 478 and 479 contained significant quantities of residues, but these were heavily overgrown by secondary mineralisation (analysed as sample CFD29). Because of this material, effectively a low grade bog ore, complete identification and quantification of the residues in these deposits was not possible. A representative selection of material from the dump contexts (478/479) was examined and recorded in the same way. The high degree of overgrowth of the slag material within these contexts by secondary bog iron ore meant that quantification and interpretation of the slag from these deposits would not be feasible.

The summary investigation of material from those contexts revealed no difference in the nature of the slag assemblage from those of the other contexts, so far as could be determined given the nature of the preservation. An estimate of overall slag content of the material from these contexts was obtained. A 16% sample of the material from [479] yielded 37% slag, suggesting that the 1147.5kg of material from this context contains 425kg of slag. The material from [478] amounted to 1698.2kg of which 1192.8kg was examined without recovery of any slag. One box of the

material did contain a rich slag assemblage, and the total slag content of the context was estimated at 40kg.

The assemblages from other contexts contained approximately 125kg bog ore out of the total 1.15t, leaving 975kg of archaeometallurgical residues. Thus there was a total of 1.44t of archaeometallurgical residues and 2.5t of bog ore.

3. Interpretation

The assemblage of iron-working residues from Clonfad is amongst the largest assemblages of its date from Ireland that has been examined in detail. Interpretation of such residues has been controversial.

Scott wrote his seminal book on early Irish Ironworking just at a time (1990) when ideas in other parts of Europe were developing rapidly. He recognised that his division of the plano-convex slag cakes into smaller smithing hearth bottoms (SHBs) and larger furnace bottoms (FBs) was somewhat arbitrary, with no clear distinguishing criteria besides size. He commented (p. 156) that "for the Irish archaeologist in the field, the situation is fraught with uncertainty when trying to identify origin, and hence anticipate structural evidence, from slag morphologies".

Such a viewpoint on plano-convex slag cakes fitted with, and leant heavily upon, the conventional wisdom of the day, for instance meshing neatly with the account of such cakes in the Historical Metallurgy Society's datasheets (Crew 1995, 1996). In this viewpoint smithing cakes were deemed to be typically less than 2000g, with blacksmithing producing cakes usually between 200 and 500g. Larger plano-convex cakes were attributed to iron smelting and termed "furnace bottoms" (e.g. Pleiner 2000, Scott 1990).. Such a view on the nature of the slag cakes went alongside a poorly-developed understanding of non-slag tapping furnaces. However, with improvements in the interpretation of iron-working residues outside Ireland this view has been challenged, particularly in the light of extensive experimental work (Crew 1991).

One of the initial great benefits to Irish archaeometallurgy of the National Roads Programme was the opportunity for examining many examples of smelting furnaces. Recent development work has resulted in large number of iron smelting residue assemblages being recognised, and many described in detail, although most are unpublished (e.g. Young 2003a, 2003b, 2005a, 2005b, 2006b, 2006c, 2006d, 2008a, 2008c, 2008f, 2008g, 2008h, 2008i, 2008j, 2008l), and a new view of early Irish iron smelting has been developed (Young 2003c, revised in Young 2005b). Residue assemblages identical to those found in Great Britain (e.g. Crew 1987, 1989, 1998). and in continental Europe (Pleiner 2000) in non-slag tapping low shaft smelting furnaces with a basal pit to collect the slag generated (the slagpit furnaces) are now recognised. This allowed the previously ubiquitous interpretation of the remains of smelting furnace as "bowl furnaces" to be replaced by a model of their being the basal pits of slagpit shaft furnaces. One of the clear outcomes of the recognition of these furnaces was that their residue assemblages did not include the large plano-convex slag cakes previously considered to be the "furnace bottoms" produced in bowl furnaces. Using this new model for iron-working residues, the plano-convex cakes from Clonfad can all be interpreted as "smithing hearth cakes" (SHCs) from iron-working processes, rather than "furnace bottoms" (FBs) from iron smelting.

Clonfad has provided the opportunity for the first detailed investigation of a large assemblage of plano-convex slag cakes. The examples investigated covered the whole size range of such cakes, from the smallest examples (Scott's SHBs) up to large cakes as big as any known from Ireland (his FBs). The chemical and mineralogical details described above show the complexity and variability of these materials, but none the less they show a high degree of homogeneity. It has been possible to argue that they all derive from secondary working of iron. Their diversity derives from the range of processes that are undertaken by smiths, ranging from bloom refining, forging or iron to plate or bar, artefact production, artefact repair and possibly even steel-making.

The detailed analyses of the slag cakes from Clonfad indicates that the smaller cakes in general show a low proportion of input from material with broadly the composition of a smelting slag, whereas a significant proportion of the larger cakes show a significant contribution from such material. This supports the hypothesis that the smaller cakes tend to represent the residue from the working of finished iron, whereas the larger cakes are associated with the refining of raw iron.

One can only speculate upon the relationship between the timing of the cleaning-out of the hearth and the refining process, but it is not unreasonable to suggest that the large cakes might represent residue from the working-down of a single bloom. If this were the case, then the blooms would have been large. Estimates of loss during bloomsmithing vary, but Crew (1991) and Sauder & Williams (2002) give estimates of around 65% for losses from bloom to bar. A detailed breakdown of the lost material (i.e. oxidised of iron, loss of slag inclusions...) has not been undertaken, nor has a detailed study of how much of the loss ends up in the hearth slag and how much as scale. Nonetheless, the iron content of the large SHCs (which are typically around 60% FeO, or 47% Fe by weight, giving 5.1kg of iron in an 11kg SHC) is broadly compatible with total losses from the refining blooms of around 8-9kg, but not all the loss will be to the slag, so the original bloom must have been significantly larger than this.. This may provide circumstantial evidence for the large SHCs each being the residue from the working down of single large blooms. Clearly the overall loss and estimate of bloom size cannot be calculated with any degree of certainty, because it is not known if complete working down to bar or sheet iron was undertaken without cleaning of the hearth, so the whole process might be represented by more than one slag cake, particularly if the refining process for a large bloom took more than a single working day.

Besides the oxidised iron and the residual smelting slag included in the raw bloom, a third input into the SHCs would have been silicate material from the melting of the tuyères. The influence of the hearth ceramics has been demonstrated above for the small SHCs, but the signal appears swamped out by the influx of smelting-derived materials in the large cakes.

One area for future research is the investigation of the small SHCs with a strong smelting slag influence. Do these cakes represent bloom refining using a more "conventional" approach to hearth management than the large SHCs, or are they something different. Do they perhaps represent deliberately remelted smelting

slags for undertaking a specialist task in the hearth, such as small scale steel making?

The brazing residues, with their evidence for handbell manufacture, provides a clue for the purpose behind at least some of the large blooms apparently being refined at Clonfad. The range of residues and the evidence for the production of hand bells raises the significance of the Clonfad smiths, and their status should be viewed alongside the craftsmen who produced the contemporary non-ferrous metalworking treasures, such as the Tara Brooch or the Ardagh Chalice.

Summary

Clonfad produced evidence for the working of iron, from bloom refining through to artefact production. The scale of the production is difficult to assess, but was certainly substantial.

The detailed chemical and textural arguments for the origin of the large slag cakes during smithing, rather than smelting, as previously supposed, is likely to be controversial, but is a major step forward in the understanding of early medieval iron working in Ireland.

This report argues for the production of very large slag cakes within pits in the base of smithing hearths, during the consolidation of particularly large blooms. Other, smaller, cakes indicate that not all blooms being worked were of this exceptional size.

The recognition of clay shrouds from the brazing of ecclesiastical hand bells indicates one use for the large blooms. The sheet iron required for the bells would have presented enormous technical challenges for the smiths, and the creation of the bells must be regarded as one of the pinnacles of early medieval iron working.

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Figure 3: Sampling detail for CFD14-CFD20

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Figure 12: Upper-crust normalised rare earth element profiles for samples from Clonfad with concentrations recalculated on an iron-free basis. Upper diagram shows analyses from SHCs with weights below 1000g, the second plot shows analyses from SHCs with weights of 1000-4000g, the third analyses from SHCs with weights over 4000g. The fourth, bottom, diagram shows miscellaneous analyses, including the tuyères and soil samples. Normalisation factors after Taylor and McLennan 1981.

Figure 13: Scatterplot of the U:Th ratio against the Ba:Mn ratio, both by weight, for bulk (not detail) samples only. Datapoints are coded to indicate the nature of the material and the SHC weight class where appropriate.

Figure 14: Upper: Interpretative sketch of section through a smithing hearth as proposed for the origin of the large Clonfad SHCs, showing the elongate tuyère (red), pro-tuyère tongue and large SHC (slags in orange). The yellow zone schematically indicates the hearth's hotzone.
Lower: Clay-walled hearth with blowhole, as commonly found on early smithing sites in Britain, for comparison.

Plates

Plate 1: Photographic record of CFD1 before sampling

Plate 2: Photographic record of CFD2 before sampling

Plate 3: Photographic record of CFD3 before sampling

Plate 4: Photographic record of CFD4 before sampling

Plate 5: Photographic record of CFD5 before sampling

Plate 6: Photographic record of CFD6 before sampling

Plate 7: Photographic record of CFD7 before sampling

Plate 8: Photographic record of CFD8 before sampling

Plate 9: Photographic record of CFD9 before sampling

Plate 10: Photographic record of CFD10 before sampling

Plate 11: Photographic record of CFD11 before sampling

Plate 12: Photographic record of CFD12 before sampling

Plate 13: Photographic record of CFD13 before sampling

Plate 14: Photographic record of CFD14 before sampling

Plate 15: Photographic record of CFD15 before sampling

Plate 16: Photographic record of CFD16 before sampling

Plate 17: Photographic record of CFD17 before sampling

Plate 18: Photographic record of CFD18 before sampling

Plate 19: Photographic record of CFD19 before sampling

Plate 20: Photographic record of CFD20 before sampling

Plate 21: Photographic record of CFD21 before sampling

Plate 22: Photographic record of CFD22 before sampling

Plate 23: Photographic record of CFD23 before sampling

Plate 24: Photographic record of CFD24 before sampling

Plate 25: Photographic record of CFD26 before sampling

Plate 26: Photographic record of CFD27 before sampling

Plate 27: Photograph of archived section of cut samples
a. CFD1
b. CFD2
c. CFD3
d. CFD4
e. CFD5
f. CFD6
g. CFD7
h. CFD8

Plate 28: Photograph of archived section of cut samples
a. CFD9
b. CFD10
c. CFD11
d. CFD12
e. CFD13
f. CFD14
g. CFD15
h. CFD16

Plate 29: Photograph of archived section of cut samples
a. CFD17
b. CFD18
c. CFD19
d. CFD20
e. CFD21
f. CFD22
g. CFD23
h. CFD24

Plate 30: Photograph of archived section of cut samples
a. CFD26
b. CFD27

Plate 31: BSEM Photomicrographs of sample CFD1B
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5
f. SOI 6
g. SOI 7
h. SOI 8

Plate 32: BSEM Photomicrographs of sample CFD1B
a. SOI 9
b. SOI 10
c. SOI 11
d. SOI 12
e. SOI 13

Plate 33: BSEM Photomicrographs of sample CFD6B
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5
f. SOI 6
g. SOI 7

Plate 34: BSEM Photomicrographs of sample CFD8B
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5
f. SOI 6

Plate 35: BSEM Photomicrographs of sample CFD10B
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4

Plate 36: BSEM Photomicrographs of sample CFD13B
a. SOI 1
b. SOI 2
c. SOI 18
d. SOI 19
e. SOI 20
f. SOI 21
g. SOI 22
h. SOI 23

Plate 37: BSEM Photomicrographs of sample CFD13B
a. SOI 24

Plate 38: BSEM Photomicrographs of sample CFD13B
a. BSEM Photomosaic comprising images of SOIs 3, 7, 8, 9, 10, 11 ,12, 13, 14, 15 ,16, 17

Plate 39: BSEM Photomicrographs of sample CFD14B
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5
f. SOI 6

Plate 40: BSEM Photomicrographs of sample CFD14C
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5
f. SOI 6
g. SOI 7
h. SOI 8
i. SOI 9

Plate 41: BSEM Photomicrographs of sample CFD14D
a. SOI 1
b. SOI 2
c. SOI 3

Plate 42: BSEM Photomicrographs of sample CFD16B
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5
f. SOI 6

Plate 43: BSEM Photomicrographs of sample CFD18B
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5
f. SOI 6
g. SOI 7
h. SOI 8

Plate 44: BSEM Photomicrographs of sample CFD18B
a. SOI 9

Plate 45: BSEM Photomicrographs of sample CFD18C
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4

Plate 46: BSEM Photomicrographs of sample CFD20B
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5
f. SOI 6
g. SOI 7
h. SOI 8

Plate 47: BSEM Photomicrographs of sample CFD20C
a. SOI 1
b. SOI 2

Plate 48: BSEM Photomicrographs of sample CFD21B
a. SOI 1
b. SOI 2
c. SOI 3

Plate 49: BSEM Photomicrographs of sample CFD21C
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5
f. SOI 6
g. SOI 7
h. SOI 8

Plate 50: BSEM Photomicrographs of sample CFD21D
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5

Plate 51: BSEM Photomicrographs of sample CFD22B
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5

Plate 52: BSEM Photomicrographs of sample CFD23B
a. SOI 1
b. SOI 2
c. SOI 3
d. Photomosaic of images of areas SOI 4 and SOI 5

Plate 53: BSEM Photomicrographs of sample CFD24B
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5
f. SOI 6
g. SOI 7
h. SOI 8

Plate 54: BSEM Photomicrographs of sample CFD24B
a. SOI 9
b. SOI 10
c. SOI 11

Plate 55: BSEM Photomicrographs of sample CFD24B
a. Photomosaic of areas of SOI7-11

Plate 56: BSEM Photomicrographs of sample CFD24C
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5 (“bleb”)

Plate 57: BSEM Photomicrographs of sample CFD26B
a. SOI 1
b. SOI 2
c. SOI 3
d. SOI 4
e. SOI 5

Plate 58: BSEM Photomicrographs of sample CFD26D
a. SOI 1
b. SOI 2
c. SOI 3

Plate 59: BSEM Photomicrographs of sample CFD27B
a. SOI 1
b. SOI 2
c. SOI 3

Plate 60: BSEM Photomicrographs of sample CFD27D
a. SOI 1
b. SOI 2
c. SOI 3

Plate 61: Photograph of an example of a tuyère (specimen A001:036:526 from c563)

Plate 62: Photograph of principal reconstructed piece of brazing shroud.

Tables

Table 1: Details of specimens selected for detailed analysis

Table 2. Weight distribution of early medieval SHCs from Clonfad.

Table 3: Major element analyses of samples.
Elements expressed as weight% oxide. Iron and manganese are expressed in two alternative ways – as Fe2O3/MnO2 and FeO /MnO(dashed box). The loss on ignition is quoted both as the observed value and as a value corrected for all iron and/or manganese present in the sample as FeII /MnII(dashed boxes). Negative loss on ignition is a gain on ignition. Analyses by XRF on fused beads.

Table 4. Trace element analyses of samples.
Elements expressed as element in parts per million (ppm) by weight. Analyses by ICP-MS.

Table 5. Trace element analyses of samples (continued).
Elements expressed as element in parts per million (ppm) by weight. Analyses by ICP-MS.

Table 6: Comparison of the Clonfad SHC assemblage with other Irish smithing assemblages.
Assemblages ordered by mean SHC weight.
Mucklagh from Young 2008d; Coolamurry from Young, 2008b; Navan Site 1 from Young 2007; Moneygall from Young 2008e; Carrigoran from Young , 2006d; Trumra 4 from Young 2008k, Clonmacnoise New Graveyard site from the author's work in progress; Ballykilmore from Young 2006b; Woodstown from Young, 2006c;.Clonmacnoise Waste Water Scheme from Young 2005a; Clonfad this study; Lismore/Bushfield 1 from Young 2008i.
The assemblages from Mucklagh, Moneygall, Navan, Carrigoran and Coolamurray are interpreted as being dominantly blacksmithing residues. The assemblages from Ballykilmore, Clonfad, Clonmacnoise and Woodstown are interpreted as including bloomsmithing residues.

Table 7. Distribution of archaeometallurgical macro-residues and associated materials by context. Figures in red indicate the estimated weights from the dump deposits; for details see text.

Table 8. Distribution of archaeometallurgical macro-residues by context, sorted by phase and feature. Figures in red indicate the estimated weights from the dump deposits; for details see text.

Table 9. Sample details of archaeometallurgical micro-residues

Appendix 1. Summary Catalogue

Appendix 2. Microanalyses by EDS.
Results ordered by specimen and site of interest.

Appendix 3. Mineralogy

A3.1 Olivine compositions by EDS
A3.2 Apatite compositions by EDS
A3.3 Glass compositions by EDS
A3.4 Pyroxene, rhönite and unknown silicate compositions by EDS
A3.5 Iron and iron oxide compositions by EDS
A3.6 Leucite compositions by EDS

sample	actual weight	original weight	context	sample	find	type	Notes	bulk analysis	SEM	detailed analysis
CFD1	424	424	116	10	#614	1	90x90x40mm compact dense SHC	A	1 (B)	
CFD2	504	504	333	175	#621	3	SHC with unusual dimpled top	A		2
CFD3	460	460	132	71	#617	1	conventional SHC with good organics	A		
CFD4	566	566	116	10	#612	1	SHC with hollowed top full of mineralised charcoal	A		
CFD5	630	630	116	10	#613	1	110x100x40mm conventional dense SHC	A		
CFD6	544	695	116	10		1	c. 80% of conventional SHC	A	1 (B)	
CFD7	970	970	563	283	#626	4		A		
CFD8	1390	1390	139		#529	2	190x140x80mm, SHC	A	1 (B)	
CFD9	278	278	563	283	#625	5	lining only SHC?	A		
CFD10	1385	1385	117	27	#615	2	med crust SHC with good upper levels	A	1 (B)	2 (C,D)
CFD11	2415	2415	132		#535	1	190x160x80mm, neatly rounded SHC, dense crust, charcoal rich core, base dimpled with pebble	A		
CFD12	2450	2450	132	71	#616	4	medium crust SHC	A		
CFD13	7340	7340	571		#435	3	Sub-circular SHC, 280x290x100mm, has dense slag bowl, one side raised 50 above top, has small area of smooth top, otherwise central part of bowl is rather friable, about 180 in diameter. Base of bowl very neatly rounded.	A	1 (B)	
CFD14	9575	9575	574		#567	4?	320x300x120mm, regularly bowl-shaped other end massive furnace bottom, interior to top rather granular, base shows one steeper end with ridge 50in then hollow then from 120in has	A	3 (B,C,D)	3 (E,F,G)
CFD15	*2005	?	563		#533	4?	in 2 pieces, 160x160x55, dense crust, granular core with hollow inner overlain partially by smooth planar top	A		
CFD16	*620	1250	298	222		2	half a small thick crust SHC	A	1 (B)	
CFD17	*1350	1500	142	161		1	90% of thick crust SHC	A		
CFD18	*2590	2880	132		#217	2	140x180x50mm flat topped dense slag puddle, with 35mm high raised central top with charcoal rich slag and blown top	A	2 (B,C)	2 (D,E)
CFD19	*3000	5450	113		#537	5	Approximately half of slightly pyramidal SHC. 230x150(part)x100mm, dense basal pool to 60mm thick, inner cavity with large vesicles partly roof by smooth surface	A		
CFD20	*2830	5660	142		#424	5	130x200x90mm. Segment from v thick SHC dense to top, triple layer, top smooth, base dimpled except I middle which has adhering gravel.c240 diameter originally - so 30%?	A	2 (B,C)	2 (D,E)
CFD21	*7870	9260	132		#210	5	260x220x100mm, slightly irregular furnace base broken both ends - so would have been more channel like than hemispherical		3 (B,C,D)	3 (E,F,G)
CFD22	*664	?	563	283	#624	4	small piece of large SHC with crystal terminations	A	1 (B)	
CFD23	2245	2245	561	255	#623	4	linguoid SHC 220x170x55mm bowl plus 45mm distal riser	A	1 (B)	
CFD24	420	420	561	255	#622	4	SHC with good organics on base	A	2(B,C)	2(D,E)
CFD25	9910	9910	128			1	320x280x150mm irregularly hemispherical furnace base, dense outer crust, but all slightly friable, 1 end looks horseshoe like in plan, open end protrudes in more friable material	none		
CFD26	*234	?	298	222	#620	6	fragments from skeletal thin crust		2 (A,C)	2 (B,D)
CFD27	5270	5270	137?		#628	n/a	Unusually-formed slag bowl with straw (?) impressions on base and flow lobes		2 (B,D)	2 (C,E)
CFD28						n/a	Subsoil sample	Yes		
CFD29			476	256		n/a	Sample of concretionary matrix to main dump deposit	Yes		
CFD30			142	51		n/a	Tuyère sherd	Yes		
CFD31			298	222		n/a	Tuyère sherd	Yes		

Table 1. Details of specimens selected for detailed analysis.

Table 2. Frequency-weight distribution of early medieval SHCs from Clonfad. All weights in g.

<100	**2**				
100-200	**6**				
200-300	**35**	*<500*	**113**		
300-400	**38**				
400-500	**32**				
500-600	**24**	*500-1000*	**120**	*0-1000*	**233**
600-700	**26**				
700-800	**21**				
800-900	**28**				
900-1000	**21**				
		1000-1500	**52**	*1000-2000*	**84**
		1500-2000	**32**		
				2000-3000	**31**
				3000-4000	**17**
				4000-5000	**3**
				5000-6000	**4**
				6000-7000	**1**
				7000-8000	**1**
				8000-9000	**0**
				9000-10000	**4**
				10000-11000	**2**
				11000-12000	**1**

Table 3.

		SiO_2	Al_2O_3	Fe_2O3	*FeO*	MnO_2	*MnO*	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	LOI(obs.)	LOI (Fe^{II},Mn^{II})	**total**
CFD1A	whole section	18.03	1.38	79.10	*71.19*	0.22	*0.18*	0.40	3.94	0.15	0.74	0.093	0.295	-4.28	3.67	**100.07**
CFD2A	whole section	16.42	1.02	80.91	*72.82*	0.12	*0.10*	0.31	1.69	0.15	0.39	0.084	0.265	-1.09	7.02	**100.27**
CFD3A	whole section	23.84	1.68	63.48	*57.13*	7.52	*6.14*	0.41	4.28	0.21	0.84	0.112	0.403	-3.10	4.63	**99.68**
CFD4A	whole section	11.39	1.02	83.95	*75.56*	0.22	*0.18*	0.15	2.07	0.13	0.17	0.060	0.524	-0.62	7.81	**99.06**
CFD5A	whole section	9.69	0.66	90.22	*81.20*	0.10	*0.08*	0.40	2.62	0.13	0.40	0.051	0.491	-4.95	4.09	**99.81**
CFD6A	whole section	16.27	1.26	78.61	*70.75*	0.93	*0.76*	0.20	2.42	0.20	0.44	0.096	0.329	-1.86	6.17	**98.90**
CFD7A	whole section	28.34	2.70	63.52	*57.17*	2.22	*1.81*	0.38	3.55	0.27	0.98	0.164	0.537	-3.36	3.40	**99.30**
CFD8A	whole section	20.11	1.57	75.36	*67.83*	0.60	*0.49*	0.38	3.99	0.22	0.72	0.095	0.372	-4.49	3.15	**98.93**
CFD9A	whole section	45.59	3.54	43.08	*38.77*	3.88	*3.17*	0.67	3.79	0.48	0.97	0.229	0.233	-3.22	1.80	**99.25**
CFD10A	whole section	21.53	1.68	70.28	*63.25*	0.34	*0.28*	0.43	4.70	0.24	0.63	0.108	0.545	-0.54	6.55	**99.95**
CFD10C	lower bowl	25.12	2.02	68.27	*61.45*	0.45	*0.37*	0.53	5.79	0.30	0.81	0.127	0.572	-4.02	2.88	**99.97**
CFD10D	upper dense layer	15.35	1.07	79.00	*71.10*	0.16	*0.13*	0.29	1.78	0.13	0.21	0.090	0.343	1.74	9.67	**100.16**
CFD11A	whole section	17.06	1.39	70.89	*63.80*	3.24	*2.64*	0.38	5.79	0.23	0.56	0.088	0.845	0.58	8.27	**101.05**
CFD12A	whole section	17.41	0.82	80.72	*72.64*	0.92	*0.75*	0.31	1.57	0.12	0.25	0.059	0.477	1.57	9.82	**104.23**
CFD13A	bulk of thick crust bowl only	23.46	1.87	66.00	*59.40*	10.50	*8.57*	0.46	5.80	0.23	0.96	0.112	0.616	-5.27	3.26	**104.74**
CFD14A	whole section	21.84	2.17	67.64	*60.88*	4.72	*3.85*	0.39	5.05	0.22	0.56	0.134	1.186	4.34	3.29	**99.57**
CFD14E	upper part of bowl	24.80	2.78	65.57	*59.01*	5.14	*4.19*	0.38	6.22	0.25	0.77	0.153	1.346	-5.24	2.27	**102.16**
CFD14F	lower part of bowl	22.16	2.13	71.80	*64.62*	5.48	*4.47*	0.43	5.48	0.22	0.63	0.128	1.122	-5.99	2.20	**103.59**
CFD14G	centre of secondary bowl	22.59	2.41	63.44	*57.09*	5.15	*4.20*	0.39	5.64	0.21	0.60	0.135	1.257	-5.10	2.20	**96.72**
CFD15A	all of crust	32.02	1.64	62.72	*56.45*	3.16	*2.58*	0.65	6.03	0.24	0.91	0.098	0.686	-4.70	2.15	**103.46**
CFD16A	whole section	28.53	1.92	67.13	*60.42*	2.28	*1.86*	0.46	5.36	0.30	1.03	0.138	0.424	-4.76	2.37	**102.81**
CFD17A	whole section	22.07	1.64	71.59	*64.43*	1.29	*1.05*	0.45	4.92	0.25	0.87	0.109	0.441	-2.13	5.27	**101.50**
CFD18A	whole section	21.74	1.57	74.43	*66.99*	0.54	*0.44*	0.25	2.96	0.18	0.78	0.091	0.443	-3.99	3.55	**98.99**
CFD18D	lower part of bowl	23.40	1.80	73.75	*66.37*	0.58	*0.47*	0.24	3.52	0.22	0.98	0.093	0.460	-5.90	1.59	**99.14**
CFD18E	friable top	27.32	2.43	65.81	*59.23*	0.56	*0.46*	0.21	5.01	0.29	1.38	0.121	0.685	-4.60	2.08	**99.22**
CFD19A	whole section of bowl fragment	27.51	2.82	69.00	*62.10*	2.37	*1.93*	0.53	5.42	0.27	0.66	0.171	0.808	-5.67	1.67	**103.88**
CFD20A	whole section	27.21	1.55	63.93	*57.54*	5.20	*4.24*	0.38	4.41	0.18	0.42	0.096	0.370	-4.17	3.18	**99.57**
CFD20D	lower part of bowl	35.18	2.00	59.02	*53.12*	5.10	*4.16*	0.44	4.03	0.25	0.55	0.125	0.347	-4.79	2.05	**102.25**
CFD20E	upper bowl and vesicular fill	27.90	1.71	65.02	*58.52*	5.47	*4.46*	0.38	5.15	0.22	0.51	0.105	0.396	-5.77	1.74	**101.09**
CFD21E	distal lower part	27.39	2.03	68.25	*61.42*	0.21	*0.17*	0.40	4.05	0.22	0.81	0.147	0.238	-4.64	2.23	**99.10**
CFD21F	distal upper part	26.00	2.50	62.96	*56.66*	0.18	*0.15*	0.28	5.38	0.24	0.89	0.169	0.338	0.41	6.74	**99.35**
CFD21G	proximal upper part	17.70	1.19	79.04	*71.13*	0.17	*0.14*	0.29	1.80	0.11	0.26	0.088	0.212	-5.73	2.21	**95.13**
CFD22A	whole section	28.14	2.32	62.28	*56.05*	4.62	*3.77*	0.34	4.41	0.22	0.70	0.145	1.015	-4.44	2.64	**99.75**
CFD23A	whole section	24.87	2.32	53.54	*48.18*	14.38	*11.73*	0.38	7.39	0.22	0.62	0.146	0.543	-3.85	4.16	**100.55**
CFD24A	whole section	25.16	1.46	67.27	*60.54*	0.94	*0.77*	0.41	2.42	0.18	0.68	0.118	0.286	-0.99	5.91	**97.94**
CFD24D	proximal part	30.18	2.03	59.71	*53.74*	0.75	*0.61*	0.43	2.99	0.22	1.02	0.151	0.318	1.13	7.24	**98.93**
CFD24E	distal part	27.08	1.36	68.50	*61.65*	0.86	*0.70*	0.46	2.25	0.18	0.62	0.108	0.222	-2.87	4.14	**98.77**
CFD26A	basal crust of thin crust	23.07	1.82	79.04	*71.13*	1.19	*0.97*	0.40	2.99	0.23	0.59	0.127	0.687	-5.97	2.16	**104.17**
CFD26C	granular contents of bowl	23.43	2.20	72.19	*64.97*	1.18	*0.96*	0.34	3.53	0.28	0.75	0.141	0.777	-6.53	0.91	**98.28**
CFD27C	base of mass (straw!)	23.79	1.78	63.71	*57.34*	11.01	*8.98*	0.42	5.69	0.21	0.50	0.119	0.348	-4.98	3.42	**102.59**
CFD27E	mid part of mass	25.94	2.08	54.96	*49.47*	10.92	*8.91*	0.42	6.41	0.26	0.62	0.135	0.399	-4.62	2.88	**97.52**
CFD28	Clonfad subsoil	50.30	5.02	2.37	*2.13*	0.09	*0.07*	0.91	20.66	0.53	0.86	0.321	0.081	18.11	18.37	**99.25**
CFD29	Clonfad concretionary ore	60.68	4.63	19.98	*17.98*	0.72	*0.59*	0.35	1.53	0.45	0.75	0.312	1.802	7.80	9.93	**99.01**
CFD30	Tuyère	85.33	6.63	3.65	3.28	0.18	0.15	0.43	0.28	0.62	1.12	0.459	0.063	0.42	0.78	**99.15**
CFD31	Tuyère	82.67	7.12	4.34	3.90	0.20	0.16	0.44	0.45	0.54	1.12	0.448	0.342	1.25	1.68	**98.89**

Table 4

	Sc	V	Cr	Co	Ni	Cu	Zn	Ga	Rb	Sr	Y	Zr	Nb	Mo	Sn	Cs	Ba
CFD1A	2.036	17.198	13.350	11.929	9.465	18.731	10.824	2.332	10.677	71.382	8.220	74.05	1.780	16.750	7.943	0.221	215.3
CFD2A	1.561	18.496	15.036	29.938	39.593	24.071	13.260	2.515	7.546	32.775	4.376	32.87	1.601	28.041	3.667	0.161	119.1
CFD3A	2.315	33.662	23.555	13.612	20.907	19.238	17.888	3.984	16.107	122.554	18.916	46.58	2.028	10.808	1.383	0.406	2302.4
CFD4A	1.479	62.340	17.467	6.549	16.535	33.357	19.495	1.831	3.199	41.491	22.337	47.85	1.358	16.431	2.287	0.044	527.2
CFD5A	1.093	10.719	11.689	28.609	24.518	30.006	15.602	2.296	8.713	50.848	3.091	63.92	1.209	15.244	5.325	0.193	109.3
CFD6A	1.946	24.788	15.690	23.867	18.734	18.454	13.487	2.224	10.431	61.210	9.264	80.71	1.968	15.412	3.547	0.141	577.9
CFD7A	3.640	48.869	28.686	16.742	16.470	10.685	11.821	3.594	19.253	96.059	33.788	109.98	3.329	13.354	2.297	0.653	1221.5
CFD8A	2.671	44.578	19.420	8.708	6.340	13.292	10.135	2.306	15.490	120.423	30.261	86.09	2.110	7.680	1.828	0.219	573.7
CFD9A	4.306	34.640	27.802	12.401	22.652	25.698	30.127	4.840	27.565	130.120	11.626	139.67	4.227	5.639	1.007	1.228	1514.1
CFD10A	3.423	58.564	143.804	11.684	894.190	12.030	16.454	2.368	16.279	119.493	46.341	39.88	2.107	16.335	1.175	0.217	277.0
CFD10C	3.969	91.850	30.064	6.144	11.043	8.481	15.372	2.685	21.486	159.342	65.332	98.58	2.808	4.158	2.329	0.325	375.6
CFD10D	2.267	39.170	20.453	24.520	34.344	26.548	17.299	2.184	5.499	36.821	14.390	31.66	1.501	39.101	5.170	0.072	112.5
CFD11A	1.687	34.687	12.262	16.261	6.351	24.379	36.591	2.254	10.808	151.677	13.072	69.05	1.697	2.029	3.096	0.128	1335.1
CFD12A	1.419	22.384	13.749	19.487	25.420	19.635	16.690	1.928	6.454	44.346	7.521	22.94	1.037	18.798	1.790	0.095	318.5
CFD13A	3.466	55.216	34.262	11.120	1.643	8.046	36.641	4.655	31.103	130.715	22.944	93.22	2.296	4.054	1.354	0.417	954.0
CFD14A	3.845	65.778	36.538	6.944	3.621	5.724	61.243	3.617	11.872	153.226	35.168	97.13	2.846	2.635	1.708	0.497	1503.1
CFD14E	4.086	63.162	37.292	7.074	9.994	4.998	55.510	4.519	17.084	193.693	42.148	108.35	3.464	2.325	4.006	0.740	1797.8
CFD14F	4.534	68.919	34.914	4.959	6.678	0.850	54.006	3.753	12.342	159.789	35.128	95.54	2.698	2.190	2.913	0.532	1519.6
CFD14G	3.797	61.898	39.274	6.768	15.429	27.472	49.395	3.502	9.712	154.164	35.026	45.04	2.332	1.836	1.557	0.366	1634.7
CFD15A	3.200	42.251	18.318	11.220	1.624	66.206	28.783	2.871	17.184	146.216	23.823	91.21	2.262	2.610	2.489	0.361	366.6
CFD16A	2.110	30.221	16.169	5.385	6.475	16.613	16.837	2.631	33.528	130.932	20.454	58.51	2.549	3.197	1.965	0.325	1258.9
CFD17A	2.265	46.330	16.744	13.878	16.435	16.962	20.442	2.440	18.731	130.298	29.554	37.83	2.015	8.137	3.364	0.277	562.5
CFD18A	2.973	111.657	23.237	9.506	2.452	9.529	53.258	2.542	17.684	83.228	50.107	89.56	2.163	10.790	2.345	0.229	268.8
CFD18D	2.987	113.226	20.511	5.267	7.910	11.282	55.093	2.654	20.721	100.907	55.458	91.61	2.344	6.066	1.476	0.263	303.3
CFD18E	3.439	94.660	19.941	7.300	15.305	13.004	43.498	3.373	31.656	137.407	70.718	122.28	3.230	4.570	3.697	0.440	411.7
CFD19A	4.508	64.608	36.563	9.446	2.711	10.727	41.179	3.449	19.029	125.384	41.527	110.82	3.486	7.346	2.993	0.667	1075.9
CFD20A	2.802	41.891	24.418	8.844	34.409	12.822	22.080	3.259	11.282	157.049	29.896	79.25	2.036	9.208	3.143	0.306	2128.0
CFD20D	3.025	43.801	21.420	7.398	2.753	6.617	27.477	3.113	17.459	151.908	26.813	100.23	2.716	4.207	0.530	0.624	1497.2
CFD20E	2.818	45.508	16.354	8.800	2.358	6.599	21.917	3.193	13.423	191.104	34.753	91.93	2.296	19.488	0.792	0.326	1984.0
CFD21E	2.767	30.172	18.118	11.379	9.713	11.807	7.739	2.149	20.609	81.464	10.598	91.43	2.751	18.407	3.194	0.334	152.6
CFD21F	2.873	31.196	17.923	13.270	6.384	10.563	43.758	2.569	26.562	105.032	11.837	113.64	3.738	6.744	5.565	0.523	200.2
CFD21G	2.016	22.122	16.613	36.818	39.447	73.207	11.844	1.696	7.098	36.668	5.508	78.10	1.836	30.239	1.712	0.196	110.6
CFD22A	3.399	49.604	36.015	7.577	9.048	9.769	60.789	3.251	14.631	140.718	31.001	53.31	2.510	1.265	3.487	0.598	1594.0
CFD23A	3.939	55.507	23.691	6.399	1.598	7.361	33.938	5.913	13.296	220.393	36.181	101.05	3.021	1.871	3.444	0.470	3322.3
CFD24A	2.368	26.555	20.241	24.276	38.051	26.292	16.759	2.425	14.570	61.332	5.231	101.83	2.627	28.659	1.322	0.405	263.6
CFD24D	2.608	24.453	21.893	40.433	109.239	37.246	76.922	2.776	21.425	88.644	6.756	108.29	3.074	49.680	2.512	0.748	361.4
CFD24E	1.811	21.930	18.410	23.706	24.164	18.442	11.805	2.302	13.120	55.420	5.169	87.56	2.125	19.428	0.925	0.347	238.2
CFD26A	3.224	47.214	26.646	5.658	4.857	15.254	23.668	3.156	13.564	72.879	23.965	90.77	2.470	2.890	12.554	0.225	448.0
CFD26C	3.310	47.204	30.680	8.189	2.953	5.815	17.444	3.316	16.638	90.439	28.447	103.55	3.079	1.953	19.865	0.268	561.9
CFD27C	2.840	54.057	29.240	7.847	4.575	31.869	30.039	4.752	9.559	224.972	25.201	91.22	2.413	2.468	4.789	0.265	2674.5
CFD27E	2.647	49.957	26.256	5.820	7.034	15.709	28.896	5.582	11.387	262.689	26.070	92.19	2.413	2.034	2.319	0.320	3073.7
CFD28	5.083	39.581	41.840	7.914	44.667	15.977	68.157	6.387	44.368	249.226	19.980	211.39	6.555	0.051	2.080	2.387	185.7
CFD29	5.443	48.938	57.521	19.902	24.713	9.826	141.228	5.486	47.793	83.872	24.469	176.05	5.337	0.920	3.711	2.085	624.0
CFD30	6.528	43.018	72.879	11.733	49.905	20.535	99.424	7.300	52.885	46.910	15.841	164.05	6.369	0.611	0.806	3.785	225.8
CFD31	7.761	44.580	80.125	14.365	62.667	44.673	120.619	7.960	55.172	55.361	20.599	171.49	8.498	0.705	0.474	3.794	294.9

Table 5

	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	Pb	Th	U
CFD1A	6.370	11.578	1.530	5.806	1.233	0.259	1.134	0.168	1.056	0.213	0.620	0.096	0.596	0.092	1.736	0.124	1.518	0.984	0.574
CFD2A	3.744	6.781	0.869	3.286	0.650	0.133	0.606	0.089	0.536	0.113	0.341	0.053	0.346	0.053	0.769	0.090	0.819	0.916	0.468
CFD3A	11.632	19.330	2.660	10.245	2.179	0.483	2.151	0.311	1.974	0.400	1.258	0.188	1.213	0.193	0.996	0.116	0.660	1.171	1.821
CFD4A	21.668	34.273	4.901	18.725	3.838	0.813	3.756	0.574	3.638	0.700	2.066	0.306	1.892	0.279	1.525	0.086	1.709	1.006	0.685
CFD5A	2.717	4.811	0.614	2.306	0.484	0.103	0.408	0.058	0.394	0.081	0.249	0.037	0.240	0.038	1.505	0.085	0.846	0.504	0.296
CFD6A	7.181	12.453	1.630	6.143	1.269	0.273	1.175	0.176	1.102	0.220	0.663	0.100	0.623	0.099	1.854	0.137	0.690	0.957	0.696
CFD7A	26.180	44.109	5.928	22.904	4.552	0.998	4.321	0.638	3.848	0.742	2.209	0.326	2.044	0.312	2.511	0.219	0.448	2.065	2.915
CFD8A	21.954	34.594	4.626	17.966	3.548	0.787	3.545	0.516	3.216	0.629	1.922	0.285	1.737	0.268	1.957	0.143	4.468	1.394	0.939
CFD9A	9.899	24.893	2.269	8.519	1.815	0.366	1.651	0.263	1.635	0.323	0.968	0.152	0.975	0.155	2.944	0.298	4.491	2.649	1.690
CFD10A	35.948	57.416	7.875	29.559	6.015	1.324	5.817	0.883	5.458	1.026	3.054	0.453	2.749	0.410	0.879	0.115	0.442	1.709	1.214
CFD10C	50.213	79.417	10.861	40.942	8.091	1.809	7.870	1.223	7.437	1.403	4.132	0.622	3.701	0.553	2.178	0.174	1.599	2.188	1.541
CFD10D	10.235	17.783	2.396	9.027	1.924	0.420	1.794	0.275	1.737	0.342	1.053	0.164	1.022	0.151	0.680	0.089	1.018	0.988	0.662
CFD11A	11.374	19.768	2.496	9.330	1.857	0.420	1.762	0.258	1.591	0.308	0.908	0.133	0.808	0.123	1.562	0.119	1.097	0.980	1.422
CFD12A	6.060	10.564	1.358	5.047	1.049	0.229	0.961	0.142	0.900	0.181	0.562	0.085	0.570	0.086	0.495	0.063	0.928	0.667	0.761
CFD13A	11.062	18.688	2.602	10.371	2.219	0.500	2.278	0.348	2.262	0.468	1.459	0.225	1.442	0.238	2.054	0.150	0.605	1.286	2.122
CFD14A	19.798	32.169	4.646	18.347	3.871	0.844	3.896	0.574	3.620	0.727	2.207	0.330	2.104	0.325	2.099	0.180	0.453	1.667	2.482
CFD14E	24.391	39.625	5.694	22.510	4.784	1.059	4.752	0.709	4.460	0.881	2.678	0.396	2.478	0.377	2.381	0.222	0.788	2.082	3.043
CFD14F	19.646	31.814	4.630	18.231	3.843	0.862	3.870	0.568	3.633	0.732	2.253	0.338	2.123	0.332	2.133	0.174	0.672	1.629	2.477
CFD14G	20.257	32.974	4.766	18.635	4.018	0.894	3.993	0.596	3.693	0.741	2.260	0.341	2.122	0.334	0.969	0.130	0.377	1.611	2.497
CFD15A	14.630	23.834	3.313	12.743	2.702	0.596	2.684	0.403	2.567	0.512	1.568	0.234	1.440	0.231	2.078	0.145	0.766	1.424	0.984
CFD16A	15.768	26.687	3.452	13.106	2.695	0.586	2.580	0.381	2.327	0.462	1.361	0.206	1.261	0.192	1.325	0.153	0.594	1.474	1.292
CFD17A	28.040	44.546	5.589	20.648	4.059	0.883	3.808	0.551	3.340	0.636	1.859	0.274	1.651	0.244	0.893	0.118	0.037	1.312	1.473
CFD18A	39.700	64.108	8.834	33.631	6.817	1.482	6.641	0.975	5.935	1.124	3.266	0.488	2.960	0.439	2.041	0.129	1.069	1.625	1.881
CFD18D	44.773	72.482	9.964	37.881	7.692	1.673	7.423	1.106	6.695	1.251	3.642	0.541	3.177	0.479	2.151	0.139	0.577	1.851	2.093
CFD18E	58.263	94.337	12.910	48.780	9.917	2.179	9.696	1.399	8.406	1.572	4.573	0.660	3.895	0.556	2.724	0.191	1.115	2.486	2.734
CFD19A	30.344	50.301	6.848	26.459	5.379	1.177	5.301	0.765	4.656	0.911	2.726	0.403	2.476	0.398	2.558	0.222	0.634	2.178	3.375
CFD20A	22.558	36.663	4.879	18.793	3.798	0.835	3.679	0.531	3.288	0.643	1.901	0.286	1.699	0.261	1.804	0.128	1.654	1.221	2.287
CFD20D	21.121	35.468	4.580	17.554	3.510	0.783	3.444	0.511	3.126	0.614	1.855	0.278	1.673	0.265	2.201	0.172	1.455	1.535	2.185
CFD20E	26.470	42.904	5.707	21.900	4.338	0.963	4.285	0.619	3.758	0.727	2.176	0.321	1.902	0.299	1.949	0.138	0.570	1.358	2.599
CFD21E	8.007	15.538	1.840	6.907	1.449	0.308	1.345	0.202	1.287	0.256	0.771	0.121	0.740	0.120	2.072	0.171	0.597	1.440	0.869
CFD21F	10.312	19.901	2.333	8.933	1.813	0.395	1.709	0.262	1.578	0.309	0.899	0.137	0.848	0.126	2.573	0.232	0.412	1.863	1.109
CFD21G	4.788	9.211	1.086	4.159	0.860	0.189	0.788	0.116	0.742	0.154	0.469	0.073	0.462	0.075	1.679	0.121	0.944	0.855	0.560
CFD22A	18.450	29.532	4.249	16.837	3.518	0.772	3.471	0.509	3.176	0.645	1.971	0.303	1.861	0.294	1.152	0.154	0.322	1.611	2.259
CFD23A	20.595	33.208	4.661	18.637	3.805	0.847	3.860	0.565	3.494	0.705	2.153	0.325	2.025	0.328	2.183	0.192	0.804	1.655	2.508
CFD24A	4.626	9.075	1.033	3.912	0.794	0.170	0.727	0.108	0.700	0.149	0.461	0.076	0.487	0.078	2.197	0.173	6.563	1.038	0.734
CFD24D	6.108	12.353	1.353	5.035	1.048	0.222	0.940	0.138	0.890	0.176	0.544	0.085	0.565	0.088	2.476	0.194	1.719	1.463	0.910
CFD24E	4.103	8.354	0.899	3.373	0.699	0.146	0.638	0.094	0.623	0.129	0.413	0.068	0.444	0.076	2.007	0.141	0.559	0.979	0.589
CFD26A	18.828	31.631	4.197	16.266	3.236	0.689	3.092	0.446	2.690	0.521	1.565	0.231	1.450	0.233	2.126	0.160	0.444	1.432	1.896
CFD26C	23.734	39.847	5.289	20.604	4.014	0.875	3.848	0.548	3.265	0.631	1.854	0.271	1.679	0.259	2.422	0.197	0.041	1.772	2.380
CFD27C	14.114	23.135	3.225	12.951	2.697	0.601	2.669	0.399	2.532	0.521	1.603	0.247	1.541	0.258	2.093	0.161	0.797	1.284	2.388
CFD27E	15.641	25.591	3.575	14.230	2.957	0.650	2.963	0.438	2.755	0.550	1.704	0.254	1.595	0.257	2.042	0.161	1.208	1.400	2.583
CFD28	17.369	31.701	4.114	15.627	3.189	0.653	2.927	0.448	2.726	0.527	1.594	0.251	1.556	0.253	4.472	0.473	9.007	3.793	1.791
CFD29	18.060	31.940	4.160	16.158	3.297	0.716	3.154	0.470	2.962	0.581	1.769	0.275	1.722	0.274	4.011	0.374	12.607	3.098	2.096
CFD30	18.219	43.399	4.189	14.893	2.980	0.594	2.663	0.419	2.479	0.468	1.429	0.2405	1.559	0.235	3.923	0.564	22.187	4.924	2.071
CFD31	19.683	53.086	4.526	16.303	3.319	0.693	3.148	0.501	3.067	0.577	1.737	0.286	1.867	0.278	3.948	0.589	20.829	5.324	2.187

Table 6.

	Mucklagh	Coolamurry	Navan	Moneygall	Carrigoran	Trumra 4	Clonmacnoise (NG)	Ballykilmore	Woodstown 6	Clonmacnoise (WWS)	Clonfad	Lismore/ Bushfield 1
date	C18/19	C10-12	E. Med.	E.Med-Med.	C10?	C5/6	C7-10	C15/17	C9-10	C10?	C7-9	E. Med?
SHC count	66	41	17	22	18	57	117	43	140	38	381	23
SHC min. wt	98		60	114		92	100	80	68		60	426
SHC max. wt	1206	2588	2990	1800	3866	3163	7815	4033	6310	5540	11000	4390
SHC mean wt	373	386	507	527	553	727	843	898	1060	1087	1302	1737
% <500g	77%	83%	82%	55%	72%	47%	50%	51%	40%	39%	30%	4%
% <1000g	95%	95%	88%	95%	89%	75%	78%	74%	71%	68%	61%	39%
% >1000g	5%	5%	12%	5%	11%	25%	22%	26%	29%	32%	39%	61%
% >3000g	0%	0%	0%	0%	6%	2%	3%	7%	7%	8%	9%	13%
Modal 100g interval	100-200	100-200	100-200	200-300	100-200	100-300	400-500	300-400	200-300	300-400	300-400	500-600

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Table 7

Context	Slags					Ceramics					Natural				Artefacts		Total		Phasing[rev	Notes
	smelting slag?	SHCs	Other smithing	Indet iron slag	Other slag	Tuyère	Lining	Clay shroud	Crucible	Indet fired clay	Bog ore/iron pan	Concretion	Natural stone	Other	Artefact	Iron	bulk	metallurgical residue		
100		342		210		182											734	734	Modern [P4]	topsoil
107		14309	172	6850		942										72	22345	22273	C17/c18 [P3A]	sag ditch 101
109		1493								24		86					1603	1517	C17/c18 [P3A]	post med smithy hearth
113		70204	1264	8656		240					1240						81604	80364	EM [P1C]	disuse of ditch 101
114		19596	138	5471		264											25469	25469	EM [P1C]	disuse of ditch 101
116		15880				198											16078	16078	EM [P1C]	use of ditch 101
117		5525	60	1154													6739	6739	EM [P1C]	use of ditch 101
118		3455		922		44											4421	4421	EM [P1C]	disuse of ditch 101
119				46		2											48	48	EM [P1C]	disuse of ditch 101
125		96		52									40				188	148	Modern [P4]	use of ditch 101
126		2305															2305	2305	EM [P1C]	disuse of ditch 101
127		2696		826		176							660				4358	3698	C17/c18 [P3A]	pit fill
128		10925		3477		58				20		122					14602	14480	EM [P1C]	disuse of ditch 101
129		11199		854		20			116	10		114				74	12387	12199	EM [P1C]	use of ditch 101
130		160		382		102											644	644	EM [P1C]	disuse of ditch 101
131				160													160	160	EM [P1C]	disuse of ditch 101
132		38892		15073		932											54897	54897	EM [P1C]	use of ditch 101
136		122				40											162	162	EM [P1C]	use of ditch 101
137		2220		3402		578											6200	6200	Med-Modern	pit fill
139		41957	452	8580		650					3395						55034	51639	EM [P1C]	use of ditch 101
141		1618															1618	1618	EM [P1C]	use of ditch 101
142		156229	4742	13845		1270							240			268	176594	176086	EM [P1C]	use of ditch 101
152				949													949	949	EM [P1C]	use of ditch 101
159		16891		1796		12											18699	18699	EM [P1C]	use of ditch 101
160		18440	356	1030		362											20188	20188	EM [P1C]	use of ditch 101
165				418		68											486	486	EM [P1C]	use of ditch 101
172		4349		62													4411	4411	EM [P1C]	use of ditch 101
176		3370		350		34											3754	3754	EM [P1B]	early use of ditch 101
180		1092															1092	1092	EM [P1B]	early use of ditch 101
184		830		32													862	862	EM [P1B]	early use of ditch 101
210															605		605	0	C18/19 [P3B]	boundary
267		109															109	109	undated	hearth
269		1158		281						26							1465	1465	C18/19 [P3B]	fill of ditch 268
273		496															496	496	EM [P1C]	fill of pit 272
288		1133	174	514		630											2451	2451	Med [P2]	upper fill of slumpedwell 287
289				145													145	145	EM [P1C]	fill of well 287
290				360					6								366	366	EM [P1C]	fill of well 287
292		2553		104													2657	2657	EM [P1C]	fill of well 287
297				75													75	75	Med [P2]	fill of well 287
298		19753	1100	6238		812		28					92				28023	27931	EM [P1C]	gully or beam slot (Workshop)
300		862		603													1465	1465	Med-Modern	fill of pit 304
311		945															945	945	EM [P1C]	use of ditch 101
333		16401	62	2430		150							587				19630	19043	EM [P1C]	disuse of ditch 101
381		36556		14801		314	224				22250			18			74163	51895	EM [P1C]	lower use ditch 605
416		280		1530		216				8			50				2084	2034	18th C [P3A]	deposit truncated by ditch 506
426		7281	280	6175		334		118									14188	14188	EM [P1C]	fill of pit 425/272
427		552															552	552	Undated	furrow
435		9675	610	2865		160		10									13320	13320	Undated	ditch cut
436				1025													1025	1025	Undated	fill of ditch 435
438				42							164						206	42	EM [P1B]	fill of furnace 437
447		2849		1990		32											4871	4871	undated	linear fill
449										56							56	56	Undated	fill of ph 448
451		1388		1465													2853	2853	EM [P1C]	fil of 450 (workshop)
464				207													207	207	EM [P1B]	cut of furnace
465		8650	624	5785		80											15139	15139	EM [P1A]	use of ditch 508
478				*40000*						4	*1658200*						1698204	*40004*	EM [P1A]	waste dump
479		1980		*423000*							*722500*		340	130			1147950	*424980*	EM [P1A]	waste dump
483		7395	738	4400				2810			3880					32	19255	15343	m7/8th C [P1B]	furnace 464
498				294	2												296	296	L8/9th C [P1C]	Workshop floor
506		22347	648	9207		984											33186	33186	EM [P1B]	ditch cut
524											14						14	0	EM [P1B]	fill of furnace 437
538	648			166													814	814	EM [P1A]	fill of pit 536
544			348														348	348	7/9th C [P1C]	backfill of ditch 506
555		152		632													784	784	undated	fill of pit 541
556		308		226						24						32	590	558	undated	fill of pit 541
561		21837	908	7860	126	770		58									31559	31559	EM [P1B]	early use of ditch 506
563		28312	616	17060		1383		114									47485	47485	7/9th C [P1C]	upper fill of ditch 506
569		4052		4910													8962	8962	undated	fill of furnace 568
570		742		1360		62											2164	2164	7/9th C [P1C]	upper fill of ditch 506-605
571		105243	1628	8224		1246					1608		410				118359	116341	7/9th C [P1C]	upper fill of ditch 506-605
572				228		104											332	332	7/9th C [P1C]	upper fill of ditch 506-605
573		806				128											934	934	7/9th C [P1C]	upper fill of ditch 506-605
574		9575															9575	9575	7/9th C [P1C]	upper fill of ditch 506-605
575		9181	128			1147											10456	10456	L8/9th C [P1C]	Workshop floor
578		430		860							5855						7145	1290	undated	fill of furnace 577
579		2900		2145							756						5801	5045	L8/9th C [P1C]	use of ditch 506
589		794		2620							1280						4694	3414	undated	fill of ph 588
591		2620		1375													3995	3995	undated	fill of furnace 590
		648	***773510***	***15048***	***645799***	***128***	***14726***	***224***	***3138***	***122***	***172***	***2421142***	***322***	***2419***	***148***	***605***	***478***	***3878629***	***1453515***	***total collection***	
		0%	78%	2%	18%	0%	1%	0%	0%	0%	0%									***% of examined residues***	

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Table 8

Context	Slags					Ceramics					Natural				Artefacts		Total		Phasing[rev]	Notes
	smelting slag?	SHCs	Other smithing	Indet iron slag	Other slag	Tuyère	Lining	Clay shroud	Crucible	Indet fired clay	Bog ore/iron pan	Concretion	Natural stone	Other	Artefact	Iron	bulk	metallurgical residue		
465		8650	624	5785		80											15139	15139	EM [P1A]	use of ditch 508
538	648			166													814	814	EM [P1A]	fill of pit 536
	648	**8650**	**624**	**5951**	**0**	**80**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**15953**	**15953**		
478				*40000*						4	*1658200*						1698204	*40004*	EM [P1A]	waste dump
479		1980		*423000*							*722500*		340	130			1147950	*424980*	EM [P1A]	waste dump
	0	**1980**	**0**	**463000**	**0**	**0**	**0**	**0**	**0**	**4**	**2380700**	**0**	**340**	**130**	**0**	**0**	**2846154**	**464984**		
483		7395	738	4400				2810			3880					32	19255	15343	m7/8th C [P1B]	furnace 464
438				42							164						206	42	EM [P1B]	fill of furnace 437
464				207													207	207	EM [P1B]	cut of furnace
524											14						14	0	EM [P1B]	fill of furnace 437
176		3370		350		34											3754	3754	EM [P1B]	early use of ditch 101
180		1092															1092	1092	EM [P1B]	early use of ditch 101
184		830		32													862	862	EM [P1B]	early use of ditch 101
	0	**12687**	**738**	**5031**	**0**	**34**	**0**	**2810**	**0**	**0**	**4058**	**0**	**0**	**0**	**0**	**32**	**25390**	**21300**		
561		21837	908	7860	126	770		58									31559	31559	EM [P1B]	early use of ditch 506
506		22347	648	9207		984											33186	33186	EM [P1B]	ditch cut
381		36556		14801		314	224				22250			18			74163	51895	EM [P1C]	lower use ditch 605
544			348														348	348	7/9th C [P1C]	upper backfill of ditch 506-605
563		28312	616	17060		1383		114									47485	47485	7/9th C [P1C]	upper backfill of ditch 506-605
570		742		1360		62											2164	2164	7/9th C [P1C]	upper backfill of ditch 506-605
571		105243	1628	8224		1246					1608		410				118359	116341	7/9th C [P1C]	upper backfill of ditch 506-605
572				228		104											332	332	7/9th C [P1C]	upper backfill of ditch 506-605
579		2900		2145							756						5801	5045	L8/9th C [P1C]	use of ditch 506
573		806				128											934	934	7/9th C [P1C]	upper backfill of ditch 506-605
574		9575															9575	9575	7/9th C [P1C]	upper backfill of ditch 506-605
	0	**228318**	**4148**	**60885**	**126**	**4991**	**224**	**172**	**0**	**0**	**24614**	**0**	**410**	**18**	**0**	**0**	**323906**	**298864**		
113		70204	1264	8656		240					1240						81604	80364	EM [P1C]	disuse of ditch 101
114		19596	138	5471		264											25469	25469	EM [P1C]	disuse of ditch 101
116		15880				198											16078	16078	EM [P1C]	disuse of ditch 101
117		5525	60	1154													6739	6739	EM [P1C]	disuse of ditch 101
118		3455		922		44											4421	4421	EM [P1C]	disuse of ditch 101
119				46		2											48	48	EM [P1C]	disuse of ditch 101
126		2305															2305	2305	EM [P1C]	disuse of ditch 101
128		10925		3477		58				20		122					14602	14480	EM [P1C]	disuse of ditch 101
129		11199		854		20			116	10		114				74	12387	12199	EM [P1C]	disuse of ditch 101
130		160		382		102											644	644	EM [P1C]	disuse of ditch 101
131				160													160	160	EM [P1C]	disuse of ditch 101
132		38892		15073		932											54897	54897	EM [P1C]	disuse of ditch 101
136		122				40											162	162	EM [P1C]	disuse of ditch 101
139		41957	452	8580		650					3395						55034	51639	EM [P1C]	disuse of ditch 101
141		1618															1618	1618	EM [P1C]	disuse of ditch 101
142		156229	4742	13845		1270							240			268	176594	176086	EM [P1C]	disuse of ditch 101
152				949													949	949	EM [P1C]	disuse of ditch 101
159		16891		1796		12											18699	18699	EM [P1C]	disuse of ditch 101
160		18440	356	1030		362											20188	20188	EM [P1C]	disuse of ditch 101
311		945															945	945	EM [P1C]	disuse of ditch 101
333		16401	62	2430		150							587				19630	19043	EM [P1C]	disuse of ditch 101
165				418		68											486	486	EM [P1C]	disuse of ditch 101
172		4349		62													4411	4411	EM [P1C]	disuse of ditch 101
	0	**435093**	**7074**	**65305**	**0**	**4412**	**0**	**0**	**116**	**30**	**4635**	**236**	**827**	**0**	**0**	**342**	**518070**	**512030**		
273		496															496	496	EM [P1C]	fill of pit 272
289				145													145	145	EM [P1C]	fill of well 287
290				360						6							366	366	EM [P1C]	fill of well 287
292		2553		104													2657	2657	EM [P1C]	fill of well 287
426		7281	280	6175		334		118									14188	14188	EM [P1C]	fill of pit 425/272
	0	**10330**	**280**	**6784**	**0**	**334**	**0**	**118**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**17852**	**17852**		
451		1388		1465													2853	2853	EM [P1C]	fil of 450 (workshop)
498				294	2												296	296	L8/9th C [P1C]	Workshop floor
575		9181	128			1147											10456	10456	L8/9th C [P1C]	Workshop floor
298		19753	1100	6238		812		28					92				28023	27931	EM [P1C]	gully or beam slot (Workshop)
	0	**30322**	**1228**	**7997**	**2**	**1959**	**0**	**28**	**0**	**0**	**0**	**0**	**92**	**0**	**0**	**0**	**41628**	**41536**		
288		1133	174	514		630											2451	2451	Med [P2]	upper fill of slumpedwell 287
297				75													75	75	Med [P2]	fill of well 287
	0	**1133**	**174**	**589**	**0**	**630**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2526**	**2526**		
137		2220		3402		578											6200	6200	Med-Modern	pit fill
300		862		603													1465	1465	Med-Modern	fill of pit 304
427		552															552	552	Undated	furrow
435		9675	610	2865		160		10									13320	13320	Undated	ditch cut
436				1025													1025	1025	Undated	fill of ditch 435
447		2849		1990		32											4871	4871	undated	linear fill
449										56							56	56	Undated	fill of ph 448
556		308		226						24						32	590	558	undated	fill of pit 541
569		4052		4910													8962	8962	undated	fill of furnace 568
267		109															109	109	undated	hearth
555		152		632													784	784	undated	fill of pit 541
578		430		860							5855						7145	1290	undated	fill of furnace 577
589		794		2620							1280						4694	3414	undated	fill of ph 588
591		2620		1375													3995	3995	undated	fill of furnace 590
	0	**24623**	**610**	**20508**	**0**	**770**	**0**	**10**	**0**	**80**	**7135**	**0**	**0**	**0**	**0**	**32**	**53768**	**46601**		
107		14309	172	6850		942										72	22345	22273	C17/c18 [P3A]	sag ditch 101
109		1493								24		86					1603	1517	C17/c18 [P3A]	post med smithy hearth
127		2696		826		176							660				4358	3698	C17/c18 [P3A]	pit fill
416		280		1530		216				8			50				2084	2034	18th C [P3A]	deposit truncated by ditch 506
	0	**18778**	**172**	**9206**	**0**	**1334**	**0**	**0**	**0**	**32**	**0**	**86**	**710**	**0**	**0**	**72**	**30390**	**29522**		
210															605		605	0	C18/19 [P3B]	boundary
269		1158		281						26							1465	1465	C18/19 [P3B]	fill of ditch 268
	0	**1158**	**0**	**281**	**0**	**0**	**0**	**0**	**0**	**26**	**0**	**0**	**0**	**0**	**605**	**0**	**2070**	**1465**		
100		342		210		182											734	734	Modern [P4]	topsoil
125		96		52									40				188	148	Modern [P4]	use of ditch 101
	0	**438**	**0**	**262**	**0**	**182**	**0**	**0**	**0**	**0**	**0**	**0**	**40**	**0**	**0**	**0**	**922**	**882**		
	0	***1419646***	***25468***	***311766***	***130***	***27156***	***224***	***598***	***244***	***336***	***50518***	***644***	***4158***	***18***	***1210***	***892***	***1843008***	***1785568***	***total collection***	

Table 9

Find	*Sample*	*Context*	*Weight*	*Notes*	*Context notes*
Magnetic					
705	43	109	60g	abundant probable within-hearth fines, including both flake and spheroidal h/s	p-m smithy
703	24	127	4g	slag fragment and concretions	p-m pit fill
701	28	132	23g	very rich h/s assemblage - mainly flake, some spheroidal	e-m, use of ditch 101
706	36	137	14g	slag fragments with one large bleb of green lining	undated pit fill
	36	137	4.2g	slag fragments including small prill fragments	undated pit fill
707	37	137	1g	small low density flowed slag fragment	undated pit fill
704	145	139	<1g	spheroidal hammerscale, 2 pieces	e-m, use of ditch 101
702	206	291	<1g	a few pieces of flake h/s with other debris	e-m, well 287
699	186	333	1g	slag droplets	e-m, use of ditch 101
700	300	369	2g	ashy debris with slag - no clear h/s	p-m hearth area B
697	223	298	82g	abundant probably within hearth fines, including both flake and spheroidal h/s, lots of rather amorphous rounded brown lumps	e-m, gully 298
696	316	508	28g	very rich h/s assemblage - mainly flake, some spheroidal	e-m, ditch 508
698	284	365	<1g	fragments of vesicular cindery slag	e-m, furnace cut
Non-magnetic					
691	43	109	44g	various slag fragments including some dense but scrappy prills	p-m smithy
692	36	137	240g	mainly angular amorphous fragments of highly vesicular slag	undated pit fill
689	145	139	80g	mainly rather rough, granular slags, but some blebs of more silicate-rich material	e-m, use of ditch 101
690	186	333	2g	slag fragments plus probable small nail	use of ditch 101 EM
694	223	298	234g	mainly sheet-like slag forms, possibly small flows from blowing wall, plus one coffee bean	e-m, gully 298
693	316	508	424g	variety of slag fragments some quite large - many ceramic related and possibly from front of tuyère, others are dense	e-m, cut of ditch 508
688	264	571	900g	similar to #223 above - lots of platy flows, 3 bags of spheroids of various sizes and lots of low density slags	e-m fill of itch 605

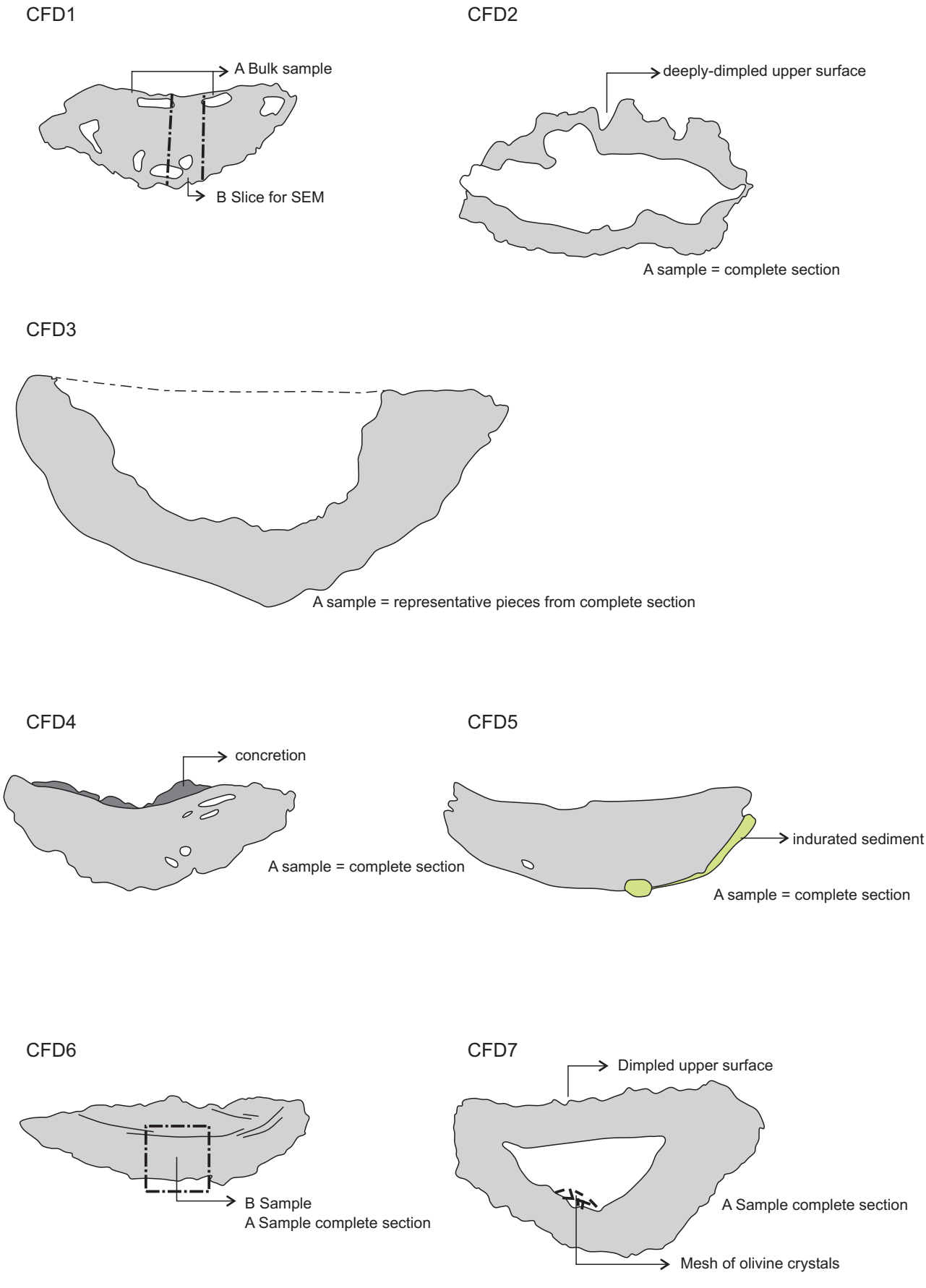

CFD1
A Bulk sample
B Slice for SEM
CFD2
deeply-dimpled upper surface
A sample = complete section
CFD3
A sample = representative pieces from complete section
CFD4
concretion
A sample = complete section
CFD5
indurated sediment
A sample = complete section
CFD6
B Sample
A Sample complete section
CFD7
Dimpled upper surface
A Sample complete section
Mesh of olivine crystals
100mm

Figure 2

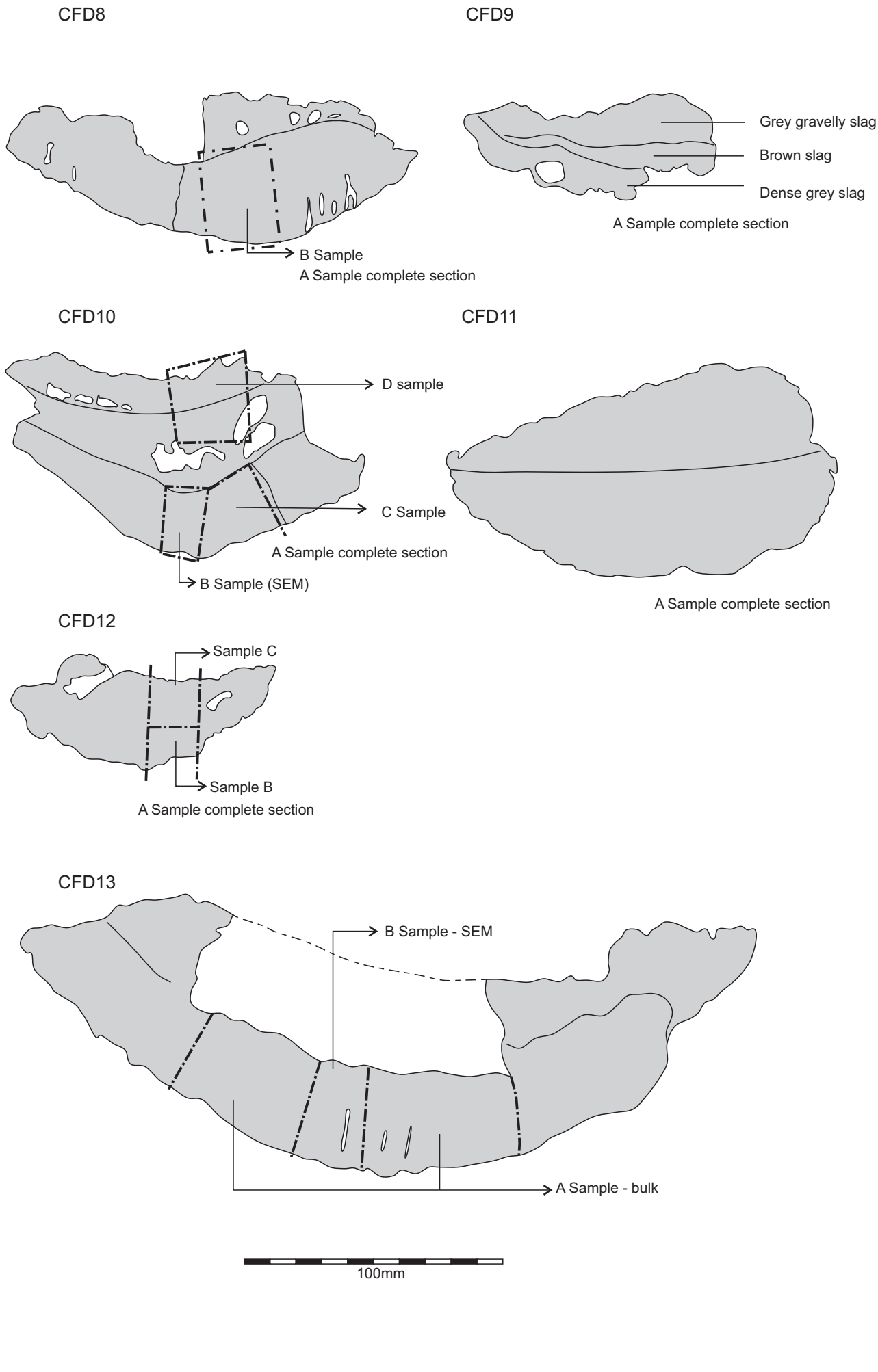

CFD8
B Sample
A Sample complete section
CFD9
Grey gravelly slag
Brown slag
Dense grey slag
A Sample complete section
CFD10
D sample
C Sample
A Sample complete section
B Sample (SEM)
CFD11
A Sample complete section
CFD12
Sample C
Sample B
A Sample complete section
CFD13
B Sample - SEM
A Sample - bulk
100mm

Figure 3

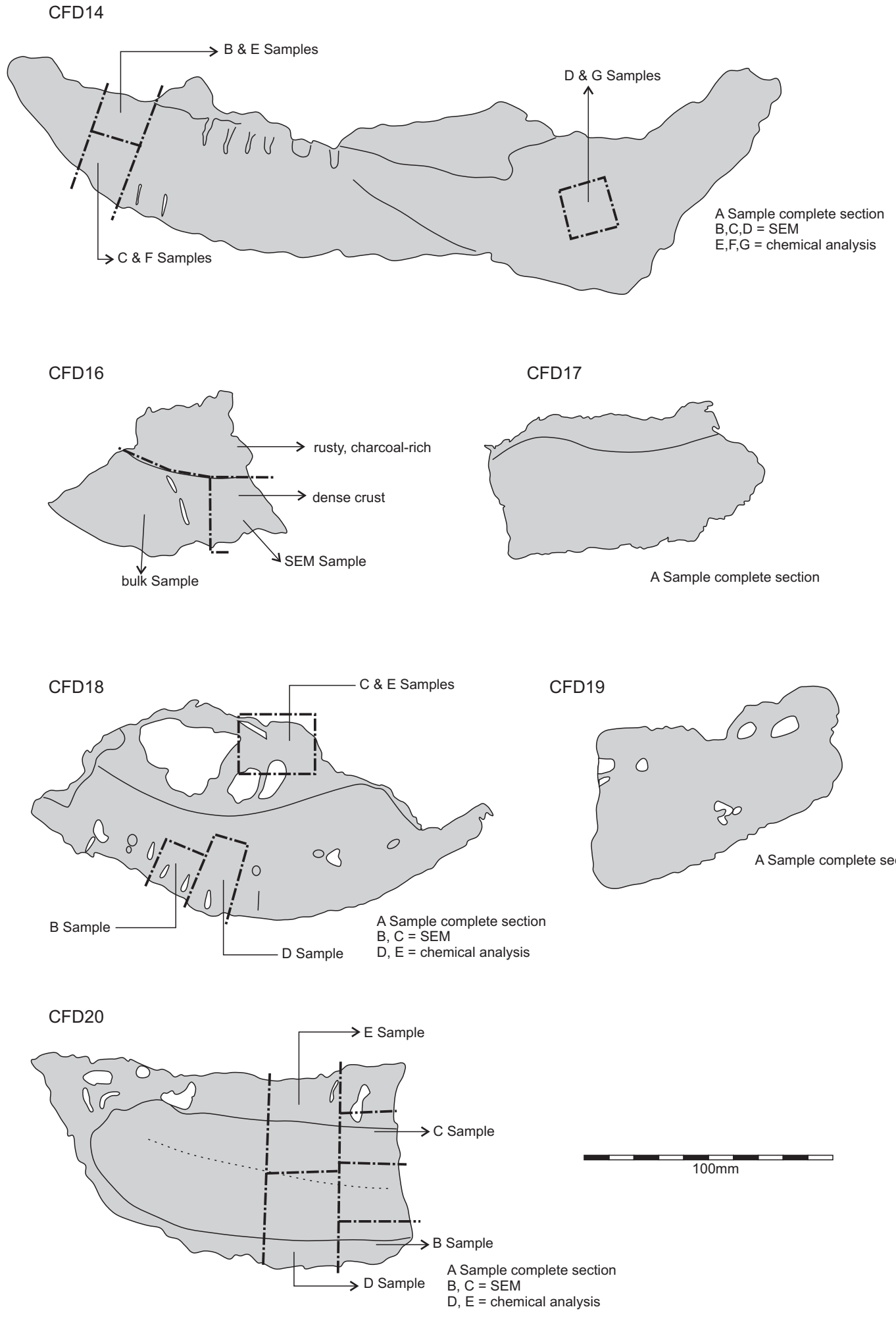
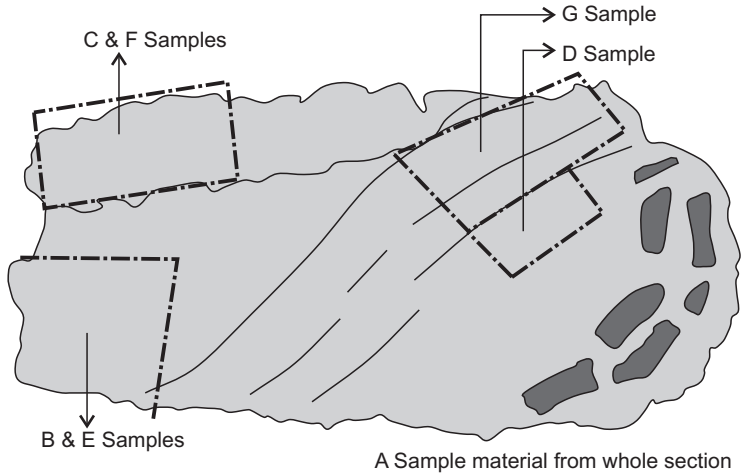
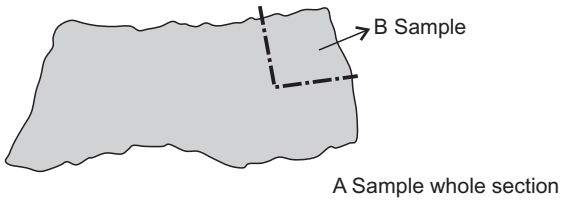

CFD14
B & E Samples
D & G Samples
C & F Samples
A Sample complete section
B,C,D = SEM
E,F,G = chemical analysis
CFD16
rusty, charcoal-rich
dense crust
SEM Sample
bulk Sample
CFD17
A Sample complete section
CFD18
C & E Samples
B Sample
D Sample
A Sample complete section
B, C = SEM
D, E = chemical analysis
CFD19
A Sample complete section
CFD20
E Sample
C Sample
B Sample
D Sample
A Sample complete section
B, C = SEM
D, E = chemical analysis
100mm

Figure 4

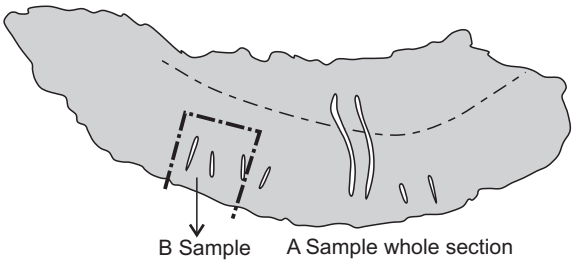
CFD21



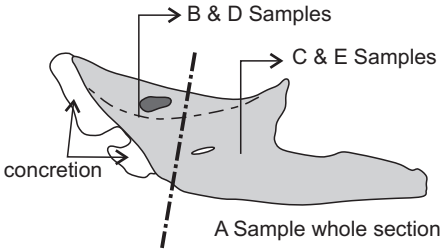
CFD22



CFD23



CFD24



CFD27

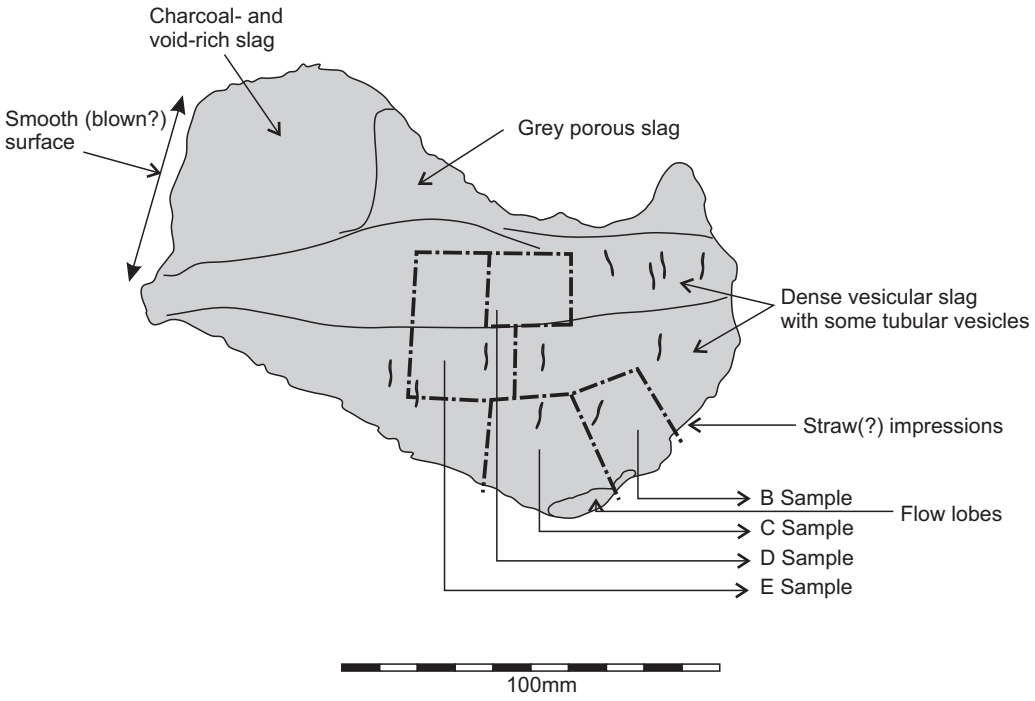


Figure 5

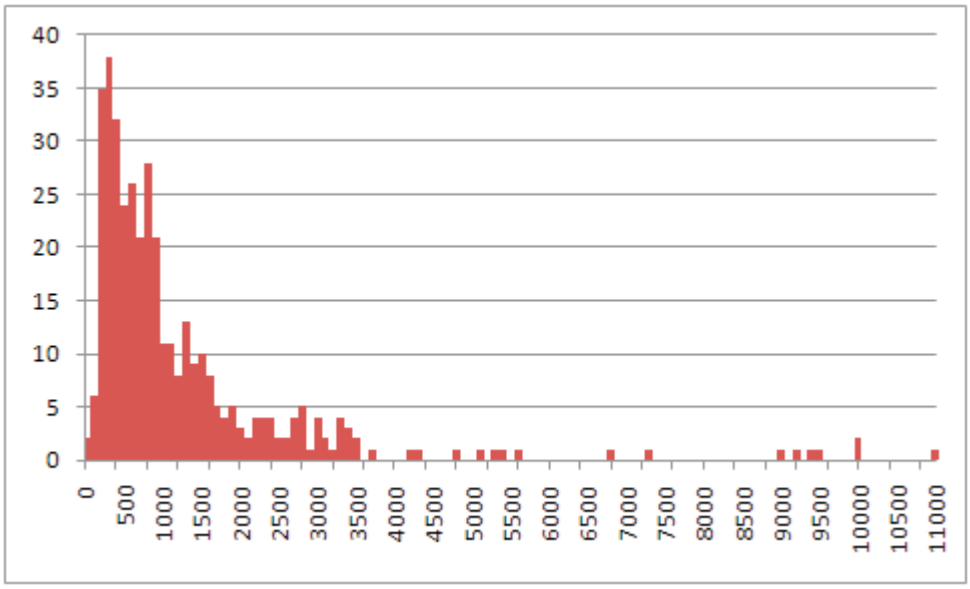

40
35
30
25
20
15
10
5
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
8500
9000
9500
10000
10500
11000

Figure 6

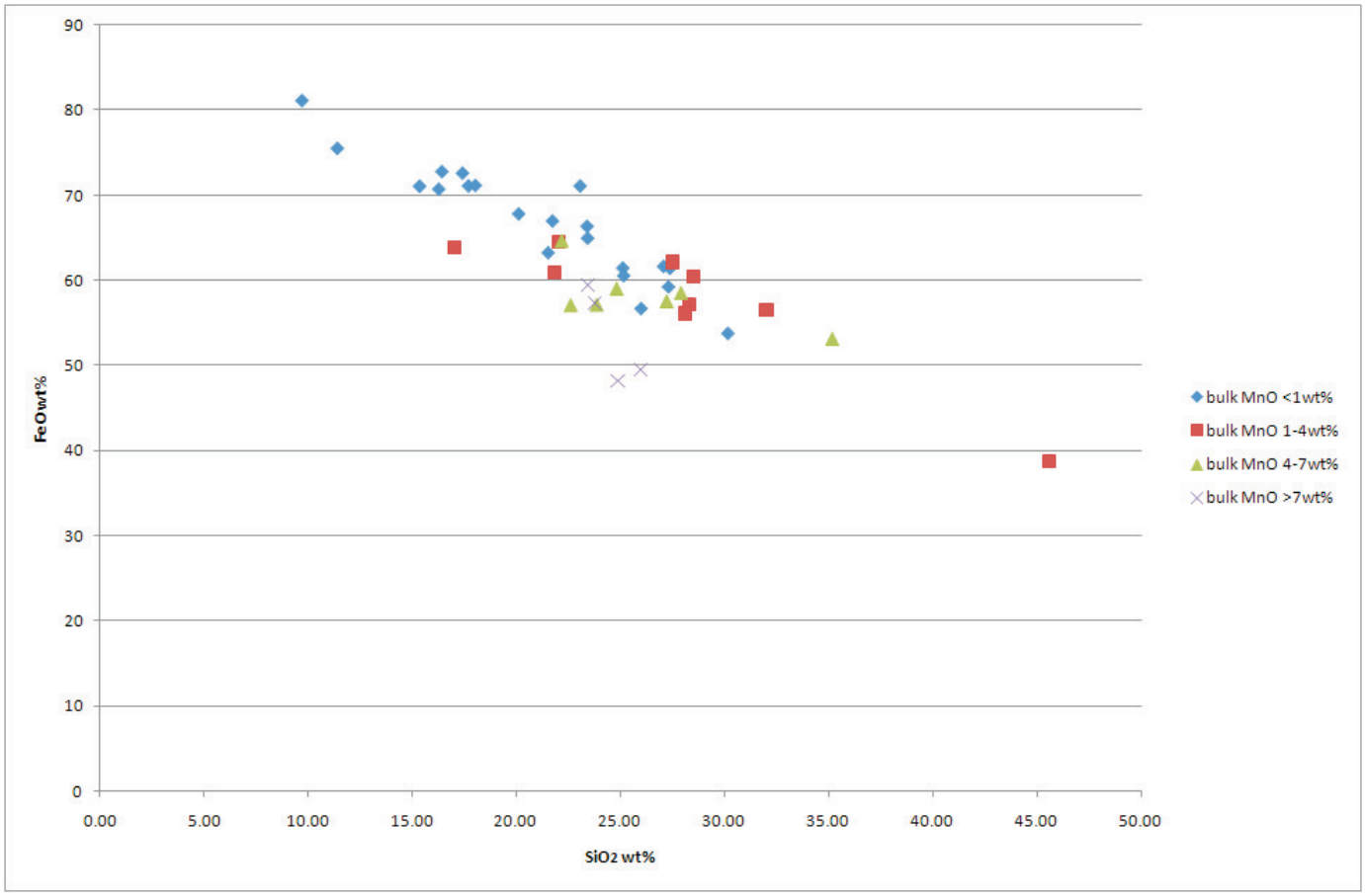

90
80
70
60
50
40
30
20
10
0
FeOwt%
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
SiO2 wt%
bulk MnO <1wt%
bulk MnO 1-4wt%
bulk MnO 4-7wt%
bulk MnO >7wt%

Figure 7

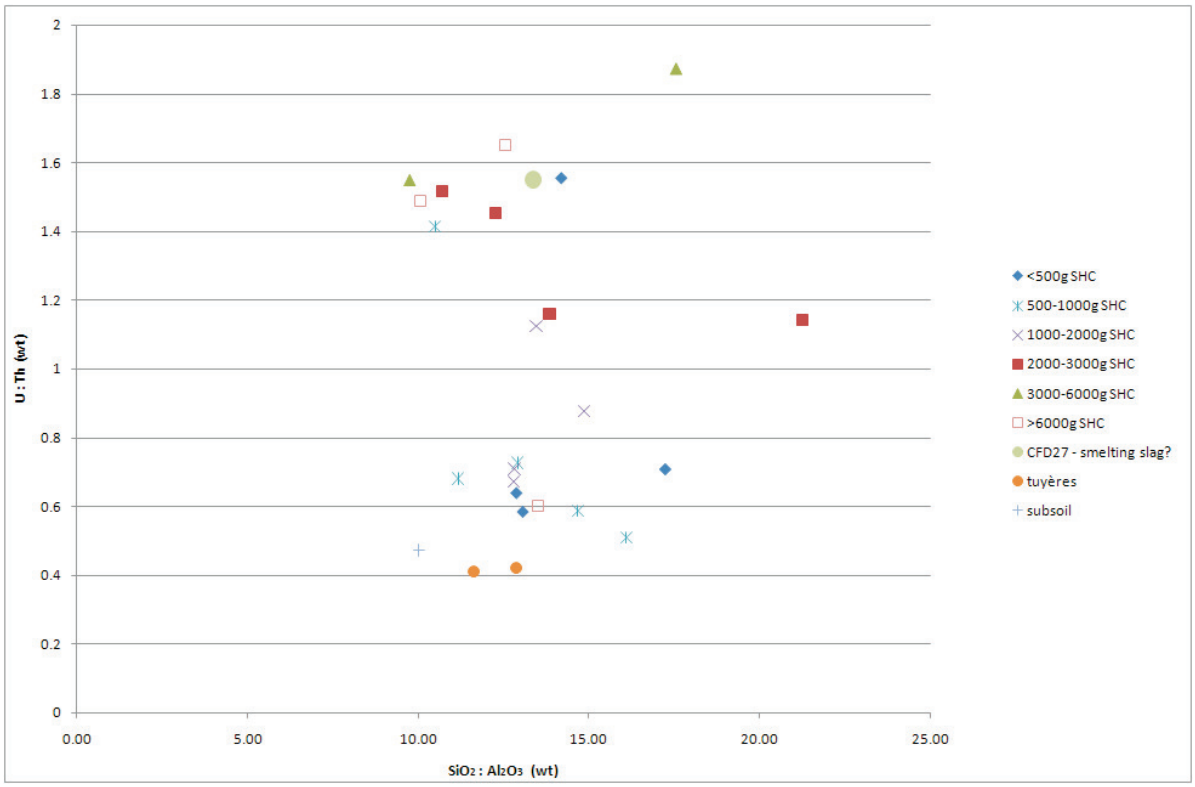

2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
U : Th (wt)
0.00
5.00
10.00
15.00
20.00
25.00
SiO2 : Al2O3 (wt)
<500g SHC
500-1000g SHC
1000-2000g SHC
2000-3000g SHC
3000-6000g SHC
>6000g SHC
CFD27 - smelting slag?
tuyères
subsoil

Figure 8

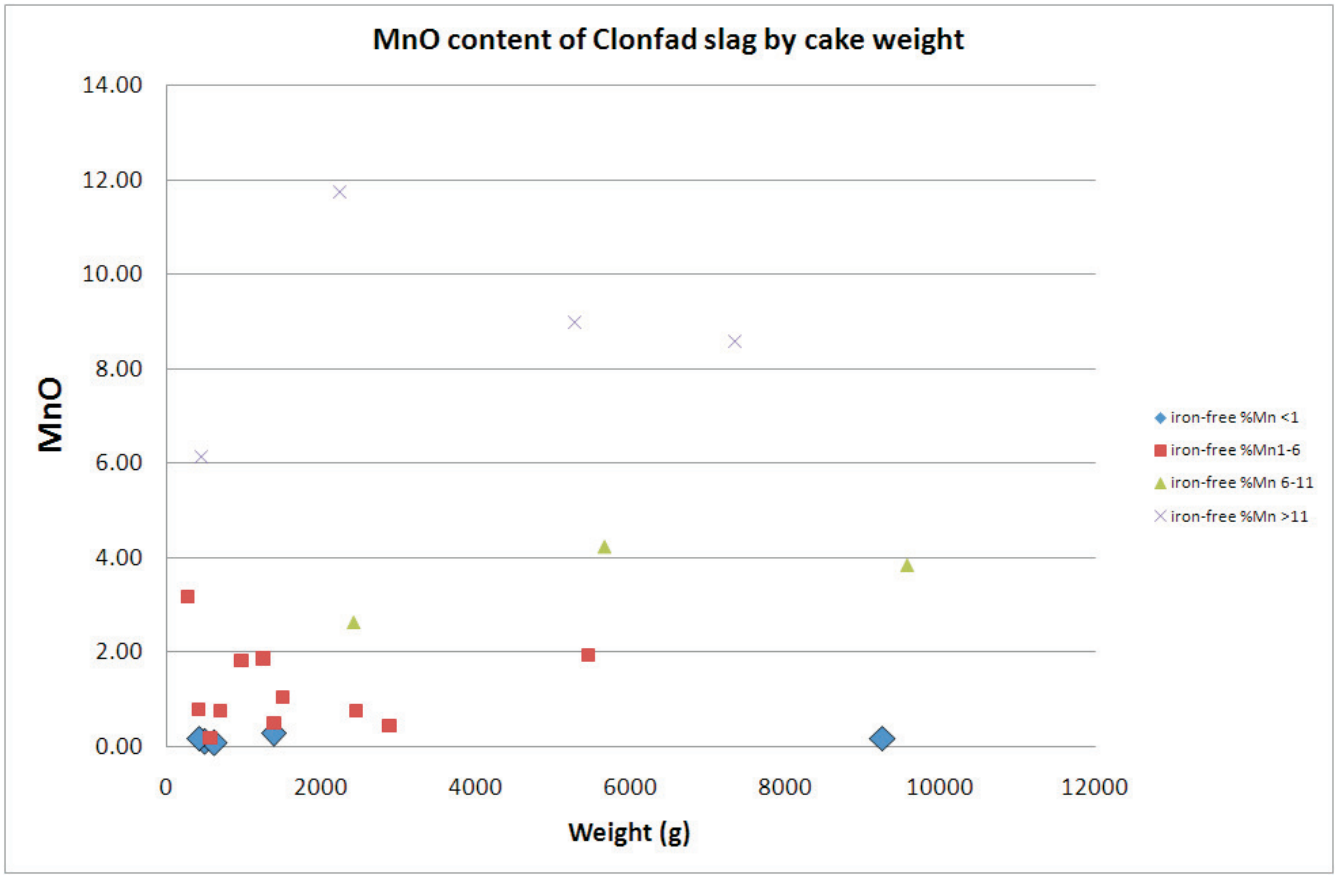

MnO content of Clonfad slag by cake weight
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
MnO
0
2000
4000
6000
8000
10000
12000
Weight (g)
iron-free %Mn <1
iron-free %Mn1-6
iron-free %Mn 6-11
iron-free %Mn >11

Figure 9

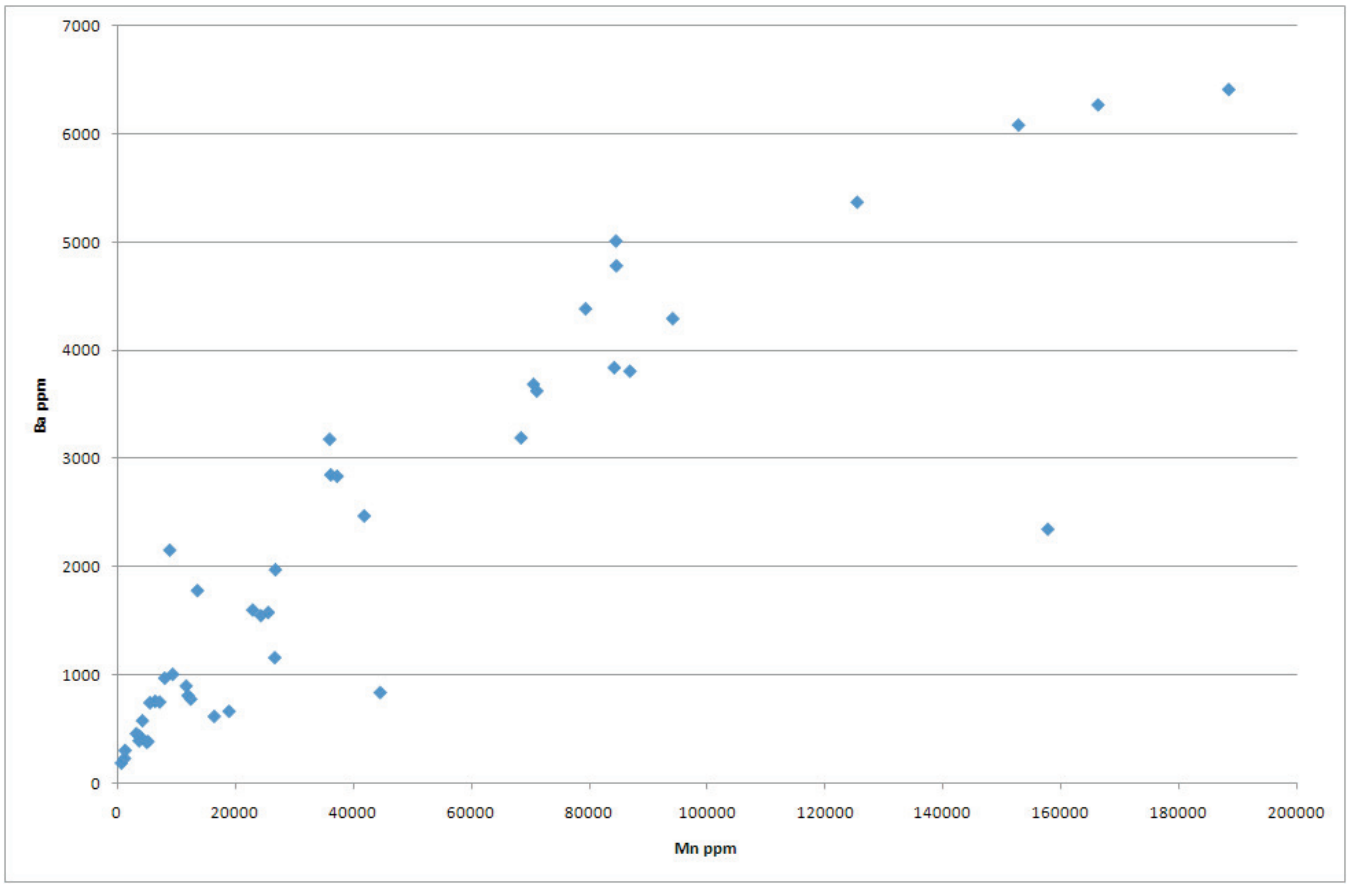

7000
6000
5000
4000
3000
2000
1000
0
Ba ppm
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
200000
Mn ppm

Figure 10

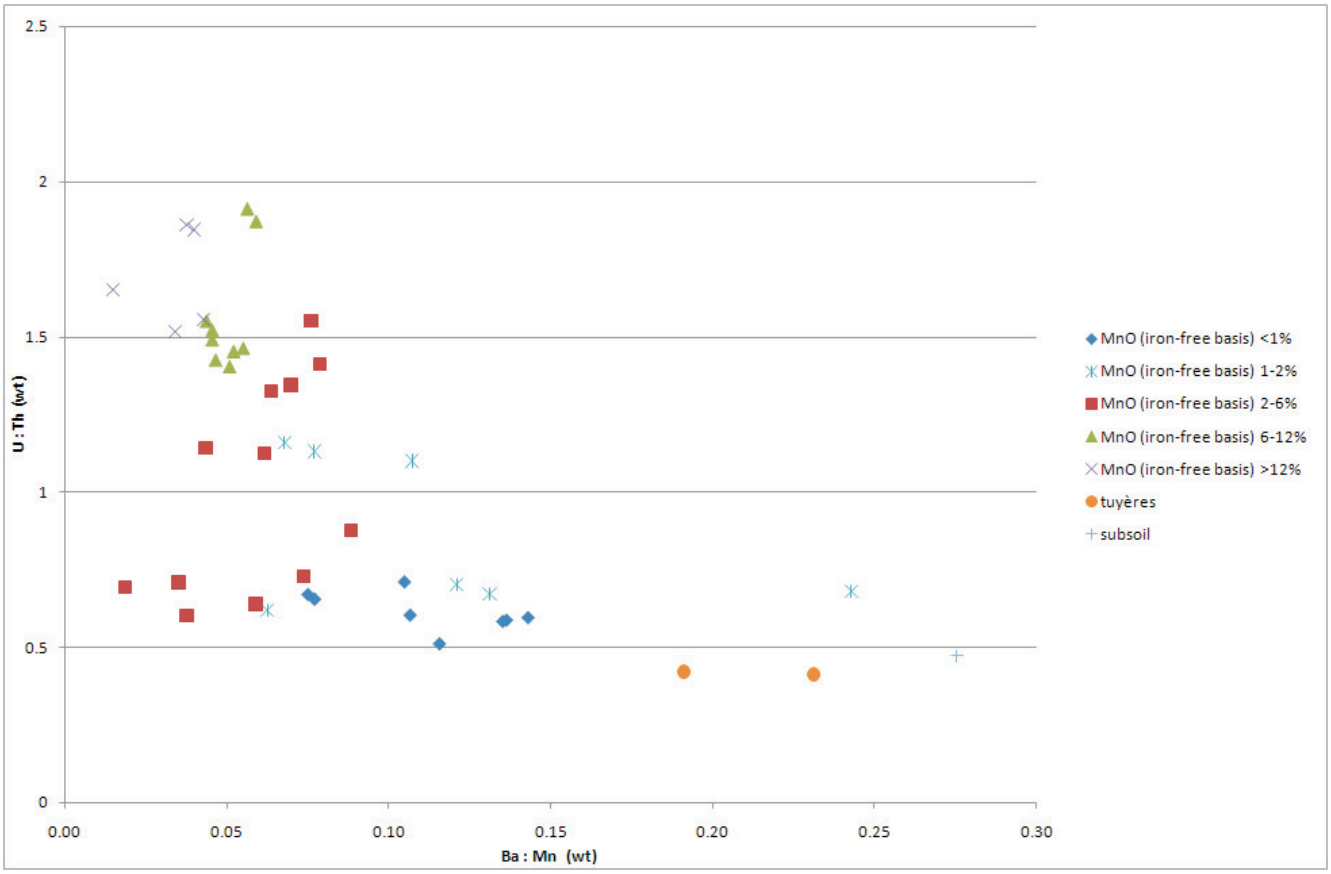
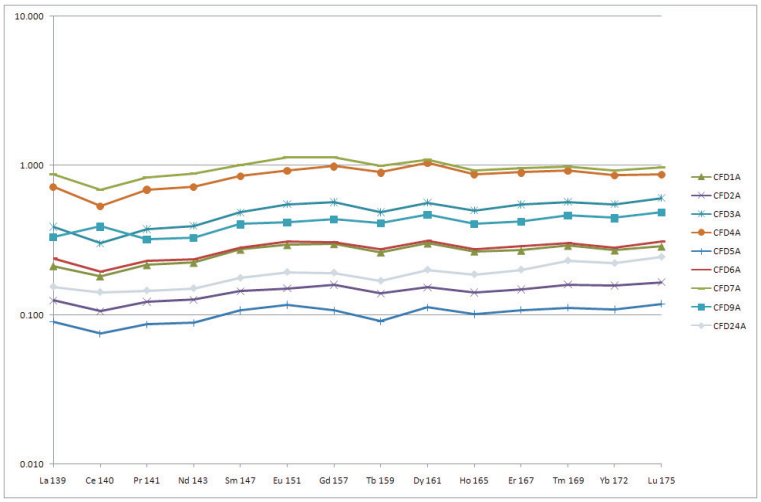
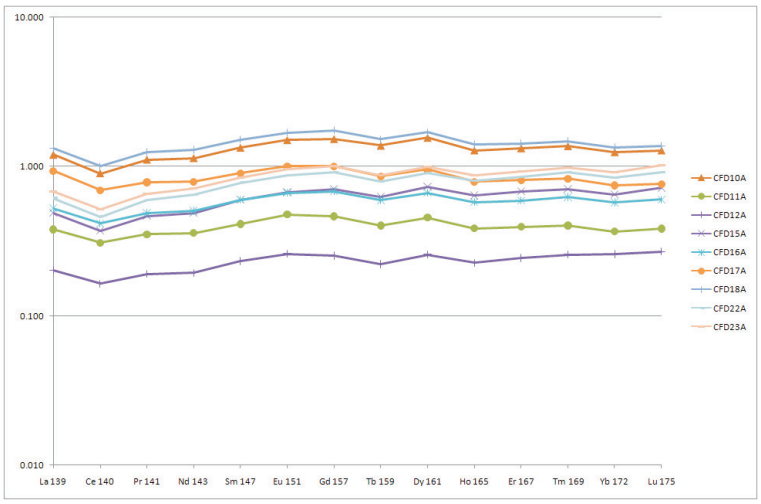
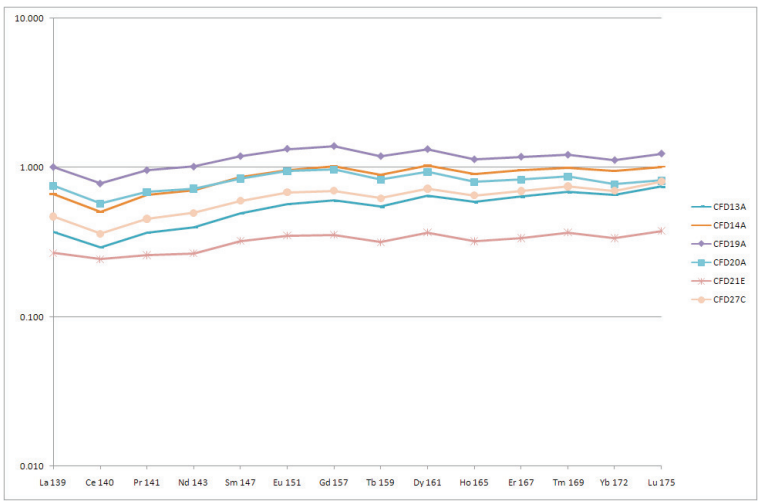

2.5
2
1.5
1
0.5
0
U : Th (wt)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Ba : Mn (wt)
MnO (iron-free basis) <1%
MnO (iron-free basis) 1-2%
MnO (iron-free basis) 2-6%
MnO (iron-free basis) 6-12%
MnO (iron-free basis) >12%
tuyères
subsoil

Figure 11


10.000
1.000
0.100
0.010
La 139
Ce 140
Pr 141
Nd 143
Sm 147
Eu 151
Gd 157
Tb 159
Dy 161
Ho 165
Er 167
Tm 169
Yb 172
Lu 175
CFD1A
CFD2A
CFD3A
CFD4A
CFD5A
CFD6A
CFD7A
CFD9A
CFD24A


10.000
1.000
0.100
0.010
La 139
Ce 140
Pr 141
Nd 143
Sm 147
Eu 151
Gd 157
Tb 159
Dy 161
Ho 165
Er 167
Tm 169
Yb 172
Lu 175
CFD10A
CFD11A
CFD12A
CFD15A
CFD16A
CFD17A
CFD18A
CFD22A
CFD23A


10.000
1.000
0.100
0.010
La 139
Ce 140
Pr 141
Nd 143
Sm 147
Eu 151
Gd 157
Tb 159
Dy 161
Ho 165
Er 167
Tm 169
Yb 172
Lu 175
CFD13A
CFD14A
CFD19A
CFD20A
CFD21E
CFD27C

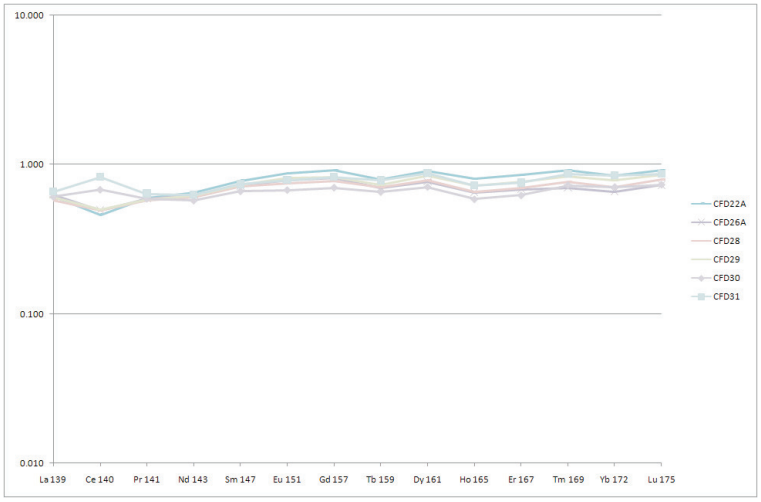
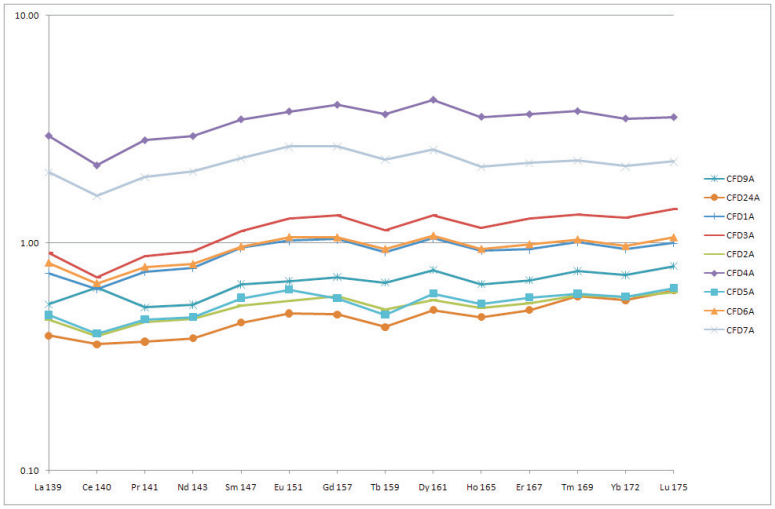
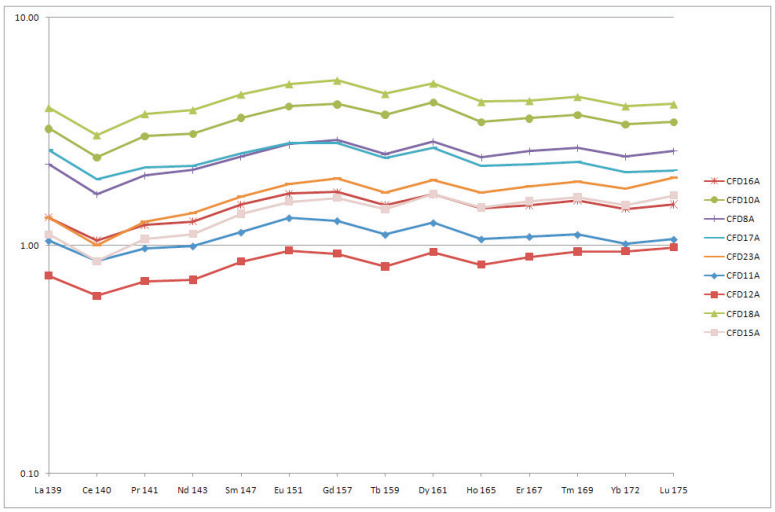
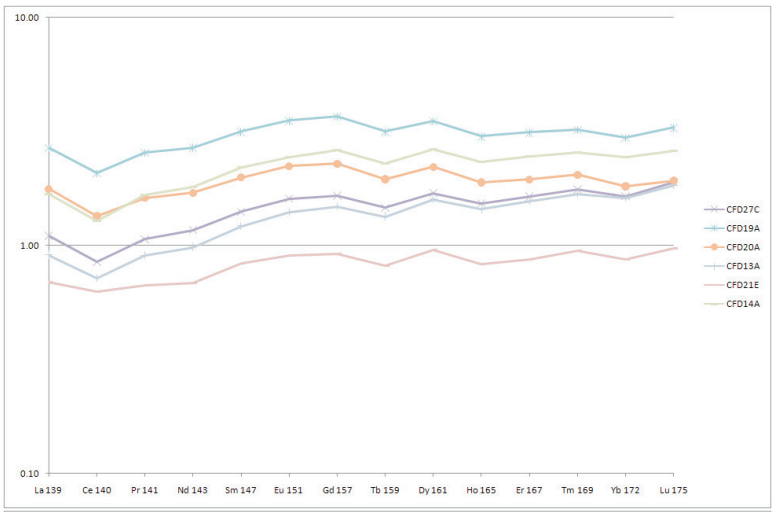

10.000
1.000
0.100
0.010
La 139
Ce 140
Pr 141
Nd 143
Sm 147
Eu 151
Gd 157
Tb 159
Dy 161
Ho 165
Er 167
Tm 169
Yb 172
Lu 175
CFD22A
CFD26A
CFD28
CFD29
CFD30
CFD31

Figure 12


10.00
1.00
0.10
La 139
Ce 140
Pr 141
Nd 143
Sm 147
Eu 151
Gd 157
Tb 159
Dy 161
Ho 165
Er 167
Tm 169
Yb 172
Lu 175
CFD9A
CFD24A
CFD1A
CFD3A
CFD2A
CFD4A
CFD5A
CFD6A
CFD7A


10.00
1.00
0.10
La 139
Ce 140
Pr 141
Nd 143
Sm 147
Eu 151
Gd 157
Tb 159
Dy 161
Ho 165
Er 167
Tm 169
Yb 172
Lu 175
CFD16A
CFD10A
CFD8A
CFD17A
CFD23A
CFD11A
CFD12A
CFD18A
CFD15A


10.00
1.00
0.10
La 139
Ce 140
Pr 141
Nd 143
Sm 147
Eu 151
Gd 157
Tb 159
Dy 161
Ho 165
Er 167
Tm 169
Yb 172
Lu 175
CFD27C
CFD19A
CFD20A
CFD13A
CFD21E
CFD14A

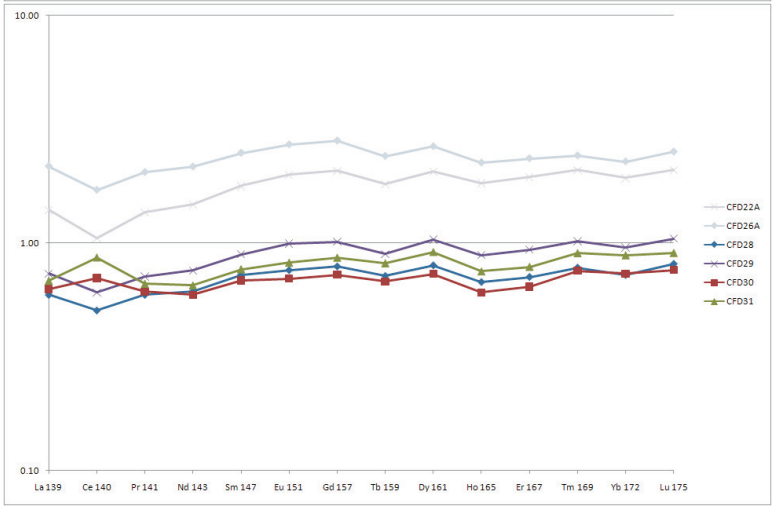

10.00
1.00
0.10
La 139
Ce 140
Pr 141
Nd 143
Sm 147
Eu 151
Gd 157
Tb 159
Dy 161
Ho 165
Er 167
Tm 169
Yb 172
Lu 175
CFD22A
CFD26A
CFD28
CFD29
CFD30
CFD31

Figure 13

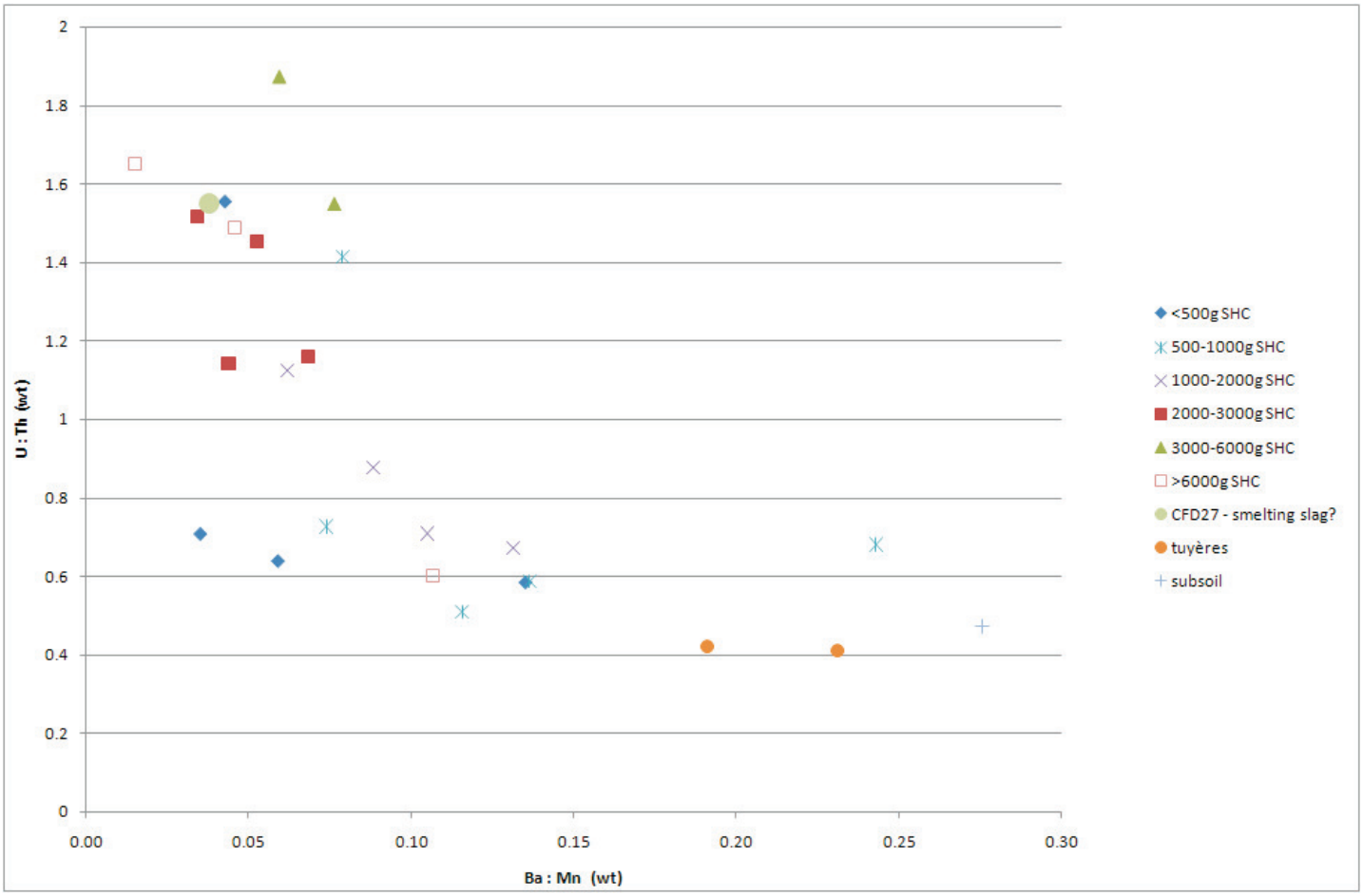

U : Th (wt)
Ba : Mn (wt)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0.00
0.05
0.10
0.15
0.20
0.25
0.30
<500g SHC
500-1000g SHC
1000-2000g SHC
2000-3000g SHC
3000-6000g SHC
>6000g SHC
CFD27 - smelting slag?
tuyères
subsoil

Figure 14

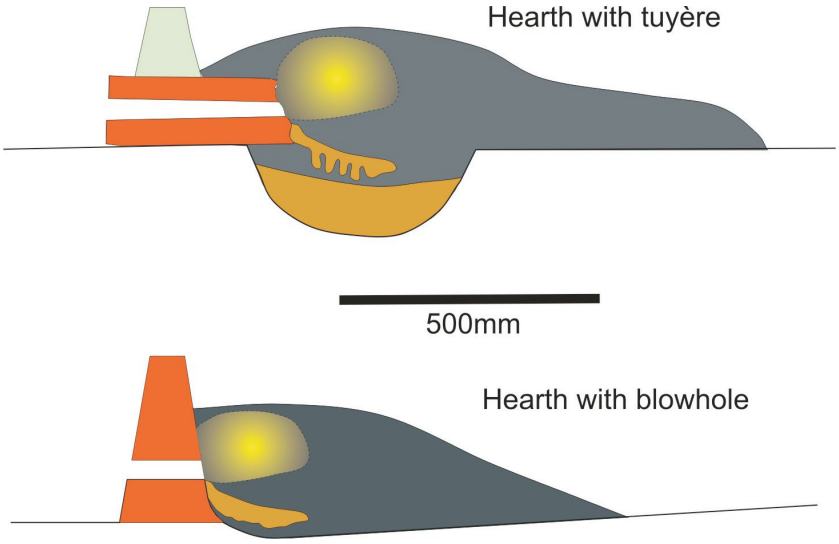


Plate 1: CFD1

Plate 2: CFD2

Plate 3: CFD3

Plate 4: CFD4

Plate 5: CFD5

Plate 6: CFD6

Plate 7: CFD7

Plate 8: CFD8

Plate 9: CFD9

Plate 10: CFD10

Plate 11: CFD11

Plate 12: CFD12

Plate 13: CFD13

Plate 14: CFD14

Plate 15: CFD15

Plate 16: CFD16

Plate 17: CFD17

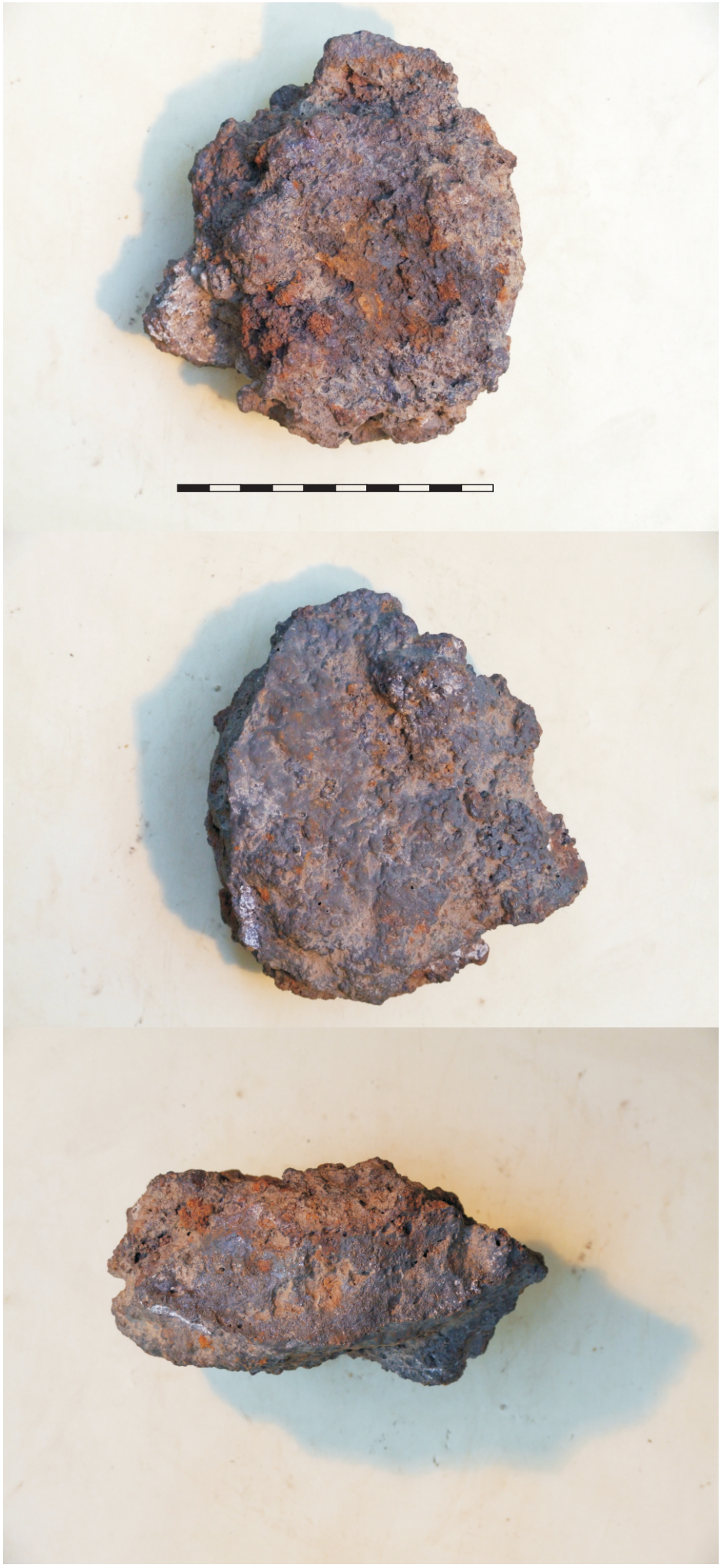


Plate 18: CFD18

Plate 19: CFD19

Plate 20: CFD20

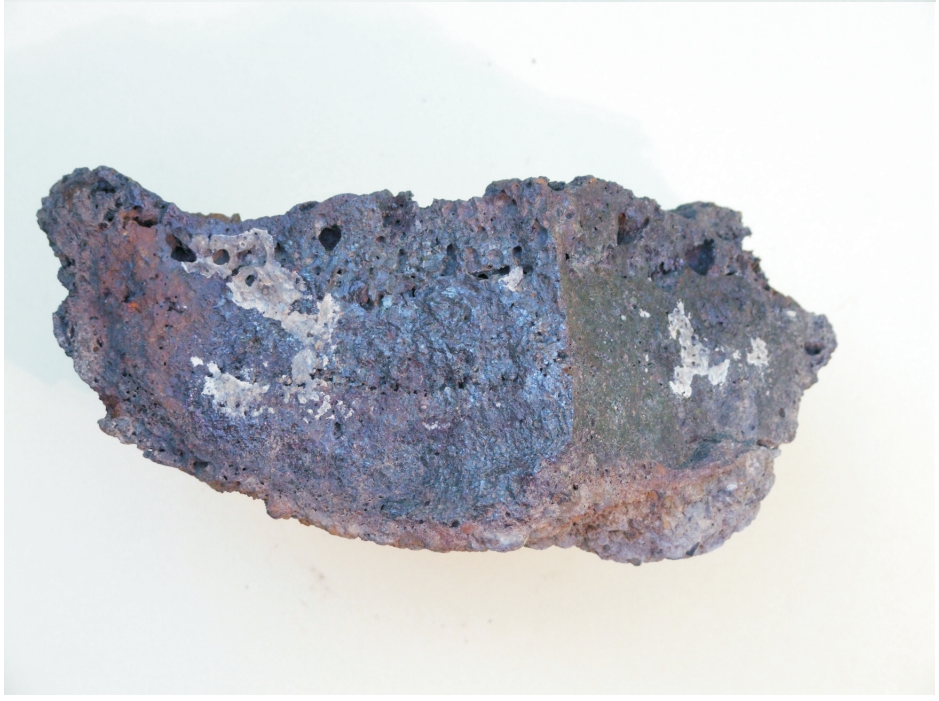


Plate 21: CFD21

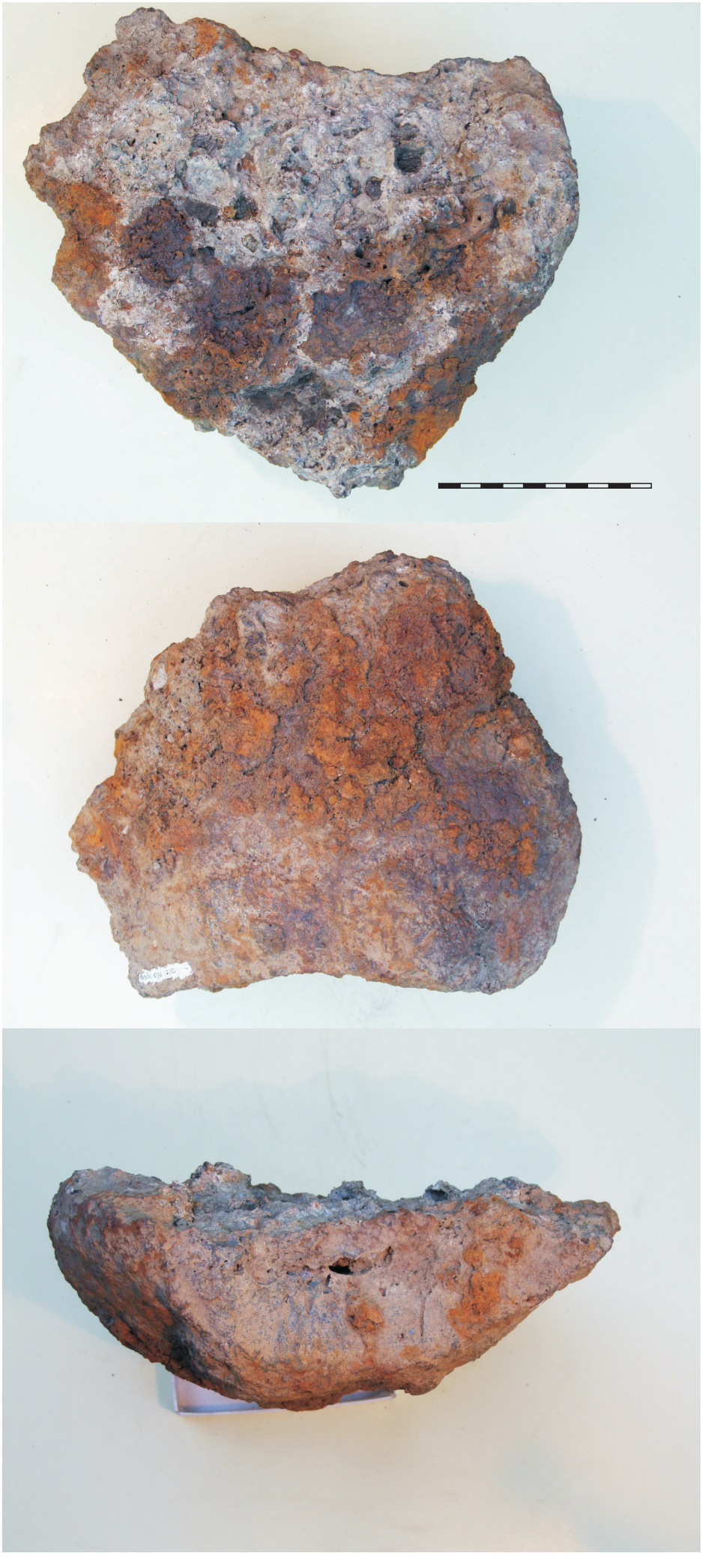


Plate 22: CFD22

Plate 23: CFD23

Plate 24: CFD24

Plate 25: CFD26

Plate 26: CFD27

a

b

c

d

e

f

g

h

a

b

c

d

e

f

g

h

a

b

c

d

e

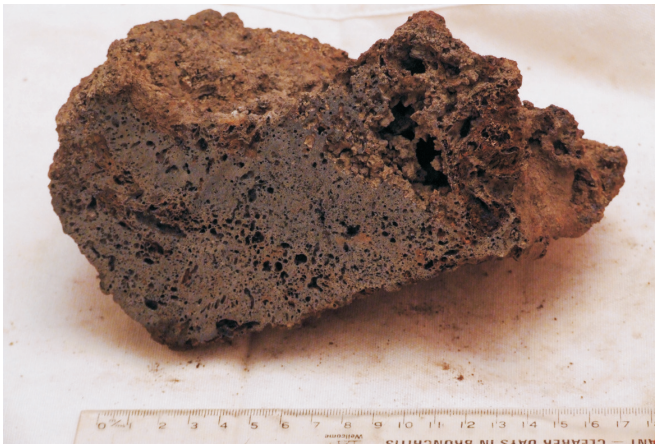
f

g

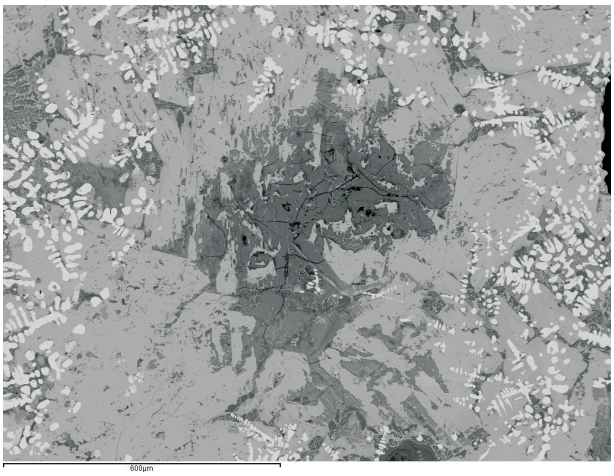
h

a

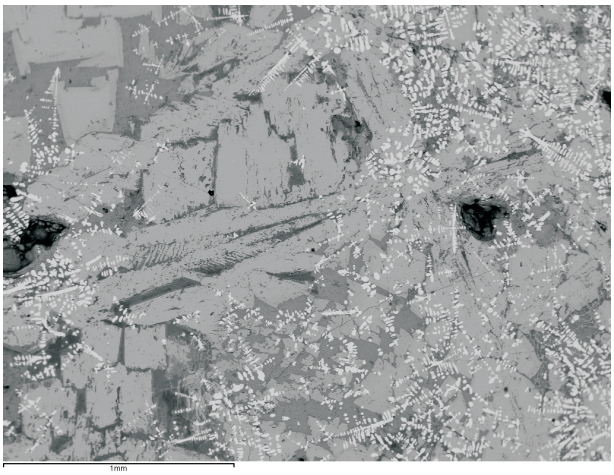
b



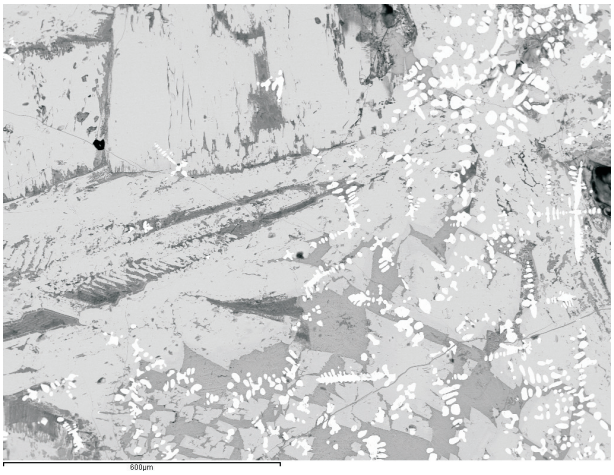
a



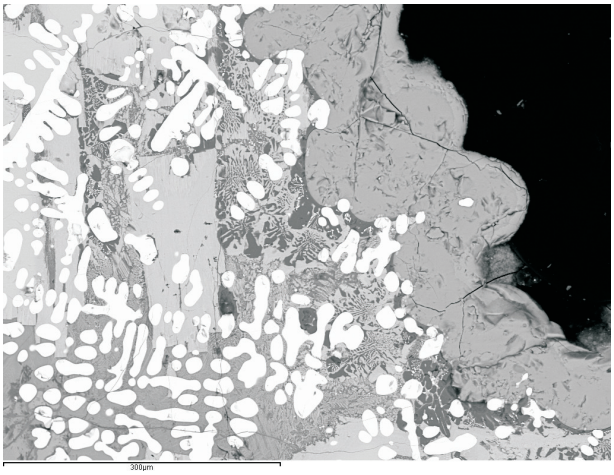
b



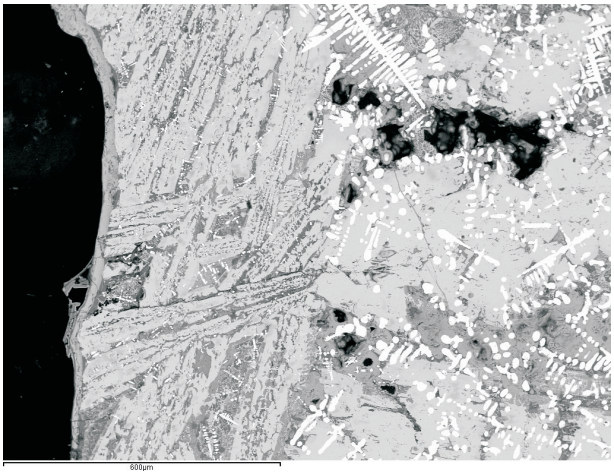
c



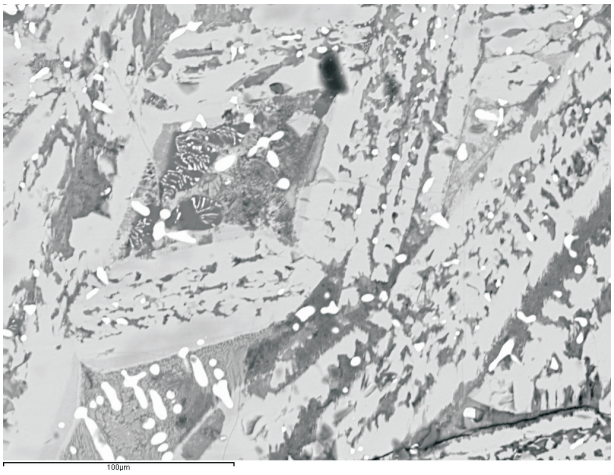
d



e

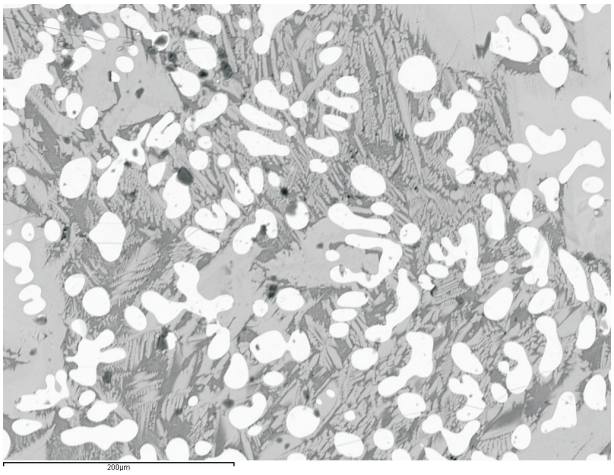


f

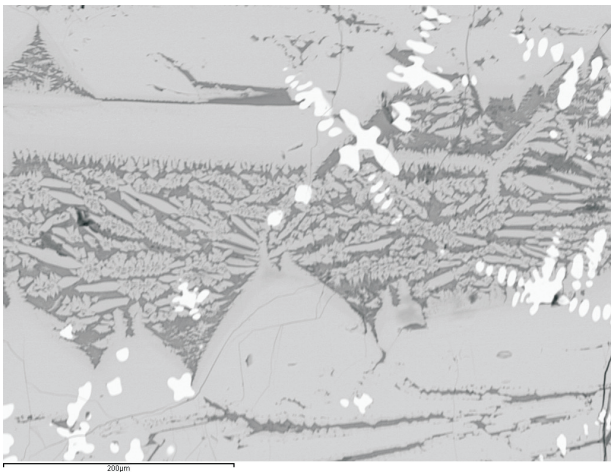


g

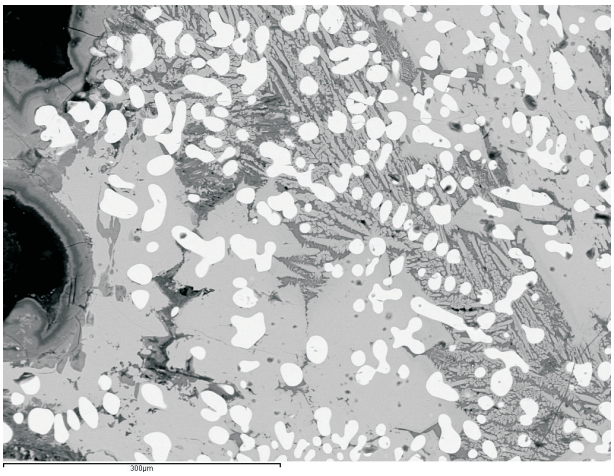
h



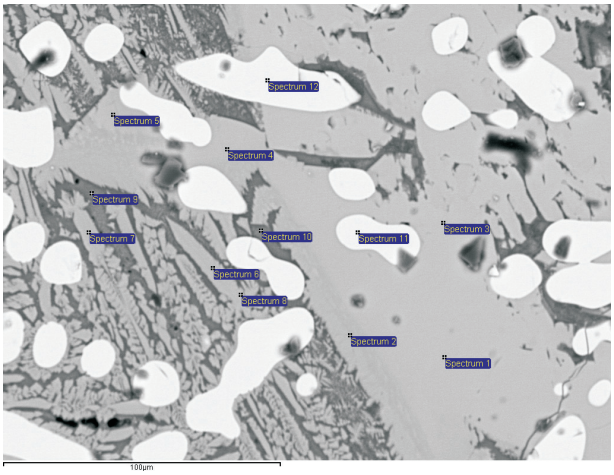
a


200µm

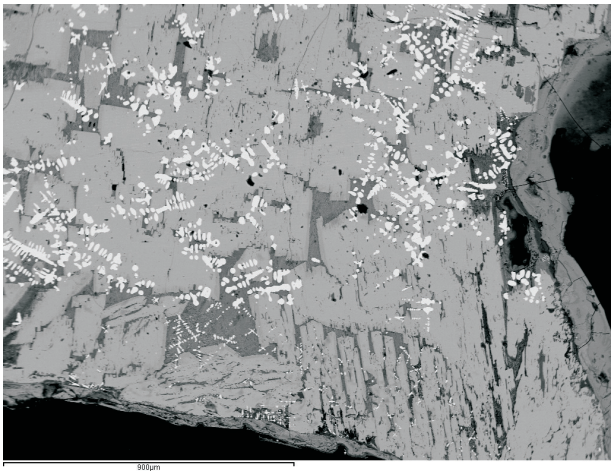
b


300µm

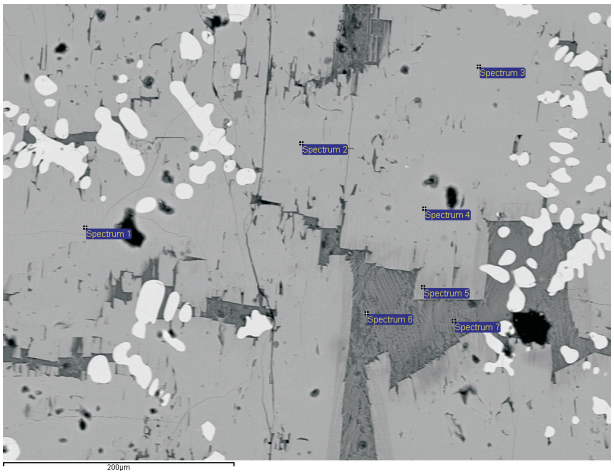
c


Spectrum 12
Spectrum 5
Spectrum 4
Spectrum 3
Spectrum 7
Spectrum 10
Spectrum 11
Spectrum 9
Spectrum 6
Spectrum 8
Spectrum 2
Spectrum 1
100µm

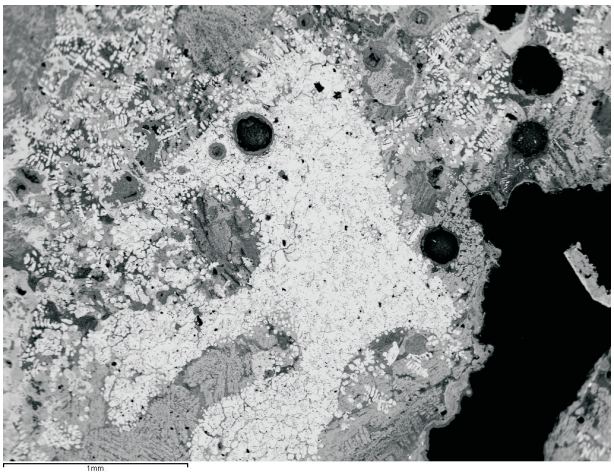
d


900µm

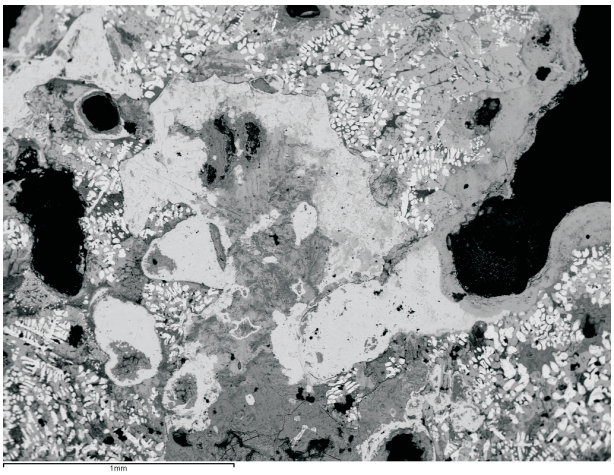
e


Spectrum 3
Spectrum 2
Spectrum 4
Spectrum 1
Spectrum 5
Spectrum 6
Spectrum 7
200µm

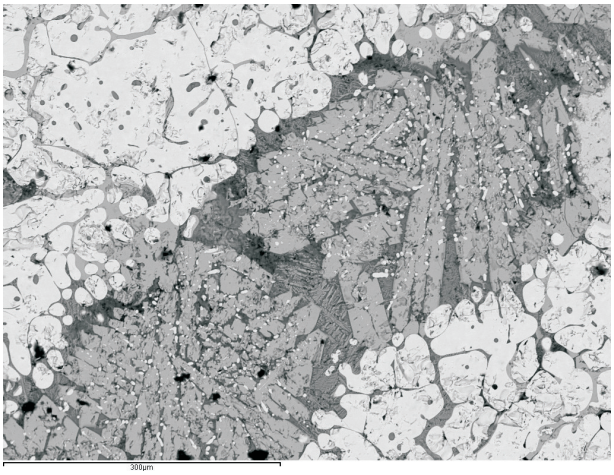
a


1mm

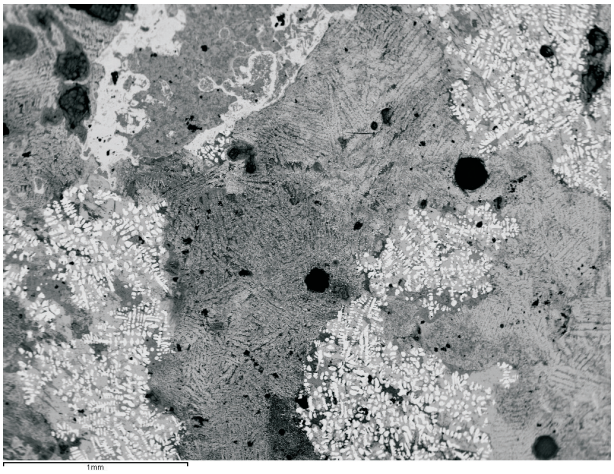
b


1mm

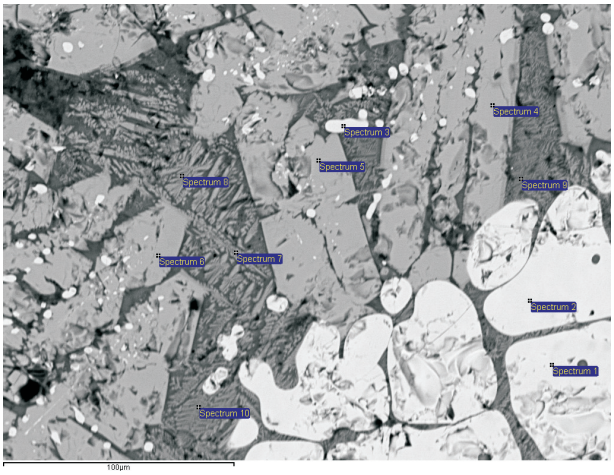
c


300µm

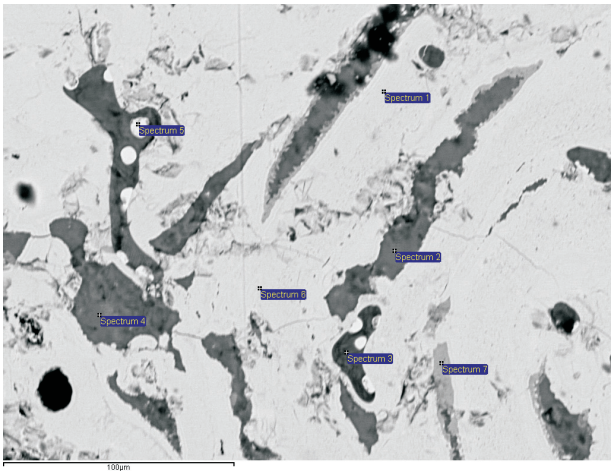
d


1mm

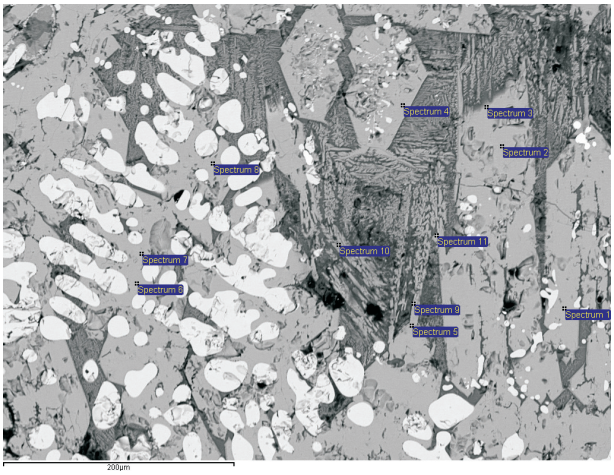
e


Spectrum 4
Spectrum 3
Spectrum 5
Spectrum 6
Spectrum 9
Spectrum 8
Spectrum 7
Spectrum 2
Spectrum 1
Spectrum 10
100µm

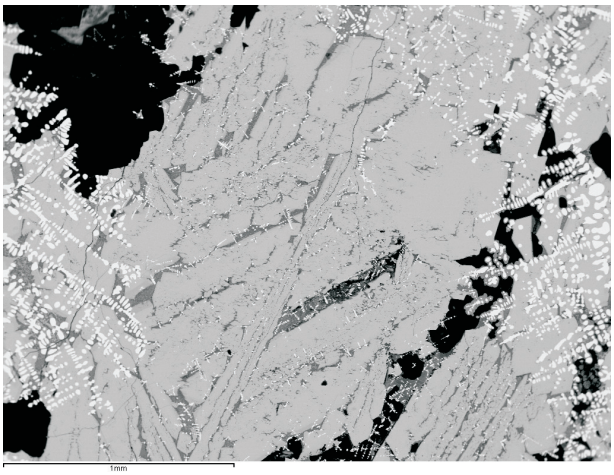
f


Spectrum 1
Spectrum 5
Spectrum 2
Spectrum 6
Spectrum 4
Spectrum 3
Spectrum 7
100µm

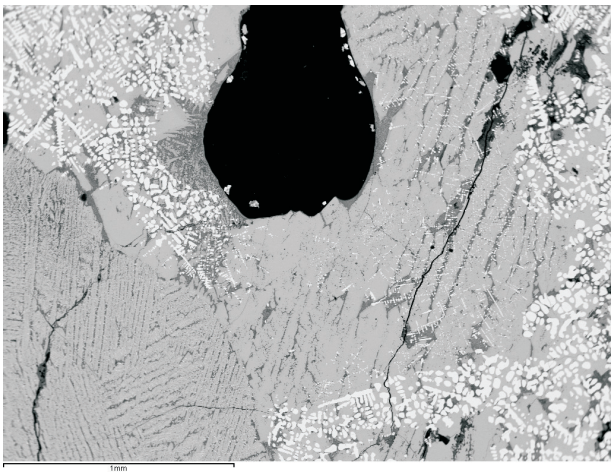
g


Spectrum 4
Spectrum 3
Spectrum 2
Spectrum 6
Spectrum 11
Spectrum 10
Spectrum 7
Spectrum 8
Spectrum 9
Spectrum 5
Spectrum 1
200µm

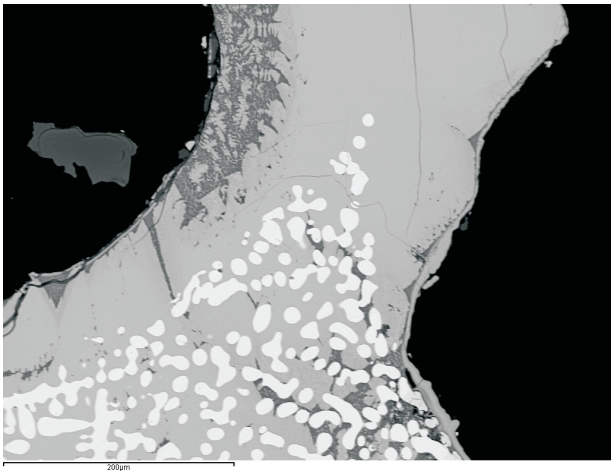
a


1mm

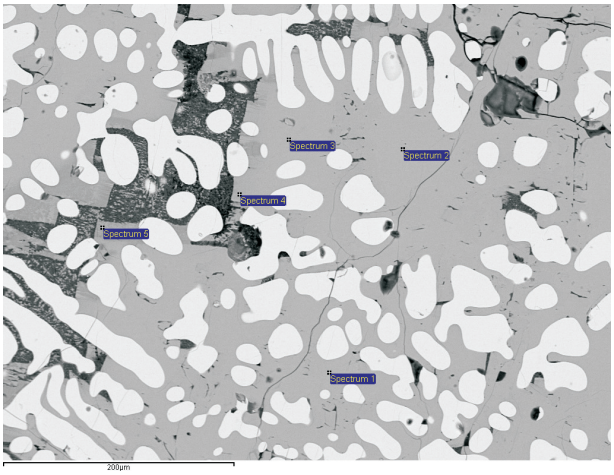
b


1mm

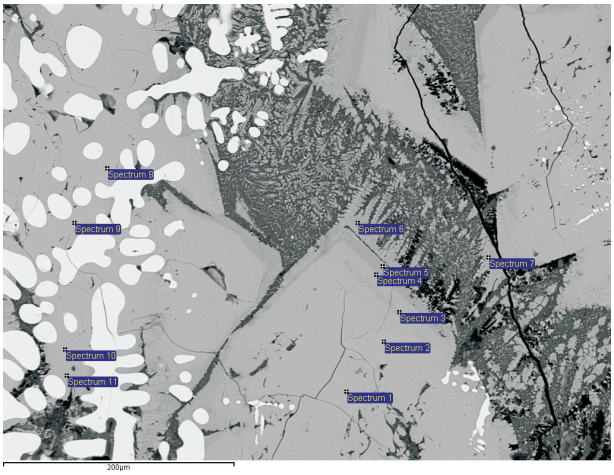
c


200µm

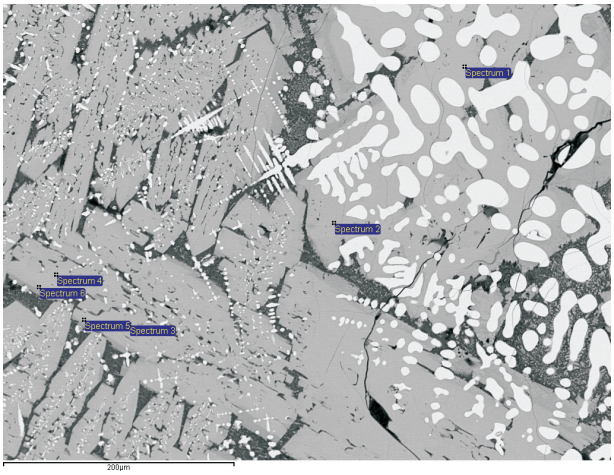
d


Spectrum 3
Spectrum 2
Spectrum 4
Spectrum 5
Spectrum 1
200µm

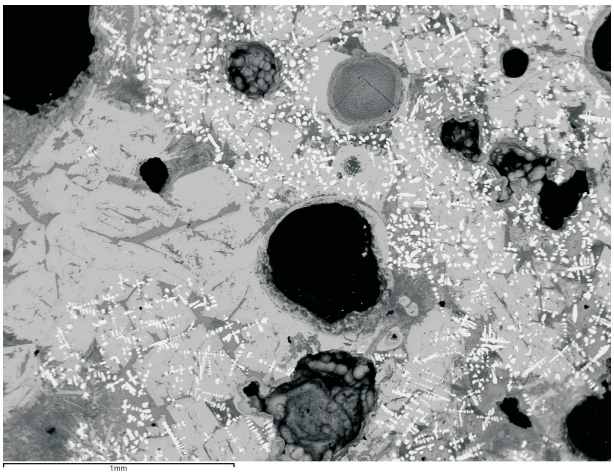
e


Spectrum 8
Spectrum 9
Spectrum 6
Spectrum 7
Spectrum 5
Spectrum 4
Spectrum 3
Spectrum 2
Spectrum 10
Spectrum 11
Spectrum 1
200µm

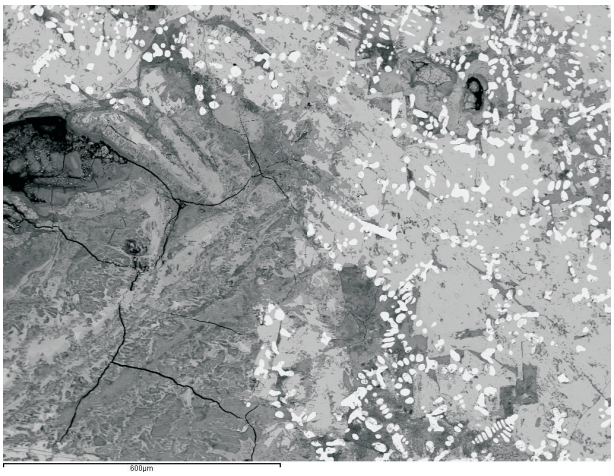
f


Spectrum 1
Spectrum 2
Spectrum 4
Spectrum 6
Spectrum 5
Spectrum 3
200µm

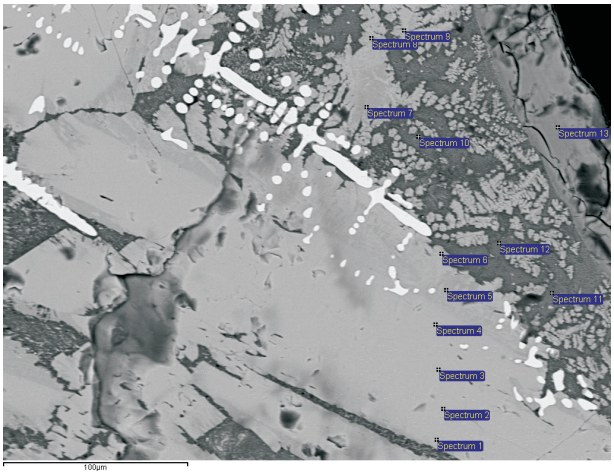
a


1mm

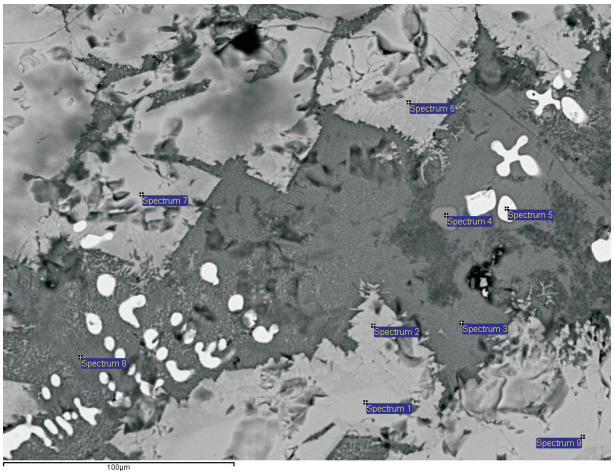
b


600µm

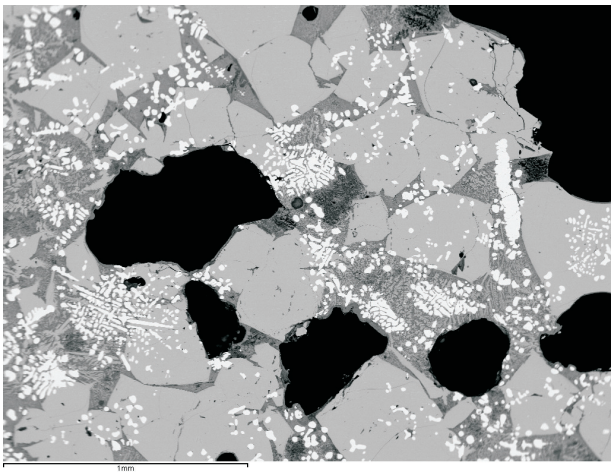
c


Spectrum 9
Spectrum 14
Spectrum 7
Spectrum 13
Spectrum 10
Spectrum 12
Spectrum 8
Spectrum 6
Spectrum 11
Spectrum 4
Spectrum 3
Spectrum 2
Spectrum 1
100µm

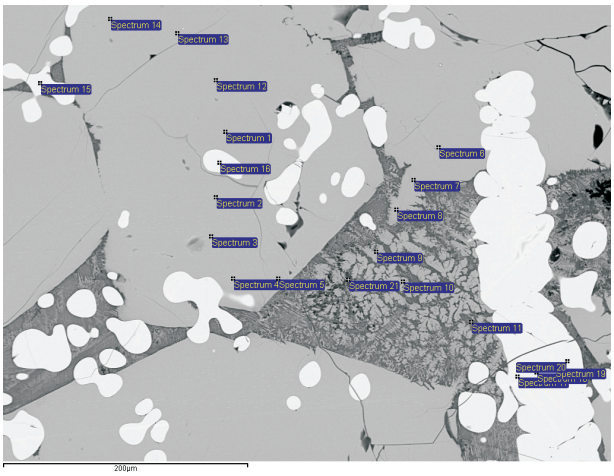
d


Spectrum 6
Spectrum 7
Spectrum 4
Spectrum 5
Spectrum 2
Spectrum 3
Spectrum 8
Spectrum 1
Spectrum 9
100µm

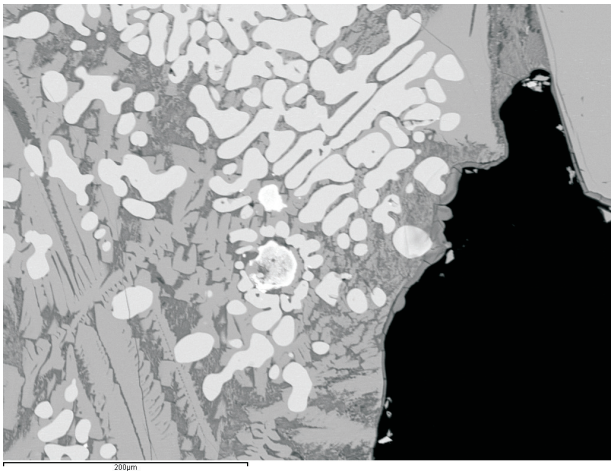
a


1mm

b


Spectrum 14
Spectrum 13
Spectrum 15
Spectrum 12
Spectrum 1
Spectrum 16
Spectrum 2
Spectrum 3
Spectrum 4
Spectrum 5
Spectrum 21
Spectrum 10
Spectrum 11
Spectrum 20
Spectrum 19
Spectrum 9
Spectrum 7
Spectrum 8
Spectrum 6
200µm

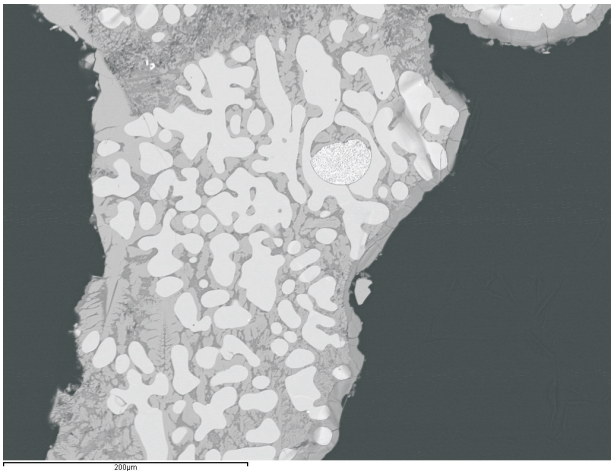
c


200µm

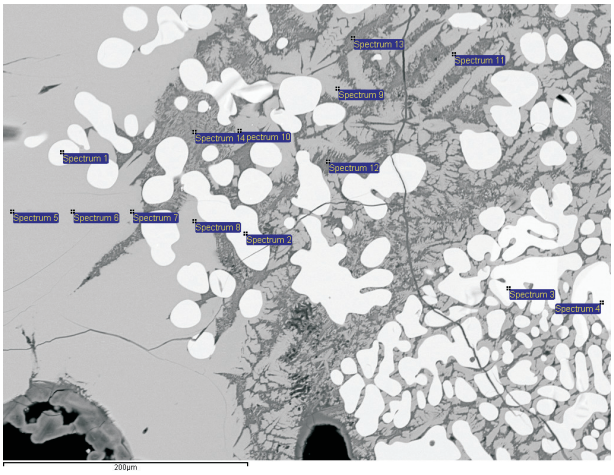
d


200µm

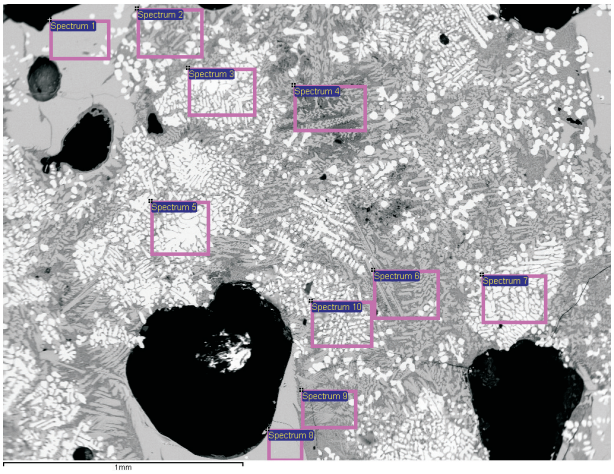
e


200µm

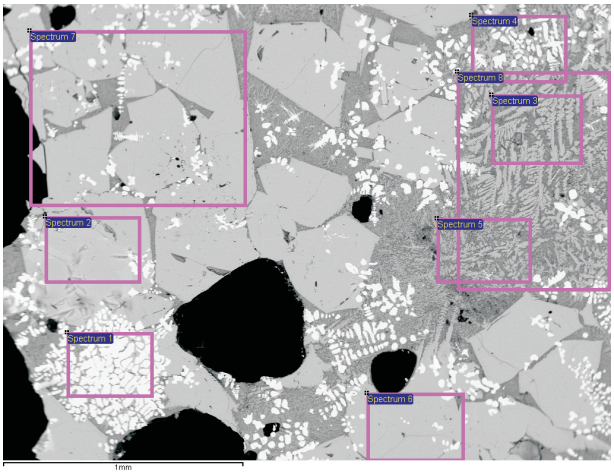
f


Spectrum 13
Spectrum 11
Spectrum 9
Spectrum 14
Spectrum 10
Spectrum 1
Spectrum 12
Spectrum 5
Spectrum 6
Spectrum 7
Spectrum 8
Spectrum 2
Spectrum 3
Spectrum 4
200µm

g


Spectrum 1
Spectrum 2
Spectrum 3
Spectrum 4
Spectrum 5
Spectrum 6
Spectrum 7
Spectrum 10
Spectrum 9
Spectrum 8
1mm

h


Spectrum 7
Spectrum 4
Spectrum 8
Spectrum 3
Spectrum 2
Spectrum 5
Spectrum 1
Spectrum 6
1mm

a

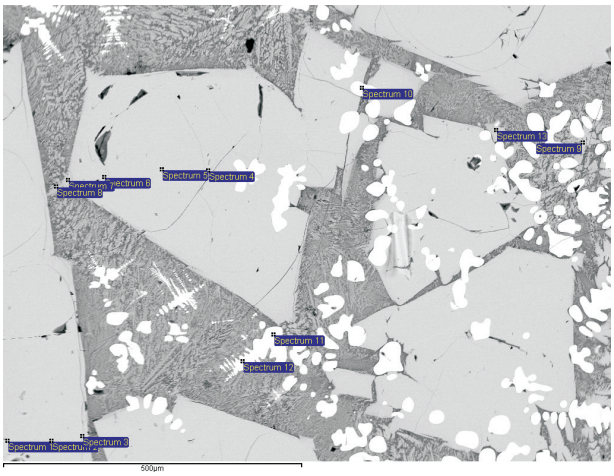
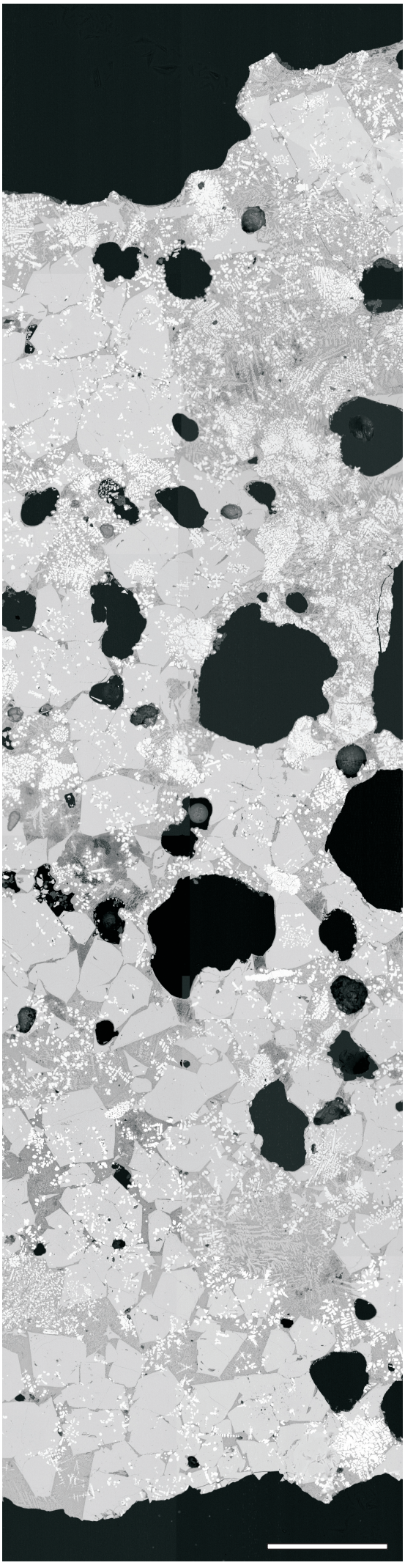
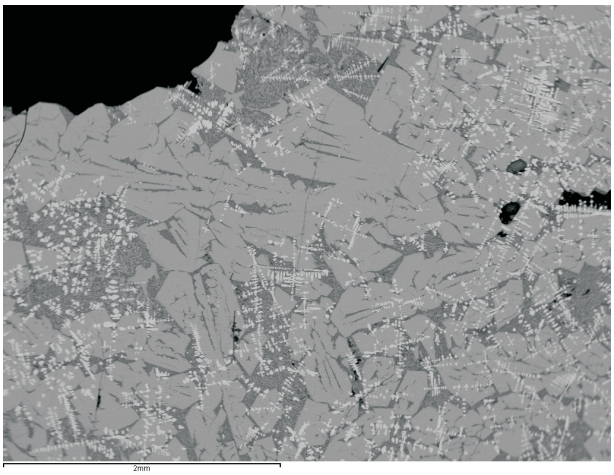

Spectrum 10
Spectrum 13
Spectrum 9
Spectrum 5
Spectrum 4
Spectrum 8
Spectrum 6
Spectrum 11
Spectrum 12
Spectrum 1
Spectrum 2
Spectrum 3
500µm

Plate 38: CFD 13B

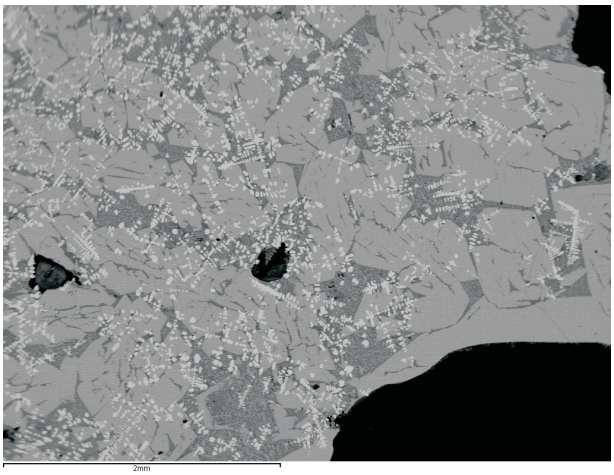
a



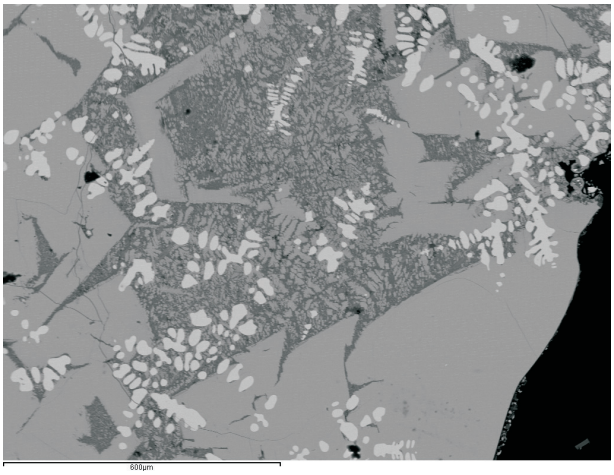
a


2mm

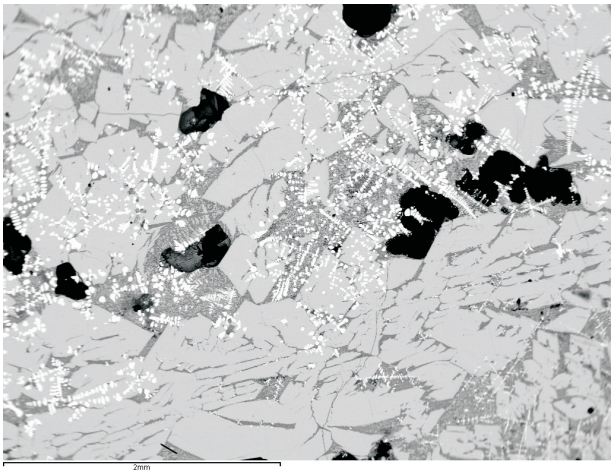
b


2mm

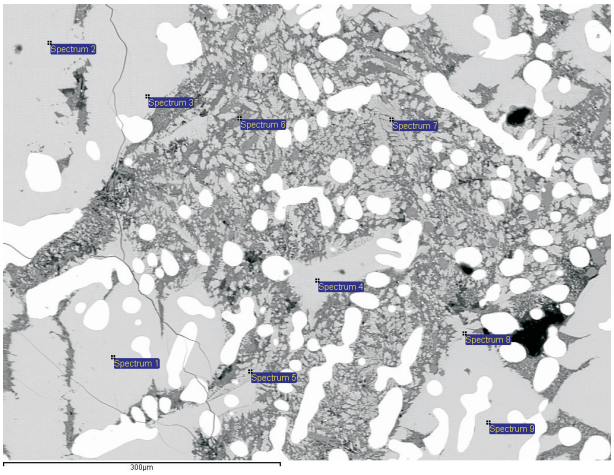
c


600µm

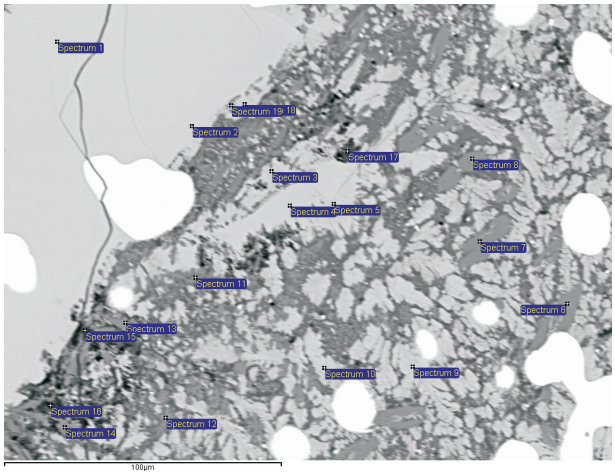
d


2mm

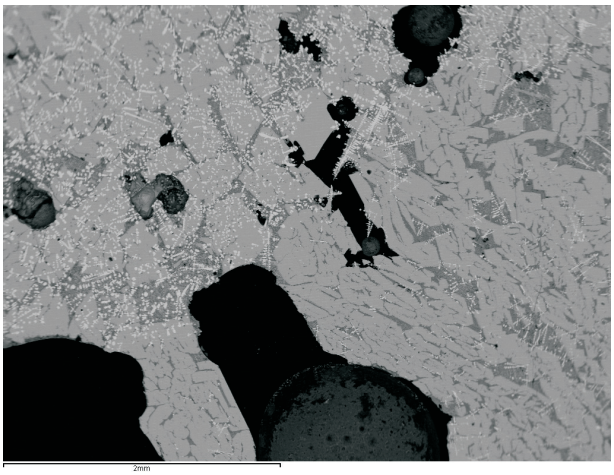
e


Spectrum 2
Spectrum 3
Spectrum 6
Spectrum 7
Spectrum 4
Spectrum 8
Spectrum 1
Spectrum 5
Spectrum 9
300µm

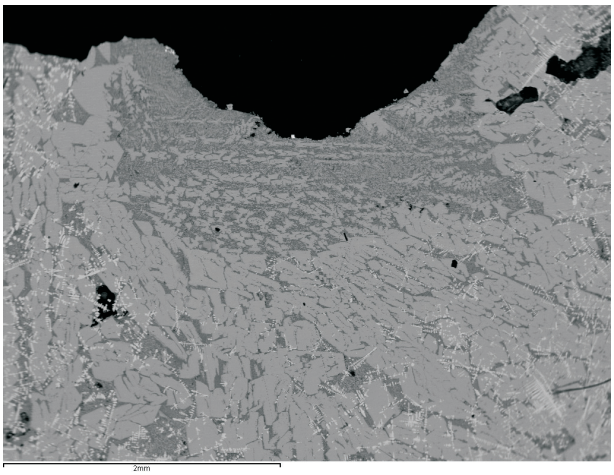
f


Spectrum 1
Spectrum 19
Spectrum 16
Spectrum 2
Spectrum 17
Spectrum 8
Spectrum 3
Spectrum 4
Spectrum 5
Spectrum 7
Spectrum 11
Spectrum 6
Spectrum 18
Spectrum 15
Spectrum 10
Spectrum 9
Spectrum 13
Spectrum 14
Spectrum 12
100µm

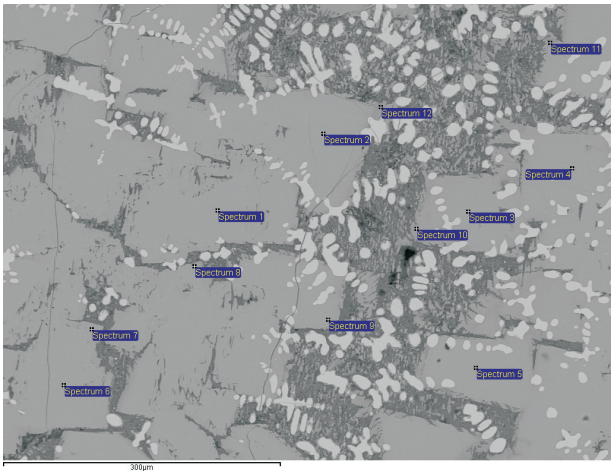
a


2mm

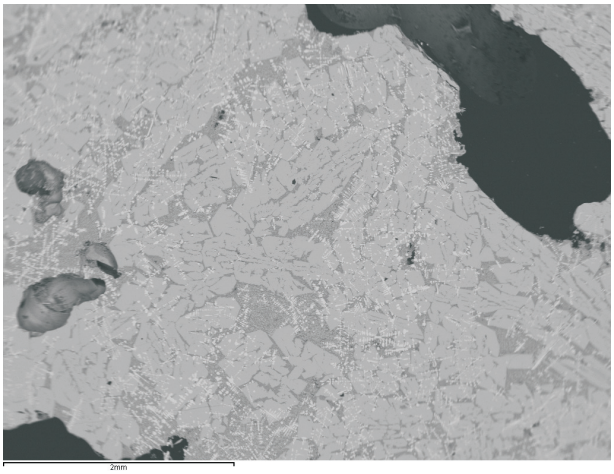
b


2mm

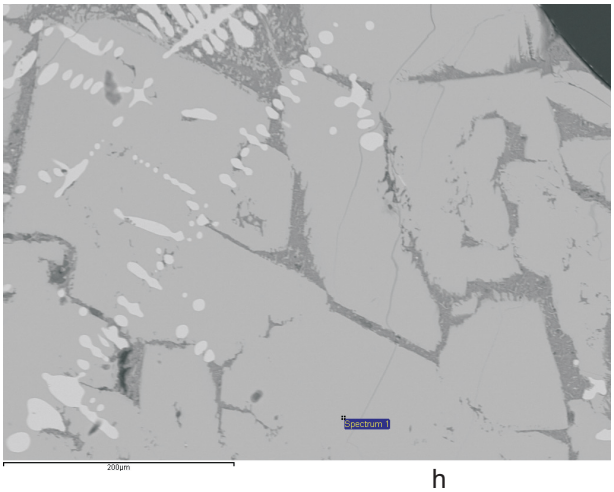
c


Spectrum 11
Spectrum 12
Spectrum 2
Spectrum 4
Spectrum 1
Spectrum 3
Spectrum 10
Spectrum 8
Spectrum 9
Spectrum 7
Spectrum 5
Spectrum 6
300µm

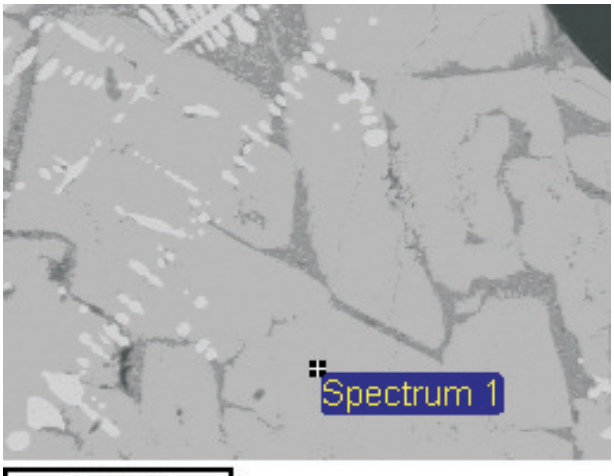
d


2mm

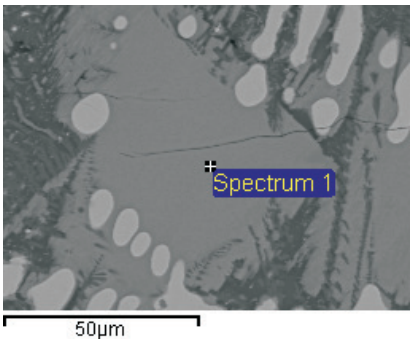
e


Spectrum 1
200µm

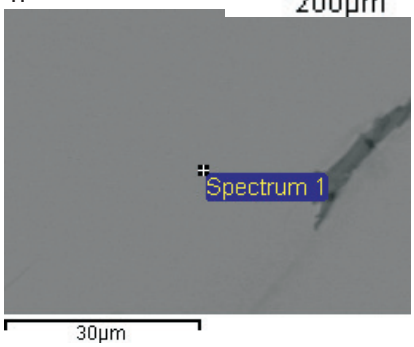
f


Spectrum 1
200µm

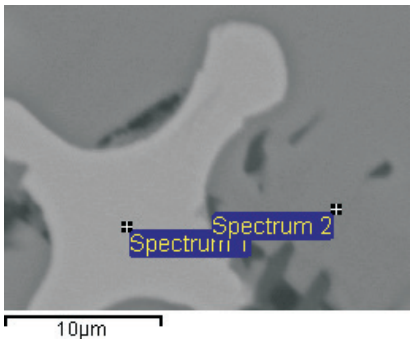
g


Spectrum 1
50µm

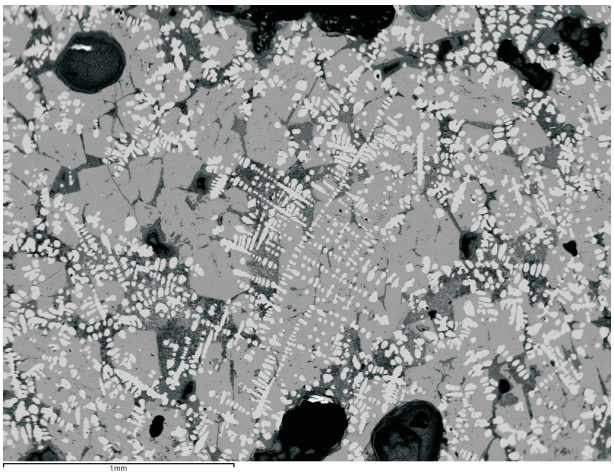
h


Spectrum 1
30µm

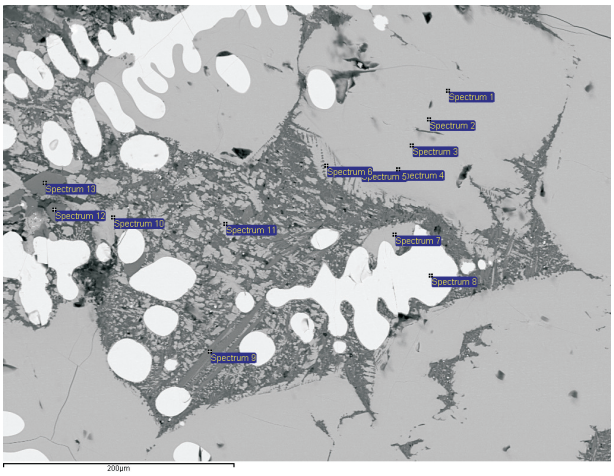
i


Spectrum 2
Spectrum 1
10µm

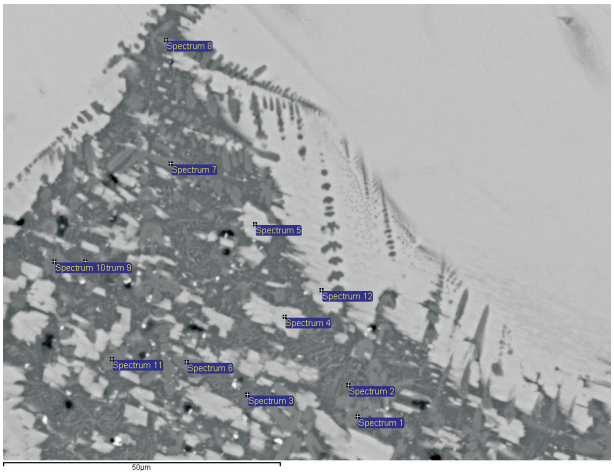
a


1mm

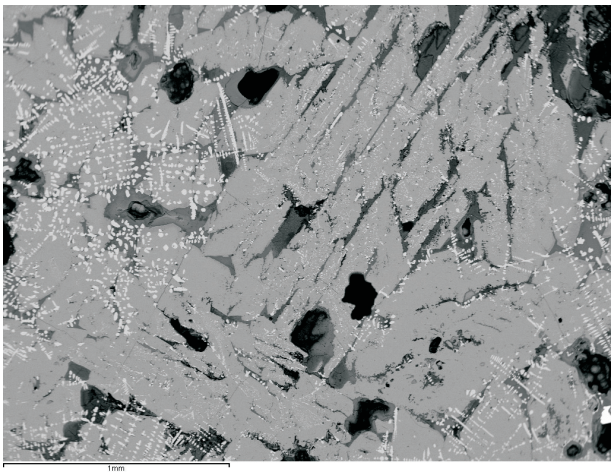
b


Spectrum 1
Spectrum 2
Spectrum 3
Spectrum 4
Spectrum 5
Spectrum 7
Spectrum 8
Spectrum 9
Spectrum 10
Spectrum 11
Spectrum 12
200µm

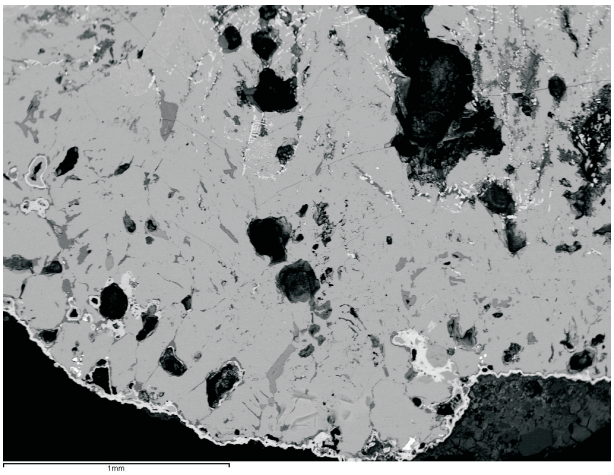
c


Spectrum 1
Spectrum 2
Spectrum 3
Spectrum 4
Spectrum 5
Spectrum 7
Spectrum 8
Spectrum 11
Spectrum 12
50µm

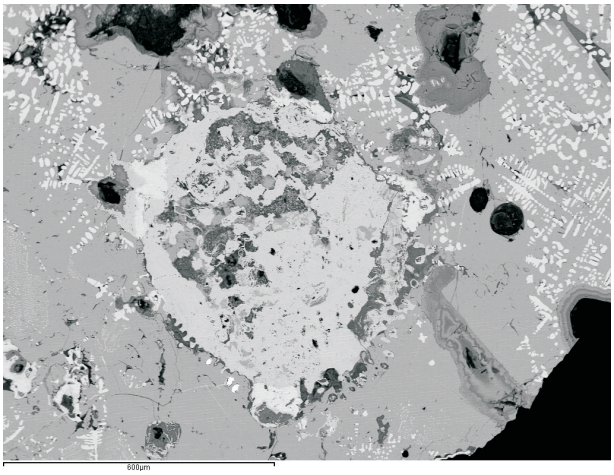
a


1mm

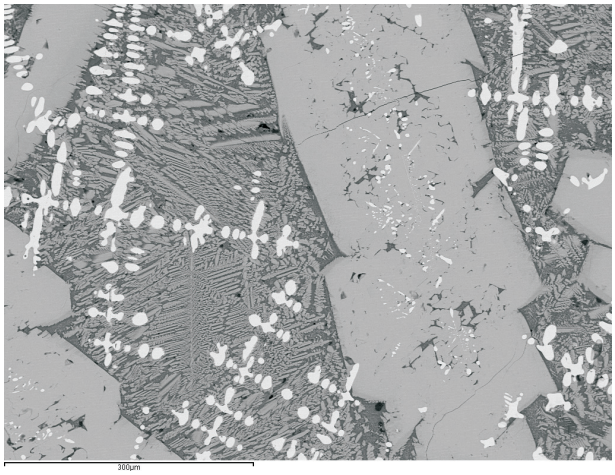
b


1mm

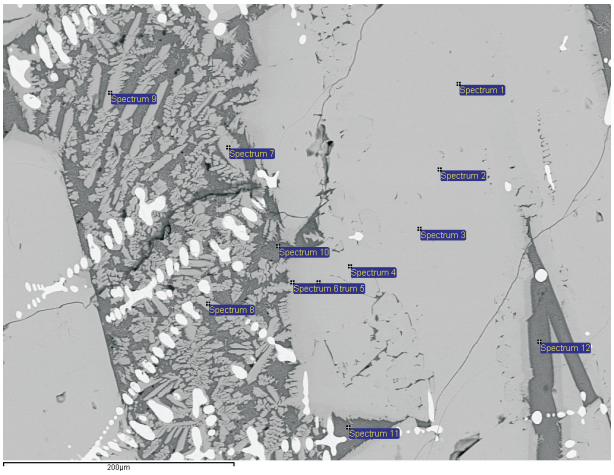
c


600µm

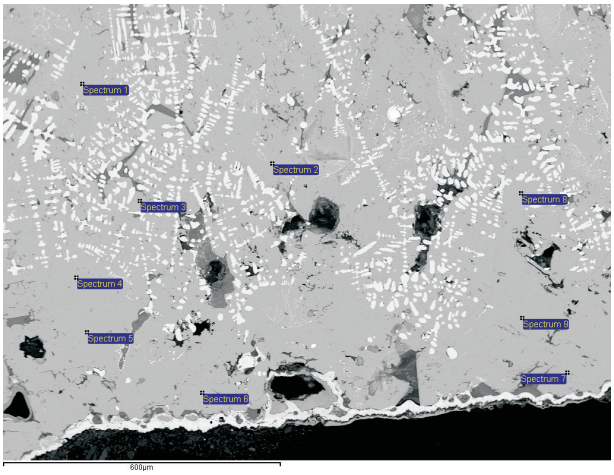
d


300µm

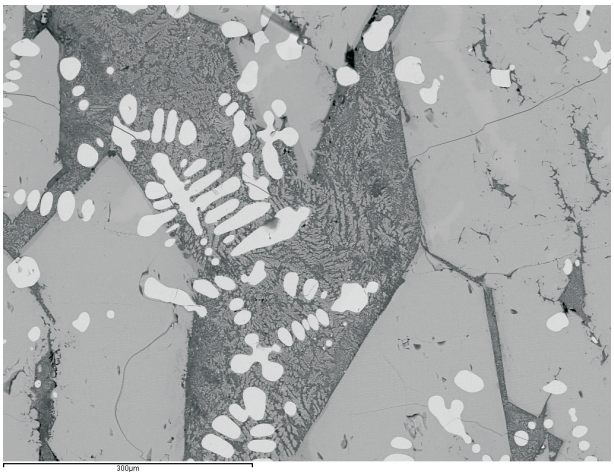
e


Spectrum 0
Spectrum 1
Spectrum 7
Spectrum 2
Spectrum 9
Spectrum 10
Spectrum 4
Spectrum 8 brum 5
Spectrum 6
Spectrum 12
Spectrum 11
200µm

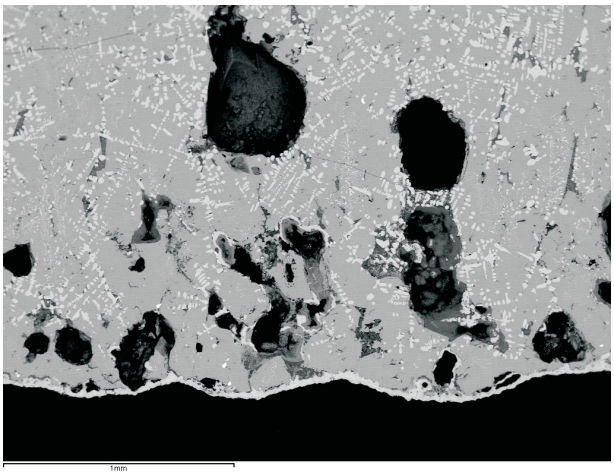
f


Spectrum 1
Spectrum 2
Spectrum 3
Spectrum 9
Spectrum 4
Spectrum 5
Spectrum 8
Spectrum 7
Spectrum 6
600µm

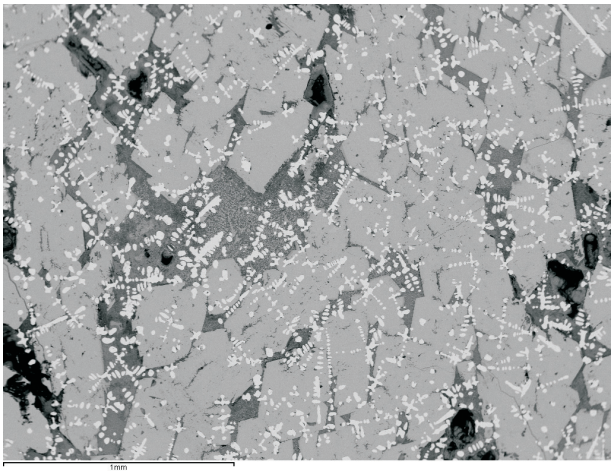
a


300µm

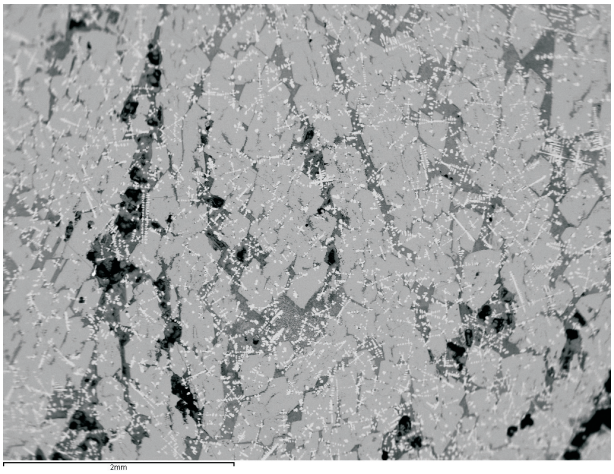
b


1mm

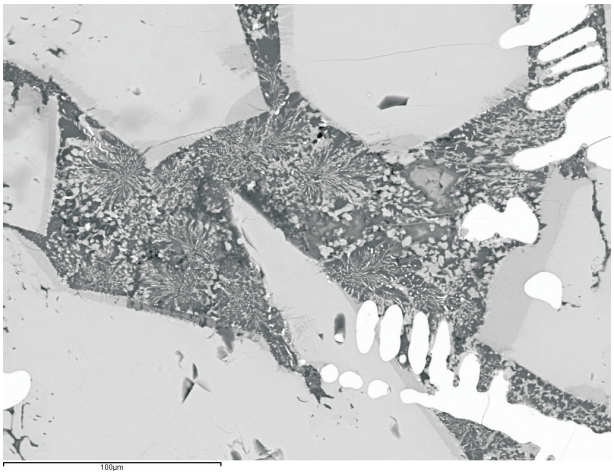
c


1mm

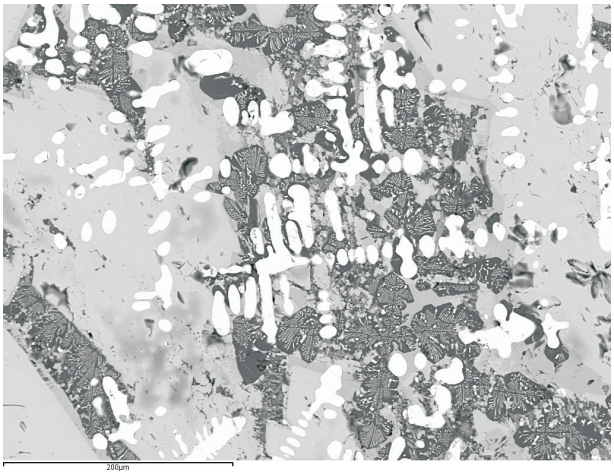
d


2mm

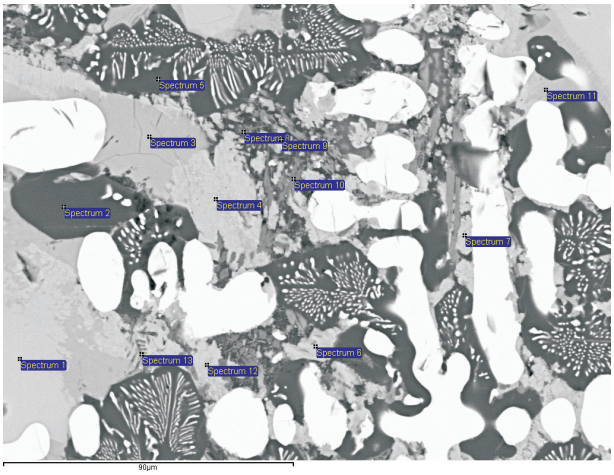
e


100µm

f


200µm

g


Spectrum 5
Spectrum 11
Spectrum 8
Spectrum 9
Spectrum 10
Spectrum 4
Spectrum 2
Spectrum 7
Spectrum 1
Spectrum 13
Spectrum 12
Spectrum 6
90µm

h

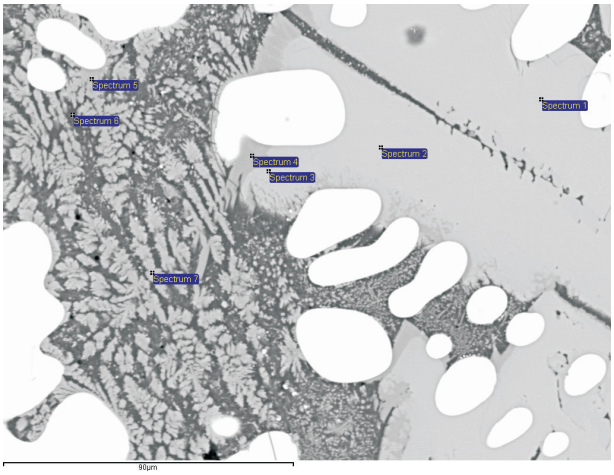
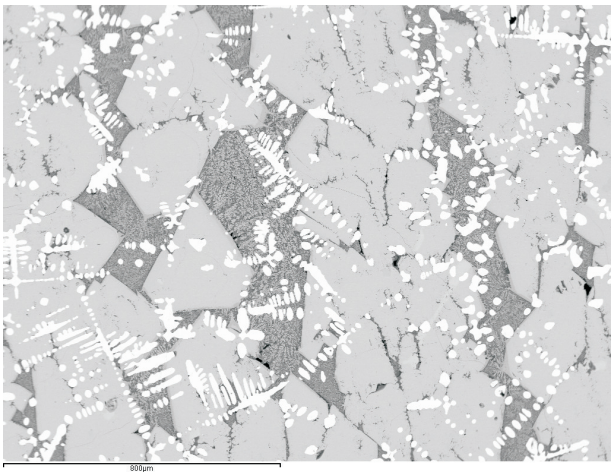
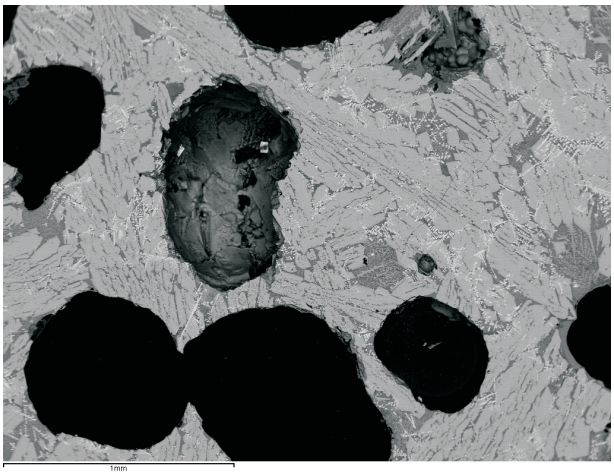

Spectrum 5
Spectrum 6
Spectrum 1
Spectrum 2
Spectrum 4
Spectrum 3
Spectrum 7
90µm

Plate 44: CFD 18B

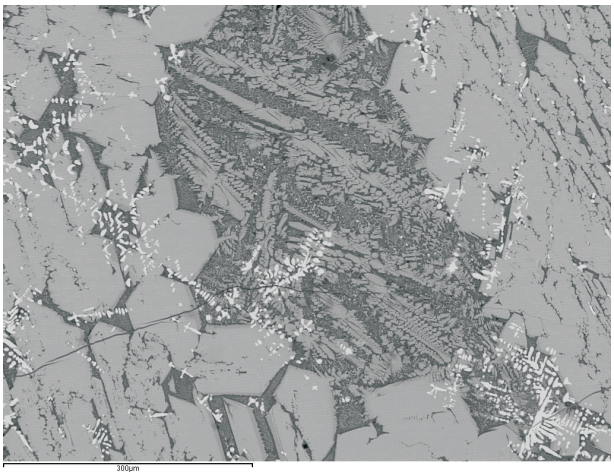
a



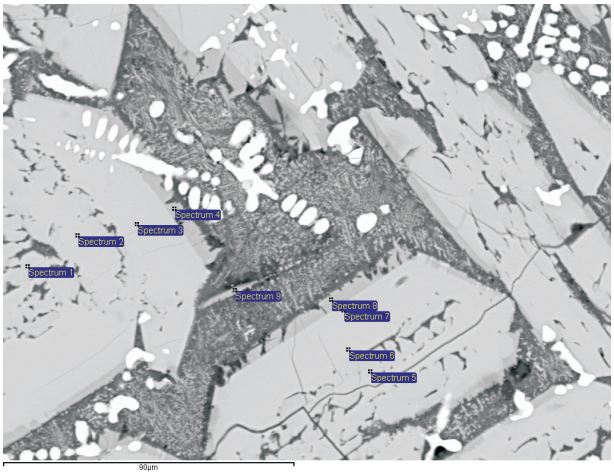
a


1mm

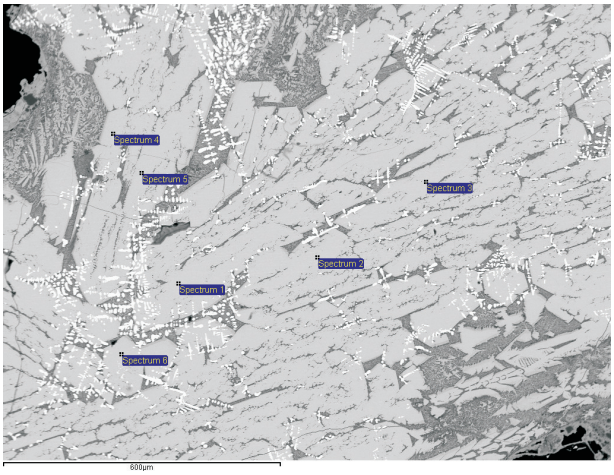
b


300µm

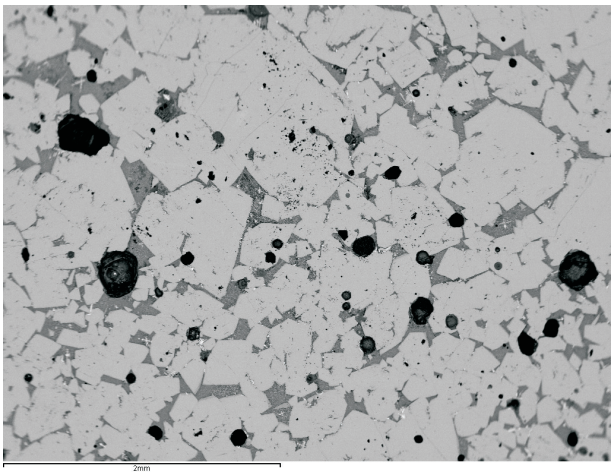
c


Spectrum 4
Spectrum 3
Spectrum 2
Spectrum 1
Spectrum 5
Spectrum 8
Spectrum 7
Spectrum 6
Spectrum 9
90µm

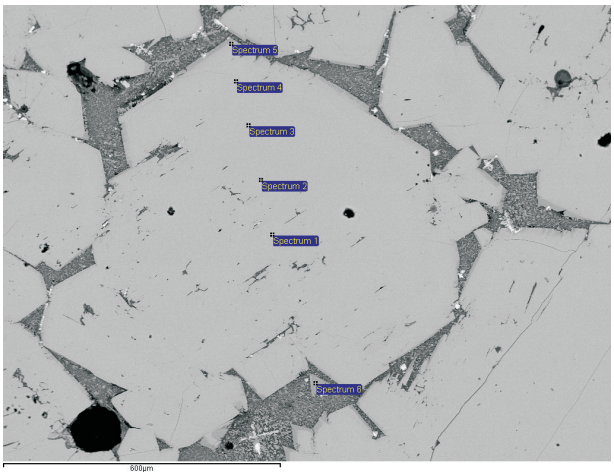
d


Spectrum 4
Spectrum 5
Spectrum 3
Spectrum 2
Spectrum 1
Spectrum 6
600µm

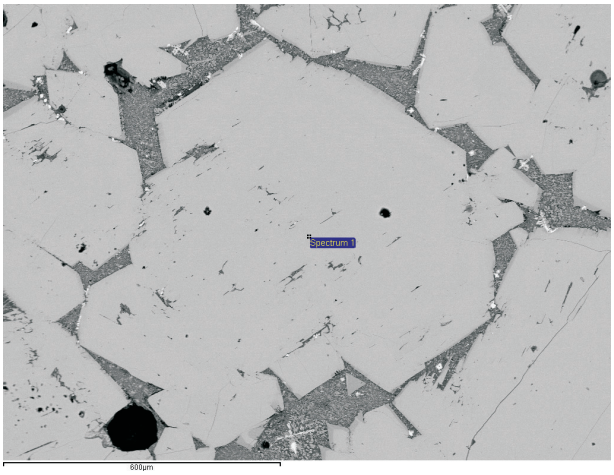
a


2mm

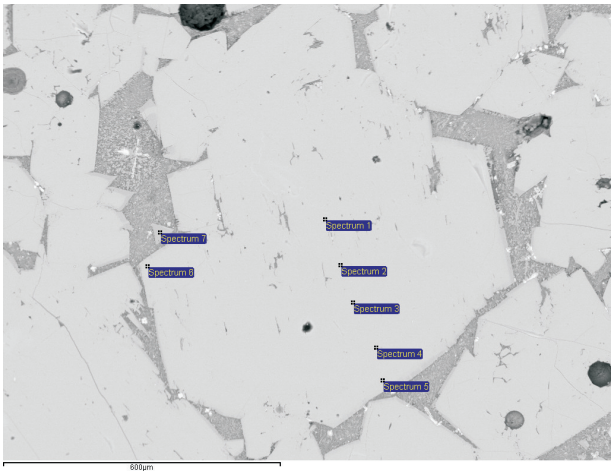
b


Spectrum 5
Spectrum 4
Spectrum 3
Spectrum 2
Spectrum 1
Spectrum 6
600µm

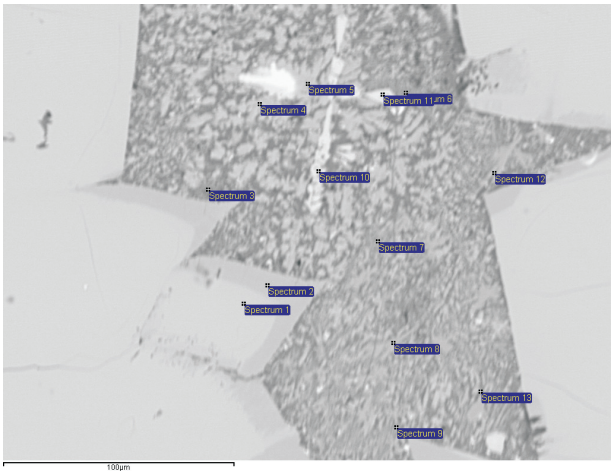
c


Spectrum 1
600µm

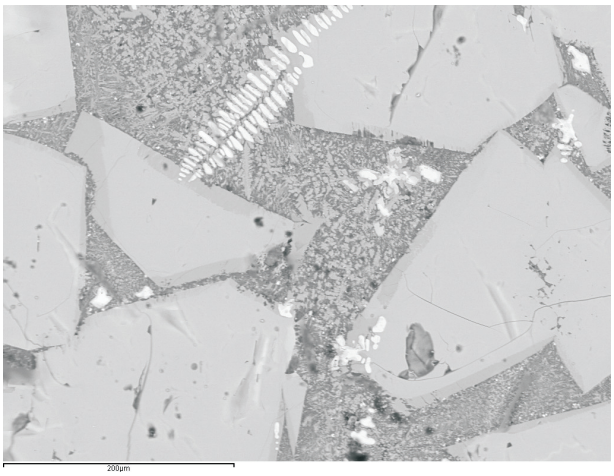
d


Spectrum 1
Spectrum 7
Spectrum 6
Spectrum 2
Spectrum 3
Spectrum 4
Spectrum 5
600µm

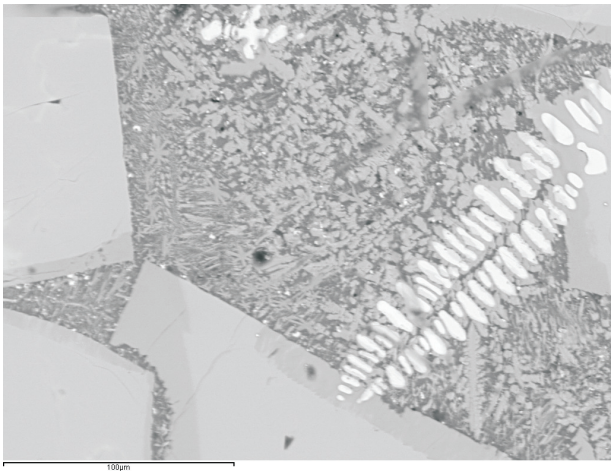
e


Spectrum 5
Spectrum 11
Spectrum 6
Spectrum 4
Spectrum 10
Spectrum 12
Spectrum 3
Spectrum 7
Spectrum 2
Spectrum 1
Spectrum 8
Spectrum 13
Spectrum 9
100µm

f


200µm

g


100µm

h

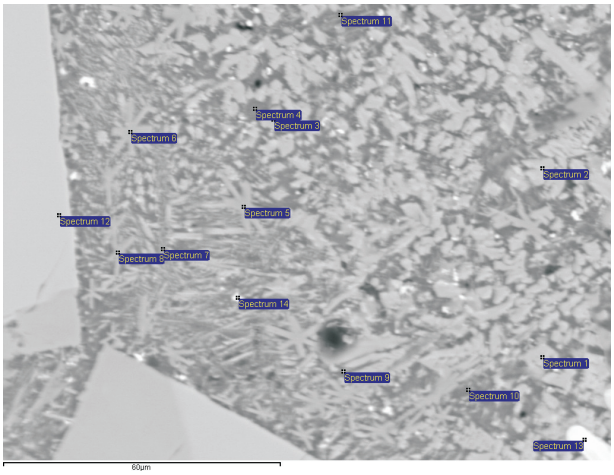
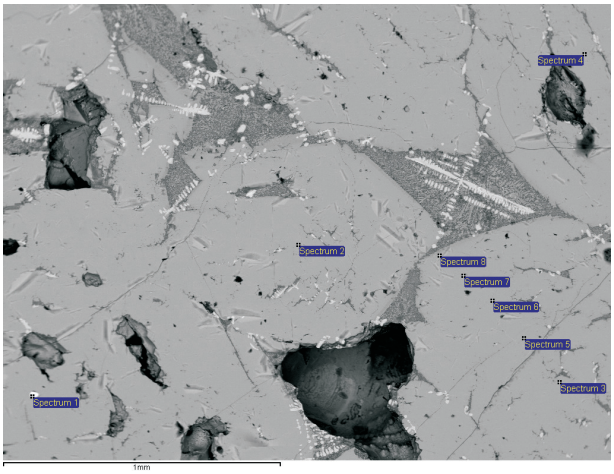
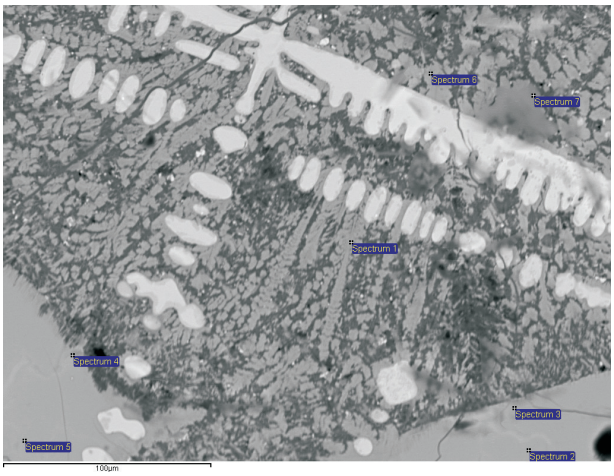

Spectrum 11
Spectrum 4
Spectrum 3
Spectrum 6
Spectrum 2
Spectrum 12
Spectrum 5
Spectrum 8
Spectrum 7
Spectrum 14
Spectrum 1
Spectrum 9
Spectrum 10
Spectrum 13
60µm

Plate 47: CFD 20C

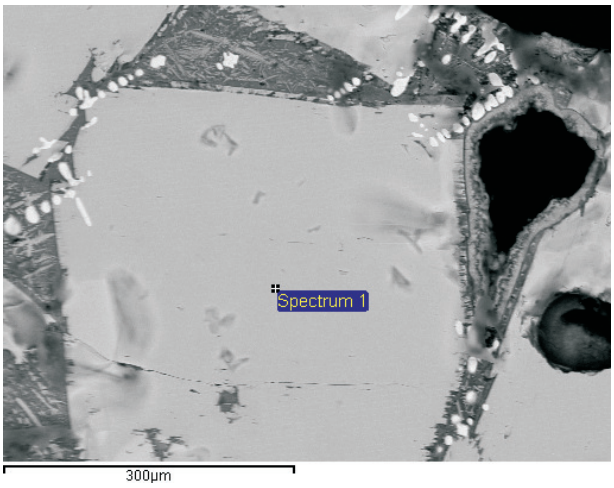
a



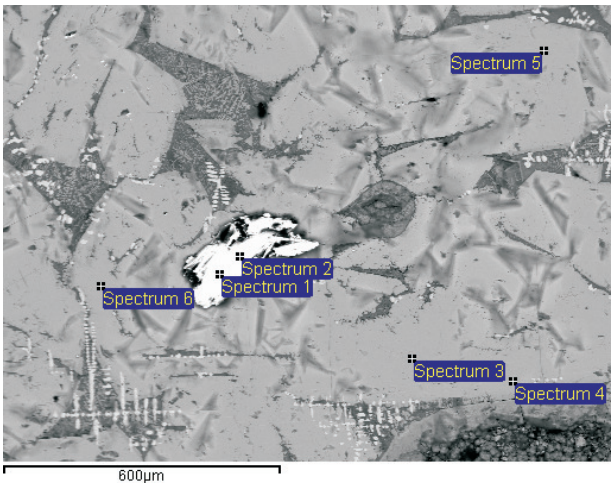


b

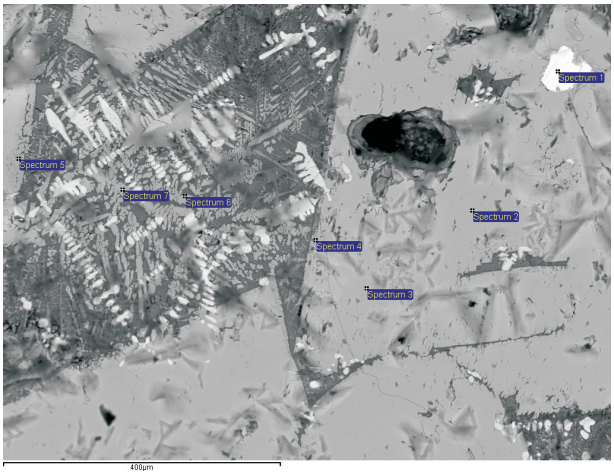
a


Spectrum 1
300µm

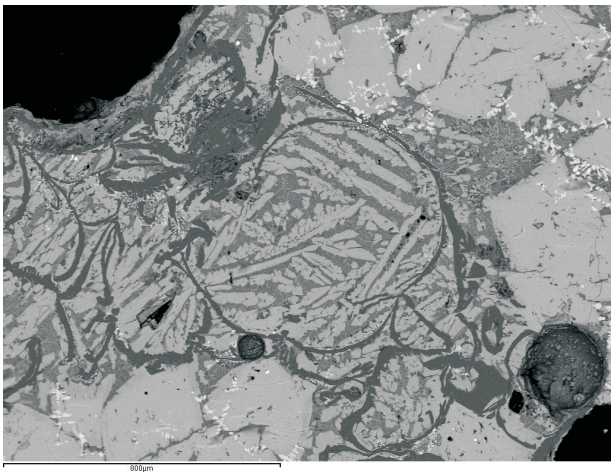
b


Spectrum 5
Spectrum 2
Spectrum 1
Spectrum 6
Spectrum 3
Spectrum 4
600µm

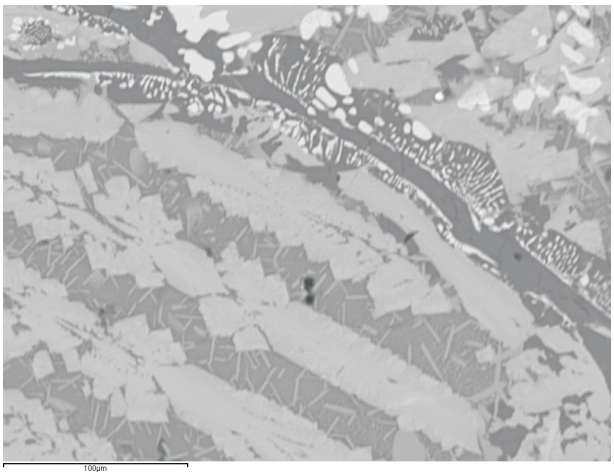
c


Spectrum 1
Spectrum 5
Spectrum 7
Spectrum 6
Spectrum 2
Spectrum 4
Spectrum 3
400µm

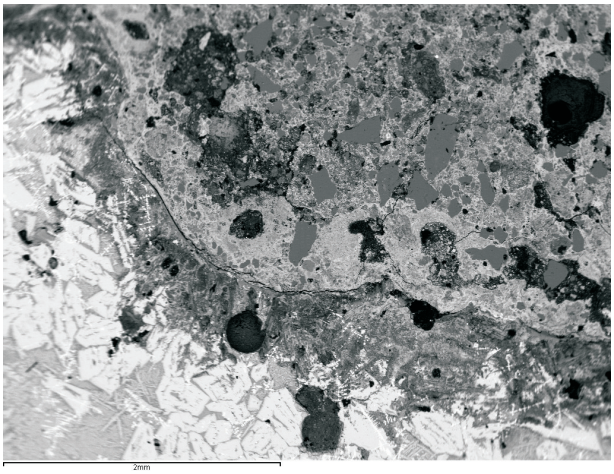
a



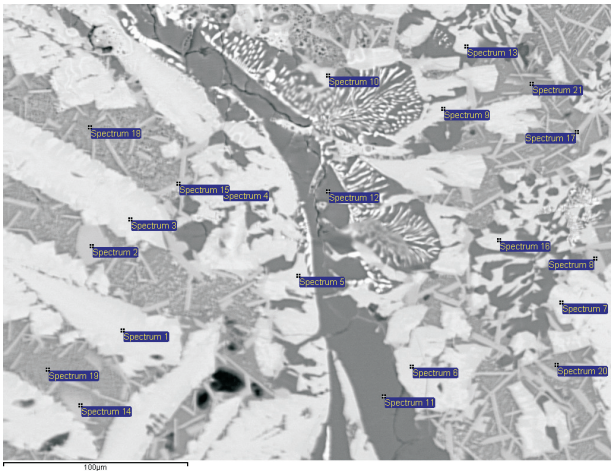
b



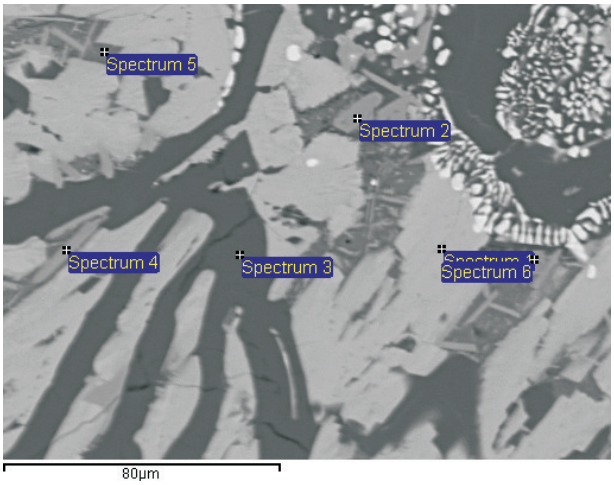
c



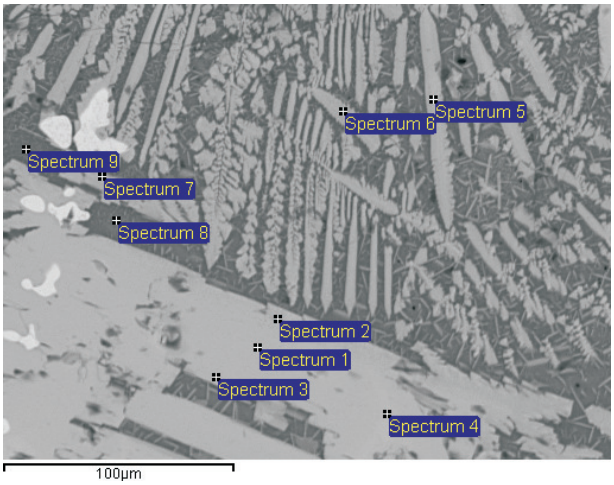
d



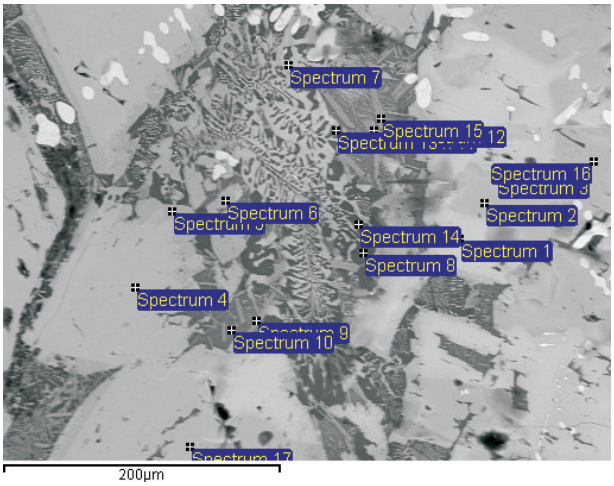
e


Spectrum 5
Spectrum 2
Spectrum 4
Spectrum 3
Spectrum 6
80µm

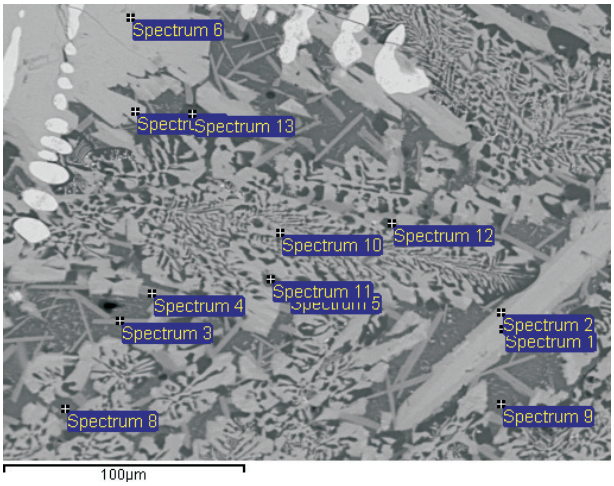
f


Spectrum 6
Spectrum 5
Spectrum 9
Spectrum 7
Spectrum 8
Spectrum 2
Spectrum 1
Spectrum 3
Spectrum 4
100µm

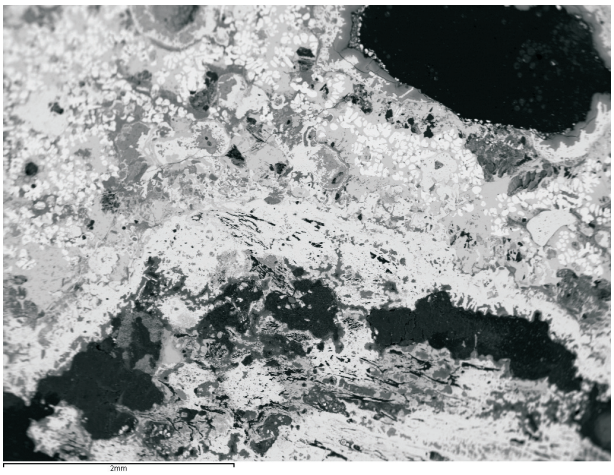
g


Spectrum 7
Spectrum 15
Spectrum 16
Spectrum 6
Spectrum 2
Spectrum 14
Spectrum 1
Spectrum 8
Spectrum 4
Spectrum 10
200µm

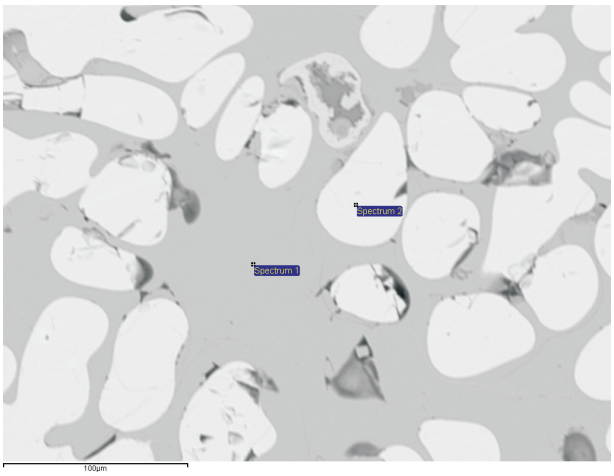
h


Spectrum 6
Spectrum 13
Spectrum 10
Spectrum 12
Spectrum 11
Spectrum 4
Spectrum 3
Spectrum 2
Spectrum 1
Spectrum 8
Spectrum 9
100µm

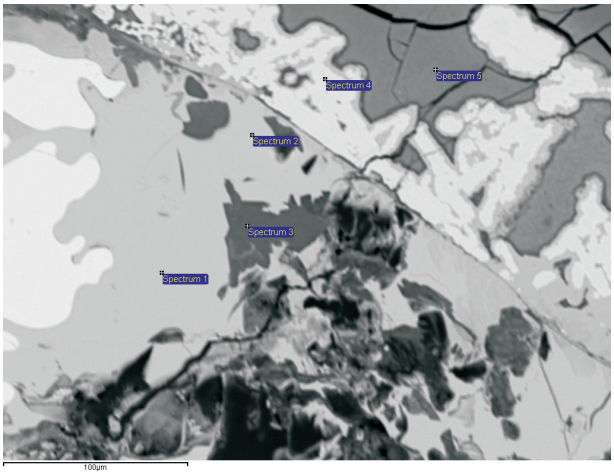
a


2mm

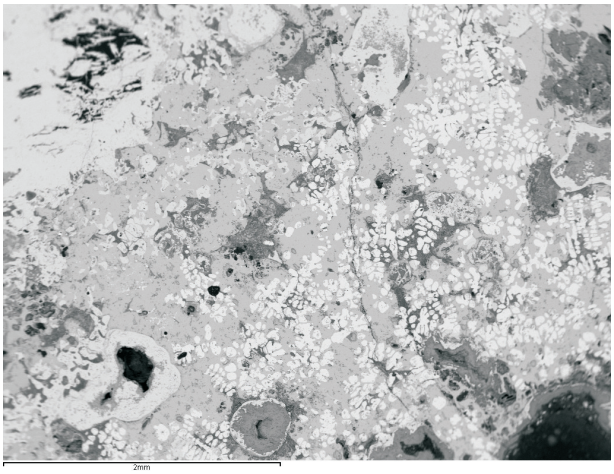
b


Spectrum 2
Spectrum 1
100µm

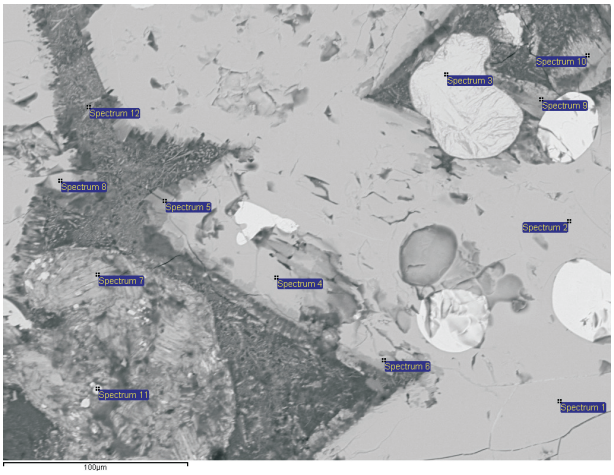
c


Spectrum 4
Spectrum 5
Spectrum 2
Spectrum 3
Spectrum 1
100µm

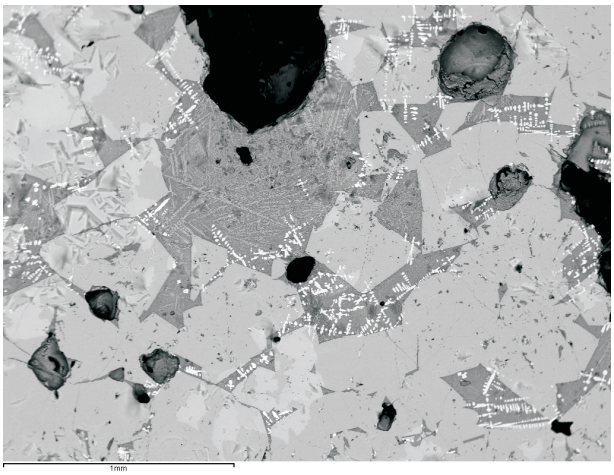
d


2mm

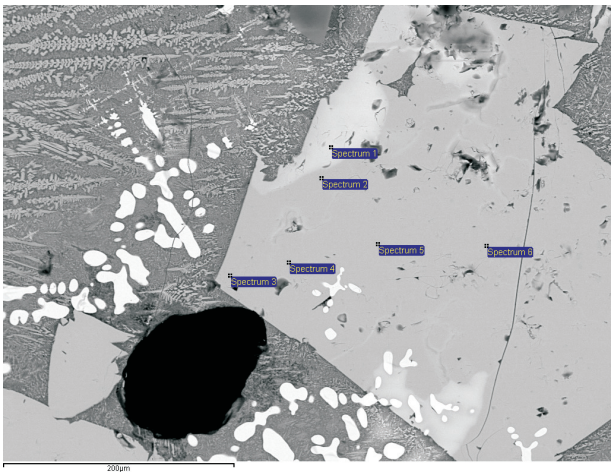
e


Spectrum 10
Spectrum 3
Spectrum 12
Spectrum 9
Spectrum 8
Spectrum 5
Spectrum 2
Spectrum 7
Spectrum 4
Spectrum 6
Spectrum 11
Spectrum 1
100µm

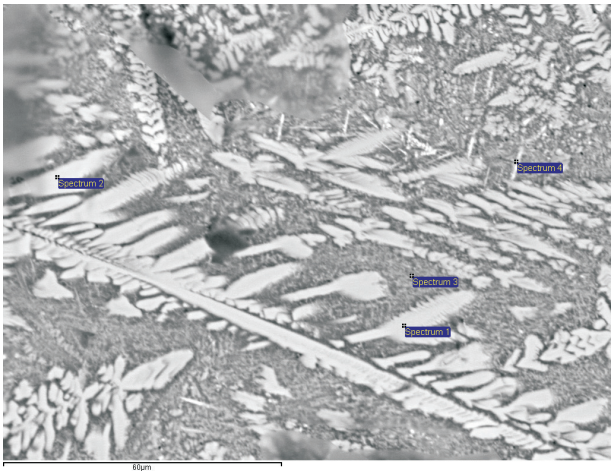
a


1mm

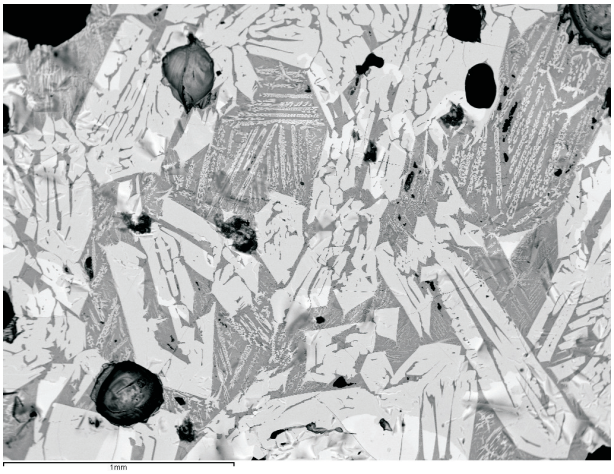
b


Spectrum 1
Spectrum 2
Spectrum 5
Spectrum 6
Spectrum 4
Spectrum 3
200µm

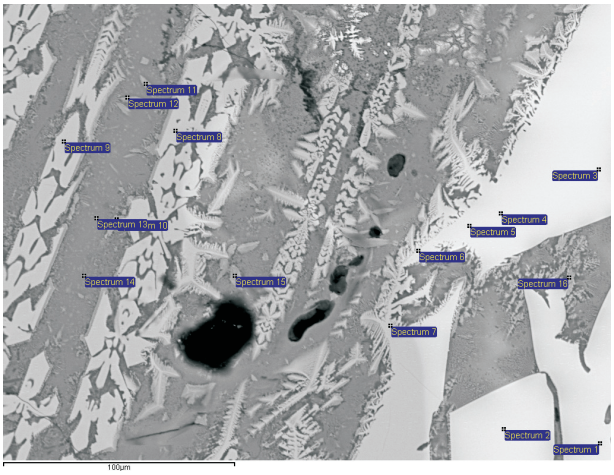
c


Spectrum 2
Spectrum 4
Spectrum 3
Spectrum 1
60µm

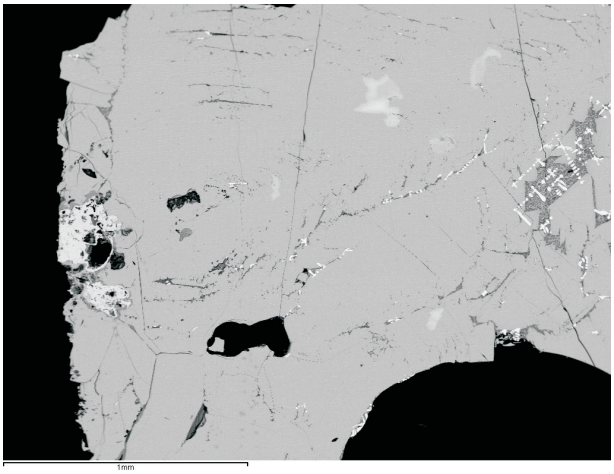
d


1mm

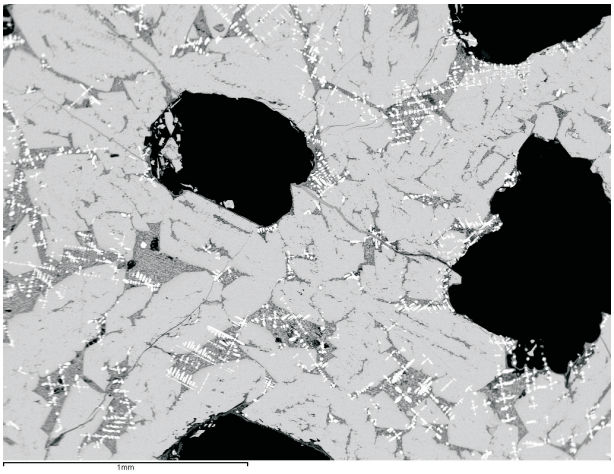
e


Spectrum 11
Spectrum 12
Spectrum 9
Spectrum 8
Spectrum 3
Spectrum 13
Spectrum 10
Spectrum 4
Spectrum 5
Spectrum 6
Spectrum 14
Spectrum 15
Spectrum 16
Spectrum 7
Spectrum 2
Spectrum 1
100µm

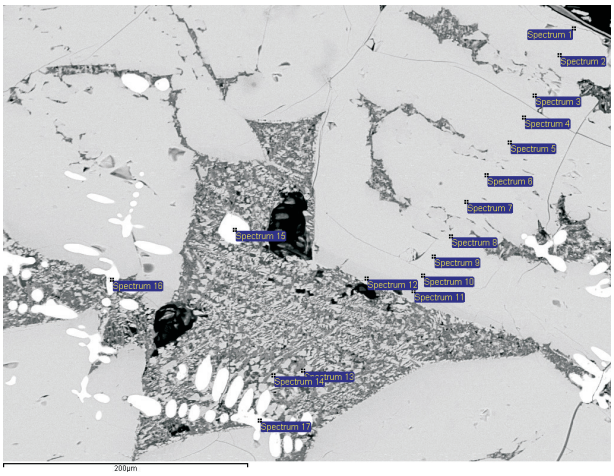
a


1mm

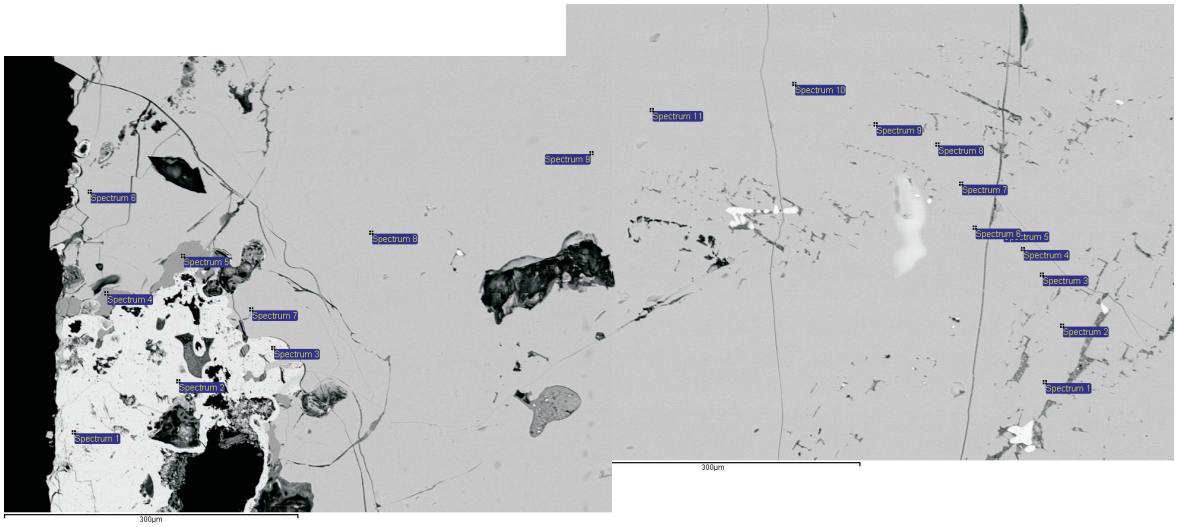
b


1mm

c


Spectrum 1
Spectrum 2
Spectrum 3
Spectrum 4
Spectrum 5
Spectrum 6
Spectrum 7
Spectrum 8
Spectrum 9
Spectrum 10
Spectrum 11
Spectrum 12
Spectrum 13
Spectrum 14
Spectrum 15
Spectrum 16
Spectrum 17
200µm

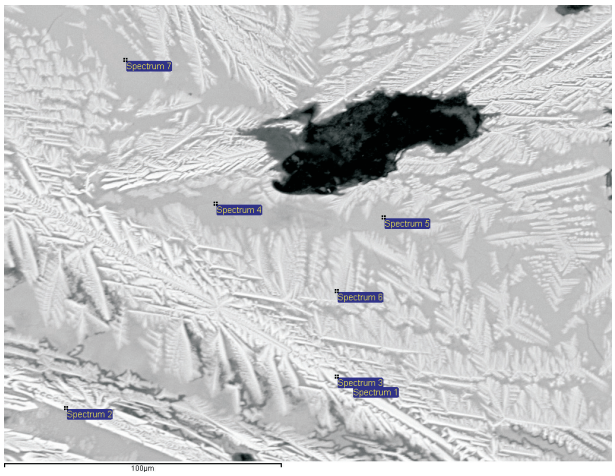
d


Spectrum 1
Spectrum 2
Spectrum 3
Spectrum 4
Spectrum 5
Spectrum 6
Spectrum 7
Spectrum 8
Spectrum 9
Spectrum 10
Spectrum 11
300µm

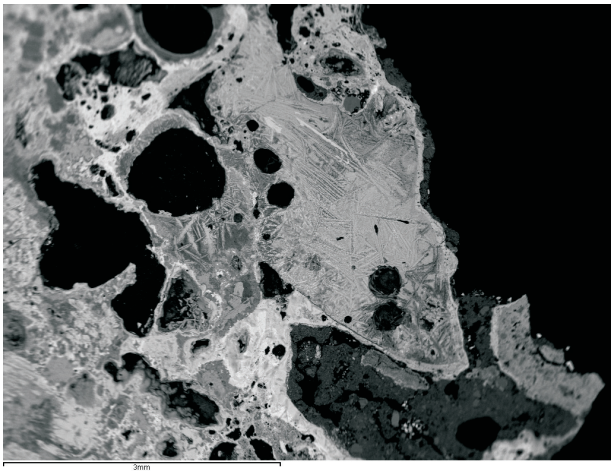
a


600µm

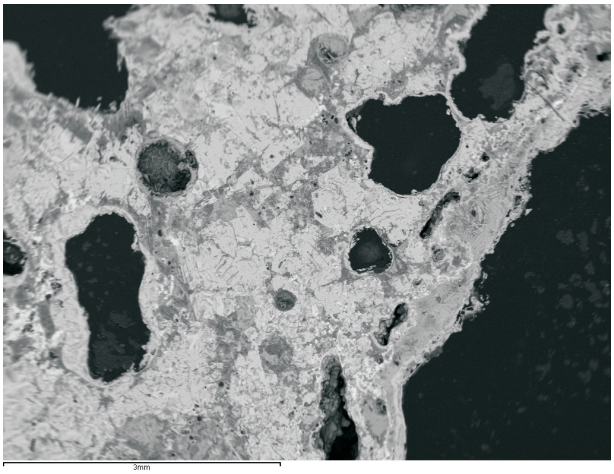
b


Spectrum 7
Spectrum 4
Spectrum 6
Spectrum 8
Spectrum 5
Spectrum 1
Spectrum 2
100µm

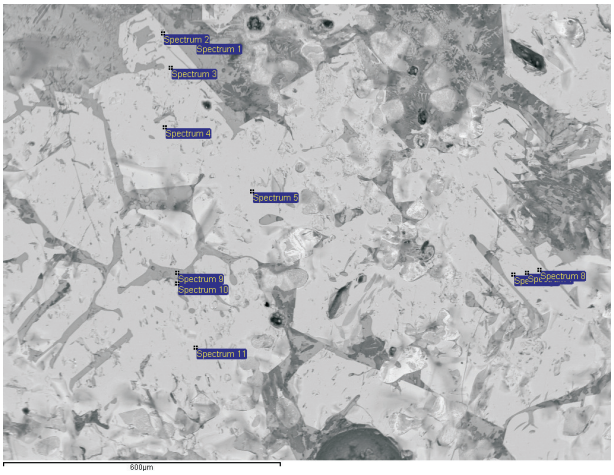
c


3mm

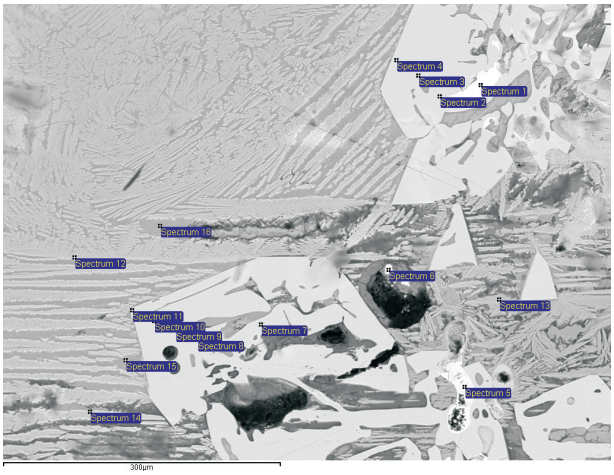
d


3mm

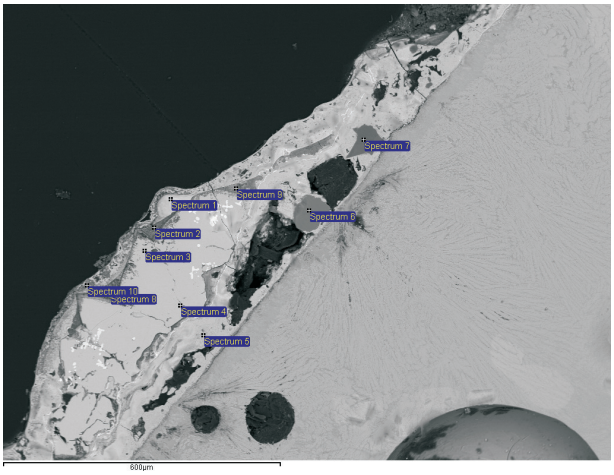
e


Spectrum 2
Spectrum 1
Spectrum 3
Spectrum 4
Spectrum 5
Spectrum 9
Spectrum 10
Spectrum 8
Spectrum 11
600µm

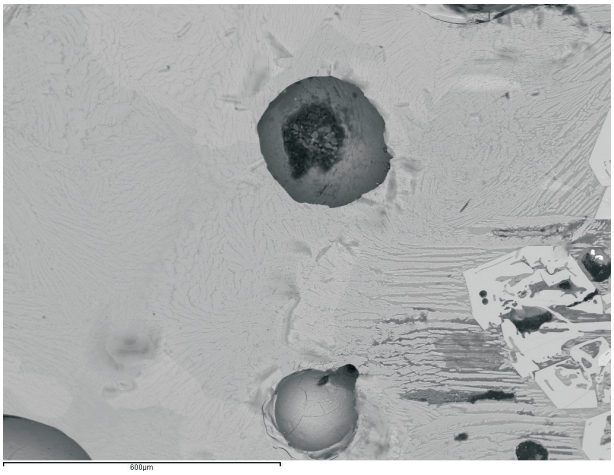
f


Spectrum 4
Spectrum 3
Spectrum 1
Spectrum 2
Spectrum 14
Spectrum 12
Spectrum 6
Spectrum 13
Spectrum 11
Spectrum 10
Spectrum 9
Spectrum 7
Spectrum 15
Spectrum 5
Spectrum 16
300µm

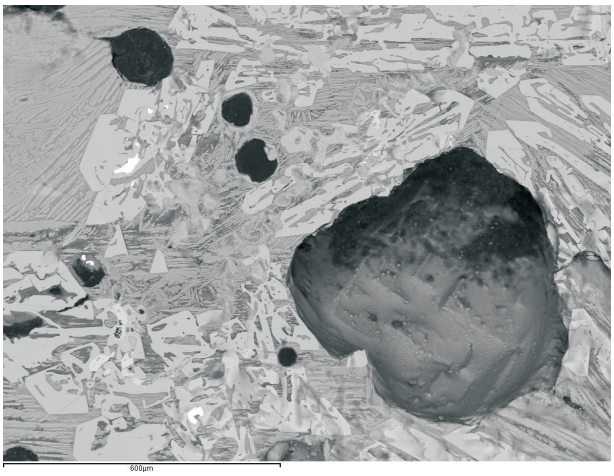
g


Spectrum 7
Spectrum 8
Spectrum 1
Spectrum 6
Spectrum 2
Spectrum 3
Spectrum 10
Spectrum 9
Spectrum 4
Spectrum 5
600µm

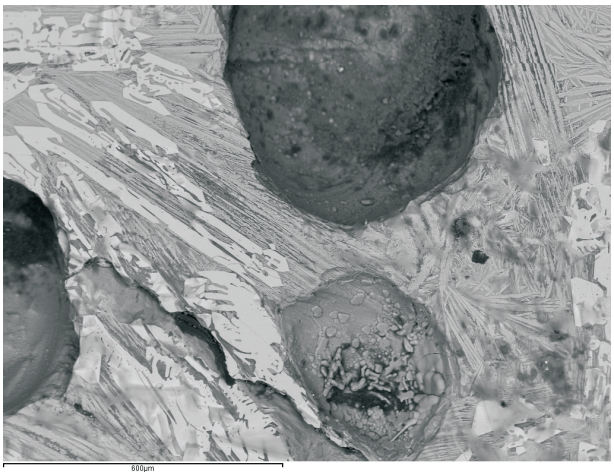
h


600µm

a



b



c

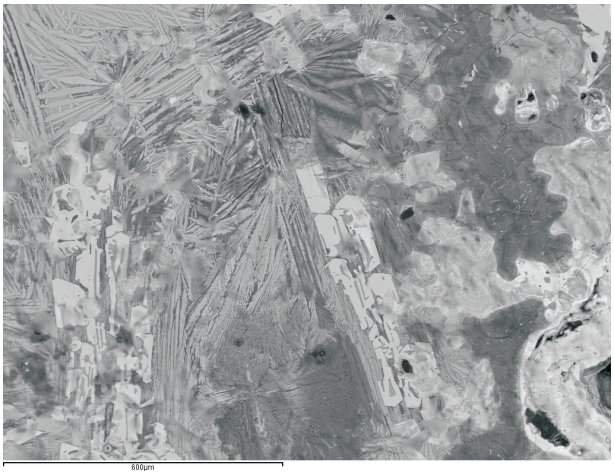
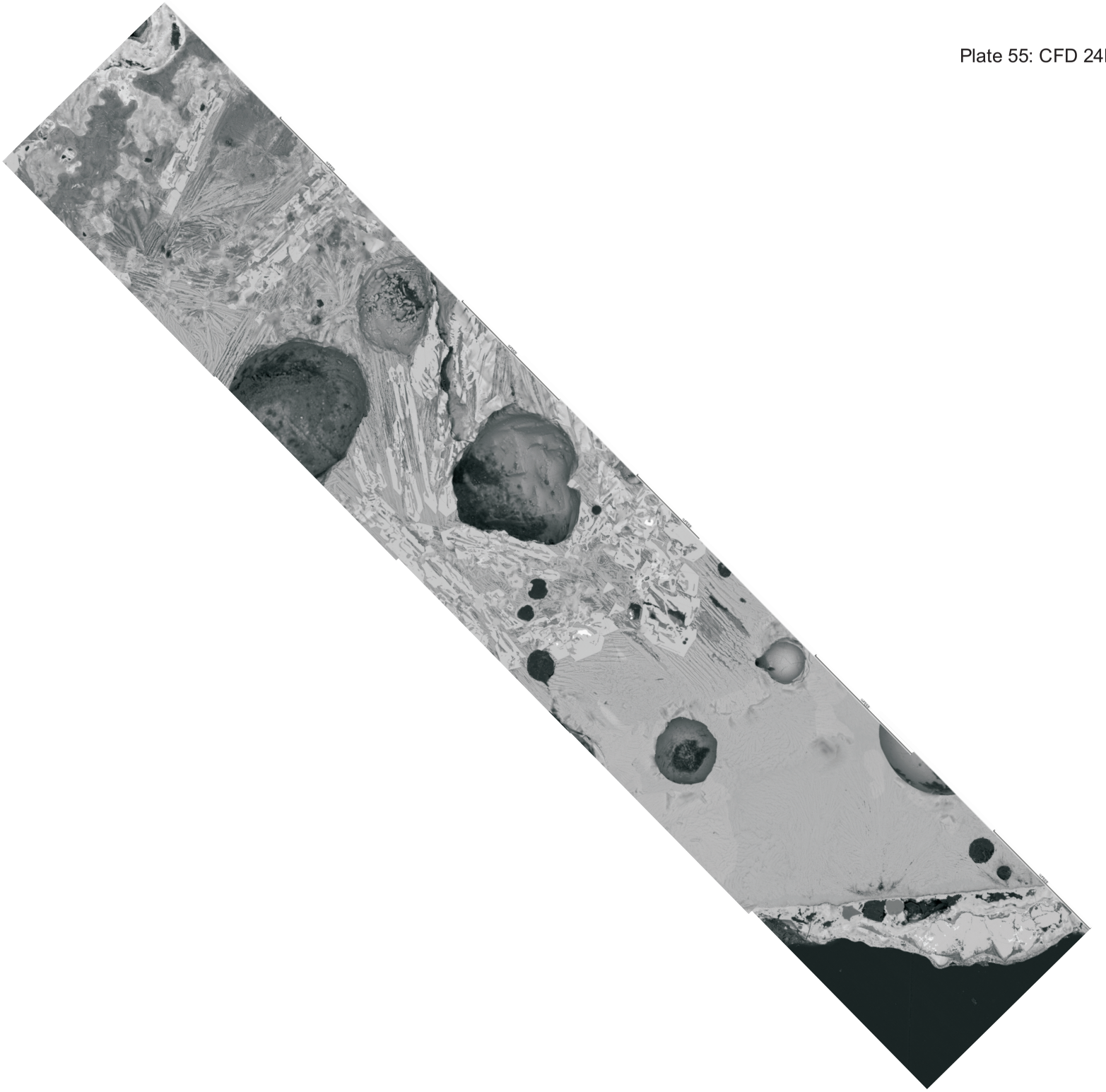
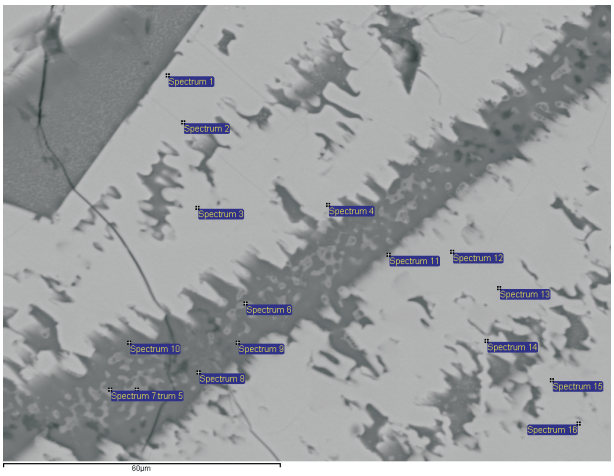


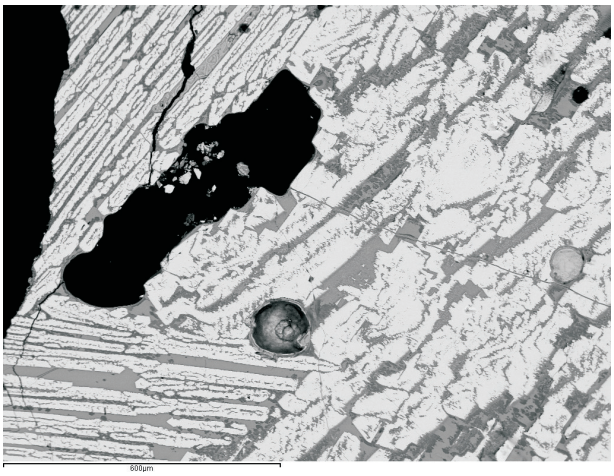
Plate 55: CFD 24B



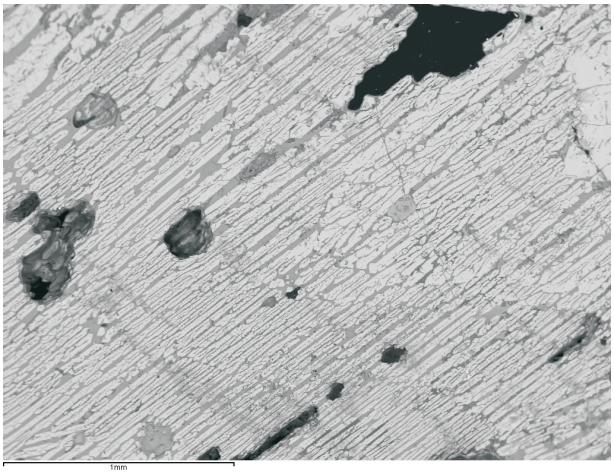
a


Spectrum 1
Spectrum 2
Spectrum 3
Spectrum 4
Spectrum 11
Spectrum 12
Spectrum 13
Spectrum 6
Spectrum 10
Spectrum 9
Spectrum 14
Spectrum 8
Spectrum 15
Spectrum 7trum 5
Spectrum 16
60µm

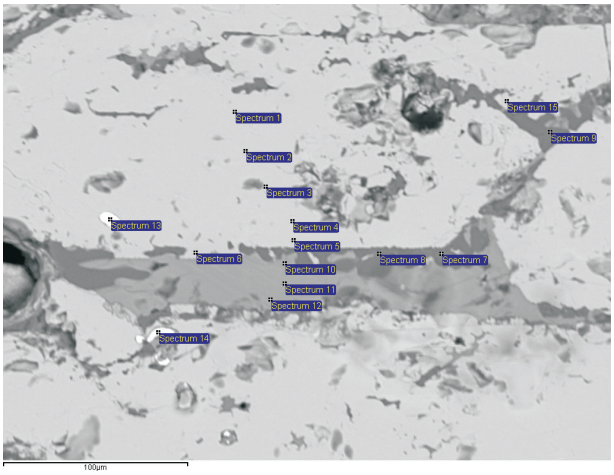
b


600µm

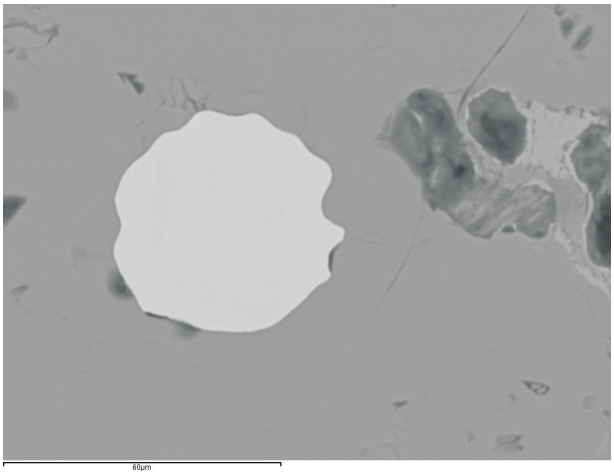
c


1mm

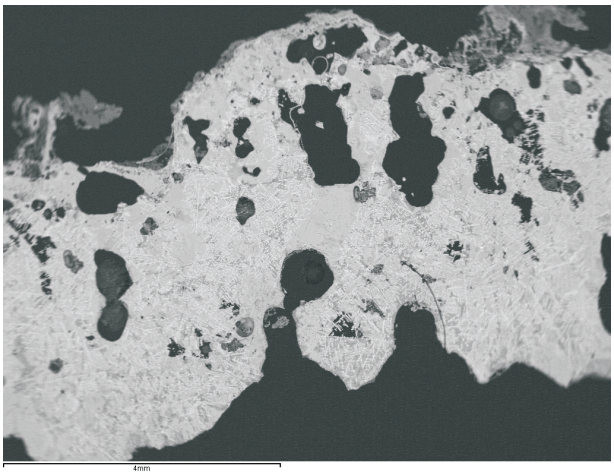
d


Spectrum 1
Spectrum 15
Spectrum 9
Spectrum 2
Spectrum 3
Spectrum 13
Spectrum 4
Spectrum 5
Spectrum 6
Spectrum 8
Spectrum 7
Spectrum 10
Spectrum 11
Spectrum 12
Spectrum 14
100µm

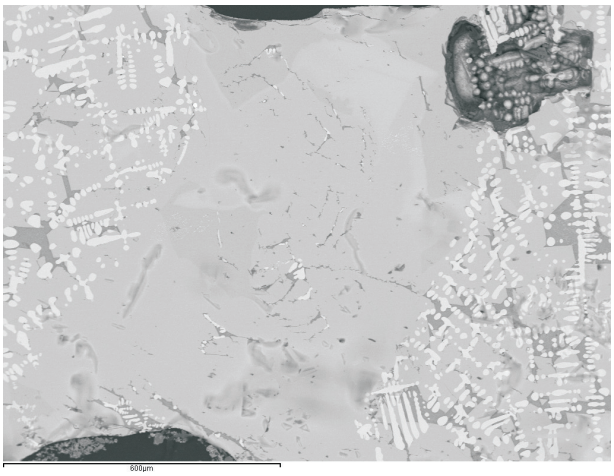
e


60µm

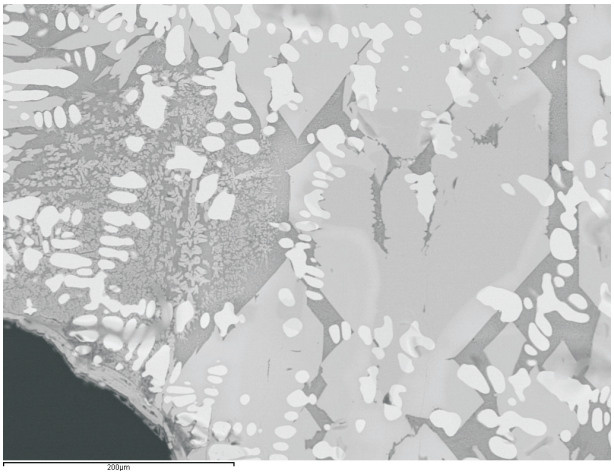
a


4mm

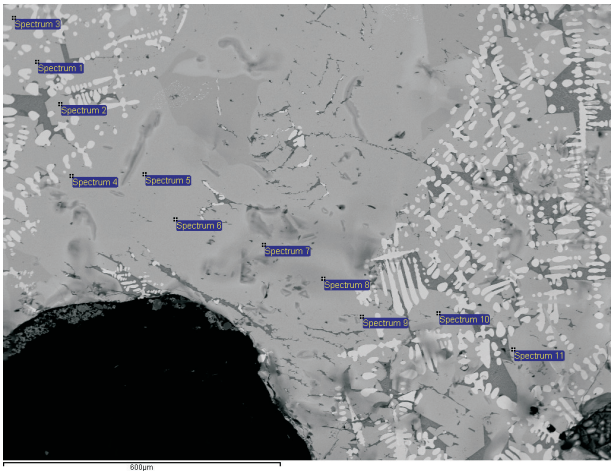
b


600µm

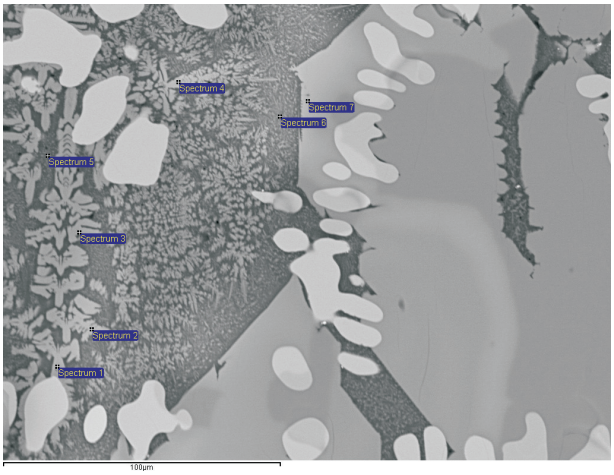
c


200µm

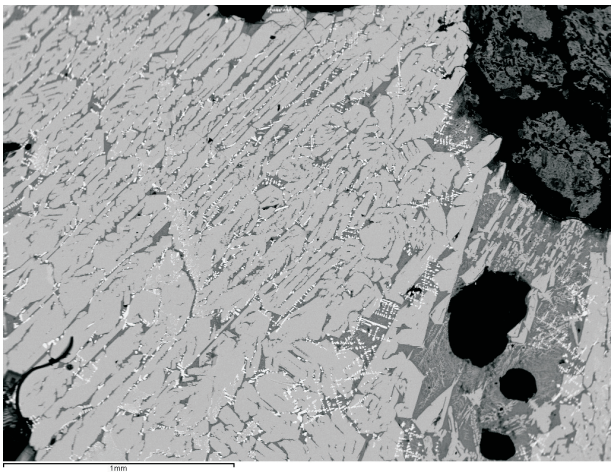
d


Spectrum 3
Spectrum 1
Spectrum 2
Spectrum 4
Spectrum 5
Spectrum 6
Spectrum 7
Spectrum 8
Spectrum 9
Spectrum 10
Spectrum 11
600µm

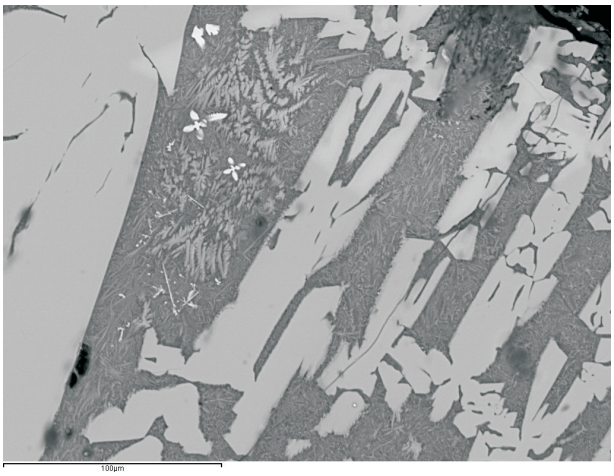
e


Spectrum 4
Spectrum 7
Spectrum 6
Spectrum 5
Spectrum 3
Spectrum 2
Spectrum 1
100µm

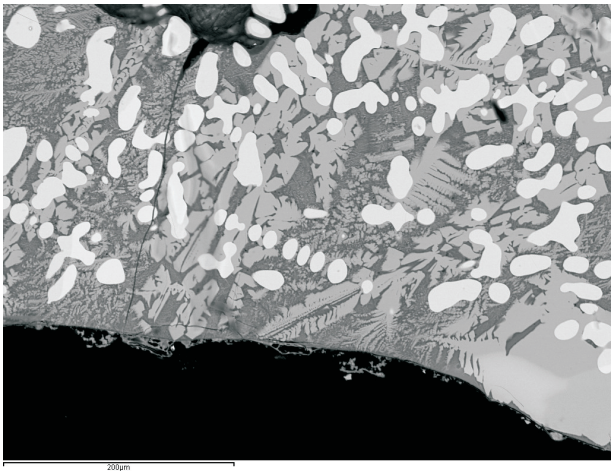
a



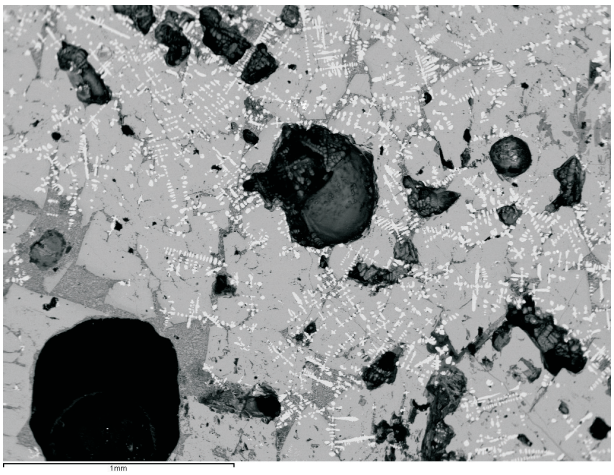
b



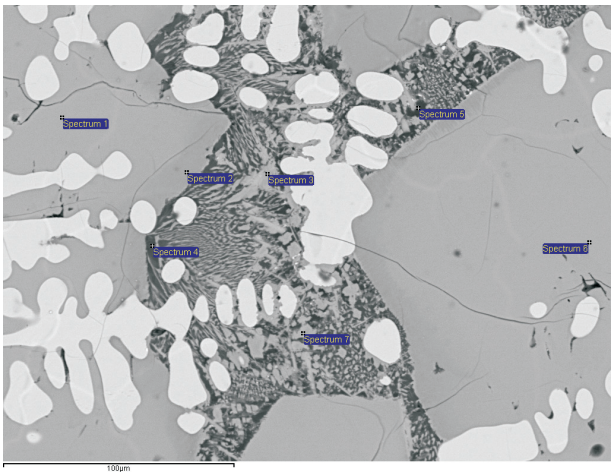
c



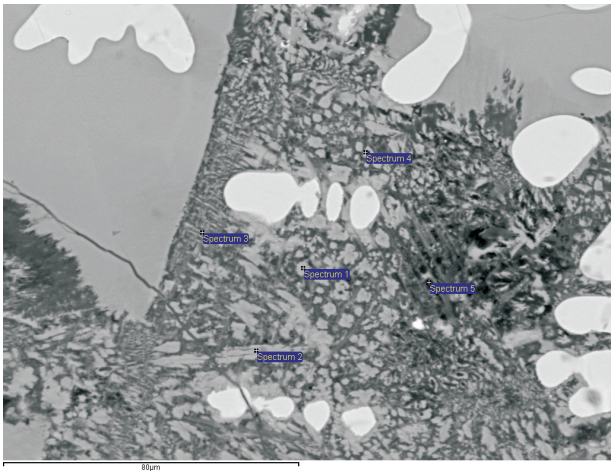
a


1mm

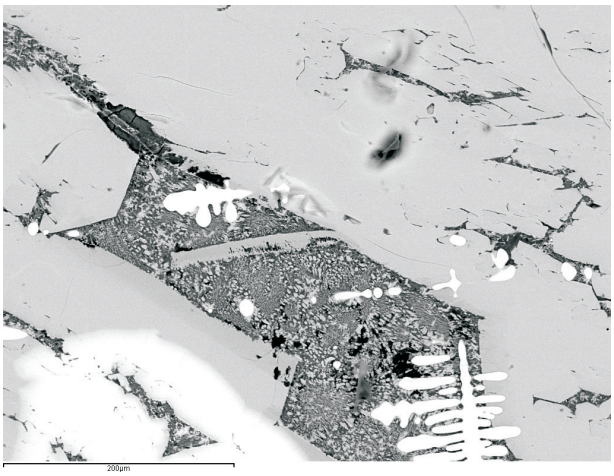
b


Spectrum 1
Spectrum 2
Spectrum 3
Spectrum 4
Spectrum 5
Spectrum 6
Spectrum 7
100µm

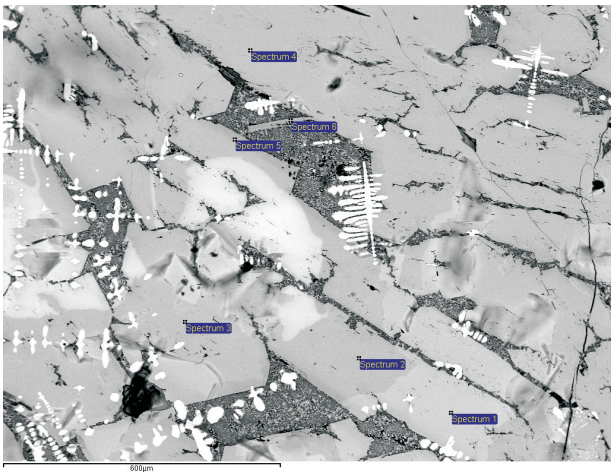
c


Spectrum 4
Spectrum 3
Spectrum 1
Spectrum 5
Spectrum 2
80µm

a


200µm

b


Spectrum 4
Spectrum 6
Spectrum 5
Spectrum 3
Spectrum 2
Spectrum 1
600µm

c

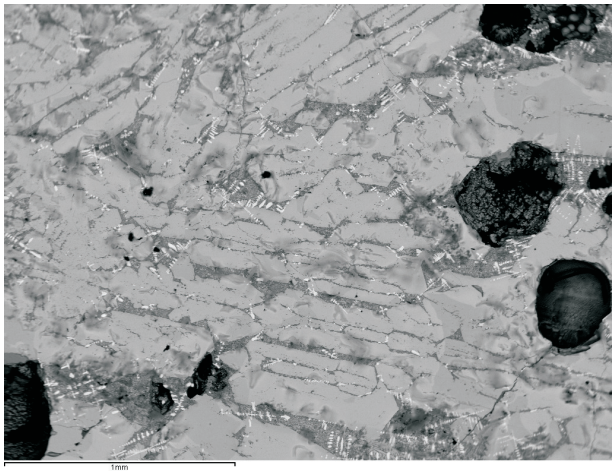
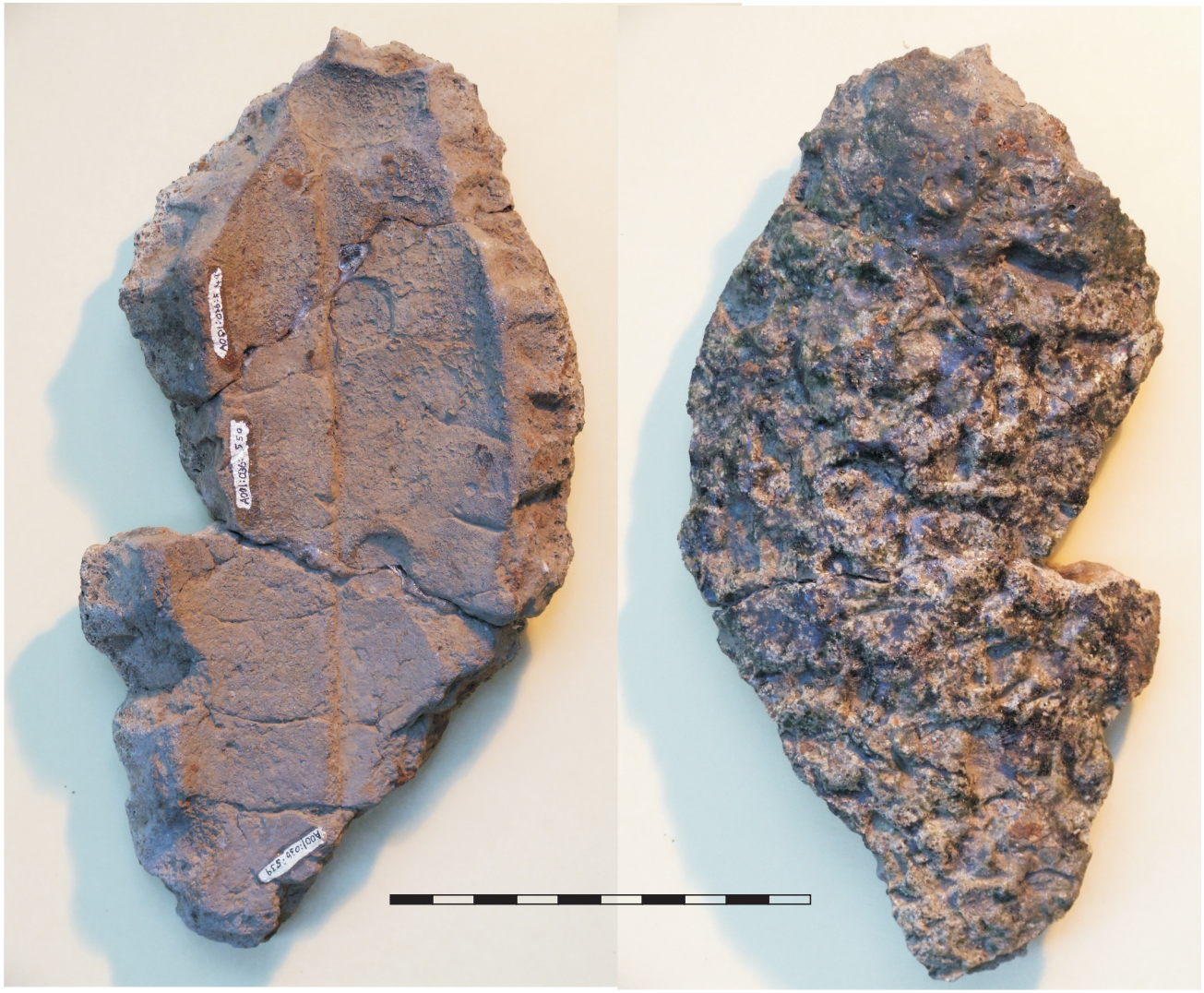

1mm

Plate 61: tuyère

Plate 62: brazing shroud



Appendix 1: summary catalogue

	material	weight	description	est. wt.
Context	**100**			
	Sample 1			
	Indet. iron slag	52	charcoal rich slag lump	
	Indet. iron slag	90	dense rounded slag nub	
	Indet. iron slag	68	piece of granular slag	
	Smithing hearth cake	342	80% of dense SHC 120x70x35	430
	Tuyère	104	probable tuyère fragment with double vitrified layer	
	Tuyère	12	vitrified clay, probably a tuyère fragment	
	Tuyère	66	tuyère fragment	
Context	**107**			
	Sample 3			
	Indet. iron slag	5735	59 larger bits of indet. Slag	
	Indet. iron slag	1115	75 smaller indet. Slag bits	
	Iron	72	iron	
	Other smithing slag	172	lining dominated mass	
	Smithing hearth cake	6565	18 pieces of thick crust SHC	
	Smithing hearth cake	3505	8 large pieces of thin crust cake	
	Smithing hearth cake	1015	v dense cake, rather deformed	1015
	Smithing hearth cake	592	conventional SHC	592
	Smithing hearth cake	608	conventional SHC	608
	Smithing hearth cake	664	dense conventional SHC	664
	Smithing hearth cake	1360	probably thin crust cake, v charcoal-rich top	1360
	Tuyère	942	19 tuyère fragments	
Context	**109**			
	Sample 37			
	Concretion	86	concretion around prob Fe piece	
	Indet. fired clay	24	melted tuyère or lining	
	Smithing hearth cake	627	5 pieces of SHC, largest 348 is a thick crust with crystal terminations	
	Smithing hearth cake	420	4 pieces of granular, finely charcoal rich to microprilly slags	
	Smithing hearth cake	446	large block from lip of thick crust cake of uncertain form	

	material	weight	description	est. wt.
Context	**113**			
	Sample 5			
	Bog ore/iron pan	1240	17 pieces of bog ore	
	Indet. iron slag	1930	10 pieces of Fe slag	
	Indet. iron slag	5315	46 smaller pieces of slag	
	Indet. iron slag	166	flowed material with internal granular crystal terminations	
	Indet. iron slag	1245	18 rounded slag pieces in bog ore	
	Other smithing slag	92	prilly slag, pro-tuyère?	
	Other smithing slag	190	slab of lining rich material, but quite dense, could be either an SHC top or pro-tuyère piece (or are these the same anyway?)	
	Other smithing slag	12	a tiny tapslag like rivulet	
	Other smithing slag	330	complexly slagged tuyère margin	
	Other smithing slag	96	small burr	
	Other smithing slag	544	3 lobate dimpled sub b/h masses	
	Smithing hearth cake	250	tiny SHC with smooth blown top	250
	Smithing hearth cake	142	possible SHC	142
	Smithing hearth cake	580	lining influenced irregular SHC with dark glassy top with pebbles. Base smooth and dimpled	580
	Smithing hearth cake	1025	part ?50% of thin crust cake	2050
	Smithing hearth cake	2220	7 large pieces of thin crust	
	Smithing hearth cake	296	tiny SHC, with smooth top	296
	Smithing hearth cake	756	90% of SHC with dished top 120x100x60	840
	Smithing hearth cake	1440	flat topped SHC with pro-tuyère blebs and prills	1440
	Smithing hearth cake	456	irregular SHC	456
	Smithing hearth cake	760	large slab of thick crust SHC	
	Smithing hearth cake	584	conventional SHC	584
	Smithing hearth cake	186	small piece of SHC with very smooth maroon top with part melted pebbles	
	Smithing hearth cake	314	pale lining dominated SHC, double layered each layer with dimpled underside and upper one with a dark glassy top	314
	Smithing hearth cake	466	irregular conventional SHC	466
	Smithing hearth cake	900	moderately dense SHC, compound with two layers, looks externally like a thin crust cake but is much too dense	900
	Smithing hearth cake	656	poorly developed charcoal rich SHC, may not be complete	656
	Smithing hearth cake	340	probable SHC, but may be part of something larger	340
	Smithing hearth cake	148	charcoal rich slag with very large fuel - 70x30mm imprint seen	
	Smithing hearth cake	312	SHC , maybe incomplete	312

material	weight	description	est. wt.
Smithing hearth cake	938	2 small fragments of large v thick crust SHC. Dense zone to 45mm	
Smithing hearth cake	368	SHC with neat circular top on much less regular lower layer	368
Smithing hearth cake	572	70% of a SHC 120dia approx, curiously has very coarse olivines in a slightly raised central area - so presumably something was above originally	820
Smithing hearth cake	720	irregular SHC, bowl is spiky and has thick plasticy flow on top	720
Smithing hearth cake	1710	slab of thick crust, crust to 50mm, prob c60%, base dimpled, top clotted	2850
Smithing hearth cake	468	conventional SHC	468
Smithing hearth cake	938	conventional SHC	938
Smithing hearth cake	596	conventional SHC	596
Smithing hearth cake	1105	chunk from a large thin crust cake, wide but very shallow	
Smithing hearth cake	668	approx 50% of thick crust cake with olivine honeycomb on top	1340
Smithing hearth cake	568	120x85x50 conventional dense SHC with charcoal rich top	568
Smithing hearth cake	2890	5 substantial thin-med crust fragments	
Smithing hearth cake	4590	40 smaller misc pieces	
Smithing hearth cake	388	conventional dense SHC 100x80x40	388
Smithing hearth cake	1415	complex double layer medium crust SHC with hollow core to upper cake	1415
Smithing hearth cake	1055	thin-med crust SHC with dense top. Has poker hole in the top 22x7mm. 130x130x80	1055
Smithing hearth cake	1655	slab of medium crust SHC with ridged base	
Smithing hearth cake	368	small piece from a thick crust cake with olive honeycomb on top	
Smithing hearth cake	2265	20 smaller slag pieces - contains both cake fragments and more amorphous pieces	
Smithing hearth cake	5155	15 pieces from large thin crust cakes	
Smithing hearth cake	2610	8 pieces from moderate to thick crust SHCs	
Smithing hearth cake	682	thin crust cake 110x110 bowl 30 deep with 30mm raised charcoal rich on top	682
Smithing hearth cake	520	incomplete charcoal-rich SHC with granular top	
Smithing hearth cake	558	irregular charcoal rich SHC	558
Smithing hearth cake	2750	6 pieces from medium to thick crust SHCs	
Smithing hearth cake	424	conventional SHC	424
Smithing hearth cake	12821	31 substantial thick crust pieces, mainly from sub-2kg SHCs	
Smithing hearth cake	454	burr	
Smithing hearth cake	356	SHC, or charcoal-rich top broken off a larger cake?	356
Smithing hearth cake	1650	3 pieces of thick crust cake	
Smithing hearth cake	1340	irregular slag cake with small SHC type bowl surmounted by large mass of rusty charcoal rich slag	1340
Smithing hearth cake	146	small thick crust fragment with marked basal ridge	

	material	weight	description	est. wt.
	Smithing hearth cake	304	probable SHC, but may be part of something larger	304
	Smithing hearth cake	366	probable SHC, but may be part of something larger	366
	Tuyère	240	4 pieces of tuyère and associated slag	
	Sample 999228			
	Smithing hearth cake	1960	110x190x60 part SHC, rectangular in plan, crust to 35, with no in fill, so concave top-prob base of big vesicle? (#228)	
	Sample 999537			
	Smithing hearth cake	3000	230x(150)x100, dense bowl to 60mm thick, pyramidal (CFD19 #537)	5450
Context	**114**			
	Sample 7			
	Indet. iron slag	1156	31 smaller pieces	
	Indet. iron slag	4315	62 small slag pieces	
	Other smithing slag	138	low density slag, maybe tongue	138
	Smithing hearth cake	360	v small part of thick crust	
	Smithing hearth cake	610	small part (burr?) of large SHC	
	Smithing hearth cake	640	3 pieces of cavernous material - extreme honeycomb or corroded?	
	Smithing hearth cake	560	deformed SHC or piece	
	Smithing hearth cake	544	deformed SHC or piece	
	Smithing hearth cake	340	deformed SHC or piece	
	Smithing hearth cake	1620	7 smaller pieces of thick crust	
	Smithing hearth cake	390	<30% of SHC with honeycomb	1300
	Smithing hearth cake	548	deformed SHC or piece	
	Smithing hearth cake	524	50% of SHC with honeycomb top	1050
	Smithing hearth cake	1225	5 substantial thin crust pieces	
	Smithing hearth cake	282	cake fragment	
	Smithing hearth cake	5620	18 pieces of normal type and thicker crust SHCs. Most appear to be from 1-2kg normal-thick crust cakes. 1 piece is probably from a larger SHC.	
	Smithing hearth cake	1085	c70% of SHC	1550
	Smithing hearth cake	378	v small part of thick crust	
	Smithing hearth cake	626	wide SHC 100x130x45	626
	Smithing hearth cake	1000	c70% of SHC. Base of slag shows bumps from riddling through hearth	1430
	Smithing hearth cake	582	piece with two rod marks on base	582
	Smithing hearth cake	420	deformed SHC or piece	
	Smithing hearth cake	538	70% of SHC, smooth top with big smooth vesicles	770
	Smithing hearth cake	288	possible small SHC	288

	material	weight	description	est. wt.
	Smithing hearth cake	364	most of small SHC	400
	Smithing hearth cake	784	50% of smooth top SHC	1570
	Smithing hearth cake	268	small piece of thin crust	
	Tuyère	264	3 pieces of tuyère, plus 1 piece of low density slag with tuyère attachment	
Context	**116**			
	Sample 10			
	Smithing hearth cake	2835	6 substantial thick crust SHC fragments	
	Smithing hearth cake	3975	9 substantial thin - medium crust fragments	
	Smithing hearth cake	626	conventional dense SHC, 110x100x40 (CFD5 #613)	626
	Smithing hearth cake	810	curious cubical block of dense slag - probably part of a thick crust cake	
	Smithing hearth cake	820	SHC 130x120x55 dense SHC with charcoal on top	820
	Smithing hearth cake	566	SHC with hollowed top full of mineralised charcoal (CFD4 #612)	566
	Smithing hearth cake	950	80% of dense thick crust SHC, 150x130x55	1190
	Smithing hearth cake	1960	16 small SHC fragments	
	Smithing hearth cake	564	v coarse charcoal rich slag block - not clear if really an SHC	
	Smithing hearth cake	556	80% of conventional flat top SHC (CFD6 #611)	695
	Smithing hearth cake	692	elongate SHC 140x110x40 with concave smooth top	692
	Smithing hearth cake	420	90x90x40 compact dense SHC (CFD1 #614)	420
	Smithing hearth cake	472	100x60x50 50% of SHC	940
	Smithing hearth cake	634	110x100x50 dense SHC	634
	Tuyère	198	1 significant and 3 tiny pieces of tuyère. Prob 140mm diameter	140
Context	**117**			
	Sample 27			
	Indet. iron slag	808	7 indet. Pieces of Fe slag	
	Indet. iron slag	346	indeterminate Fe-slags, uncounted	
	Other smithing slag	60	slag mass broken from below tuyère	
	Smithing hearth cake	1580	shallow thin crust SHC 145x180x80, dimpled base, rusty top, charcoal rich slag around probable proximal end.	1580
	Smithing hearth cake	560	60-70% of thick crust SHC 80x110x40	860
	Smithing hearth cake	2010	7 substantial SHC fragments, thick, prob dia c 130 typical	
	Smithing hearth cake	1375	145x140x90 multilayer thin crust cake. Blown surface on top layer. Good organics (CFD10 #615)	1385

	material	weight	description	est. wt.
Context	**118**			
	Sample 32			
	Indet. iron slag	426	5 pieces of highly vesicular "frothy" slag	
	Indet. iron slag	94	low density slag with lining or tuyère attached	
	Indet. iron slag	402	4 small pieces of slag, partly coated in bog ore	
	Smithing hearth cake	340	small corroded SHC, with straw in concretion	340
	Smithing hearth cake	1770	5 dense SHC pieces	
	Smithing hearth cake	1125	slab from a thin crust cake granular centre, worn and concreted	
	Smithing hearth cake	220	curious v weathered siliceous looking SHC. Some red staining. 80x70x30. Is this possibly associated with Cu working?	220
	Tuyère	44	tuyère sherd	
Context	**119**			
	Sample 371			
	Indet. iron slag	46	undiagnostic slag	
	Tuyère	2	vitrified clay, prob. tuyère fragment	
Context	**125**			
	Sample 130			
	Indet. iron slag	52	three small pieces of Fe-slag	
	Natural stone	40	stone	
	Smithing hearth cake	96	tiny SHC 60dia	96
Context	**126**			
	Sample 21			
	Smithing hearth cake	804	piece from massive thick crust SHC, basal crust to 60, charcoal-rich slag layer to 10, guess at 25-40%, original 150-200 diameter Lead grey colour. Top has clotted texture directly overlain by buff ashy charcoal-rich layer	2500
	Smithing hearth cake	785	massive, worn, double cake with earlier crust protruding rather than simply stacked	785
	Smithing hearth cake	716	slightly dished SHC with large slag lobe hanging from centre of base	716
Context	**127**			
	Sample 48			
	Indet. iron slag	826	11 pieces of Fe slag	
	Natural stone	660	stone	

	material	weight	description	est. wt.
	Smithing hearth cake	358	highly deformed lump of crust - not clear if this an SHC or just a part	
	Smithing hearth cake	430	small dense conventional SHC	430
	Smithing hearth cake	226	part of small dense SHC	
	Smithing hearth cake	934	massive irregular coarse-grained slag block, voids have platy olivines. Possibly burr area of a thick crust cake, but not certain	
	Smithing hearth cake	316	probably incomplete friable charcoal-rich slag	
	Smithing hearth cake	432	small piece of thick crust SHC, crust to 50mm	
	Tuyère	176	3 pieces of tuyère	
Context	**128**			
	Sample 14			
	Concretion	122	concretion containing large nail	
	Indet. fired clay	20	2 pieces of vitrified clay	
	Indet. iron slag	3155	34 pieces of Fe slag	
	Indet. iron slag	202	tap slag like flow, 120x80x30	
	Indet. iron slag	120	4 small pieces of slag	
	Smithing hearth cake	1015	small piece from massive thick crust cake	
	Tuyère	58	slagged tuyère tip	
	Sample 999092			
	Smithing hearth cake	9910	320x280x150 irregularly hemispherical SHC, dense outer crust, but all slightly friable, 1 end looks horseshoe like in plan, open end protrudes in more friable material (#92)	1074
Context	**129**			
	Sample 25			
	Concretion	114	2 pieces of prob concretion around iron	
	Indet. iron slag	540	18 small slag pieces	
	Indet. iron slag	48	small piece of contact between fired clay and charcoal-rich slag	
	Indet. iron slag	198	3 undiagnostic slag pieces	
	Iron	46	corroded iron	
	Iron	10	2 small iron pieces	
	Smithing hearth cake	784	2 pieces of broken deep bowl, thin crust, very prilly between charcoal voids	
	Tuyère	10	small tuyère sherd (not weighed individually!)	
	Sample 403			
	Indet. iron slag	22	2 pieces of ashy slag	
	Iron	6	corroded iron sheet	
	Sample 5000			

material	weight	description	est. wt.
Smithing hearth cake	672	c60% of low convexity SHC with vesicular crust	1120
Smithing hearth cake	2730	small part of large bowl with accretionary material, probably very big	
Smithing hearth cake	2030	60% dense crust with core of granular material in hollow, c190 diameter, 90 deep, crust to 50mm	3380
Smithing hearth cake	764	25% 180 dia x 60 thick highly vesicular SHC	3060
Smithing hearth cake	962	50% of SHC, 180 dia x 60 thick, dense slag bowl with smooth top with fine charcoal rich slag adhering to top	1920
Smithing hearth cake	702	130x110x50 SHC with charcoal rich core	702
Smithing hearth cake	1135	c80% of SHC, thick crust with tubular vesicles, core granular 140x140x60	1420
Smithing hearth cake	1420	c40-60% of v thick SHC, dense smooth top, 190x190x75	2840
Sample 5002			
Indet. fired clay	10	fired clay	
Indet. iron slag	46	4 pieces of indet slag	
Iron	4	corroded iron	
Iron	8	corroded iron	
Sample 999057			
Crucible	2	#28, rim from moderately tight corner, pale ext. Glaze	
Crucible	25	#197, large sherd with complete profile of triangular crucible, light external glazing, slight oxidised firing internally	
Crucible	7	#195, sherd extending up side to tight corner, probably accentuated for use as a pouring lip	
Crucible	3	#83, body sherd near angle, hard pale grey	
Crucible	3	#80, sherd running up wall to thin rim, pale gey externally, buff internally, hair tempered	
Crucible	5	#457, body sherd, grey externally, buff internally	
Crucible	5	#171, grey, rather irregular rim sherd from near angle	
Crucible	3	#59 lower body sherd, grey	
Crucible	4	#88, partially oxidised fired rim sherd	
Crucible	5	#66, body sherd	
Crucible	3	#40, oxidised fired sherd with flat rim on thick incurved side	
Crucible	3	#74, body sherd in grey fabric	
Crucible	4	#79, body sherd in hard pale fabric	
Crucible	15	#524, base from rather thick triangular crucible, well vitrifed and dark externally, but orange on inside	
Crucible	4	#77, wide splayed irregular rim, buff on inside, v pale external glaze.	
Crucible	4	#82, sherd from planar side into angle	
Crucible	5	#81, sherd from near base to rim in tight angle	
Crucible	5	#65, body sherd, slightly buff internally	
Crucible	1	#78, rim with tight corner	

	material	weight	description	est. wt.
	Crucible	3	#57, base sherd, grey	
	Crucible	5	#53, base sherd, pale grey	
	Crucible	2	#60, fine grey fabric, hint of buff, v fine fabric	
	Tuyère	3	dark glazed piece of orange ceramic, probalby a tuyère sherd, #78	
	Tuyère	7	#136, angle of tuyère front	
Context	**130**			
	Sample 16			
	Indet. iron slag	382	4 pieces of irregular charcoal rich slag	
	Smithing hearth cake	160	small piece of thick crust cake	
	Tuyère	102	2 pieces of c120 diameter tuyère	120
Context	**131**			
	Sample 58			
	Indet. iron slag	32	small tap slag like prilly flow	
	Indet. iron slag	128	5 small Fe-slag pieces	
Context	**132**			
	Sample 46			
	Indet. iron slag	1695	27 odd bits of slag	
	Indet. iron slag	844	5 largish pieces of porous slag	
	Smithing hearth cake	1015	SHC, 130x120c40 plus lump on top going up an extra 30	1015
	Smithing hearth cake	680	open granular SHC like object	
	Smithing hearth cake	258	90x85x30	258
	Smithing hearth cake	470	charcoal rich prob SHC on two layers	470
	Smithing hearth cake	406	v cavernous prob. SHC	
	Smithing hearth cake	702	maximum of 25% of thick crust SHC, crust to 35, bowl 80 deep, hollow	2800
	Smithing hearth cake	550	margin of deep bowl, filled with charcoal-rich material, 90 deep, extends 45 in from margin, thin crust with quite smooth outer surface, crust appears to extend across top	
	Smithing hearth cake	1425	85% of SHC 130x100x70	1680
	Smithing hearth cake	328	90x60x35 SHC fragment	
	Smithing hearth cake	2280	5 large dense fragments	
	Smithing hearth cake	614	dense SHC, 100x110x35	614
	Smithing hearth cake	850	90% of SHC 130x90x55	940
	Tuyère	92	3 tuyère fragments	
	Sample 71			

material	weight	description	est. wt.
Indet. iron slag	5100	misc iron slag, no of pieces not recorded	
Indet. iron slag	68	2 pieces of convoluted lining slag prills	
Indet. iron slag	6576	53 larger slag pieces	
Indet. iron slag	790	fine debris	
Smithing hearth cake	616	SHC with top missing revealing interior honeycomb	616
Smithing hearth cake	658	part of double layer SHC, not possible to judge original size	
Smithing hearth cake	490	part of thick crust SHC with 40-50 crust and "coralline" texture above	
Smithing hearth cake	414	small irregular SHC	414
Smithing hearth cake	584	3 pieces of SHC showing some flowage of slag out of the cakes	
Smithing hearth cake	548	small SHC with flown top	548
Smithing hearth cake	1510	approx 50% of thick crust cake	3020
Smithing hearth cake	228	small irregular SHC	228
Smithing hearth cake	212	small irregular SHC	212
Smithing hearth cake	468	small SHC (CFD3 #617)	468
Smithing hearth cake	370	small irregular SHC	370
Smithing hearth cake	224	small irregular SHC	224
Smithing hearth cake	514	part of v dense SHC	
Smithing hearth cake	242	small irregular SHC	242
Smithing hearth cake	206	small irregular SHC	206
Smithing hearth cake	1090	140x110x80 rather conical SHC	1090
Smithing hearth cake	2430	perfect SHC, bowl 180x160x70 with additional 30 upstanding material. Some charcoal on top but mainly pale blebby flows proximally. On proximal margin shows flows leaking over edge. Fine organics on base	2430
Smithing hearth cake	2450	slightly incomplete thin crust cake, 220x200x90, labelled #216 (CFD12 #616)	2450
Tuyère	96	part of tuyère face 130-150 dia, flat face was inclined to hearth	140
Tuyère	126	part of base of tuyère with slag running back under it, bears imprint of 7x12mm poker	
Tuyère	30	small piece of tuyère face	
Tuyère	588	27 pieces of tuyère, small diam	140
Sample 220			
Smithing hearth cake	294	piece from a thin crust bowl, outside looks granular, inside is "coralline", crust <10mm	
Smithing hearth cake	508	250mm diameter cake fragment with 90 degree arc, preserved in 50mm from edge. Outside is granular, inside "coralline". V thin crust	
Sample 270			
Smithing hearth cake	843	part of thin crust cake c 200mm diameter	
Sample 999210			
Smithing hearth cake	7870	260x220x100, channel like SHC, large block	9260

	material	weight	description	est. wt.
	Sample 999217			
	Smithing hearth cake	2590	140x180x50, flat topped dense slag puddle (CFD18 #217)	2880
	Sample 999535			
	Smithing hearth cake	2415	190x160x80, neatly rounded SHC, dense crust, pebble on base (CFD 11 #535)	2415
	Sample 999541			
	Smithing hearth cake	1540	170x130x50 c60% of flat topped SHC, lower crust dense 20mm, infill friable, lower smooth dimpled with earlier slag pieces stuck on (#541)	2560
Context	**136**			
	Sample 30			
	Smithing hearth cake	122	4 small slag pieces	
	Tuyère	40	badly melted tuyère fragment	
Context	**137**			
	Sample 41			
	Indet. iron slag	136	3 pieces of lining attached to dark slag. Not certainly part of tuyère	
	Indet. iron slag	166	flowed slag attached to lining	
	Indet. iron slag	3100	misc iron slags, including lots of charcoal-rich material	
	Smithing hearth cake	360	small piece from top angle of big, somewhat hollow, SHC	
	Smithing hearth cake	320	incomplete small SHC	
	Smithing hearth cake	1540	c50% of SHC, imperfect growth, possibly indicating partial clearance of hearth	3080
	Tuyère	578	9 pieces of a v large tuyère. Coarse tempered fabric. Small area of hole suggests large diameter (or square hole?). tuyère block must have been around 200mm	200
Context	**139**			
	Sample 144			
	Indet. iron slag	6930	110 indet. Slag pieces	
	Indet. iron slag	116	exploding piece - probably contains iron	
	Indet. iron slag	600	4 pieces of variably flowed material	
	Other smithing slag	96	small slag flow from lower face of a tuyère	
	Other smithing slag	356	2 sub b/h dimpled masses	
	Smithing hearth cake	312	small SHC	312
	Smithing hearth cake	612	double layer SHC	612
	Smithing hearth cake	1070	part of a double SHC, upper bowl dense, lower one apparently less so.	

material	weight	description	est. wt.
Smithing hearth cake	796	irregular SHC, contains slab of older cake	796
Smithing hearth cake	692	flat top with hollow, SHC	692
Smithing hearth cake	5565	18 pieces of broken thick crust cake	
Smithing hearth cake	352	irregular SHC	352
Smithing hearth cake	652	slightly incomplete SHC	700
Smithing hearth cake	166	small SHC, broken, with flowage on break	
Smithing hearth cake	172	possible SHC?	172
Smithing hearth cake	456	conventional SHC	456
Smithing hearth cake	256	50%, SHC with smooth dished maroon top	512
Smithing hearth cake	194	probable SHC	194
Smithing hearth cake	304	slightly flowed on top, SHC	304
Smithing hearth cake	630	part of vesicular slag bowl with clotted texture on top. 160x130 partial length, 70 deep of which 30 is crust	
Smithing hearth cake	166	small SHC	166
Smithing hearth cake	352	probable SHC	352
Smithing hearth cake	278	approximately 70% of an SHC 90 diameter and 50 deep, smooth dimpled top	400
Smithing hearth cake	212	smooth top , dimpled base, probably not complete SHC	
Smithing hearth cake	368	SHC, approximately 85%	430
Smithing hearth cake	212	small irregular SHC	212
Smithing hearth cake	774	3 thin crust SHC fragments	
Smithing hearth cake	1365	piece hard to orientate, but is burr region from enormous cake. Main thick crust zone is 65 thick, burr region 110 wide. This burr is similar to SF #210 from this context, suggesting a cake of 10kg	10000
Smithing hearth cake	252	SHC, smooth blown top, 100x80x30, dimpled base	252
Smithing hearth cake	964	SHC, 150x100x50, bowl has distinct lateral flange	964
Smithing hearth cake	5125	78 pieces, almost all clearly SHC fragments	
Smithing hearth cake	268	SHC, 100x80x45 with an almost clinkery appearance top	268
Smithing hearth cake	322	SHC 110x80x35, smooth blown top and irregularly lobate base	322
Smithing hearth cake	808	small SHC, probably with a smooth hollow top, but deformed during extraction, 140x110x70	808
Smithing hearth cake	1285	irregular SHC-like mass. Top slightly convex because of charcoal rich material. 115x140x75	1285
Smithing hearth cake	1910	slightly incomplete cake 140x120x90. Shows vesicular medium crust slag bowl, filled with a clotted texture granular slag with a planar top. A thin zone of soft charcoal-rich slag separates this from the uppermost charcoal-rich hard slab.	1910
Smithing hearth cake	660	about 40% of dense slag bowl with perfect crystal terminations. Bowl likely to have been c 170 wide and 80 deep. Total weight is bowl only.	1650
Smithing hearth cake	1305	3 pieces of large thick crust SHCs	

	material	weight	description	est. wt.
	Smithing hearth cake	1835	dense SHC (80%) with slight concentric texture, upper surface has lots of pale material embedded in it. Piece looks water worn 180x160x70	2290
	Smithing hearth cake	446	SHC, approximately 60%	740
	Smithing hearth cake	516	SHC. 90x100v40, approx 60%	790
	Smithing hearth cake	720	incomplete biconvex dense SHC, edges abraded away, approx 80%	900
	Smithing hearth cake	616	SHC 120x110x60, very irregular lots of included charcoal	616
	Tuyère	358	5 tuyère fragments	
	Tuyère	292	6 tuyère pieces	
	Sample 160			
	Bog ore/iron pan	3395	bog ore	
	Indet. iron slag	934	7 indet Fe slag pieces	
	Smithing hearth cake	5245	7 substantial SHC fragments, mainly fairly thick crust	
	Smithing hearth cake	1380	dished thin crust SHC with good concentric lines on upper surface	1380
	Sample 999158			
	Smithing hearth cake	954	150x150x60, conical SHC, top has hole 80dia, 30 deep, base dimpled, slag granular (#158)	954
	Sample 999529			
	Smithing hearth cake	1390	190x140x80 SHC (CFD8 #529)	1390
Context	**141**			
	Sample 49			
	Smithing hearth cake	143	piece from base of large tuyère with rusty build up on base	200
	Smithing hearth cake	1475	6 pieces of broken small/medium SHC	
Context	**142**			
	Sample 51			
	Indet. iron slag	3895	31 pieces of indet slag	
	Indet. iron slag	2975	smaller slag pieces, mainly small cake debris, but some hollow box material, and a couple of lining dominated blebby/prilly material pieces	
	Indet. iron slag	146	granular basal slag	
	Indet. iron slag	294	possible dense slag tongue	294
	Indet. iron slag	3270	c85 pieces of Fe-slag	
	Indet. iron slag	2230	60 small slag pieces	
	Indet. iron slag	1035	irregular slag lump	
	Iron	268	rusty block - ?iron inside	
	Natural stone	240	2 pieces of bog ore	

material	weight	description	est. wt.
Other smithing slag	808	6 pieces of prilly slag, mainly lining dominated (in front of tuyère maybe)	
Other smithing slag	60	charcoal-rich slag with tuyère tip showing	
Other smithing slag	590	3 rusty masses which may be pro-tuyère masses, more dense than the low density masses and tongues above	
Other smithing slag	72	dense flow from lower side of tuyère	
Other smithing slag	554	2 blocks of slag showing tuyère contacts	
Other smithing slag	66	small sub-tuyère flow	
Other smithing slag	606	well dimpled irregular slag mass	
Other smithing slag	966	large ball-like burr, probably the cake sank into the hearth floor	
Other smithing slag	170	slag attached to tuyère tip, lining dominated on top, dense below in lobe below tuyère, charcoal-rich in front.	
Other smithing slag	694	10 pieces of low density slag tongues	
Other smithing slag	86	small lingoid low density mass resembling small SHC, 80x40x25	86
Other smithing slag	70	2 pieces of slag from tuyère face	
Smithing hearth cake	640	almost complete small SHC 12-x130x45	640
Smithing hearth cake	9610	23 pieces of thick crust cakes. These are mainly from v large cakes, but all too small to determine size. Deepest cake has 70mm thick lower crust	
Smithing hearth cake	1155	part of thin crust SHC with a central denser smooth top with a deep hole	
Smithing hearth cake	8945	30 pieces of thick crust slag from mainly small SHCs	
Smithing hearth cake	712	double layer thick crust fragment	
Smithing hearth cake	3895	59 smaller cake fragments and amorphous lumps	
Smithing hearth cake	1580	significant piece of thickish crust cake. Probably 60% of original which would have been 180 dia by 80mm deep	2630
Smithing hearth cake	470	SHC	470
Smithing hearth cake	1080	c70% dense SHC	1540
Smithing hearth cake	794	c85% of dense SHC	930
Smithing hearth cake	606	c50% of dense cake	1210
Smithing hearth cake	346	small viscous charcoal moulds on top	346
Smithing hearth cake	896	SHC, showing slight double layer	896
Smithing hearth cake	1880	massive thick crust cake, 30-40%, crust to 60mm, c220 original diameter	5370
Smithing hearth cake	548	SHC	548
Smithing hearth cake	5395	60 smaller slag pieces, mainly fragments of intermediate crust material (ie, has a thin crust and charcoal)	
Smithing hearth cake	708	approximately 60% of thin crust SHC	1180
Smithing hearth cake	460	SHC	460
Smithing hearth cake	546	SHC	546
Smithing hearth cake	216	incomplete SHC	

material	weight	description	est. wt.
Smithing hearth cake	350	incomplete SHC	
Smithing hearth cake	450	40% of SHC	1125
Smithing hearth cake	3800	15 pieces of medium crust cake, largely from large cakes	
Smithing hearth cake	374	thick crust fragment or possibly burr	
Smithing hearth cake	5640	13 large pieces of thick crust SHCs	
Smithing hearth cake	1004	4 pieces of friable charcoal-rich SHC with no crust	
Smithing hearth cake	994	SHC with irregular rough appearance	994
Smithing hearth cake	2900	8 pieces of thin crust appearance, but actually quite dense	
Smithing hearth cake	604	complete dense SHC	604
Smithing hearth cake	318	complete dense SHC	318
Smithing hearth cake	116	complete dense SHC	116
Smithing hearth cake	1930	140x100x50 SHC with 140x100x30 on top after first one filled	1930
Smithing hearth cake	728	complete dense SHC	728
Smithing hearth cake	1340	v dense SHC with rough appearance	1340
Smithing hearth cake	902	9 smaller pieces of SHC	
Smithing hearth cake	700	irregular thick crust SHC	700
Smithing hearth cake	972	complex multiphase SHC with well flown top layer above charcoal-rich core	972
Smithing hearth cake	8200	17 pieces of dense SHC, mostly from fairly large dense cakes	
Smithing hearth cake	1535	incomplete SHC, c70%	2200
Smithing hearth cake	1425	incomplete v dense SHC, c 60%	2375
Smithing hearth cake	702	complete dense SHC, 120x110x45, all the above are variations on the same theme, some have very Fe-rich tops, some very fayalitic puddles, which in some cases overflow the edges	702
Smithing hearth cake	796	complete dense SHC	796
Smithing hearth cake	670	complete dense SHC	670
Smithing hearth cake	478	complete dense SHC	478
Smithing hearth cake	314	complete dense SHC	314
Smithing hearth cake	428	SHC showing tuyère attachment	428
Smithing hearth cake	290	small conventional SHC	290
Smithing hearth cake	700	small conventional SHC, has hole from bar used to extract it - 20x7mm	700
Smithing hearth cake	398	c50% of small SHC	800
Smithing hearth cake	530	large burr	
Smithing hearth cake	2890	16 pieces of thin crust cake	
Smithing hearth cake	1440	c90% of thin crust cake with central raised blown area, smooth and maroon	1600
Smithing hearth cake	294	c70% of small SHC	420
Smithing hearth cake	1300	rather flat rough SHC, apparently thin crust	1300
Smithing hearth cake	5730	14 substantial thick crust pieces	

material	weight	description	est. wt.
Smithing hearth cake	704	80% of dense SHC with flat top	880
Smithing hearth cake	824	irregular thick crust SHC	824
Smithing hearth cake	328	small slab like SHC	328
Smithing hearth cake	5260	8 large pieces of more thin crust material. All fairly low proportions of their cakes	
Smithing hearth cake	490	dimpled thin crust material below, but rather dense	490
Smithing hearth cake	390	small globular SHC	390
Smithing hearth cake	954	thin crust SHC	954
Smithing hearth cake	632	70% of thick crust SHC, fairly flat	900
Smithing hearth cake	574	60-70% of thick crust SHC	880
Smithing hearth cake	262	small lining rich, rather prilly, probable SHC	262
Smithing hearth cake	862	dense, perfectly flat top, slightly 2 layer, 110x120x50	862
Smithing hearth cake	892	broken small hollow cake	892
Smithing hearth cake	3825	7 pieces of pyramidal cakes, rather dense, thick crust types. Estimated depths and diameters : 60/110, 70/160, 90/180, 60/130	
Smithing hearth cake	2380	13 fragments of mainly thin crust, some quite granular	
Smithing hearth cake	3460	11 thick crust pieces, none probably from particularly large cakes	
Smithing hearth cake	1485	c85% of medium crust SHC, 140x150x60	1750
Smithing hearth cake	2695	10 pieces of thin crust cake	
Smithing hearth cake	244	possible small SHC	244
Smithing hearth cake	114	SHC fragment	
Smithing hearth cake	246	possible small SHC	246
Smithing hearth cake	1280	thinnish crust cake, somewhat irregular rusty top, 170x130x50	1280
Smithing hearth cake	1320	c70% of conventional SHC	1890
Smithing hearth cake	338	c50% of small SHC	680
Smithing hearth cake	2180	thin crust cake with flowed pat of slag on top, 180x200x80	2180
Smithing hearth cake	1845	130x160x80 double layer dense SHC with perfectly flat top. Dimpled base	1845
Smithing hearth cake	1330	complete dense SHC	1330
Smithing hearth cake	296	SHC	296
Smithing hearth cake	288	c60% SHC	480
Smithing hearth cake	278	possible small deformed SHC	278
Smithing hearth cake	4225	7 pieces of similar fairly thick crust cakes of slightly wider shape/form	
Smithing hearth cake	1320	c90% SHC	1470
Smithing hearth cake	796	c70% of somewhat granular cake	1140
Smithing hearth cake	572	c20% of thick crust SHC	2860
Smithing hearth cake	310	small conventional SHC	310
Smithing hearth cake	4275	10 smaller SHC pieces	

	material	weight	description	est. wt.
	Smithing hearth cake	540	slab of layered thin crust cake. 2 sheets of slag with more sintery material between, 1 of layers shows olivine terminations	
	Smithing hearth cake	970	SHC	970
	Smithing hearth cake	1445	SHC, 140x130x70, dished smooth top with adhering charcoal material	1445
	Smithing hearth cake	360	80x80x30 probable SHC - but may be fragment from something larger	360
	Smithing hearth cake	1125	low density charcoal rich mass - possibly a little deformed	1125
	Smithing hearth cake	206	thin SHC	206
	Smithing hearth cake	632	slightly irregular but conventional SHC	632
	Smithing hearth cake	308	charcoal rich SHC	308
	Smithing hearth cake	424	conventional circular SHC 90x100x40	424
	Smithing hearth cake	488	SHC, 110x100x45	488
	Smithing hearth cake	348	irregular SHC, or possibly fragment of something larger	348
	Tuyère	144	piece of tuyère 140-160 diameter	150
	Tuyère	524	11 tuyère pieces	
	Tuyère	288	5 pieces of tuyère	
	Tuyère	110	4 pieces of tuyère	
	Tuyère	204	2 pieces of tuyère	
	Sample 161			
	Smithing hearth cake	1345	incomplete two layer thick crust SHC. Upper layer very Fe-rich, lower layer a massive crust, base gently dimpled (CFD17 #618)	1500
	Smithing hearth cake	1560	thin crust cake 220x140x70, thickens away from proximal end,. Where has raised smooth area and slight burr/collar. Charcoal-rich material on most of top, dimpled base	1560
	Smithing hearth cake	970	c30% of v dense cake c 180mm diameter and 60 deep	3230
	Smithing hearth cake	960	c60% slab from thick crust SHC, dimpled top, dimpled base 120x100x40	1600
	Sample 999424			
	Smithing hearth cake	2830	130x200x90, segment from v thick SHC, dense	9430
	Sample 999426			
	Smithing hearth cake	2720	220x220x110, irregularly bowl shaped SHC, hollow 120 diam offset from one end by zone with v coarse charcoal (#426)	2720
Context	**152**			
	Sample 397			
	Indet. iron slag	373	variety of small pieces of hearth slags. Mainly low density material, some plasticy blebs. One small piece of thin crust with voids.	
	Indet. iron slag	576	2 irregular slag pieces	

	material	weight	description	est. wt.
Context	**159**			
	Sample 96			
	Indet. iron slag	120	low density slag coated in bog ore	
	Indet. iron slag	1370	16 small pieces of indet. Slag	
	Indet. iron slag	306	very strange dark waxy-looking dense basal (or sub-tuyère?) flow	
	Smithing hearth cake	692	c60% of thin crust SHC	1150
	Smithing hearth cake	8795	19 large pieces of thin crust material	
	Smithing hearth cake	402	conventional SHC	402
	Smithing hearth cake	618	conventional SHC	618
	Smithing hearth cake	4220	uncounted thick crust pieces	
	Smithing hearth cake	456	c50% of conventional SHC	910
	Smithing hearth cake	838	conventional SHC	838
	Smithing hearth cake	494	conventional SHC	494
	Smithing hearth cake	376	conventional SHC	376
	Tuyère	12	small tuyère fragment	
Context	**160**			
	Sample 15			
	Smithing hearth cake	1065	granular SHC	1056
	Smithing hearth cake	860	SHC with charcoal-rich top	860
	Smithing hearth cake	276	small SHC	276
	Smithing hearth cake	656	SHC with open bowl	656
	Sample 106			
	Smithing hearth cake	1216	curious SHC with two slabs of differing thickness crust joined by later smooth slag	1216
	Sample 111			
	Indet. iron slag	1030	11 smaller pieces of slag	
	Other smithing slag	182	low density pro-tuyère flowed material	
	Other smithing slag	174	SHC or pro-tuyère block?	174
	Smithing hearth cake	460	c60% of moderately thick crust SHC	770
	Smithing hearth cake	1275	7 pieces of thin crust	
	Smithing hearth cake	1065	thick crust piece, c180 diameter, c30%?, 90 thick with crust <50, bowl filling, Fe-rich rusty and rubbly.	3550
	Smithing hearth cake	860	c25% maybe from same cake as above - certainly very similar dimensions	3440
	Smithing hearth cake	282	50% of conventional SHC	560
	Smithing hearth cake	604	fairly flat bowl shaped SHC. Thinnish crust with charcoal-rich fill to bowl	604
	Smithing hearth cake	294	slab-like SHC	294

	material	weight	description	est. wt.
	Smithing hearth cake	1155	incomplete double dense SHC, lower section just a part of cake, fairly thin crust, well dimpled base	
	Smithing hearth cake	1320	complete SHC with thinnish crust, lots of void space with granular texture, 160x160x70	1320
	Smithing hearth cake	504	SHC	504
	Smithing hearth cake	818	SHC	818
	Smithing hearth cake	904	SHC	904
	Smithing hearth cake	1045	60-70% of cake with grey dimpled base. Moderate crust and charcoal-rich fill to bowl. Similar to basal part of compound cake (1155) above	1610
	Smithing hearth cake	326	SHC	326
	Smithing hearth cake	504	(60%) SHC	840
	Smithing hearth cake	308	SHC	308
	Smithing hearth cake	396	SHC	396
	Smithing hearth cake	96	small part of conventional SHC	
	Smithing hearth cake	386	60% of conventional SHC	640
	Tuyère	362	8 pieces of tuyère and associated slag	
	Sample 999112			
	Smithing hearth cake	1765	very dense, 160x140x65, smaller SHC, appears dense slag all way through (#112)	1765
Context	**165**			
	Sample 90			
	Indet. iron slag	292	2 pieces of amorphous charcoal rich block	
	Indet. iron slag	126	irregular prilly block, probably small SHC, or pro-tuyère slag	126
	Tuyère	68	very highly contorted and vitrified tuyère	
Context	**172**			
	Sample 99			
	Indet. iron slag	62	irregular micro-prilly slag lump	
	Smithing hearth cake	574	100x130x40 wide flat SHC with charcoal on upper surface	574
	Smithing hearth cake	730	150x105x30 wide flat SHC with charcoal on upper surface	730
	Smithing hearth cake	1315	piece which has apparently 2 stacked SHCs of granular charcoal rich material - but may rather be just the core of a larger granular cake of perhaps 300mm diameter. 150x150x80	
	Sample 999213			
	Smithing hearth cake	1730	220x160x70 slightly irregular basal bowl, top is crystal terminations, one area has pale glass cf that around well blown bloom, prob c70%, crust to 30 thick, no infill (#213)	2470

	material	weight	description	est. wt.
Context	**176**			
	Sample 352			
	Indet. iron slag	350	4 assorted Fe-slag pieces	
	Smithing hearth cake	798	60% of thick crust SHC. Coarse crystal termination	1330
	Smithing hearth cake	588	3 other SHC fragments	
	Smithing hearth cake	394	complete SHC 100x80x40	394
	Smithing hearth cake	1190	approx 50% of thick crust, 130dia 80 deep of which main bowl 50 with crust of up to 35	2380
	Smithing hearth cake	400	dense wide shallow SHC fragment, 150x60x35 prob <40%	1000
	Tuyère	34	tuyère fragment	
Context	**180**			
	Sample 140			
	Smithing hearth cake	268	SHC fragment with v dense base, pale fuel ash / lining slags above with charcoal	
	Smithing hearth cake	824	dense double SHC, lower cake 100x100x40, upper 120x80x20	824
Context	**184**			
	Sample 157			
	Indet. iron slag	32	prilly low density slag	
	Smithing hearth cake	546	Piece from edge of v dense big SHC. Top big vesicles and purple surface. Multiple flow like units, making the block look like tap slag internally. Outer surface micro-prilly. If circular than around 200 diameter, making this piece c. 20%	2730
	Smithing hearth cake	284	90x80x35 small dense SHC	284
Context	**210**			
	Sample 402			
	Artefact	605	2 pieces of iron cauldron	
Context	**267**			
	Sample 171			
	Smithing hearth cake	109	5 pieces of generally rather prilly/lobate hearth slags	
Context	**269**			
	Sample 178			

	material	weight	description	est. wt.
	Indet. fired clay	26	vitrified clay	
	Indet. iron slag	18	2 small granular slag pieces	
	Smithing hearth cake	278	approx 50% of concavo-convex SHC. Dense	560
	Sample 179			
	Smithing hearth cake	252	worn SHC or SHC fragment	
	Sample 180			
	Indet. iron slag	127	indet. Rounded slag nub	
	Sample 181			
	Smithing hearth cake	410	lump from thin crust cake with granular top. Crust to 10, piece to 40, orientation unclear	
	Sample 182			
	Indet. iron slag	136	slag nub	
	Sample 183			
	Smithing hearth cake	218	worn fragment from thick crust cake	
Context	**273**			
	Sample 174			
	Smithing hearth cake	496	complete slightly dish-topped SHC, 95x110x35, central hollow drops 10.	496
Context	**288**			
	Sample 348			
	Indet. iron slag	236	3 pieces of indet slag with concretion	
	Indet. iron slag	278	low density slag attached to planar wall or tuyère	
	Other smithing slag	174	slag lump originally attached to base of tuyère and sloping hearth base beneath	
	Smithing hearth cake	1133	6 fragments from SHCs	
	Tuyère	630	Large block - apparently tip of large diameter tuyère, has burr attached to base with charcoal rich slag above that, plus accumulation of rusty material attached to lower part of face of tuyère itself	
Context	**289**			
	Sample 349			
	Indet. iron slag	145	2 pieces of Fe slag, one exploding	
Context	**290**			
	Sample 350			
	Indet. iron slag	268	2 pieces of granular slag	

	material	weight	description	est. wt.
	Indet. iron slag	92	concreted slag lump	
	Sample 999229			
	Crucible	6	#229, pale grey body, pale external glaze, maroon internally, rim sherd	
Context	**292**			
	Sample 351			
	Indet. iron slag	84	2 weathered slag pieces	
	Indet. iron slag	20	small piece of well-flowed slag	
	Smithing hearth cake	1002	c45% of large thick crust SHC. Slightly concave top with ashy fill	2230
	Smithing hearth cake	76	small thick crust piece	
	Smithing hearth cake	1475	double layer, hollow topped, dense SHC, 180x110x90	1475
Context	**297**			
	Sample 399			
	Indet. iron slag	75	3 pieces of ashy hearth slag or peat residue?	
Context	**298**			
	Sample 222			
	Clay shroud	28	clay brazing shroud fragment	
	Indet. iron slag	436	5 pieces of low density, prob tuyère-related slag	
	Indet. iron slag	530	3 granular slag lumps	
	Indet. iron slag	298	flow lobed material inside concretion	
	Indet. iron slag	98	block of slag with charcoal moulds	
	Indet. iron slag	426	14 pieces of dense prilly slag. This is markedly different from most of the assemblage	
	Indet. iron slag	3540	undiagnostic Fe-slags	
	Indet. iron slag	462	6 other slag pieces	
	Indet. iron slag	448	4 pieces of flown slags	
	Natural stone	92	stone	
	Other smithing slag	1100	burr with stone (quartzite) placed in front and now with slag over	
	Smithing hearth cake	1145	SHC fragment with crusts to 55 overlain by up to 50 of charcoal rich material. 1 end shows breakage by poker, 80mm length seen over which it tapers from 25to 10mm wide (or was moved…)	
	Smithing hearth cake	738	approx 50%of dense thick crust SHC	1475
	Smithing hearth cake	232	SHC	232
	Smithing hearth cake	624	thick crust material, crust to c30 with charcoal rich material on top (CFD16 #617)	1250

	material	weight	description	est. wt.
	Smithing hearth cake	238	thick crust fragment	
	Smithing hearth cake	834	6 pieces of thin crust SHC	
	Smithing hearth cake	1390	80% or so of dense flat cake, originally probably 190x230x50 with 35 crust. Top surface is granular, probably crystal terminations, so an upper slag layer may be missing. (this slag said to be similar to context 172?)	1740
	Smithing hearth cake	1580	long shallow dense SHC, 200x150x50, shows slight proximal lip, basal surface rough, moderate amount of charcoal-rich material on top	1580
	Smithing hearth cake	2000	11 fragments from small SHCs	
	Smithing hearth cake	1615	3 pieces of lower density material granular material from big SHCs	
	Smithing hearth cake	2525	3 large SHC fragments	
	Smithing hearth cake	862	3 pieces of thick crust SHC	
	Smithing hearth cake	872	SHC	872
	Smithing hearth cake	206	SHC	206
	Smithing hearth cake	230	SHC	230
	Smithing hearth cake	472	SHC	472
	Smithing hearth cake	1145	5 pieces of granular thin crust material	
	Smithing hearth cake	706	SHC, with 2 layers, top v fluid with deep charcoal dimples	706
	Smithing hearth cake	1815	7 pieces of charcoal-rich material probably from smaller cakes	
	Smithing hearth cake	228	part of broken thin crust cake showing almost skeletal structure (CFD26 #620)	
	Smithing hearth cake	296	SHC	296
	Tuyère	144	2 tuyère pieces	
	Tuyère	352	10 pieces of tuyère	
	Tuyère	316	10 tuyère fragments	
Context	**300**			
	Sample 132			
	Indet. iron slag	603	8 small slag fragments	
	Smithing hearth cake	862	block from edge of large cake, has charcoal rich core with flat top and fairly thin crust basally, which thickens upwards and has well-flowed lip.	
Context	**311**			
	Sample 369			
	Smithing hearth cake	945	7 slag pieces, mainly suggestive of thin crust cakes	
Context	**333**			
	Sample 175			

	material	weight	description	est. wt.
	Indet. iron slag	2430	assorted small slag pieces	
	Natural stone	128	stones	
	Smithing hearth cake	1885	6 dense SHC fragments	
	Smithing hearth cake	500	SHC with extreme lobes and dimples on upper surface (CFD2 #621)	500
	Smithing hearth cake	2510	double layer broad SHC. Upper cake suggestive of 230 diameter, lower part probably small part of cake left in hearth	
	Sample 332			
	Other smithing slag	62	low density prilly mass	
	Smithing hearth cake	1055	SHC 140x130x45	1055
	Smithing hearth cake	534	irregular SHC 120x100x70	534
	Smithing hearth cake	4200	37 SHC fragments ranging from thin crusts to very coarsely crystalline pieces, to ordinary SHCs, to thin crusts with granular cores, but all very fragmentary	
	Tuyère	150	2 tuyère fragments	
	Sample 335			
	Smithing hearth cake	904	SHC with distinct flange (described in notes as distal - but ma be more likely to be proximal and extend towards tuyère tip?). 180x130x70. Concavo-convex with very smooth top	904
	Smithing hearth cake	928	single block of probable SHC coated in bog ore. Concretionary material appears quite limey.	
	Smithing hearth cake	2315	Complex charcoal rich SHC. 200x150x90. Has three layers - basal thin crust, charcoal-rich core and then lobed top plate in front of tuyère	2315
	Smithing hearth cake	1570	large thin-crust SHC. Top has medium charcoal left among raised slag lobes. Core is charcoal rich. Base is fractured suggesting attempt to remove or manipulate during working. 150x160x60	1570
	Sample 400			
	Natural stone	459	stone	
Context	**381**			
	Sample 323			
	Bog ore/iron pan	2770	bog ore	
	Indet. iron slag	5080	slag coated in bog ore, mainly thick crust fragments	
	Other	18	bone	
	Tuyère	78	2 tuyère pieces	
	Sample 353			
	Bog ore/iron pan	12400	bog iron ore - possibly Mn rich	
	Bog ore/iron pan	1670	bog ore	
	Bog ore/iron pan	5410	bog ore	
	Indet. iron slag	3740	uncounted charcoal rich slags	

	material	weight	description	est. wt.
	Indet. iron slag	36	small dense prill	
	Indet. iron slag	1060	misc 8 slag pieces	
	Indet. iron slag	4885	40 various pieces	
	Lining	224	3 pieces of apparent lining slag	
	Smithing hearth cake	1895	Large SHC, broken around edges	1895
	Smithing hearth cake	5120	large SHC, probably thin crust type, coated in thin layer of bog ore, 280x200x150	5120
	Smithing hearth cake	896	charcoal-rich cake in bog ore	896
	Smithing hearth cake	764	charcoal-rich cake in bog ore	764
	Smithing hearth cake	2145	thin crust SHC, mainly charcoal-rich , coarse charcoal, coated in bog ore	2145
	Smithing hearth cake	1755	complete wide flat SHC, 220x150x55	1755
	Smithing hearth cake	2375	50-60% of thick crust SHC, crust to 55mm, top charcoal rich with no void, 160x180x80	4320
	Smithing hearth cake	1120	medium crust SHC c80%	1400
	Smithing hearth cake	4800	thick crust cake coated in bog ore in 2 pieces	4800
	Smithing hearth cake	1775	approx 50% of thick crust SHC 200x[100]x80, top a rather amorphous layer with some charcoal	3550
	Smithing hearth cake	3715	thin crust SHC, slightly incomplete around edges, has high domed top, 260x190x130	3715
	Smithing hearth cake	860	small medium crust piece (c25%?)	3440
	Smithing hearth cake	520	thick crust fragment	
	Smithing hearth cake	5820	uncounted pieces from thick crust SHCs	
	Smithing hearth cake	936	small thick crust SHC piece	
	Smithing hearth cake	2060	2 thin crust slabs	
	Tuyère	144	3 tuyère fragments	
	Tuyère	40	fired clay - probably tuyère fragments	
	Tuyère	52	vitrified tuyère fragment	
Context	**416**			
	Sample 375			
	Indet. iron slag	50	coalesced prilly rod	
	Indet. iron slag	80	slag piece spalled off the lower side of a tuyère	
	Indet. iron slag	1400	17 pieces of variable Fe slag, including at least one substantial dense thick crust fragment	
	Natural stone	50	stone	
	Smithing hearth cake	280	small rather low density SHC 100x70x55	280
	Tuyère	148	tuyère piece. Curvature suggests 200 dia	200
	Tuyère	68	tuyère fragment and 3 tiny slag pieces	
	Sample 5001			
	Indet. fired clay	8	vitrified clay fragment	

	material	weight	description	est. wt.
Context	**426**			
	Sample 204			
	Clay shroud	118	sherd from clay shroud	
	Indet. iron slag	1175	large mass of blebby plastic slag with lots of included charcoal	
	Indet. iron slag	5000	35 pieces of misc slag, mainly SHC fragments	
	Other smithing slag	280	slag tongue, dark and glassy on top, 120x60x55	280
	Smithing hearth cake	802	small charcoal rich SHC inside a tilted crust. Possibly two phases of growth and part of first crust is lost	802
	Smithing hearth cake	1620	large SHC with missing edges (c70%), crust has tubular vesicles	2300
	Smithing hearth cake	2325	part of large SHC, c180dia and 80 thick, ?70%	3300
	Smithing hearth cake	904	5 pieces of friable charcoal-rich slag, with some showing crystal faces like "coralline" slag	
	Smithing hearth cake	530	concavo-convex SHC, 110x120x50	530
	Smithing hearth cake	658	fragment from charcoal rich SHC, no crust	
	Smithing hearth cake	442	small dense SHC, 90x90x50 probably missing edges	442
	Tuyère	334	7 fragments of tuyère, c150 diameter but slightly angular, hole 40mm dia suggested by preserved part	150
Context	**427**			
	Sample 233			
	Smithing hearth cake	74	2 fresher charcoal-rich nubs	
	Smithing hearth cake	478	4 very worn dense thick crust pieces	
Context	**435**			
	Sample 192			
	Indet. iron slag	480	14 pieces of various Fe-slag	
	Smithing hearth cake	664	thin crust open textured SHC-like lump, 250x110x50	664
	Smithing hearth cake	216	open-textured lump, crystalline ("coralline") on one side, charcoal-rich on the other	
	Sample 200			
	Clay shroud	10	clay brazing shroud piece	
	Indet. iron slag	2385	55 smaller slag pieces	
	Other smithing slag	188	lining rich slag, rusty towards base, probably pendent from tuyère	
	Other smithing slag	422	10 pieces of blebby/prilly lining rich slags, probably from in front of tuyère	
	Smithing hearth cake	644	SHC, very rusty so not certain if complete	644
	Smithing hearth cake	360	2 small SHC fragments	

	material	weight	description	est. wt.
	Smithing hearth cake	686	dense SHC with fluid top and raised charcoal-rich, rusty area	686
	Smithing hearth cake	790	c40% of thick crust	1975
	Smithing hearth cake	484	SHC deformed on extraction	484
	Smithing hearth cake	1205	70% of thick crust SHC	1780
	Smithing hearth cake	834	small normal SHC	834
	Smithing hearth cake	576	40-50% of thick crust SHC,	1280
	Smithing hearth cake	742	dimpled base like a thin crust SHC	742
	Smithing hearth cake	488	incomplete thin crust SHC	
	Smithing hearth cake	458	small SHC, deformed on extraction	458
	Smithing hearth cake	180	possible SHC	180
	Smithing hearth cake	574	60% of SHC	960
	Smithing hearth cake	492	small SHC with a fluid top	492
	Tuyère	160	5 pieces of tuyère	
	Sample 213			
	Smithing hearth cake	282	almost complete small SHC with strongly raised dense lobes with moulds between on upper surface	282
Context	**436**			
	Sample 244			
	Indet. iron slag	1025	various broken fragments, all undiagnostic, 1 probable SHC fragment has tool hole c8mm x >25mm	
Context	**438**			
	Sample 189			
	Bog ore/iron pan	164	Fe-pan	
	Indet. iron slag	42	Fe slag piece	
Context	**447**			
	Sample 191			
	Indet. iron slag	1820	assorted small slag fragments	
	Indet. iron slag	170	slag lump with 25mm wide tool hole	
	Smithing hearth cake	524	complexly contorted cake or part cake	
	Smithing hearth cake	2075	poorly preserved large cake. Ridged base with unknown internal structure. Passes up into granular voids with broken fragile roof. Raised portion along one side. Bowl 50 deep, 170 dia, overall including raised part 180 across by 100 tall	2075
	Smithing hearth cake	250	fragment of thick crust SHC	
	Tuyère	32	3 tuyère sherds	

	material	weight	description	est. wt.
Context	**449**			
	Sample 194			
	Indet. fired clay	56	vitrified clay, slightly dished, looks like a normal wall, but…	
Context	**451**			
	Sample 198			
	Indet. iron slag	228	irregular block of black low density attached to ceramic	
	Indet. iron slag	511	58 pieces of debris. Small slag fragments, corroded iron, concreted material, including some good smithing floor material with both spheroidal and flake hammerscale	
	Indet. iron slag	266	dense slag block with flow lobes at one end. 20 thick, smooth like blown top of SHC for 40, then disappears under basal skim of tuyère material for a distance of 60mm, with a distinctly lobate termination. Base of flow is gravelly.	
	Indet. iron slag	460	indet slag fragments	
	Smithing hearth cake	366	irregular dense SHC	366
	Smithing hearth cake	360	irregular dense SHC	360
	Smithing hearth cake	662	massive fragment (c50%) of thick crust SHC	1325
Context	**464**			
	Sample 215			
	Indet. iron slag	207	variety of small slag pieces	
Context	**465**			
	Sample 201			
	Indet. iron slag	5785	58 pieces of indet Fe slag	
	Other smithing slag	540	pendulous plasticy dished mass, hanging from small tuyère	540
	Other smithing slag	84	tuyère piece with assoc slag	
	Smithing hearth cake	1600	complete thin crust type SHC	1600
	Smithing hearth cake	1925	complete thin crust type SHC	1925
	Smithing hearth cake	428	complete thin crust type SHC	428
	Smithing hearth cake	824	incomplete thin crust type SHC	
	Smithing hearth cake	216	small conventional burr	
	Smithing hearth cake	398	conventional small SHC	398
	Smithing hearth cake	60	tiny conventional SHC?	60
	Smithing hearth cake	2205	various small pieces of thick crust cake, 3, including cake to 60mm	

	material	weight	description	est. wt.
	Smithing hearth cake	994	4 pieces of plasticy slag mass	
	Tuyère	80	tuyère fragment	130
Context	**478**			
	Sample 230			
	Indet. fired clay	4	2 pieces of vitrified clay	
	Indet. iron slag	28	tiny piece of slag sheet	
Context	**479**			
	Sample 242			
	Bog ore/iron pan	20200	ore and pan	
	Bog ore/iron pan	20600	ore	
	Bog ore/iron pan	20600	bog ore	
	Smithing hearth cake	1980	worn concavo-convex v dense cake 170x160x90	1980
	Sample 245			
	Natural stone	340	stone	
	Sample 246			
	Other	130	v light weight, brown, porous material. Is this sintered iron rich peat? A v strange material	
Context	**483**			
	Sample 229			
	Bog ore/iron pan	3880	bog ore/pan	
	Clay shroud	50	4 pieces of brazing shroud	
	Indet. iron slag	4400	45 minor slag pieces	
	Iron	32	Fe fragment (saved)	
	Other smithing slag	552	14 pieces of low density prilly lining slags, some with clay attached	
	Other smithing slag	186	low density slag tongue with clay attached	
	Smithing hearth cake	2110	small piece (20%) of big bowl. Has basal low density pale plasticy flow. 110 deep. Dense crust and acute angle at top. Internally granular	10000
	Smithing hearth cake	842	SHC 70% 120x120x50	1200
	Smithing hearth cake	168	tongue like SHC fragment	
	Smithing hearth cake	322	SHC bowl fragment (50%)	644
	Smithing hearth cake	352	SHC fragment, v dense, pale weathering	
	Smithing hearth cake	2085	SHC 180x190x70	2085
	Smithing hearth cake	270	SHC (or possibly fragment)	270
	Smithing hearth cake	372	bowl fragment	
	Smithing hearth cake	640	SHC fragment	

	material	weight	description	est. wt.
	Smithing hearth cake	234	SHC 110x90x50	234
	Sample 999540			
	Clay shroud	41	#572, brazing shroud, curved no internal surface, handle area?	
	Clay shroud	62	#559. brazing shroud, thick, over angle	
	Clay shroud	46	#568, brazing shroud, flat face	
	Clay shroud	115	#558, brazing shroud, thick, flat face	
	Clay shroud	17	#580, brazing shroud, short length of seam	
	Clay shroud	36	#566, brazing shroud	
	Clay shroud	25	#582, brazing shroud, short length of seam with 1 rivet	
	Clay shroud	70	#569, brazing shroud, planar face with bend	
	Clay shroud	50	#575, brazing shroud, bottom of shoulder fold	
	Clay shroud	22	#564, brazing shroud	
	Clay shroud	95	#554 & #553, brazing shroud, planar face with bend, #553 has small amount of Cu alloy corrosion adhering	
	Clay shroud	509	18 pieces of brazing shroud, #570, #531, #565, #583, #595, #579, #590, #573, #588, #562, #577, #578, #587, #574, #563, #560, #589 & #576	
	Clay shroud	98	#557, brazing shroud, thin coating to angle, possible mouth edge	
	Clay shroud	34	#586, brazing shroud, thick	
	Clay shroud	36	#581, brazing shroud, possibly base of handle	
	Clay shroud	155	#551 & #552, brazing shroud, lower angle	
	Clay shroud	37	#584, brazing shroud, possibly over shoulder fold	
	Clay shroud	500	#539, #549 & #554, brazing shroud, large piece with end seam	
	Clay shroud	283	#540, #547 & #548, brazing shroud, top of flat face	
	Clay shroud	23	#561, brazing shroud, with right angle out-turn of uncertain purpose	
	Clay shroud	214	#546 & #544, brazing shroud, lower angle	
	Clay shroud	292	#540 & #555, brazing shroud, 2 pieces from long side, misreconstructed in field	
Context	**498**			
	Sample 250			
	Indet. iron slag	294	5 pieces of rather granular, charcoal rich slag	
	Other slag	2	bright blue fuel ash slag	
Context	**506**			
	Sample 306			

	material	weight	description	est. wt.
	Smithing hearth cake	1260	single block of slag appearing to be formed of tiny sintered balls. If circular in plan would need to be 500 diameter	
	Sample 307			
	Indet. iron slag	8565	66 smaller slag pieces	
	Indet. iron slag	642	7 pieces of indet Fe-slag	
	Other smithing slag	292	burr piece	
	Other smithing slag	356	4 pieces of blebby, lining dominated slag	
	Smithing hearth cake	6310	10 big pieces of thin crust cakes, all contorted	
	Smithing hearth cake	1240	wide shallow SHC, 150x170x50	1240
	Smithing hearth cake	3865	incomplete, concentrically structured thin crust SHC	
	Smithing hearth cake	946	complete SHC, 140x150x50, outer part of top has charcoal, inner part is blown smooth, with funnel like hole leading down into interior. Base has fine ashy charcoal	946
	Smithing hearth cake	2750	5 chunks of thick crust cakes	
	Smithing hearth cake	1905	c70% of thick crust cake, 200x120x70	2721
	Smithing hearth cake	882	slightly incomplete SHC, poor crust, irregular charcoal-rich top	882
	Smithing hearth cake	1115	slab of thin crust material	
	Smithing hearth cake	964	somewhat contorted charcoal rich SHC	964
	Smithing hearth cake	1110	fairly complete SHC, has poor crust, quite coarse charcoal layer and remains of glassy blown top.	1110
	Tuyère	14	tuyère fragment	
	Tuyère	970	16 pieces of tuyère	
Context	**524**			
	Sample 224			
	Bog ore/iron pan	14	this material is all soil with very weakly indurated mottled bog ore growths. Was apparently removed as slag cake - but there appear to be no slag inclusions at all	
Context	**538**			
	Sample 274			
	Indet. iron slag	166	3 assorted slag fragments	
	Possible smelting slag	648	block from side of bowl made up of coalesced prills. Most likely orientation suggests bowl 300dia, 130 deep.	
Context	**544**			
	Sample 241			

	material	weight	description	est. wt.
	Other smithing slag	348	3 pieces of tuyère-related material, 1 small tuyère sherd, 1 rusty slab curved slab presumably pro-tuyère, 1 small SHC-like cake with lots of lining material	
Context	**555**			
	Sample 398			
	Indet. iron slag	578	9 pieces of open structured prilly slag	
	Indet. iron slag	54	lining slag - probably a sub b/h or pro-tuyère piece	
	Smithing hearth cake	152	dense burr	
Context	**556**			
	Sample 288			
	Indet. fired clay	24	fragment from vitrified planar face	
	Indet. iron slag	26	Slag flown around medium to large charcoal moulds	
	Indet. iron slag	200	4 pieces of slag	
	Iron	32	nail shank plus another small iron piece	
	Smithing hearth cake	308	small SHC	308
Context	**561**			
	Sample 255			
	Clay shroud	58	sherd of clay brazing shroud	
	Indet. iron slag	7860	smaller smithing slag pieces	
	Other slag	126	An elongate slag runner (or stick/poker mould?)	
	Other smithing slag	274	crude slag tongue	274
	Other smithing slag	204	a flowed bulbous lobe of slag with a highly porous crystalline (coralline) interior	
	Other smithing slag	430	3 pieces of tuyère-related slag	
	Smithing hearth cake	2925	80% of cake with one end broken when hot - or alternatively attached to straight wall, 210x150x80	3440
	Smithing hearth cake	330	1 small fragment from a thick crust cake	
	Smithing hearth cake	6730	77 pieces of thin crust charcoal-rich material. 1 piece has good basal organics.	
	Smithing hearth cake	1245	elongate thin crust SHC. 170x140x75. Rather irregular in plan.	1245
	Smithing hearth cake	346	irregular small SHC 100x100x40	346
	Smithing hearth cake	2250	lingulate thin crust cake, bowl 220x170x55 with 45 distal riser (CFD23 #623)	2250
	Smithing hearth cake	230	small SHC 90x90x40	230
	Smithing hearth cake	596	shallow SHC with dimpled top	596
	Smithing hearth cake	2920	210x150x90, complete dense SHC	2920

	material	weight	description	est. wt.
	Smithing hearth cake	2755	230x190x80, irregular SHC	2755
	Smithing hearth cake	1510	150x140x50 dense disc-like SHC	1510
	Tuyère	440	11 pieces of tuyère	
	Tuyère	330	6 pieces of tuyère, or possible lining, none diagnostic	
Context	**563**			
	Sample 248			
	Indet. iron slag	1510	irregular slag mass 190x240x80. Has a lower dense lobe like mass, apparently topped by a flat contact with charcoal-rich material	
	Indet. iron slag	1530	prilly slag mass with virtually no crust. Has bowl and lower irregular part, suggestive of draping over a stone in the hearth side. Lower part is all small prills - like a smelting cake. 160x140x100	
	Indet. iron slag	680	undiagnostic slag pieces	
	Smithing hearth cake	878	slightly irregular SHC with lots of charcoal 150x120x55	878
	Smithing hearth cake	296	thin crust fragment with some quite large charcoal moulds	
	Smithing hearth cake	172	small flow lobed mass, possibly a very irregular SHC, or top layer of one.	
	Smithing hearth cake	850	2 v dense thick crust fragments	
	Smithing hearth cake	1190	c70% of thick crust cake, central pool to 55mm, c150 diameter and 60 deep bowl originally, with up to 35mm of charcoal rich adhering to top	1700
	Smithing hearth cake	834	dense SHC 110x120x55	834
	Smithing hearth cake	268	small cake apparently entirely of lining material, lots of small pebbles, 100x100x60. Strongly lobate	268
	Smithing hearth cake	6990	36 pieces of thin crust SHC material	
	Smithing hearth cake	864	2 fragments from large thick crust SHCs	
	Smithing hearth cake	1010	irregular fragment from big thin crust cake	
	Smithing hearth cake	420	irregular thick crust fragment	
	Smithing hearth cake	938	large mass of dense but charcoal rich slag, original form unknown, rounded.	
	Tuyère	262	2 tuyère fragments, one with lots of adhering slag. Suggests wedge shaped slag mass tracking up under tuyère	
	Tuyère	262	2 tuyère pieces	
	Sample 283			
	Clay shroud	114	3 pieces of clay brazing shroud	
	Indet. iron slag	12950	86 pieces of mainly dense iron slag	
	Indet. iron slag	390	9 bits of indet iron slag	
	Other smithing slag	282	low density sub blowhole cake, 100x80x40 (CFD9 #625)	282
	Other smithing slag	130	prilly low density slag	
	Other smithing slag	204	low density prilly slag, pro-tuyère mass	204

	material	weight	description	est. wt.
	Smithing hearth cake	662	slab of thick crust from big cake, crust to 50mm, crystal terminations on top (CFD22 #624)	
	Smithing hearth cake	914	3 largish pieces of contorted crust, essentially thin crust with granular interior	
	Smithing hearth cake	1425	6 fragments of fairly conventional small SHCs	
	Smithing hearth cake	274	small rather blebby/prilly lining dominated cake	274
	Smithing hearth cake	548	c65% of SHC, 100x100x30	840
	Smithing hearth cake	652	SHC 130x100x60, rather irregular	652
	Smithing hearth cake	2880	200 diameter, 110 deep bowl, fairly thin crust, granular, vesicular core and very irregular top, c85%	3390
	Smithing hearth cake	2025	60% of large SHC, bowl, crust to 50, 190 diameter x 110 deep, bowl not filled	3375
	Smithing hearth cake	288	part of irregular small SHC	
	Smithing hearth cake	884	small fragment of big cake with thin crust and substantial granular mass	
	Smithing hearth cake	1045	SHC, full of dense slag, dimpled top, 150x130x70	1045
	Tuyère	244	2 tuyère fragments	
	Sample 999526			
	Tuyère	615	tuyère sherd, with half section preserved (#526)	
	Sample 999533			
	Smithing hearth cake	2005	160x160x55, in two pieces, dense crust, granular core, ? Smooth top(CFD15 #533)	
Context	**569**			
	Sample 257			
	Indet. iron slag	4910	72 pieces of bog ore coated material. All slag lumps except for one small piece of iron sheet	
	Smithing hearth cake	3180	dense slag cake, top slightly dished. 180x160x80	3180
	Smithing hearth cake	872	c80% of small SHC	1080
Context	**570**			
	Sample 284			
	Indet. iron slag	1360	mixed Fe slags	
	Smithing hearth cake	742	SHC with tip missing, 80%?, 120x120x55. Smooth top, but with granular material piled on top	930
	Tuyère	62	3 small pieces of tuyère	
Context	**571**			
	Sample 291			
	Bog ore/iron pan	1300	bog ore, 1 piece has 2 large tuyère sherds in it	

material	weight	description	est. wt.
Indet. iron slag	386	low density, lining generated slag with small burr. Lower part is coalesced pale greenish prills, orientation not clear (could hang down below wall/tuyère or extend forward from a vertical ended burr)	
Indet. iron slag	1055	massive irregular slag block	
Indet. iron slag	680	8 smaller pieces of undiagnostic slag	
Indet. iron slag	166	exploding block of slag/corrosion	
Other smithing slag	400	very irregular sub b/h lobate pale mass, with lining/tuy2 attached 70x90x70	400
Other smithing slag	142	low density sub b/h tongue with small burr attached	142
Other smithing slag	80	lining or tuyère slag	
Other smithing slag	94	small pro-tuyère slag mass	94
Smithing hearth cake	382	slabby SHC	382
Smithing hearth cake	1035	perfectly rounded burr	
Smithing hearth cake	444	part of a cake with a slightly thicker crust <50%	900
Smithing hearth cake	4010	30 pieces of less diagnostic material. Mainly small pieces of thin crust type, but may include small imperfectly formed SHCs	
Smithing hearth cake	638	porous SHC	638
Smithing hearth cake	325	slabby SHC	325
Smithing hearth cake	832	thin crust SHC	832
Smithing hearth cake	1980	probably 60-70% of medium crusted SHC	3050
Smithing hearth cake	3040	5 larger pieces of thin crust material	
Smithing hearth cake	166	broken tip of SHC	
Smithing hearth cake	1035	tiny part of large porous cake, curved slab of moderately dense crust	
Smithing hearth cake	2160	200x230x80 c70% of broad cake with only a thin crust and thick charcoal-rich layer with a flat top.	3100
Smithing hearth cake	1190	small conical thin crust base, supporting slab of lining rich material above, 100x140x95	1190
Smithing hearth cake	830	150x130x50, nice SHC example with smooth top bearing big lobes and dimples	830
Smithing hearth cake	1050	probably complete thin crust type SHC, but deformed	1050
Smithing hearth cake	692	2 broken pieces of SHCs with dense slag and prilly bases	
Smithing hearth cake	964	complete thin crust type SHC	964
Smithing hearth cake	256	flat topped conventional SHC	256
Smithing hearth cake	1075	chunk from blowing end of large granular cake. Inclined lining slag on top is probably blowing zone. Cake is 90 thick (below inclined <50 blowing zone), and is crudely stratified	
Smithing hearth cake	516	convex topped SHC	516
Smithing hearth cake	394	biconvex SHC	394
Smithing hearth cake	3369	80% of subcircular granular slag cake, 220wide by 90 deep. Top very irregular, basal surface fairly smooth. Where broken crust is highly vesicular with rounded vesicles in middle, passing laterally into more granular material.	4210

material	weight	description	est. wt.
Smithing hearth cake	6295	40 pieces of iron slag - all thin crust type SHC	
Smithing hearth cake	546	small dense SHC 110x100x45	546
Smithing hearth cake	536	irregular wide SHC, charcoal rich	536
Smithing hearth cake	1730	6 SHC fragments	
Smithing hearth cake	750	irregular dense SHC	750
Smithing hearth cake	586	c50% of dense SHC	1170
Smithing hearth cake	748	irregular SHC 150x110x60	748
Smithing hearth cake	600	irregular charcoal mass from large SHC	
Smithing hearth cake	824	prob c55% of thick crust cake, 140 diameter by 85 deep, lower crust 45 thick, slightly dished top to crust, with convex pile of charcoal-rich slag on top.	1500
Smithing hearth cake	592	irregular SHC with lobate top	592
Smithing hearth cake	2490	5 pieces from large thin crust cakes	
Smithing hearth cake	852	small dense SHC 110x100x60	852
Smithing hearth cake	4920	Part of large vertically sided mass with smooth top, 170x150x160. Slag is dominantly charcoal rich and stratified. Base flat, surviving vertical side suggests cake was originally 230 diameter.	11000
Smithing hearth cake	742	slightly irregular SHC, 90x120x70	742
Smithing hearth cake	3900	16 pieces of both thin and thick crust SHCs	
Smithing hearth cake	1255	dense cake, 95%, smooth flat top 120x130x45	1320
Smithing hearth cake	516	thin crust SHC	516
Smithing hearth cake	2290	90 degree segment from 400mm diameter furnace? Reminiscent of some Clonmacnoise material, has vertical side of 80, which then angles in for 70 (50 or so down), has a thin crust with minor flow lobes on outside. Does not appear to have core, but to have been concavo-convex. Full weight v speculative	9000
Smithing hearth cake	700	incomplete thin crust cake, deep	
Smithing hearth cake	2690	large chunk of granular cake 180x130x120. Has basal thinnish vesicular crust, overlain by very thick granular core. From a very large cake.	
Smithing hearth cake	1240	29 pieces from thin crust cakes	
Smithing hearth cake	1875	about 1/3 of large thin crust cake, c220 diameter by 80 deep	5625
Smithing hearth cake	496	pyramidal thin crust cake with flat top 90x120x60	496
Smithing hearth cake	588	2 pieces from thin crust cakes but with a central massive slag puddle	
Smithing hearth cake	1840	thin crust cake with well-developed lower bowl 160x130x60, then has raised central portion up to 50mm high and 80mm diameter of charcoal rich material	1840
Smithing hearth cake	1685	130x180x65, long SHC with thin crust and charcoal-rich core	1685
Smithing hearth cake	510	irregular dense SHC	510
Smithing hearth cake	660	approx 50% of deep SHC, proximal end shows planar face suggesting contact with stone. 140x80x70	660

material	weight	description	est. wt.
Tuyère	48	tuyère fragment	
Tuyère	132	three tuyère fragments, largest piece is slightly angular, suggesting a 90x120 oval tuyère	120
Tuyère	488	8 tuyère fragments	
Sample 319			
Indet. iron slag	2330	14 pieces of slag all containing yellow-brown ashy material	
Indet. iron slag	334	fired clay piece, very dense, so probably a burr	
Indet. iron slag	170	2 pieces of probable tuyère associated slag	
Indet. iron slag	1325	22 smaller slag pieces	
Indet. iron slag	172	2 prilly slag pieces formed by flowage of dense slag	
Indet. iron slag	868	uncounted small slag pieces	
Natural stone	76	stone	
Other smithing slag	486	lining rich tongue lying on early small dense mass	486
Other smithing slag	250	moderately dense small sub b/h mass	250
Other smithing slag	176	two small low density sub b/h or tuyère masses	
Smithing hearth cake	662	SHC inside concretion	
Smithing hearth cake	2900	6 pieces of charcoal rich slags, some attached to dense crusts	
Smithing hearth cake	132	smooth top, charcoal rich below, possibly tiny SHC, 90x60x40	132
Smithing hearth cake	418	dense SHC, deformed on extraction, prob about 50%	840
Smithing hearth cake	6815	270x230x100 large thin crust type cake, probably achieved its strange shape because of incomplete hearth clearance, but has substantial part of earlier bowl attached	6815
Smithing hearth cake	1175	dense SHC, approx 70%, c160 diameter and 70 deep. Smooth flown top, flow lobes on base (from extraction?)	1680
Smithing hearth cake	376	piece of SHC with smooth maroon blown top over low density charcoal rich material.	
Smithing hearth cake	3120	pieces of slag, 13 in total, with a granular and finely organic texture similar to material in 6815 cake above	
Smithing hearth cake	368	thick crust fragment	
Smithing hearth cake	442	small, rather low density SHC, 110x95x60	442
Smithing hearth cake	130	piece from small dense SHC	
Smithing hearth cake	206	fragment of thin crust with ashy material on top	
Smithing hearth cake	470	slab of thick crust with crystal terminations on top	
Tuyère	450	11 tuyère fragments	
Sample 391			
Bog ore/iron pan	308	ore/pan	
Indet. iron slag	738	10 small slag pieces	
Natural stone	334	stone	

	material	weight	description	est. wt.
	Smithing hearth cake	2050	elongate block with granular slag in thin crust cake, base formed by a series of lobes	
	Smithing hearth cake	634	thin crust granular cake 140x110x50, possibly entire SHC	634
	Smithing hearth cake	936	a large thick crust burr	
	Smithing hearth cake	1029	slab of thick crust material 130x90 with crust 30-45 thick	
	Smithing hearth cake	1419	apparently the burr region from a 100 thick very large ,charcoal rich cake. Internally stratified.	
	Smithing hearth cake	892	granular slag with concentric structure seen in thin crust cakes	
	Smithing hearth cake	202	approx. 50% of small dense SHC	400
	Smithing hearth cake	632	dual layer thinnish crust, 130x100x60, probably not complete	
	Smithing hearth cake	358	small thin SHC, possibly hollow top because edges folded in extraction 100x80x50	358
	Smithing hearth cake	308	piece with crust base and charcoal-rich top, possibly SHC, 100x70x45	
	Smithing hearth cake	814	6 more amorphous pieces from granular slag cakes	
	Smithing hearth cake	906	base of large thin crust bowl with charcoal-rich granular slag with a few prills in very centre of bowl	
	Smithing hearth cake	1670	curious block with thick crust to 55 at one end, remainder of block is charcoal-rich and granular. Thick crust could be burr - but if so is atypical.	
	Tuyère	128	2 tuyère pieces (1 broken)	
	Sample 999435			
	Smithing hearth cake	7340	280x290x120 plano convex SHC, central part friable (CFD13 #435)	7340
Context	**572**			
	Sample 302			
	Indet. iron slag	228	3 slag pieces	
	Tuyère	104	5 tuyère pieces, 150 diameter	150
Context	**573**			
	Sample 303			
	Smithing hearth cake	272	3 pieces of granular prilly slags, probably from thin crust bowls	
	Smithing hearth cake	150	piece of deformed empty thin crust	
	Smithing hearth cake	384	thin crust SHC, probably incomplete, granular core	
	Tuyère	10	tuyère sherd	
	Tuyère	118	tuyère, 18mm hole in 110mm block	110
Context	**574**			
	Sample 999567			

	material	weight	description	est. wt.
	Smithing hearth cake	9575	320x300x120 plano convex SHC with one steep end (CFD14 #567)	9575
Context	**575**			
	Sample 254			
	Other smithing slag	128	high viscosity flown bleb with granular interior	
	Smithing hearth cake	726	almost complete thin crust type SHC, quite coarse charcoal on top	726
	Smithing hearth cake	6555	110 pieces of slag, mainly from thin crust cakes	
	Smithing hearth cake	202	possible small charcoal rich SHC, but may be piece from larger specimen	
	Smithing hearth cake	260	thick crust fragment	
	Smithing hearth cake	772	3 pieces of thicker crust cake	
	Smithing hearth cake	666	conventional charcoal rich cake with smooth dished top (prob thin crust)	666
	Tuyère	1147	25 pieces of tuyère, some slagged	
Context	**578**			
	Sample 258			
	Bog ore/iron pan	5855	bog ore	
	Indet. iron slag	860	7 lumps of slag in ore	
	Smithing hearth cake	430	small SHC coated in bog ore	420
Context	**579**			
	Sample 309			
	Bog ore/iron pan	756	10 pieces of bog ore - one or two verging on smithing floor	
	Indet. iron slag	150	small lining dominated slag mass	
	Indet. iron slag	560	fresh, 5 pieces of charcoal rich lining dominated slag	
	Indet. iron slag	1435	15 pieces of slag with bog ore coatings	
	Smithing hearth cake	938	fresh, small part of enormous thick crust cake, total 90 thick of which 50 is crust	
	Smithing hearth cake	488	small dense flat-topped SHC coated in ore 80x110x35	488
	Smithing hearth cake	294	fresh, low density lining dominated cake with smooth maroon blown top but irregular below (might this just be top of larger object?)	
	Smithing hearth cake	1180	v good SHC. Overall 155x150x85, bowl 40 deep, base rich in charcoal, overlain by open charcoal-dominated slag, then has upper dark glassy surfaced plate of slag	1180
Context	**589**			
	Sample 261			

	material	weight	description	est. wt.
	Bog ore/iron pan	1280	ore	
	Indet. iron slag	2620	6 pieces of rounded slag in bog ore	
	Smithing hearth cake	794	thick crust fragment	
Context	**591**			
	Sample 262			
	Indet. iron slag	1375	5 pieces of slag in concretionary material. Concretion also includes some scale. Nature of enclosed slags is not known.	
	Sample 999536			
	Smithing hearth cake	2620	highly concreted mass probably concavo-convex cake, 200x155x60, accreted material includes charcoal and hammerscale (s+f) (#536)	2620

Appendix 2: Microanalysis by EDS

S	A	#	Phase	Notes	Phase nomenclature	Weight% element															
						Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	As	Ba	O	Total
1B	11	1	olivine	inner main	Fa97, Ca11% Mn1%	0.00	0.63	0.19	14.00	0.00	0.00		0.00	4.42	0.00		0.32	49.90			32.68	*102.13*
1B	11	2	olivine	margin main	Fa99, Ca26%	0.00	0.23	0.00	14.26	0.00	0.00		0.00	10.71	0.00		0.15	42.14			32.79	*100.29*
1B	11	3	olivine	inner main	Fa97, Ca8%	0.00	0.76	0.00	14.07	0.00	0.00		0.00	3.19	0.00		0.22	50.50			32.33	*101.08*
1B	11	4	olivine	outgrowth of main	Fa98, Ca18%	0.00	0.37	0.00	14.08	0.10	0.00		0.00	7.34	0.00		0.28	46.68			32.80	*101.66*
1B	11	5	olivine	outgrowth of main	Fa98, Ca18%	0.00	0.35	0.17	13.95	0.14	0.00		0.00	7.52	0.00		0.24	47.13			33.03	*102.53*
1B	11	6	mixed-ol	late dendrite	Fa99, Ca26%	0.00	0.21	0.14	14.17	0.19	0.00		0.14	10.95	0.00		0.00	42.40			33.22	*101.44*
1B	11	7	mixed-ol	late dendrite	Fa99, Ca26%	0.21	0.17	0.13	14.34	0.17	0.00		0.10	10.81	0.00		0.17	42.38			33.39	*101.88*
1B	11	8	mixed-ol	late dendrite	Fa100, Ca35%	0.24	0.00	0.33	14.55	0.25	0.00		0.27	10.01	0.00		0.18	42.69			33.61	*102.12*
1B	11	9	glass	interstitial		2.33	0.00	8.48	20.19	0.92	0.50		9.04	4.46	0.28		0.00	15.58			41.57	*103.34*
1B	11	10	glass	interstitial		2.20	0.00	8.34	18.31	1.19	0.43		7.91	6.23	0.10		0.00	17.08			40.29	*102.08*
1B	11	11	wustite	dendrite		0.00	0.19	0.22	0.18	0.00	0.00		0.00	0.14	0.00		0.00	76.70			22.55	*99.98*
1B	11	12	wustite	dendrite		0.00	0.00	0.29	0.22	0.00	0.00		0.00	0.09	0.00		0.00	75.95			22.31	*98.87*
1B	13	1	olivine	coarse main inner	Fa96, Ca7%	0.00	0.91	0.00	13.97	0.00			0.00	2.73			0.25	50.59			32.17	*100.63*
1B	13	2	olivine	coarse main inner	Fa97, Ca7%, Mn1%	0.00	0.80	0.00	14.06	0.00			0.00	2.68			0.29	51.46			32.44	*101.73*
1B	13	3	olivine	coarse main inner	Fa97, Ca7%	0.00	0.71	0.00	14.10	0.00			0.00	2.92			0.25	50.70			32.29	*100.98*
1B	13	4	olivine	coarse main inner	Fa98, Ca8%	0.00	0.79	0.13	14.34	0.10			0.00	3.15			0.28	51.23			33.12	*103.13*
1B	13	5	olivine	margin main	Fa99, Ca30%	0.00	0.16	0.35	14.17	0.20			0.00	12.47			0.00	40.26			33.33	*100.94*
1B	13	6	mixed-ol	late dendrite	Fa100, Ca32%	1.52	0.00	4.72	16.83	0.55			4.54	9.23			0.00	27.23			37.02	*101.63*
1B	13	7	mixed-ol	late dendrite	Fa100, Ca30%	1.47	0.00	4.77	16.71	0.66			4.26	8.74			0.00	28.35			37.13	*102.10*
6B	5	1	wustite	oxidised iron?		0.00	0.00	0.28	0.13	0.00	0.00		0.00	0.00	0.13		0.51	76.00			22.40	*99.45*
6B	5	2	wustite	oxidised iron?		0.00	0.00	0.24	0.16	0.00	0.00		0.00	0.00	0.00		0.52	76.77			22.54	*100.23*
6B	5	3	wustite	small dendrite		0.00	0.00	0.28	0.22	0.00	0.00		0.15	0.27	0.30		0.20	74.86			22.34	*98.61*
6B	5	4	olivine	core	Fa98, Ca5%, Mn2%	0.00	0.36	0.22	13.35	0.00	0.00		0.00	1.81	0.00		1.22	51.34			31.43	*99.73*
6B	5	5	olivine	core	Fa98, Ca5%, Mn3%	0.00	0.55	0.12	13.77	0.00	0.00		0.00	2.24	0.00		1.47	51.09			32.11	*101.34*
6B	5	6	olivine	has w cotectite	Fa98, Ca6%, Mn2%	0.00	0.39	0.16	13.44	0.00	0.00		0.00	2.26	0.00		1.30	50.79			31.54	*99.87*
6B	5	7	mixed ol	late dendrite	Fa99, Ca29%, Mn2%	1.16	0.14	4.32	16.51	0.34	0.12		4.00	8.86	0.18		0.63	28.58			36.62	*101.47*
6B	5	8	mixed ol	late dendrite	Fa99, Ca28%, Mn2%	0.92	0.16	3.35	15.95	0.30	0.09		3.21	9.07	0.13		0.69	31.64			35.71	*101.20*
6B	5	9	mixed ol	late dendrite	Fa100, Ca31%, Mn1%	1.35	0.00	5.80	17.39	0.47	0.15		5.21	7.81	0.19		0.40	24.35			37.67	*100.78*
6B	5	10	mixed ol	late dendrite	Fa100, Ca31%, Mn2%	1.10	0.00	3.88	16.52	0.36	0.00		3.90	9.39	0.00		0.70	28.93			36.16	*100.94*
6B	6	1	wustite	oxidised iron			0.00	0.00	0.16	0.00	0.09	0.09	0.00	0.00			0.00	68.45	0.84		20.19	*89.83*
6B	6	2	glass	medium			0.00	2.98	9.42	0.00	0.18	0.42	0.00	0.56			0.00	39.04	0.00		25.07	*77.67*
6B	6	3	glass	dark			0.00	3.14	23.50	0.36	0.00	0.00	0.66	1.44			0.24	22.33	0.00		37.21	*88.88*
6B	6	4	glass	medium			0.00	2.26	8.88	0.00	0.22	0.47	0.00	0.48			0.00	39.91	0.00		24.08	*76.30*
6B	6	5	wustite	spheroid in inclusion			0.23	1.46	0.26	0.00	0.00	0.00	0.00	0.00			0.47	73.89	0.00		23.05	*99.36*
6B	6	6	wustite	oxidised iron			0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00			0.00	69.86	0.88		20.29	*91.13*
6B	6	7	fe-ox	altered? pore margin			0.20	2.52	0.41	0.00	0.00	0.00	0.00	0.13			0.00	56.61	0.00		19.11	*78.98*
6B	7	1	olivine	core main	Fa98, Ca3%, Mn2%	0.00	0.50	0.16	13.24	0.00			0.00	1.26	0.00		0.99	52.39			31.36	*99.90*
6B	7	2	olivine	core main	Fa99, Ca6%, Mn2%	0.00	0.20	0.00	13.49	0.14			0.00	2.35	0.00		1.15	51.30			31.65	*100.29*
6B	7	3	olivine	margin main	Fa100, Ca9%, Mn1%	0.19	0.00	0.17	13.50	0.00			0.00	3.49	0.00		0.79	50.25			31.62	*100.02*
6B	7	4	olivine	margin of grain with W	Fa100, Ca6%, Mn2%	0.00	0.00	0.17	13.41	0.10			0.00	2.56	0.00		1.15	51.70			31.72	*100.81*
6B	7	5	olivine	margin main	Fa99, Ca8%, Mn2%	0.00	0.18	3.67	13.08	0.12			0.00	3.27	0.00		1.12	48.16			33.87	*103.47*
6B	7	6	olivine	core main	Fa97, Ca5%, Mn3%	0.00	0.70	0.00	13.66	0.00			0.00	1.92	0.00		1.82	51.10			31.96	*101.16*
6B	7	7	olivine	core main	Fa98, Ca5%, Mn3%	0.00	0.46	0.00	13.68	0.00			0.00	1.90	0.00		1.43	51.77			31.89	*101.13*
6B	7	8	olivine	core main	Fa98, Ca4%, Mn3%	0.00	0.48	0.00	13.70	0.00			0.00	1.65	0.00		1.43	51.66			31.80	*100.72*
6B	7	9	olivine	root dendrite	Fa100, Ca11%, Mn2%	0.29	0.00	1.17	14.11	0.00			0.56	4.40	0.00		1.04	46.28			32.65	*100.49*
6B	7	10	mixed ol	late dendrite	Fa100, Ca19%, Mn2%	0.79	0.00	6.84	14.09	0.18			2.46	5.89	0.00		0.67	35.14			35.76	*101.83*
6B	7	11	mixed ol	late dendrite	Fa100, Ca21%, Mn1%	2.29	0.00	7.47	16.86	0.34			6.03	4.68	0.27		0.34	23.50			37.20	*98.97*
8B	4	1	olivine	core main	Fa97, Ca5%, Mn1%		0.64		13.57	0.00				1.86			0.69	51.30			31.52	*99.57*
8B	4	2	olivine	core main	Fa97, Ca4%, Mn1%		0.75		13.64	0.10				1.67			0.80	51.51			31.81	*100.28*
8B	4	3	olivine	inner main	Fa97, Ca6%, Mn1%		0.58		13.65	0.00				2.41			0.68	51.28			31.78	*100.38*
8B	4	4	olivine	margin main	Fa99, Ca18%, Mn1%		0.24		13.75	0.00				7.25			0.62	45.69			31.98	*99.53*

S	A	#	Phase	Notes	Phase nomenclature	Weight% element															
						Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	As	Ba	O	Total
8B	4	5	olivine	margin main	Fa99, Ca25%, Mn1%		0.20		14.07	0.18				10.27			0.57	41.96			32.69	*99.95*
8B	5	1	olivine	core main	Fa97, Ca7%, Mn1%	0.00	0.61		13.67	0.00			0.00	2.73			0.81	50.30			31.71	*99.82*
8B	5	2	olivine	inner main	Fa98, Ca7%, Mn1%	0.00	0.53		13.52	0.00			0.00	3.00			0.81	50.10			31.54	*99.49*
8B	5	3	olivine	inner main	Fa99, Ca16%, Mn1%	0.00	0.27		13.82	0.11			0.00	6.65			0.63	46.20			32.14	*99.82*
8B	5	4	olivine	margin main	Fa99, Ca22%, Mn1%	0.20	0.18		14.01	0.09			0.00	8.84			0.47	43.95			32.53	*100.29*
8B	5	5	olivine	margin main	Fa100, Ca29%, Mn1%	0.00	0.00		13.58	0.20			0.00	11.80			0.36	40.14			32.04	*98.12*
8B	5	6	olivine	root dendrite	Fa100, Ca31%, Mn1%	0.29	0.00		13.91	0.39			0.00	12.60			0.33	38.80			32.69	*99.02*
8B	5	7	olivine	root dendrite	Fa100, Ca32%, Mn1%	0.25	0.00		13.97	0.24			0.14	13.20			0.41	38.15			32.66	*99.03*
8B	5	8	olivine	inner main	Fa98, Ca6%, Mn1%	0.00	0.54		13.70	0.00			0.00	2.33			0.66	50.84			31.65	*99.73*
8B	5	9	olivine	core main	Fa97, Ca6%, Mn1%	0.00	0.58		13.62	0.11			0.00	2.34			0.61	50.70			31.67	*99.62*
8B	5	10	olivine	inner main	Fa99, Ca12%, Mn1%	0.00	0.28		13.64	0.13			0.00	4.64			0.57	48.40			31.78	*99.44*
8B	5	11	olivine	margin main	Fa99, Ca14%, Mn1%	0.00	0.25		13.59	0.00			0.00	5.64			0.60	47.25			31.60	*98.92*
8B	6	1	olivine	core main	Fa98, Ca7%, Mn1%		0.49		13.55					2.69			0.66	50.49			31.49	*99.37*
8B	6	2	olivine	inner main	Fa98, Ca12%, Mn1%		0.35		13.68					4.83			0.61	48.36			31.77	*99.59*
8B	6	3	olivine	core in pore	Fa98, Ca8%, Mn1%		0.46		13.50					3.31			0.66	50.08			31.54	*99.55*
8B	6	4	olivine	core in pore	Fa97, Ca6%, Mn1%		0.58		13.30					2.56			0.68	50.73			31.29	*99.14*
8B	6	5	olivine	margin in pore	Fa99, Ca13%, Mn1%		0.25		13.53					5.39			0.59	47.55			31.53	*98.85*
8B	6	6	olivine	margin in pore	Fa98, Ca16%, Mn1%		0.32		13.50					6.59			0.49	46.40			31.66	*98.96*
10B	3	1	olivine	inner main	Fa97, Ca10%, Mn1%	0.00	0.60	0.00	13.52	0.00	0.00		0.00	3.89	0.00		0.52	48.68			31.44	*98.65*
10B	3	2	olivine	core main	Fa97, Ca9%, Mn1%	0.00	0.67	0.11	13.33	0.00	0.00		0.00	3.66	0.00		0.49	48.42			31.20	*97.87*
10B	3	3	olivine	inner main	Fa97, Ca10%, Mn1%	0.00	0.56	0.00	13.61	0.00	0.00		0.00	3.86	0.00		0.56	49.00			31.62	*99.21*
10B	3	4	olivine	inner main	Fa98, Ca11%, Mn1%	0.00	0.52	0.00	13.65	0.00	0.00		0.00	4.51	0.00		0.47	48.10			31.62	*98.88*
10B	3	5	olivine	margin main	Fa100, Ca30%	0.00	0.00	0.12	14.03	0.13	0.00		0.00	12.38	0.00		0.26	39.47			32.59	*98.98*
10B	3	6	olivine	margin main	Fa100, Ca18%	0.00	0.00	0.00	13.87	0.22	0.00		0.13	7.06	0.00		0.16	46.14			32.21	*99.79*
10B	3	7	olivine	late mass	Fa100, Ca36%	0.18	0.00	0.88	13.22	0.43	0.00		0.00	14.86	0.00		0.19	36.34			32.86	*98.95*
10B	3	8	olivine	late mass margin	Fa100, Ca25%	0.00	0.00	0.23	13.71	0.30	0.00		0.16	9.97	0.00		0.26	41.12			32.08	*97.82*
10B	3	9	olivine	late dendrite	Fa100, Ca20%	0.27	0.00	0.42	13.98	0.30	0.00		0.22	8.13	0.00		0.23	43.81			32.68	*100.02*
10B	3	10	glass	glass		2.04	0.00	9.16	17.68	1.31	0.48		5.80	7.14	0.38		0.00	17.48			40.70	*102.17*
10B	3	11	glass	glass		1.97	0.00	8.27	15.77	1.60	1.58		4.68	7.96	0.62		0.00	20.94			40.99	*104.39*
10B	3	12	glass	glass		2.29	0.00	8.49	16.90	1.81	0.29		5.72	8.13	0.39		0.00	16.19			39.69	*99.90*
10B	3	13	secondary	in pore		0.00	0.00	0.70	10.98	0.09	0.10		0.00	0.47	0.00		0.00	43.06			25.91	*81.30*
10B	4	1	olivine	inner main	Fa98, Ca14%. Mn1%	0.00	0.41	0.00	13.42	0.00	0.00		0.00	5.62	0.00		0.44	47.09			31.41	*98.38*
10B	4	2	olivine	inner main	Fa99, Ca21%, Mn1%	0.00	0.15	0.00	13.36	0.12	0.00		0.00	8.59	0.00		0.29	43.40			31.43	*97.35*
10B	4	3	glass	may be mixed		1.83	0.00	6.63	16.32	1.25	0.74		4.93	8.74	0.24		0.00	20.48			38.38	*99.55*
10B	4	4	olivine	mixed?	Fa100, Ca3%	0.00	0.00	2.01	9.19	0.19	0.00		0.11	0.80	0.00		0.00	43.06			25.17	*80.52*
10B	4	5	wustite	dendrite		0.00	0.00	0.39	0.25	0.00	0.00		0.08	0.16	0.64		0.00	73.14			22.09	*96.76*
10B	4	6	olivine	inner edge main	Fa99, Ca35%	0.00	0.15	0.14	13.73	0.24	0.00		0.00	14.60	0.00		0.22	36.84			32.62	*98.54*
10B	4	7	olivine	inner main	Fa98, Ca17%, Mn1%	0.00	0.31	0.00	13.52	0.16	0.00		0.00	7.04	0.00		0.37	45.73			31.83	*98.97*
10B	4	8	glass	may be mixed		2.24	0.00	9.17	16.83	1.43	0.50		5.58	8.56	0.26		0.00	16.58			40.18	*101.33*
10B	4	9	olivine	inner main	Fa98, Ca12%, Mn1%	0.00	0.53	0.00	13.46	0.00	0.00		0.00	4.97	0.00		0.46	47.71			31.47	*98.59*
13b	2	1	olivine	core main	Fa97, Ca5%, Mn18%	0.00	0.65	0.00	13.74	0.11	0.00		0.00	2.06	0.00		10.27	41.93			32.04	*100.79*
13b	2	2	olivine	core main	Fa97, Ca5%, Mn17%	0.00	0.54	0.00	13.78	0.00	0.00		0.00	2.22	0.00		9.54	42.25			31.82	*100.15*
13b	2	3	olivine	inner main	Fa98, Ca6%, Mn17%	0.00	0.44	0.00	13.59	0.16	0.00		0.00	2.44	0.00		9.47	42.01			31.74	*99.85*
13b	2	4	olivine	outer main	Fa99, Ca7%, Mn14%	0.00	0.21	0.00	13.61	0.00	0.00		0.00	2.94	0.00		7.90	42.98			31.43	*99.08*
13b	2	5	olivine	margin main	Fa100 Ca10%, Mn13%	0.00	0.00	0.13	13.34	0.31	0.00		0.00	3.92	0.00		6.91	42.97			31.60	*99.19*
13b	2	6	olivine	outer main	Fa99, Ca8%, Mn15%	0.00	0.27	0.13	13.41	0.00	0.00		0.00	3.14	0.00		8.10	42.75			31.42	*99.21*
13b	2	7	olivine	root of o/g	Fa100 Ca12%, Mn13%	0.00	0.00	0.13	13.60	0.25	0.00		0.00	5.04	0.00		7.24	41.78			32.02	*100.06*
13b	2	8	olivine	late o/g	Fa100 Ca18%, Mn12%	0.00	0.00	0.12	13.36	0.52	0.00		0.00	7.38	0.00		6.79	39.25			32.17	*99.59*
13b	2	9	olivine	late interstitial	Fa100 Ca26%, Mn10%	0.33	0.00	0.37	13.98	0.56	0.00		0.31	10.25	0.00		5.45	35.65			33.05	*99.95*
13b	2	10	olivine	late interstitial	Fa99, Ca25%, Mn10%	0.27	0.14	0.82	13.67	0.67	0.08		0.99	9.42	0.00		5.28	33.67			32.63	*97.63*
13b	2	11	glass?	interstitial		1.60	0.00	7.72	16.61	3.02	0.31		6.57	10.11	0.28		1.67	12.93			40.48	*101.31*
13b	2	12	olivine	core main	Fa97, Ca5%, Mn18%	0.00	0.62	0.13	13.85	0.00	0.00		0.00	2.06	0.00		10.09	42.13			32.14	*101.02*
13b	2	13	olivine	inner main	Fa97, Ca5%, Mn18%	0.00	0.55	0.11	13.71	0.00	0.00		0.00	2.14	0.00		9.89	41.80			31.79	*99.99*
13b	2	14	olivine	outer main	Fa98, Ca6%, Mn17%	0.00	0.46	0.00	13.74	0.10	0.00		0.00	2.32	0.00		9.28	42.67			31.94	*100.51*
13b	2	15	wustite	dendrite		0.00	0.17	0.32	0.14	0.00	0.00		0.00	0.11	0.14		2.44	73.07			22.34	*98.73*
13b	2	16	wustite	bleb (dendrite?)		0.00	0.00	0.28	0.00	0.00	0.00		0.00	0.00	0.00		3.78	72.10			22.00	*98.16*

S	A	#	Phase	Notes	Phase nomenclature	Weight% element																
						Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	As	Ba	O	Total
13b	2	17	wustite	scale outer		0.00	0.00	0.28	0.10	0.00	0.00		0.00	0.00	0.12		2.52	72.60			21.97	*97.58*
13b	2	18	wustite	scale inner		0.00	0.00	0.24	0.11	0.00	0.00		0.00	0.00	0.10		2.44	72.72			21.95	*97.57*
13b	2	19	wustite	scale inner		0.00	0.00	0.30	0.11	0.00	0.00		0.00	0.00	0.00		2.61	72.62			21.96	*97.59*
13b	2	20	wustite	scale outer		0.00	0.00	0.29	0.10	0.00	0.00		0.08	0.00	0.12		2.62	72.17			21.90	*97.28*
13b	2	21	glass	interstitial		1.21	0.00	6.62	18.80	0.58	0.14		4.37	5.90	0.22		2.37	22.11			39.10	*101.41*
13b	21	1	wustite	wustite outside lump		0.00	0.00	0.28	0.18	0.00	0.00		0.00	0.00	0.00		3.04	70.91		0.00	21.65	*96.06*
13b	21	2	wustite	wustite outside lump		0.00	0.00	0.23	0.12	0.00	0.00		0.00	0.00	0.25		2.00	71.35		0.00	21.53	*95.47*
13b	21	3	wustite	dense clot		0.00	0.00	0.41	0.13	0.00	0.00		0.00	0.11	0.18		2.59	73.54		0.00	22.50	*99.47*
13b	21	4	wustite	dense clot		0.00	0.00	0.34	0.12	0.00	0.00		0.00	0.00	0.00		2.76	73.59		0.00	22.32	*99.13*
13b	21	5	olivine	inner	Fa98, Ca7%, Mn17%	0.00	0.33	0.00	13.43	0.10	0.00		0.00	2.57	0.00		8.89	41.38		0.00	31.11	*97.81*
13b	21	6	olivine	outer	Fa98, Ca8%, Mn15%	0.00	0.28	0.00	13.17	0.09	0.00		0.00	3.32	0.00		8.11	41.46		0.00	30.87	*97.30*
13b	21	7	olivine	margin	Fa98, Ca14%, Mn13%	0.00	0.00	0.00	13.32	0.30	0.00		0.00	5.60	0.00		6.98	39.95		0.00	31.27	*97.41*
13b	21	8	olivine	margin	Fa99, Ca14%, Mn14%	0.00	0.12	0.00	13.34	0.40	0.00		0.00	5.53	0.00		7.37	39.64		0.00	31.50	*97.89*
13b	21	9	olivine	late interstitial	Fa100, Ca18%, Mn13%	0.00	0.00	0.11	13.24	0.56	0.00		0.00	7.00	0.00		6.95	37.84		0.00	31.56	*97.27*
13b	21	10	olivine	late interstitial	Fa100, Ca20%, Mn11%	0.00	0.00	0.22	13.53	0.33	0.00		0.34	7.93	0.00		6.05	36.98		0.00	31.63	*97.01*
13b	21	11	olivine	late interstitial	Fa99, Ca19%, Mn13%	0.00	0.16	0.15	13.04	0.59	0.00		0.00	7.27	0.00		6.74	36.95		0.00	31.30	*96.20*
13b	21	12	mixed	glassy interstitial		0.60	0.00	5.51	12.95	4.86	0.76		6.22	13.15	0.00		1.41	13.66		0.65	38.20	*97.97*
13b	21	13	mixed	glassy interstitial		0.72	0.00	5.66	14.89	2.65	0.45		6.34	9.59	0.14		2.00	18.45		0.60	37.49	*98.97*
13b	21	14	mixed	ol-rich interstitial		0.74	0.00	4.25	15.33	1.35	0.26		4.61	8.56	0.00		3.00	24.17		0.50	35.85	*98.61*
13b	22	1	area	main ol some w	area	0.00	0.40	0.19	11.81	0.11	0.00		0.00	2.06	0.00		8.28	39.10		0.00	28.45	*90.40*
13b	22	2	area	fine ol some w	area	0.70	0.00	2.71	11.15	1.10	0.13		2.22	6.32	0.00		3.46	35.76		0.35	31.23	*95.13*
13b	22	3	area	dominated by w	area	0.23	0.00	1.45	5.63	0.41	0.09		0.88	2.95	0.00		3.52	56.52		0.00	27.02	*98.71*
13b	22	4	area	silicate entirely	area	0.91	0.00	5.70	13.92	1.38	0.13		3.26	6.59	0.20		3.17	22.98		0.40	34.22	*92.88*
13b	22	5	area	dense w	area	0.28	0.00	1.31	4.98	0.44	0.00		0.77	2.44	0.00		3.60	56.87		0.00	25.98	*96.67*
13b	22	6	area	silicate almost entirely	area	0.89	0.00	3.19	13.53	1.37	0.21		2.61	7.45	0.16		4.00	29.70		0.31	33.97	*97.38*
13b	22	7	area	dense w	area	0.31	0.00	1.40	5.72	0.50	0.09		0.96	2.92	0.00		3.56	55.45		0.00	26.93	*97.84*
13b	22	8	area	main ol	Fa98, Ca7%, Mn15%	0.00	0.37	0.18	12.45	0.20	0.00		0.00	2.68	0.00		7.91	39.62		0.00	29.57	*92.97*
13b	22	9	area	fine silicates some w	area	0.90	0.00	3.59	14.02	1.50	0.24		3.07	9.06	0.00		3.12	26.01		0.54	34.44	*96.49*
13b	22	10	area	equal silicate /w	area	0.59	0.00	2.34	9.26	0.82	0.13		1.74	5.12	0.00		3.45	44.83		0.44	30.40	*99.13*
13b	23	1	area	dense w patch	area	0.00	0.00	0.67	3.30	0.24	0.07		0.40	1.53	0.00		2.72	55.10			22.05	*86.09*
13b	23	2	area	coarse ol with w, no interstitial	Fa97, Ca5%, Mn16%	0.00	0.52	0.27	11.76	0.10	0.00		0.00	1.70	0.00		7.79	39.62			28.42	*90.20*
13b	23	3	area	interstitial materials	area	0.62	0.12	3.19	12.76	1.11	0.12		2.49	6.84	0.20		3.72	27.32			31.57	*90.06*
13b	23	4	area	i m with some w	area	0.56	0.00	2.29	9.28	0.93	0.12		1.75	5.32	0.18		2.81	36.08			27.93	*87.24*
13b	23	5	area	fine interstitial area	area	0.74	0.00	3.95	14.02	1.55	0.26		3.45	8.62	0.28		3.07	25.91			34.80	*96.66*
13b	23	6	area	main ol little w	area	0.00	0.48	0.29	12.42	0.10	0.00		0.08	2.06	0.00		7.88	41.90			30.00	*95.22*
13b	23	7	area	coarse ol area with little w	area	0.00	0.31	0.84	11.82	0.33	0.00		0.44	2.81	0.00		6.80	38.79			29.15	*91.28*
13b	23	8	area	larger area of interstitial zone	area	0.66	0.00	3.33	12.75	1.28	0.23		2.82	7.26	0.20		3.29	28.54			32.45	*92.80*
13b	24	1	olivine	main inner	Fa97, Ca6%, Mn18%		0.53	0.00	12.71	0.00			0.00	2.25	0.00		9.38	38.79			29.57	*93.22*
13b	24	2	olivine	main outer	Fa97, Ca4%, Mn14%		0.49	0.00	12.81	0.00			0.00	1.70	0.00		7.51	42.39			29.93	*94.83*
13b	24	3	olivine	main margin	Fa100, Ca8%, Mn13%		0.00	0.11	12.63	0.21			0.00	2.92	0.00		6.77	41.54			29.79	*93.96*
13b	24	4	olivine	main core	Fa97, Ca4%, Mn15%		0.64	0.00	13.34	0.10			0.00	1.61	0.00		8.15	43.21			31.14	*98.19*
13b	24	5	olivine	main inner	Fa98, Ca4%, Mn15%		0.44	0.14	13.60	0.10			0.00	1.77	0.00		7.92	43.65			31.56	*99.18*
13b	24	6	olivine	main outer	Fa98, Ca6%, Mn15%		0.31	0.00	13.43	0.13			0.00	2.53	0.00		8.03	42.91			31.32	*98.66*
13b	24	7	olivine	root of o/g	Fa100, Ca11%, Mn11%		0.00	0.11	13.44	0.32			0.00	6.60	0.00		5.81	39.68			31.51	*97.47*
13b	24	8	olivine	late o/g	Fa100, Ca29%, Mn8%		0.00	0.30	13.63	0.73			0.19	11.38	0.00		4.59	34.55			32.55	*97.92*
13b	24	9	olivine	late o/g	Fa100, Ca23%, Mn11%		0.00	0.12	13.00	0.58			0.00	9.22	0.00		5.98	36.06			31.42	*96.38*
13b	24	10	wustite	blebby dendrite			0.00	0.30	0.11	0.00			0.00	0.00	0.24		2.04	71.13			21.52	*95.34*
13b	24	11	wustite	blebby dendrite			0.00	0.32	0.14	0.00			0.00	0.00	0.26		1.62	71.21			21.49	*95.04*
13b	24	12	wustite	fine dendrite on bleb			0.00	0.32	0.13	0.00			0.00	0.12	0.32		1.37	71.06			21.45	*94.76*
13b	24	13	olivine	? Main margin	Fa100, Ca18%, Mn11%		0.00	0.00	13.12	0.49			0.00	7.27	0.00		6.02	38.61			31.29	*96.79*
14B	5	1	olivine	inner main	Fa97, Ca5%, Mn10%	0.00	0.63	0.18	13.67	0.20	0.00	0.00	0.00	2.08			5.60	46.04		0.00	32.05	*100.45*
14B	5	2	olivine	inner main	Fa97, Ca5%, Mn10%	0.00	0.53	0.12	13.78	0.00	0.00	0.00	0.00	1.95			5.76	46.53		0.00	31.94	*100.61*
14B	5	3	olivine	edge main	Fa99, Ca8%, Mn9%	0.00	0.28	0.14	13.52	0.20	0.00	0.00	0.00	3.05			4.81	45.96		0.00	31.76	*99.73*
14B	5	4	olivine	edge main	Fa100, Ca14%, Mn8%	0.31	0.00	0.00	13.61	0.55	0.00	0.00	0.00	5.65			4.62	43.00		0.00	32.25	*99.99*

S	A	#	Phase	Notes	Phase nomenclature	Weight% element															
						Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	As	Ba	O	Total
14B	5	5	olivine	secondary o/g	Fa100, Ca40%, Mn5%	0.00	0.00	0.84	11.76	3.42	0.00	0.00	0.44	15.28			2.85	29.44		0.28	34.04	*98.34*
14B	5	6	apatite	mixed		0.58	0.00	2.45	6.95	11.20	0.21	0.18	1.39	30.58			0.61	5.57		0.41	39.39	*99.52*
14B	5	7	olivine	late dendrite	Fa100, Ca38%, Mn4%	0.53	0.00	2.22	12.79	3.34	0.10	0.00	1.01	13.94			2.25	29.47		0.30	36.20	*102.35*
14B	5	8	olivine	late root	Fa99, Ca155, Mn8%	0.00	0.14	0.00	13.57	0.33	0.00	0.00	0.00	5.89			4.33	42.50		0.00	31.76	*98.52*
14B	5	9	olivine	inner main	Fa98, Ca6%, Mn10%	0.00	0.38	0.11	13.45	0.16	0.00	0.00	0.00	2.38			5.33	45.47		0.00	31.41	*98.70*
14B	6	1	olivine	inner main	Fa98, Ca5%, Mn10%	0.00	0.45	0.19	13.64	0.14	0.00	0.00	0.00	1.84	0.00		5.53	46.10		0.00	31.73	*99.62*
14B	6	2	olivine	margin main	Fa100, Ca10%, Mn8%	0.00	0.00	0.00	13.50	0.16	0.00	0.00	0.00	3.79	0.00		4.47	45.20		0.00	31.36	*98.47*
14B	6	3	olivine	late fringe	Fa100, Ca19%, Mn7%	0.00	0.00	0.39	14.02	0.30	0.00	0.00	0.13	7.74	0.00		3.69	40.84		0.00	32.61	*99.74*
14B	6	4	olivine	?margin main/late	Fa100, Ca15%, Mn8%	0.00	0.00	0.16	13.36	0.38	0.00	0.00	0.00	6.10	0.00		4.22	42.59		0.00	31.72	*98.54*
14B	6	5	olivine	late fringe	Fa100, Ca18%, Mn8%	0.21	0.00	0.23	13.36	0.42	0.00	0.00	0.00	7.21	0.00		4.37	40.68		0.00	31.84	*98.32*
14B	6	6	apatite			0.00	0.00	0.43	5.07	13.66	0.00	0.20	0.27	34.57	0.15		0.41	4.23		0.00	39.09	*98.09*
14B	6	7	apatite			0.00	0.00	0.47	5.01	13.62	0.13	0.22	0.37	34.86	0.00		0.45	4.23		0.00	39.23	*98.59*
14B	6	8	apatite			0.35	0.00	2.21	7.88	10.86	0.12	0.14	1.23	28.43	0.00		0.65	9.08		0.00	39.64	*100.57*
14B	6	9	olivine	late dendrite	Fa100, Ca25%, Mn6%	0.23	0.00	0.24	13.53	0.66	0.00	0.00	0.15	10.02	0.00		3.17	38.33		0.00	32.49	*98.82*
14B	6	10	olivine	late dendrite	Fa100, Ca27%, Mn6%	0.31	0.00	0.46	13.39	0.65	0.00	0.00	0.28	10.39	0.00		3.02	36.90		0.00	32.27	*97.67*
14B	6	11	glass	mixed?		2.51	0.00	9.79	14.06	4.99	0.73	0.00	6.55	11.66	0.00		0.52	9.88		1.50	42.29	*104.48*
14B	6	12	apatite			0.96	0.00	3.90	6.54	12.68	0.17	0.00	2.11	26.40	0.00		0.26	6.15		0.73	40.78	*100.67*
14B	6	13	apatite			0.71	0.00	2.13	4.36	13.91	0.38	0.00	1.50	27.82	0.00		0.60	6.98		0.73	39.32	*98.45*
14B	6	14	apatite			0.35	0.00	0.72	3.38	15.57	0.08	0.00	0.30	34.62	0.00		0.35	3.05		0.32	39.74	*98.48*
14B	6	15	glass	mixed?		0.20	0.00	5.26	10.61	6.17	0.00	0.00	0.98	15.54	0.00		1.38	8.97		0.60	34.26	*83.99*
14B	6	16	glass	mixed?		0.45	0.10	7.85	15.73	1.57	0.12	0.00	2.07	7.23	0.18		1.07	9.02		0.77	33.76	*79.94*
14B	6	17	glass	mixed?		0.18	0.00	8.39	7.73	2.71	0.00	0.00	0.24	8.36	0.00		3.84	18.42		0.00	29.62	*79.50*
14B	6	18	olivine	late o/g		0.00	0.00	0.13	13.33	0.55	0.00	0.00	0.00	9.21	0.00		3.60	38.59		0.00	31.80	*97.22*
14B	6	19	ol/apatite	mixed?		0.00	0.00	0.48	7.10	8.99	0.00	0.00	0.45	22.57	0.00		1.70	18.69		0.00	35.08	*95.06*
14C	3	1	olivine	core main	Fa97, Ca5%, Mn10%	0.00	0.61	0.17	14.13	0.19				1.86			5.85	47.42			32.93	*103.17*
14C	3	2	olivine	core main	Fa97, Ca5%, Mn10%	0.00	0.55	0.15	14.04	0.25				1.97			5.79	47.60			32.93	*103.29*
14C	3	3	olivine	core main	Fa99, Ca8%, Mn9%	0.00	0.25	0.00	14.09	0.14				3.31			5.03	47.06			32.65	*102.51*
14C	3	4	olivine	core main	Fa98, Ca6%, Mn9%	0.00	0.40	0.12	14.15	0.10				2.70			5.41	47.76			32.96	*103.59*
14C	3	5	olivine	core main	Fa98, Ca6%, Mn10%	0.00	0.37	0.15	14.17	0.13				2.38			5.40	47.35			32.76	*102.69*
14C	3	6	olivine	core main	Fa97, Ca5%, Mn10%	0.19	0.60	0.12	14.02	0.12				2.02			5.68	47.70			32.81	*103.26*
14C	3	7	olivine	margin main	Fa98, Ca6%, Mn9%	0.00	0.39	0.00	14.06	0.00				2.55			5.26	47.71			32.49	*102.45*
14C	3	8	olivine	margin main	Fa99, Ca10%, Mn8%	0.00	0.23	0.14	14.39	0.00				4.01			4.54	46.60			32.94	*102.85*
14C	3	9	olivine	margin main	Fa99, Ca10%, Mn8%	0.00	0.23	0.15	14.21	0.10				4.36			4.57	47.00			33.13	*103.74*
14C	3	10	olivine	margin/fringe	Fa100, Ca27%, Mn7%	0.00	0.00	0.00	14.17	0.29				11.22			3.83	38.95			33.28	*101.75*
14C	3	11	olivine	margin main	Fa100, Ca18%, Mn7%	0.28	0.00	4.39	13.12	0.56				7.03			3.82	41.15			35.39	*105.74*
14C	3	12	olivine	late fringe	Fa100, Ca30%, Mn6%	0.35	0.00	0.12	14.05	0.66				12.39			3.36	37.27			33.68	*101.88*
14D	2	1	olivine	core main	Fa98, Ca5%, Mn10%	0.00	0.45	0.00	13.70	0.10		0.00	0.00	2.24	0.00		5.47	47.12			32.01	*101.09*
14D	2	2	olivine	inner1	Fa98, Ca6%, Mn10%	0.00	0.43	0.16	13.85	0.00		0.00	0.00	2.32	0.00		5.51	46.61			32.09	*100.98*
14D	2	3	olivine	inner2	Fa98, Ca7%, Mn9%	0.00	0.35	0.00	13.89	0.00		0.00	0.00	2.69	0.00		5.23	46.47			31.96	*100.58*
14D	2	4	olivine	inner3	Fa99, Ca9%, Mn8%	0.00	0.19	0.00	13.83	0.16		0.00	0.00	3.85	0.00		4.64	46.12			32.19	*100.99*
14D	2	5	olivine	margin main	Fa100, Ca18%, Mn7%	0.00	0.00	0.16	13.80	0.26		0.00	0.00	7.19	0.00		4.11	42.75			32.52	*100.79*
14D	2	6	olivine	overgrowth	Fa100. Ca18%, Mn7%	0.00	0.00	0.19	13.76	0.41		0.00	0.00	7.24	0.00		3.91	41.82			32.38	*99.71*
14D	2	7	olivine	inner main?	Fa99, Ca10%, Mn8%	0.00	0.29	0.00	13.83	0.00		0.00	0.00	4.01	0.00		4.62	45.38			31.89	*100.01*
14D	2	8	wustite	dendrite		0.00	0.00	0.44	0.11	0.00		0.00	0.00	0.08	0.37		1.33	74.55			22.55	*99.44*
14D	2	9	apatite			0.29	0.00	1.60	5.63	13.33		0.17	1.27	32.82	0.16		0.42	4.21			39.95	*99.85*
14D	2	10	olivine	late	Fa100, Ca18%, Mn8%	0.21	0.00	0.15	13.85	0.45		0.00	0.00	7.28	0.00		4.27	42.04			32.76	*101.01*
14D	2	11	olivine	late	Fa99, Ca18%, Mn7%	0.24	0.14	0.19	13.73	0.61		0.00	0.00	7.45	0.00		3.91	42.37			33.03	*101.68*
14D	2	12	apatite			0.00	0.00	0.12	2.63	16.18		0.27	0.15	37.87	0.00		0.38	2.62			40.01	*100.25*
14D	2	13	apatite			0.00	0.00	0.12	2.51	16.49		0.26	0.08	38.17	0.00		0.34	2.37			40.29	*100.62*
14D	3	1	apatite	mixed		0.33		3.11	7.23	11.60	0.00	0.14	1.76	30.04	0.00		0.39	4.88		0.44	40.32	*100.87*
14D	3	2	glass	mixed?		1.62		12.38	17.36	1.91	0.00	0.00	5.85	9.80	0.30		0.44	11.16		1.42	42.63	*104.87*
14D	3	3	glass	mixed?		1.83		12.67	17.44	0.95	1.46	0.00	5.75	7.32	0.28		0.52	14.98		1.58	44.12	*108.91*
14D	3	4	olivine	late	Fa100, Ca20%, Mn6%	0.00		0.38	13.98	0.34	0.00	0.00	0.17	8.17	0.00		3.34	41.53		0.00	33.11	*101.50*
14D	3	5	olivine	late	Fa100, Ca17%, Mn6%	0.25		0.66	13.95	0.34	0.00	0.00	0.31	6.81	0.00		3.34	42.42		0.00	32.91	*100.99*
14D	3	6	apatite			0.61		2.39	5.14	13.00	0.21	0.00	1.53	29.76	0.15		0.48	5.30		0.78	39.35	*98.70*
14D	3	7	apatite			0.63		3.10	5.75	13.24	0.00	0.00	1.81	30.11	0.13		0.49	4.53		0.52	40.60	*100.90*

S	A	#	Phase	Notes	Phase nomenclature	Weight% element																
						Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	As	Ba	O	Total
14D	3	8	apatite	mixed		0.95		6.33	9.20	9.91	0.00	0.00	3.29	24.63	0.00		0.39	5.42		0.77	41.51	*102.41*
14D	3	9	glass	mixed?		2.10		13.91	18.06	0.51	1.09	0.00	6.80	6.44	0.21		0.47	11.64		2.01	43.76	*106.99*
14D	3	10	apatite			0.55		2.14	4.49	14.22	0.00	0.00	1.37	31.51	0.00		0.41	4.28		0.51	40.17	*100.30*
14D	3	11	apatite	mixed		0.61		3.49	6.91	11.13	0.00	0.00	2.24	26.42	0.15		0.41	5.98		0.83	38.86	*97.56*
14D	3	12	olivine	margin of o/g	Fa100, Ca25%, Mn6%	0.29		1.76	14.15	0.62	0.18	0.00	1.32	9.13	0.00		2.79	35.20		0.54	33.74	*99.73*
16B	5	1	olivine	core main	Fa98, Ca5%, Mn4%	0.00	0.44	0.00	13.55	0.00	0.00		0.00	2.15	0.00		2.14	49.59		0.00	31.42	*99.29*
16B	5	2	olivine	core main	Fa98, Ca5%, Mn4%	0.00	0.41	0.00	13.50	0.00	0.00		0.00	2.17	0.00		2.09	49.73		0.00	31.37	*99.26*
16B	5	3	olivine	core main	Fa98, Ca5%, Mn4%	0.00	0.46	0.00	13.49	0.00	0.00		0.00	2.18	0.00		2.05	49.65		0.00	31.36	*99.18*
16B	5	4	olivine	inner main	Fa98, Ca7%, Mn4%	0.00	0.23	0.15	13.73	0.00	0.00		0.00	2.80	0.00		2.05	49.58		0.00	31.85	*100.39*
16B	5	5	olivine	inner main	Fa100, Ca12%, Mn3%	0.00	0.00	0.13	13.75	0.09	0.00		0.00	4.63	0.00		1.72	47.57		0.00	31.87	*99.75*
16B	5	6	olivine	margin main/o-g	Fa99, Ca26%, Mn2%	0.00	0.17	0.36	14.23	0.23	0.00		0.57	10.38	0.00		1.23	39.43		0.00	32.85	*99.45*
16B	5	7	olivine	late dendrite	Fa100, Ca26%, Mn2%	0.00	0.00	0.13	13.79	0.23	0.00		0.12	10.54	0.00		1.14	41.03		0.00	32.43	*99.40*
16B	5	8	olivine	late dendrite	Fa100, Ca28%, Mn2%	0.00	0.00	0.14	13.73	0.32	0.00		0.13	11.66	0.00		1.14	39.87		0.00	32.62	*99.61*
16B	5	9	olivine	late dendrite	Fa100, Ca27%, Mn2%	0.00	0.00	0.00	13.73	0.29	0.00		0.15	10.89	0.00		1.22	40.24		0.00	32.29	*98.81*
16B	5	10	glass	mixed?		1.82	0.00	8.64	18.23	0.96	0.60		7.63	4.85	0.35		0.16	13.53		1.10	39.02	*96.90*
16B	5	11	glass	mixed?		1.80	0.00	7.39	17.69	1.17	0.29		6.12	7.79	0.00		0.30	18.18		1.01	39.08	*100.83*
16B	5	12	glass	mixed?		2.02	0.00	8.11	17.49	1.18	0.39		6.35	7.13	0.20		0.29	18.19		1.03	39.64	*102.01*
16B	6	1	olivine	main	Fa97, Ca4%, Mn4%		0.75		13.52					1.48			2.38	49.72			31.43	*99.28*
16B	6	2	olivine	main	Fa97, Ca4%, Mn5%		0.78		13.57					1.42			2.49	49.15			31.34	*98.75*
16B	6	3	olivine	nr W cotectite	Fa98, Ca11%, Mn4%		0.41		13.67					4.66			2.05	47.32			31.86	*99.97*
16B	6	4	olivine	W-free zone	Fa96, Ca4%, Mn5%		0.78		13.33					1.42			2.48	48.95			31.01	*97.98*
16B	6	5	olivine	W-free zone	Fa96, Ca3%, Mn5%		0.84		13.28					1.32			2.48	48.47			30.82	*97.21*
16B	6	6	olivine	base of cake	Fa96, Ca3%, Mn5%		1.01		13.60					1.13			2.52	49.64			31.57	*99.48*
16B	6	7	olivine	base of cake	Fa98, Ca6%, Mn4%		0.51		13.24					2.29			2.16	48.37			30.83	*97.42*
16B	6	8	olivine	main	Fa96, Ca3%, Mn4%		0.87		13.40					1.31			2.32	49.20			31.14	*98.24*
16B	6	9	olivine	W-free zone	Fa96, Ca3%, Mn5%		0.86		13.44					1.30			2.54	49.25			31.25	*98.64*
18B	7	1	olivine	main edge	Fa100, Ca10%, Mn1%	0.00		0.12	13.72	0.00	0.00		0.00	4.22			0.48	49.77		0.00	31.82	*100.13*
18B	7	2	leucite			0.45		13.92	25.47	0.08	0.00		16.95	0.00			0.00	0.94		0.63	45.47	*103.91*
18B	7	3	olivine	main margin	Fa100, Ca37%	0.23		0.11	13.79	0.53	0.00		0.00	15.34			0.26	36.46		0.00	33.21	*99.93*
18B	7	4	olivine	altered margin/late	Fa100, Ca20%, Mn1%	0.00		0.13	13.61	0.36	0.00		0.00	8.22			0.37	44.21		0.00	32.14	*99.04*
18B	7	5	leucite			0.36		13.43	25.01	0.00	0.00		17.10	0.14			0.00	1.21		0.49	44.52	*102.26*
18B	7	6	olivine	altered late	Fa100, Ca18%, Mn1%	0.00		0.00	14.32	0.42	0.00		0.00	7.26			0.42	45.75		0.00	32.99	*101.16*
18B	7	7	olivine	altered late	Fa100, Ca19%, Mn1%	0.95		1.60	14.07	0.32	0.00		0.31	7.14			0.30	43.29		0.00	33.60	*101.59*
18B	7	8	glass?	mixed!		3.71		12.58	16.82	2.16	0.19		4.11	9.97			0.00	9.32		1.30	42.37	*102.55*
18B	7	9	olivine	late	Fa100, Ca14%, Mn1%	0.00		0.33	14.04	0.33	0.00		0.00	5.70			0.31	47.18		0.00	32.59	*100.47*
18B	7	10	apatite	mixed?		1.58		3.71	6.07	12.46	0.37		1.06	29.83			0.00	3.98		0.39	40.72	*100.16*
18B	7	11	olivine	ol late o/g?	Fa100, Ca33%, Mn1%	0.35		0.00	14.02	0.55	0.00		0.00	13.66			0.34	38.31		0.00	33.32	*100.54*
18B	7	12	olivine	altered late	Fa100, Ca24%, Mn1%	0.00		0.18	13.66	0.41	0.00		0.00	9.67			0.41	42.66		0.00	32.45	*99.44*
18B	7	13	mixed	apatite dendrite in late ol		0.00		1.39	7.10	5.99	0.38		0.18	13.31			0.00	35.16		0.00	33.06	*96.59*
18B	8	1	olivine	core main	Fa99, Ca3%, Mn1%	0.00	0.34	0.00	13.67	0.00	0.00		0.00	1.28	0.00		0.65	52.46			31.53	*99.94*
18B	8	2	olivine	inner main	Fa100, Ca6%, Mn1%	0.00	0.00	0.00	13.57	0.00	0.00		0.00	2.53	0.00		0.53	51.55			31.39	*99.57*
18B	8	3	olivine	margin main	Fa100, Ca13%, Mn1%	0.00	0.00	0.13	13.65	0.13	0.00		0.00	5.31	0.00		0.49	48.11			31.88	*99.70*
18B	8	4	olivine	altered or o-g?	Fa100, Ca38%, Mn1%	0.21	0.00	0.00	14.08	0.37	0.00		0.00	16.11	0.00		0.39	35.80			33.39	*100.35*
18B	8	5	olivine	late dendrite	Fa100, Ca38%	0.24	0.00	0.19	13.74	0.64	0.00		0.18	15.68	0.00		0.26	35.20			33.18	*99.30*
18B	8	6	glass	mixed		2.06	0.00	11.31	20.01	0.76	0.29		10.06	4.49	0.23		0.13	9.67			41.80	*100.80*
18B	8	7	olivine	late dendrite	Fa100, Ca32%, Mn1%	0.32	0.00	0.60	14.31	0.49	0.00		0.46	12.67	0.00		0.30	38.03			33.71	*100.89*
18C	3	1	olivine	core main	Fa99, Ca10%, Mn1%	0.00	0.19	0.00	13.70	0.00	0.00		0.10	4.21			0.43	49.20			31.65	*99.48*
18C	3	2	olivine	core main	Fa99, Ca5%, Mn1%	0.00	0.25	0.13	13.38	0.15	0.00		0.00	2.14			0.53	50.88			31.30	*98.75*
18C	3	3	olivine	inner main	Fa99, Ca5%, Mn1%	0.00	0.14	0.17	13.26	0.00	0.00		0.00	2.14			0.55	50.95			30.97	*98.18*
18C	3	4	olivine	altered or o-g?	Fa100, Ca36%	0.00	0.00	0.11	14.58	0.20	0.00		0.00	15.05			0.00	36.92			33.54	*100.39*
18C	3	5	olivine	inner main	Fa99, Ca9%, Mn1%	0.00	0.19	0.00	13.77	0.00	0.00		0.00	3.67			0.49	49.57			31.62	*99.32*
18C	3	6	olivine	inner main	Fa99, Ca5%, Mn1%	0.00	0.17	0.13	13.47	0.00	0.00		0.00	1.93			0.47	51.26			31.17	*98.60*
18C	3	7	olivine	margin main	Fa100, Ca10%, Mn1%	0.00	0.00	0.00	13.85	0.00	0.00		0.00	3.99			0.41	49.57			31.69	*99.51*
18C	3	8	olivine	altered or o-g?	Fa100, Ca35%	0.24	0.00	0.31	14.79	0.19	0.00		0.15	14.52			0.20	36.96			33.92	*101.29*
18C	3	9	ol - mixed?	late dendrite	Fa100, Ca36%	0.67	0.00	7.18	15.91	0.56	0.20		2.60	9.97			0.00	24.92			37.42	*99.45*
18C	4	1	olivine	inner main	Fa99, Ca3%, Mn1%		0.33	0.15	13.51					1.36			0.57	52.24			31.42	*99.57*

S	A	#	Phase	Notes	Phase nomenclature	Weight% element															
						Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	As	Ba	O	Total
18C	4	2	olivine	inner main	Fa99, Ca4%, Mn1%		0.31	0.15	13.44					1.48			0.58	51.76			31.25	*98.98*
18C	4	3	olivine	inner main	Fa99, Ca3%, Mn1%		0.23	0.00	13.67					1.30			0.63	51.81			31.27	*98.91*
18C	4	4	olivine	inner main	Fa99, Ca6%, Mn1%		0.15	0.12	13.62					2.33			0.46	50.48			31.25	*98.40*
18C	4	5	olivine	inner main	Fa99, Ca4%, Mn1%		0.27	0.17	13.50					1.45			0.55	51.90			31.31	*99.14*
18C	4	6	olivine	inner main	Fa99, Ca4%, Mn1%		0.28	0.17	13.24					1.51			0.55	50.66			30.70	*97.12*
20b	2	1	olivine	core main	Fa97, Ca4%, Mn10%		0.66		14.41					1.55			5.67	49.48			33.30	*105.07*
20b	2	2	olivine	to	Fa97, Ca3%, Mn10%		0.76		14.38					1.06			5.72	49.81			33.25	*104.98*
20b	2	3	olivine	to	Fa97, Ca3%, Mn9%		0.65		14.37					1.08			5.42	50.12			33.17	*104.81*
20b	2	4	olivine	to	Fa97, Ca3%, Mn10%,		0.62		14.49					1.09			5.91	50.18			33.45	*105.74*
20b	2	5	olivine	margin or late	Fa100, Ca14%, Mn6%				14.55					6.01			3.69	46.77			33.45	*104.47*
20b	2	6	olivine	margin or late	Fa100, Ca36%, Mn4%				14.87	0.24				15.78			2.66	36.84			34.88	*105.28*
20b	4	1	olivine	core = SOI-1	Fa98, Ca3%, Mn10%		0.52		13.78					1.20			5.25	47.25			31.59	*99.59*
20b	4	2	olivine	to	Fa97, Ca4%, Mn9%		0.59		13.75					1.57			5.09	46.76			31.56	*99.32*
20b	4	3	olivine	to	Fa96, Ca2%, Mn10%		0.83		13.73					0.92			5.34	47.07			31.60	*99.50*
20b	4	4	olivine	to	Fa97, Ca3%, Mn10%		0.56		13.59					1.07			5.34	47.04			31.30	*98.89*
20b	4	5	olivine	near margin	Fa100, Ca6%, Mn8%				13.66					2.38			4.27	46.87			31.18	*98.36*
20b	4	6	olivine	near margin	Fa100, Ca8%, Mn7%				13.78					3.30			3.89	46.47			31.46	*98.90*
20b	4	7	olivine	margin or late	Fa100, Ca37%, Mn4%				14.07	0.24				15.16			2.49	33.98			32.86	*98.82*
20b	5	1	olivine	near margin	Fa100, Ca12%, Mn7%				13.70					4.62			3.66	44.93			31.39	*98.30*
20b	5	2	olivine	margin main	Fa100, Ca38%, Mn4%			0.17	14.17	0.33				15.87			2.34	33.26			33.26	*99.40*
20b	5	3	glass/leucite			1.96		9.02	17.41	1.87	0.24		5.07	10.01	0.51		0.45	14.87			41.08	*102.50*
20b	5	4	olivine	late dendrite	Fa100, Ca31%, Mn4%	0.36		0.53	13.93	0.53			0.35	12.31			2.11	35.56			32.94	*98.62*
20b	5	5	olivine	late dendrite	Fa100, Ca29%, Mn4%	0.32		0.42	13.71	0.58			0.15	11.96			2.12	37.73			33.08	*100.06*
20b	5	6	glass/leucite			1.94		7.46	16.55	2.36	0.55		5.02	10.49			0.54	14.68		1.17	39.76	*100.53*
20b	5	7	glass/leucite			1.90		6.67	16.36	1.28	0.92		4.25	10.16	0.41		0.74	19.15			39.15	*100.98*
20b	5	8	pyroxene?			0.28		8.36	11.92	0.23			0.62	8.51	2.15		0.59	31.13			35.67	*99.87*
20b	5	9	glass/leucite			1.58		6.70	16.82	1.33	0.45		4.17	9.58			0.85	18.51		1.73	38.48	*100.20*
20b	5	10	magnetite	cruciform dendrite				5.36	2.07					1.43	2.33	0.33	0.57	56.59			25.90	*94.59*
20b	5	11	magnetite	cruciform dendrite				4.68	1.34	0.14	0.26		0.28	0.85	2.53	0.37	0.45	59.40			25.79	*96.09*
20b	5	12	rhönite	late lath		0.74		7.87	12.87	0.25	0.33		1.02	8.89	1.76		0.67	28.76			36.11	*99.27*
20b	5	13	rhönite	late dark		2.53		8.69	16.87	1.17	0.52		4.80	7.91	0.53		0.71	16.64			39.57	*99.93*
20b	8	1	olivine	late dendrite	Fa98, Ca32%, Mn3%			0.39	13.48	0.62			0.27	12.77			1.84	34.48			32.07	*95.91*
20b	8	2	olivine	late dendrite	Fa95, Ca31%, Mn3%			0.85	13.64	0.67			0.51	12.03			1.59	33.76			32.21	*95.27*
20b	8	3	olivine	late dendrite	Fa95, Ca38%, Mn3%	0.41		0.72	13.69	0.85			0.49	14.51			1.57	30.51			32.56	*95.29*
20b	8	4	uncertain	late dark		2.37		9.88	17.36	2.49	0.60		6.31	8.44				5.90		1.95	40.09	*95.40*
20b	8	5	rhönite	late rosette		0.31		7.89	11.81				0.42	8.37	2.18		0.50	30.72			34.40	*96.59*
20b	8	6	rhönite	late rosette				8.22	11.31		0.34		0.19	8.30	2.51		0.59	31.69			34.98	*98.13*
20b	8	7	uncertain	late dark		1.61		6.64	16.28	1.95	0.56		4.17	10.19			0.65	16.55		1.41	38.39	*98.39*
20b	8	8	rhönite	late rosette		0.69		9.09	13.04	0.48	0.12		1.18	8.53	1.69		0.49	27.42			36.76	*99.49*
20b	8	9	uncertain	late dark		1.46		7.43	15.42	1.55	0.27		5.74	8.33			0.39	9.12		1.80	34.54	*86.06*
20b	8	10	uncertain	late dark		2.05		8.51	17.04	0.48	0.23		5.10	4.67			0.49	12.92		1.03	35.54	*88.08*
20b	8	11	uncertain	late dark		2.15		9.67	17.10	1.38	0.31		6.16	6.56	0.64		0.25	9.15			38.07	*91.44*
20b	8	12	olivine	margin main	Fa100, Ca12%, Mn5%				12.86	0.22				4.65			2.69	43.18			29.94	*93.53*
20b	8	13	fe-oxide					0.23	0.23					0.20			0.57	72.84			21.58	*95.65*
20b	8	14	mixed			0.52		4.32	8.88	1.68	14.24		2.19	5.99			0.26	33.24		2.44	50.35	*124.11*
20c	1	1	iron?					0.36										85.57			24.83	*110.76*
20c	1	2	olivine	core main	Fa98, Ca4%, Mn9%		0.49		13.04					1.37			4.91	46.31			30.43	*96.55*
20c	1	3	olivine	core main	Fa99, Ca6%, Mn8%		0.22		12.72					2.18			4.25	45.02			29.65	*94.04*
20c	1	4	olivine	core main	Fa97, Ca3%, Mn10%		0.51		11.44					0.92			4.60	40.88			26.79	*85.14*
20c	1	5	olivine	inner main	Fa98, Ca4%, Mn9%		0.38		12.42					1.61			4.47	44.50			29.10	*92.49*
20c	1	6	olivine	to	Fa97, Ca3%, Mn10%		0.58		12.83					1.09			5.08	44.74			29.73	*94.04*
20c	1	7	olivine	to	Fa98, Ca3%, Mn10%		0.46		12.73					1.20			4.98	45.29			29.71	*94.38*
20c	1	8	olivine	margin main	Fa100, Ca10%, Mn7%				12.75					3.69			3.57	43.85			29.60	*93.44*
20c	2	1	olivine	late dendrite	Fa100, Ca30%, Mn3%	0.31		0.78	13.20	0.50			0.51	11.41			1.79	34.42			31.52	*94.43*
20c	2	2	olivine	near margin main	Fa100, Ca8%, Mn7%				12.84					3.18			3.62	44.41			29.67	*93.72*
20c	2	3	olivine	margin main	Fa100, Ca12%, Mn5%				12.38	0.25				4.65			2.74	43.56			29.56	*93.15*

S	A	#	*Phase*	*Notes*	*Phase nomenclature*	*Weight% element*															
						Na	*Mg*	*Al*	*Si*	*P*	*S*	*Cl*	*K*	*Ca*	*Ti*	*V*	*Mn*	*Fe*	*As*	*Ba*	*O*	*Total*
20c	2	4	olivine	margin main	Fa100, Ca21%, Mn5%				12.80	0.16				8.04			2.80	39.63			30.17	*93.60*
20c	2	5	olivine	inner main	Fa100, Ca6%, Mn8%				13.01					2.31			4.09	45.08			29.85	*94.33*
20c	2	6	olivine	late dendrite	Fa100, Ca28%, Mn4%			0.40	13.17	0.32			0.21	10.68			2.03	36.22			31.04	*94.07*
20c	2	7	olivine	late dendrite	Fa100, Ca31%, Mn4%	0.80		3.43	14.09	0.73	0.18		1.35	9.63			1.56	28.87		0.56	33.50	*94.69*
21b	1	1	olivine	core main	Fa97, Ca3%		0.54		12.26					0.97				47.22			28.24	*89.23*
21b	2	1	brass	contamination from saw	Cu 55 Zn 45																	
21b	2	2	brass	contamination from saw	Cu 65 Zn 35																	
21b	2	3	olivine	core main	Fa97, Ca3%		0.59		13.54					1.12				52.17			31.21	*98.62*
21b	2	4	olivine	core main	Fa99, Ca5%		0.22		13.47					1.83				51.80			31.06	*98.38*
21b	2	5	olivine	core main	Fa98, Ca4%		0.40		13.48					1.40			0.22	51.64			31.04	*98.18*
21b	2	6	olivine	core main	Fa98, Ca3%		0.55		13.52					1.19			0.25	51.97			31.20	*98.68*
21b	3	1	iron															#####			29.88	*134.18*
21b	3	2	olivine	core main	Fa97, Ca2%		0.72		13.47					0.95				52.48			31.23	*98.86*
21b	3	3	olivine	inner main	Fa97, Ca3%, Mn1%		0.59		12.83					1.05			0.28	51.23			30.18	*96.16*
21b	3	4	olivine	margin main	Fa100, Ca27%			0.32	14.02					10.90				40.32			32.16	*97.72*
21b	3	5	olivine	margin main	Fa100, Ca33%			0.26	14.49					13.81				38.46			33.27	*100.28*
21b	3	6	olivine	late dendrite	Fa100, Ca33%				14.39					13.51				38.70			32.87	*99.46*
21b	3	7	olivine	late dendrite	Fa100, Ca29%				14.03	0.14				12.08				40.45			32.57	*99.27*
21c	4	1	olivine	late ol - dendrite core	Fa100, Ca22%				13.14					8.56				42.34			30.52	*94.55*
21c	4	2	rhönite	equant		0.30		8.70	11.21				0.24	8.49	3.64			28.46			34.64	*95.68*
21c	4	3	olivine	dendrite core	Fa100, Ca25%				13.21					9.33				39.95			30.22	*92.73*
21c	4	4	olivine	marginal ol (with W?)	Fa100, Ca27%			0.17	13.16					10.41				39.93			30.74	*94.41*
21c	4	5	olivine	marginal ol (with W?)	Fa100, Ca26%				12.96					9.93				39.63			30.09	*92.61*
21c	4	6	olivine	marginal ol (with W?)	Fa100, Ca29%			0.18	13.03	0.18				11.22				37.61			30.50	*92.73*
21c	4	7	olivine	marginal ol (with W?)	Fa100, Ca35%			0.17	13.28					13.83				35.38			30.94	*93.61*
21c	4	8	rhönite	equant		0.81		10.58	12.67	0.57			0.52	9.68	0.94			21.36			35.59	*92.73*
21c	4	9	olivine	marginal ol (with W?)	Fa100, Ca30%				13.03				0.15	11.76				37.50			30.31	*92.75*
21c	4	10	olivine	marginal ol (with W?)	Fa100, Ca26%			0.45	13.69	0.20			0.27	9.67				38.25			31.13	*93.66*
21c	4	11	leucite			0.74		12.40	23.20				15.80					0.54			41.11	*93.78*
21c	4	12	leucite			0.64		11.79	22.56				14.46	0.71				2.91			40.49	*93.58*
21c	4	13	olivine	cotectic with L	Fa100, Ca33%			1.02	13.55	0.17			1.24	11.89				33.51			31.16	*92.53*
21c	4	14	glass			0.26		9.21	11.18	0.15			0.40	8.08	3.02			26.35			34.09	*92.73*
21c	4	15	rhönite	needle		1.48		10.10	13.07	0.42	0.13		0.45	8.77	2.72			25.06			37.72	*99.93*
21c	4	16	olivine	cotectic with L	Fa100, Ca28%			0.17	12.51	0.30			0.18	10.23				37.00			29.51	*89.89*
21c	4	17	rhönite	needle		2.23		9.58	13.92	0.54	0.15		0.94	8.55	0.65			19.64			35.75	*91.96*
21c	4	18	glass			2.38		8.17	16.47	0.68	0.26		2.45	9.22	0.20			13.99			36.45	*90.27*
21c	4	19	glass			3.08		8.16	16.73	0.68	0.21		2.87	9.22				14.59			37.04	*92.59*
21c	4	20	glass			1.35		9.90	12.65	0.43			0.39	8.70	2.09			23.92			36.04	*95.46*
21c	4	21	glass			3.47		9.63	16.13	0.54	0.24		2.04	8.90				11.17			36.38	*88.50*
21c	5	1	olivine	marginal	Fa100, Ca23%				13.49	0.17				9.32				42.58			31.52	*97.08*
21c	5	2	rhönite	equant		0.29		11.36	11.54	0.18				8.71	1.48			28.64			36.26	*98.46*
21c	5	3	leucite			0.79		12.98	24.46				16.55					0.69			43.27	*98.74*
21c	5	4	rhönite	needle		0.96		10.96	12.89	0.44	0.74		0.43	8.78	2.38			26.33			39.16	*103.06*
21c	5	5	glass			3.58		10.45	17.28	1.01	0.32		1.22	9.97	0.33			14.31			40.55	*99.02*
21c	5	6	rhönite	needle		0.58		11.52	12.63	0.32	0.19		0.44	8.62	1.12			25.40			37.09	*97.92*
21c	6	1	olivine	core main	Fa100, Ca9%				12.60					3.36			0.24	47.90			29.49	*93.59*
21c	6	2	olivine	margin main	Fa100, Ca20%			1.73	12.42					7.46			0.22	41.96			30.76	*94.55*
21c	6	3	olivine	margin main	Fa100, Ca11%				12.60					4.07				46.36			29.26	*92.29*
21c	6	4	olivine	inner main	Fa100, Ca8%				12.47					2.85				46.07			28.54	*89.92*
21c	6	5	olivine	late dendrite	Fa100, Ca31%			0.64	13.06					11.48				35.71			30.26	*91.15*
21c	6	6	olivine	late dendrite	Fa100, Ca29%			0.28	12.90	0.18			0.23	10.85				37.73			30.37	*92.54*
21c	6	7	olivine	late dendrite	Fa100, Ca24%			0.17	12.81					9.14				39.89			29.83	*91.85*
21c	6	8	glass			1.92		11.23	17.74	0.53	0.14		6.02	6.38	0.37			12.74			39.43	*96.49*
21c	6	9	glass			2.14		11.47	18.82	0.54			7.73	5.43	0.35			8.41			39.64	*94.86*
21c	7	1	olivine	inner main	Fa100, Ca6%, Mn1%				13.09					1.93			0.23	44.05			28.36	*87.66*
21c	7	2	olivine	inner main	Fa99, Ca5%		0.22		13.31					1.91			0.19	51.54			30.89	*98.06*

S	A	#	*Phase*	*Notes*	*Phase nomenclature*	*Weight% element*															
						Na	*Mg*	*Al*	*Si*	*P*	*S*	*Cl*	*K*	*Ca*	*Ti*	*V*	*Mn*	*Fe*	*As*	*Ba*	*O*	*Total*
21c	7	3	olivine	inner main	Fa99, Ca5%		0.31		13.39					2.02			0.22	51.30			31.02	*98.26*
21c	7	4	olivine	inner main	Fa100, Ca7%				13.50					2.69			0.24	51.41			31.26	*99.10*
21c	7	5	olivine	margin main	Fa100, Ca35%				14.01	0.22				14.28				37.10			32.57	*98.18*
21c	7	6	olivine	late blocky	Fa100, Ca36%				14.00					15.08				37.05			32.58	*98.71*
21c	7	7	olivine	cotectic with L	Fa100, Ca34%				13.70	0.26			0.14	13.75				36.63			31.96	*96.45*
21c	7	8	leucite			0.51		13.38	24.97				16.91					1.01			44.27	*101.04*
21c	7	9	rhönite			0.91		11.22	13.86	0.30			0.37	9.60	2.48			28.95			40.34	*108.04*
21c	7	10	glass			3.55		9.76	17.54	0.86	0.28		1.99	10.93	0.17			14.65			40.51	*100.25*
21c	7	11	glass			0.41		10.59	12.67	0.22				9.17	1.31			31.17			37.76	*103.31*
21c	7	12	rhönite			3.68		10.12	17.76	0.64	0.28		2.73	10.49	0.28			14.19			40.77	*100.94*
21c	7	13	leucite			0.62		13.31	24.49				16.60					0.66		0.49	43.59	*99.76*
21c	7	14	leucite			0.48		12.73	23.60	0.17			15.76					2.65			42.59	*97.99*
21c	7	15	rhönite			0.39		10.38	12.28				0.16	9.24	1.87			31.46			37.48	*103.69*
21c	7	16	olivine	inner main	Fa100, Ca6%				13.39					2.53				50.82			30.82	*97.55*
21c	7	17	olivine	inner main	Fa99, Ca5%		0.26		13.45					2.11				51.78			31.18	*98.79*
21c	8	1	olivine	core late	Fa100, Ca20%				13.68	0.15				8.04				45.27			31.96	*99.09*
21c	8	2	olivine	margin late	Fa100, Ca34%				14.11					13.98				37.67			32.44	*98.19*
21c	8	3	rhönite			0.62		12.16	12.70	0.27			0.15	9.21	2.09			28.33			39.06	*104.59*
21c	8	4	rhönite			0.46		11.78	11.93	0.18			0.14	9.20	1.31			28.24			37.13	*100.36*
21c	8	5	olivine	cotectic with leucite	Fa100, Ca32%				14.17					12.87				38.25			32.24	*97.53*
21c	8	6	olivine	inner main	Fa100, Ca10%				13.58					3.83				50.22			31.39	*99.03*
21c	8	7	olivine	margin main	Fa100, Ca16%				13.46					6.31				46.93			31.29	*97.98*
21c	8	8	glass			4.44		11.78	17.54	1.08	0.93		1.40	9.85	0.17			12.86			42.81	*102.86*
21c	8	9	glass			3.28		12.68	16.58	0.87	0.63		1.30	9.90				13.51			41.46	*100.21*
21c	8	10	olivine	cotectic with leucite	Fa100, Ca25%			0.76	14.24	0.16			1.17	9.48				39.79			32.53	*98.13*
21c	8	11	leucite			0.68		11.83	22.15				14.08	1.98				3.51			40.67	*94.90*
21c	8	12	leucite			0.57		9.27	20.17				11.03	4.28	0.27			11.57			38.89	*96.06*
21c	8	13	leucite			0.69		12.72	23.95				15.47	1.02				3.51			43.42	*100.78*
21d	3	1	olivine	main	Fa98, Ca2%, Mn1%		0.58		13.43					0.82			0.44	52.78			31.25	*99.30*
21d	3	2	wustite					0.41										75.35			21.95	*97.71*
21d	4	1	olivine	main	Fa98, Ca3%, Mn1%		0.56		13.33					1.09			0.44	52.45			31.15	*99.03*
21d	4	2	olivine	near vesicle margin	Fa99, Ca3%, Mn1%		0.35		13.47					1.32			0.44	52.30			31.21	*99.09*
21d	4	3	silica?					3.52	33.80					0.31				5.61			43.36	*86.59*
21d	4	4	oxide	weathering					0.18									68.58			19.85	*88.60*
21d	4	5	oxide	weathering				1.43	10.86			0.17		0.23				35.60			23.94	*72.23*
21d	6	1	olivine	core main	Fa98, Ca4%, Mn1%		0.38		13.03					1.41			0.55	50.69			30.33	*96.39*
21d	6	2	olivine	inner man	Fa98, Ca3%, Mn1%		0.39		13.18					1.26			0.39	51.05			30.52	*96.79*
21d	6	3	oxide	weathered					0.32									66.66			19.46	*86.45*
21d	6	4	olivine	near margin main	Fa99, Ca8%, Mn1%		0.20		13.23					3.04			0.46	49.26			30.66	*96.85*
21d	6	5	olivine	margin main	Fa100, Ca5%			2.32	10.20	0.38				1.45				38.99			26.10	*79.79*
21d	6	6	olivine	margin main	Fa100. Ca9%			0.50	12.76	0.16				2.99			0.24	44.27			29.12	*90.03*
21d	6	7	?	vesicle fill				0.78	3.84		0.13	0.32						52.56			20.31	*77.94*
21d	6	8	olivine	margin main	Fa100, Ca7%				13.22					2.85			0.22	49.31			30.39	*95.99*
21d	6	9	olivine	late?	Fa100, Ca5%			4.16	11.66	0.50	0.12			1.43				38.13			29.30	*85.30*
21d	6	10	olivine	late?	Fa100, Ca7%			0.74	12.10	0.40				2.08				40.87			27.50	*83.70*
21d	6	11	fe-oxide	vesicle fill				0.52	0.14		0.13							65.86			19.69	*86.34*
21d	6	12	rhönite	late lath		0.25		7.99	17.94	0.81			2.32	3.30	0.20			17.45			35.61	*85.87*
22b	2	1	olivine	inner main	Fa100, Ca5%, Mn6%				13.26					1.86			3.10	43.16			29.12	*90.51*
22b	2	2	olivine	inner main	Fa100, Ca5%, Mn6%				13.31	0.23				1.90			3.31	49.07			31.24	*99.05*
22b	2	3	olivine	near margin main	Fa100, Ca8%, Mn6%			0.19	13.23	0.21				3.02			3.25	47.86			31.37	*99.13*
22b	2	4	olivine	inner main	Fa100, Ca5%, Mn6%				13.43	0.17				1.93			3.43	49.12			31.36	*99.44*
22b	2	5	olivine	inner main	Fa100, Ca3%, Mn7%				13.44					1.36			3.81	49.44			31.12	*99.16*
22b	2	6	olivine	core main	Fa99, Ca3%, Mn7%		0.28		13.34					1.04			4.06	49.21			31.08	*99.02*
22b	3	1	mixed ol.	late dendrite	Fa100, Ca12%, Mn5%	0.35		0.34	13.05	0.91			0.23	4.58			2.78	45.55			32.20	*99.98*
22b	3	2	mixed olivine	late dendrite	Fa100, Ca12%, Mn5%			0.53	13.03	0.91			0.20	4.56			2.60	45.49			32.14	*99.47*

S	A	#	Phase	Notes	Phase nomenclature	Weight% element																
						Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	As	Ba	O	Total
22b	3	3	mixed	fine interstitial material		1.10		6.81	14.25	2.38	0.52		3.93	11.19	0.59		0.86	20.44			38.30	*100.37*
22b	3	4	rhönite	bright		0.71		6.03	12.48	1.93	0.49		2.22	9.77	0.62		1.01	31.15			37.05	*103.46*
22b	5	1	olivine	inner main	Fa97, Ca2%, Mn9%		0.49		12.92					0.74			4.32	40.09			28.08	*86.63*
22b	5	2	olivine	inner main	Fa99, Ca3%, Mn9%		0.28		13.15					0.97			4.09	42.37			28.88	*89.73*
22b	5	3	olivine	inner main	Fa99, Ca3%, Mn9%		0.27		13.10					1.00			4.16	42.46			28.87	*89.85*
22b	5	4	olivine	near margin main	Fa100, Ca3%, Mn8%				12.80					1.14			3.66	40.37			27.67	*85.64*
22b	5	5	olivine	main outgrowth	Fa100, Ca4%, Mn8%				12.79	0.19				1.24			3.64	40.95			28.09	*86.89*
22b	5	6	olivine	distal main outgrowth	Fa100, Ca6%, Mn8%			0.77	13.84	0.24			0.51	2.03			3.48	40.45			30.27	*91.58*
22b	5	7	olivine	distal main outgrowth	Fa100, Ca4%, Mn8%			0.18	13.12	0.32				1.71			4.12	47.74			31.08	*98.27*
22b	5	8	olivine	late dendrite	Fa100, Ca5%, Mn7%				13.25					1.97			3.97	47.63			30.69	*97.50*
22b	5	9	olivine	late dendrite	Fa100, Ca6%, Mn7%				13.37	0.20				2.31			3.87	48.12			31.32	*99.19*
22b	5	10	rhönite	o/g on late dendrite		0.50		2.85	16.40	0.46			1.90	4.22	0.19		2.92	36.06			35.36	*100.85*
22b	5	11	rhönite	small in interstitial area		0.42		4.50	14.26	0.67			0.93	9.14	1.17		0.80	31.70			35.21	*98.81*
22b	5	12	rhönite	small in interstitial area		0.61		4.38	16.29	1.27			1.97	10.79	0.74		1.15	25.13			37.05	*99.38*
22b	5	13	glass			0.48		4.31	17.36	1.40	0.51		1.23	14.01	0.56		1.21	18.07			38.10	*97.24*
22b	5	14	glass			0.51		4.55	17.02	1.47	0.38		1.18	13.22	0.66		1.11	19.73			38.02	*97.85*
22b	5	15	rhönite	small in interstitial area				4.42	13.65	0.47			1.07	7.84	0.98		0.80	33.21			33.83	*96.27*
22b	5	16	olivine	small dendrite		0.92		4.58	17.65	1.66			3.17	6.02	0.21		2.49	28.80			38.81	*104.30*
23b	3	1	olivine	near vesicle	Fa98, Ca8%, Mn25%	0.00	0.28	0.00	13.81	0.14			0.00	3.32	0.00		13.89	36.77			32.00	*100.21*
23b	3	2	olivine	near vesicle	Fa99, Ca11, Mn22%	0.00	0.14	0.00	13.84	0.00			0.00	4.51	0.00		12.33	36.76			31.78	*99.36*
23b	3	3	olivine	transect across complex	Fa98, Ca11%, Mn22%	0.00	0.32	0.00	13.73	0.00			0.00	4.26	0.00		12.38	37.27			31.84	*99.81*
23b	3	4	olivine	to	Fa97, Ca8%, Mn26%	0.00	0.42	0.00	13.55	0.22			0.00	3.06	0.00		14.22	36.68			31.87	*100.02*
23b	3	5	olivine	to	Fa97, Ca8%, Mn25%	0.00	0.46	0.00	13.55	0.16			0.00	3.08	0.00		14.11	36.67			31.78	*99.81*
23b	3	6	olivine	to	Fa98, Ca8%, Mn26%	0.00	0.37	0.00	13.69	0.15			0.00	3.20	0.00		14.27	36.31			31.87	*99.86*
23b	3	7	olivine	to	Fa97, Ca8%, Mn25%	0.00	0.41	0.00	13.81	0.12			0.00	3.24	0.00		14.08	36.84			32.10	*100.59*
23b	3	8	olivine	to	Fa98, Ca12%, Mn22%	0.00	0.25	0.00	13.93	0.00			0.00	4.95	0.00		12.50	36.74			32.17	*100.54*
23b	3	9	olivine	to	Fa98, Ca8%, Mn25%	0.00	0.30	0.00	13.70	0.18			0.00	3.36	0.00		13.95	36.67			31.95	*100.11*
23b	3	10	olivine	to	Fa99, Ca12%, Mn21%	0.00	0.16	0.00	13.71	0.00			0.00	4.78	0.00		11.54	37.58			31.76	*99.53*
23b	3	11	olivine	margin	Fa100 Ca22%, Mn17%	0.00	0.00	0.00	14.01	0.12			0.00	8.91	0.10		9.48	34.99			32.52	*100.13*
23b	3	12	olivine	margin	Fa100 Ca27%, Mn15%	0.00	0.00	0.00	13.84	0.35			0.00	11.09	0.00		8.52	32.93			32.56	*99.30*
23b	3	13	olivine	late	Fa100 Ca23%, Mn13%	0.30	0.00	0.00	13.47	0.70			0.13	9.01	0.00		7.26	35.66			32.30	*98.82*
23b	3	14	olivine	late	Fa100 Ca21%, Mn14%	0.34	0.00	0.00	13.62	0.90			0.26	8.48	0.00		7.76	35.50			32.67	*99.52*
23b	3	15	wustite			0.00	0.00	0.00	0.12	0.00			0.00	0.17	0.31		2.25	71.94			21.67	*96.46*
23b	3	16	wustite			0.00	0.00	1.18	0.13	0.00			0.00	0.17	1.02		2.83	67.38			22.07	*94.77*
23b	3	17	wustite			0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.24		2.43	72.40			21.61	*96.68*
23b	4	1	fe-oxide	oxidised iron			0.00	0.00	0.00	0.00	0.15			0.00			0.16	67.44			19.59	*87.33*
23b	4	2	fe-oxide	oxidised iron			0.00	0.00	0.10	0.09	0.20			0.00			0.00	65.69			19.36	*85.44*
23b	4	3	fe-oxide	oxidised iron			0.00	0.00	0.00	0.00	0.27			0.14			0.43	65.83			19.45	*86.12*
23b	4	4	pyroxene?	(Mn,Fe, Ca, Mg)SiO3			0.66	0.10	21.68	0.00	0.00			5.26			19.28	16.43			37.65	*101.06*
23b	4	5	pyroxene?	(Mn,Fe, Ca, Mg)SiO3			0.67	0.14	21.68	0.10	0.00			6.20			19.39	15.37			37.92	*101.47*
23b	4	6	olivine	close to iron	Fa97, Ca7%, Mn27%		0.56	0.11	13.88	0.09	0.00			2.81			15.02	36.26			32.28	*101.02*
23b	4	7	olivine	close to iron	Fa96, Ca6%, Mn31%		0.64	0.00	13.85	0.10	0.00			2.56			17.41	33.59			32.05	*100.20*
23b	4	8	olivine	moderately close to iron	Fa97, Ca6%, Mn28%		0.43	0.00	13.66	0.14	0.00			2.54			15.26	35.72			31.72	*99.48*
23b	4	9	olivine	fairly close to iron	Fa96, Ca6%, Mn27%		0.61	0.17	13.74	0.20	0.00			2.60			15.20	35.72			32.16	*100.41*
23b	5	1	olivine	blocky outer	Fa97, Ca7%, Mn27%		0.44		13.82	0.10				2.74			14.59	35.84			31.78	*99.30*
23b	5	2	olivine	blocky outer	Fa97, Ca7%, Mn27%		0.51		13.58	0.15				2.65			14.90	35.64			31.60	*99.02*
23b	5	3	olivine	blocky outer	Fa97, Ca6%, Mn27%		0.52		13.60	0.00				2.58			14.61	35.83			31.39	*98.54*
23b	5	4	olivine	dense	Fa96, Ca6%, Mn27%		0.65		13.81	0.16				2.43			14.92	36.00			31.99	*99.94*
23b	5	5	olivine	dense	Fa96, Ca6%, Mn27%		0.62		13.65	0.23				2.51			15.19	35.87			31.96	*100.02*
23b	5	6	olivine	dense	Fa97, Ca6%, Mn27%		0.56		13.55	0.23				2.51			14.98	35.84			31.73	*99.40*
23b	5	7	olivine	blocky outer	Fa97, Ca6%, Mn27%		0.54		13.76	0.13				2.56			14.79	36.32			31.93	*100.02*
23b	5	8	olivine	blocky outer	Fa96, Ca6%, Mn27%		0.58		13.73	0.00				2.56			15.01	36.40			31.85	*100.14*
23b	5	9	olivine	blocky outer	Fa96, Ca6%, Mn27%		0.57		13.77	0.10				2.55			14.98	36.15			31.93	*100.06*
23b	5	10	olivine	dense	Fa96, Ca6%, Mn27%		0.62		13.88	0.19				2.59			15.04	36.13			32.22	*100.66*
23b	5	11	olivine	dense	Fa96, Ca6%, Mn27%		0.59		13.78	0.11				2.62			14.95	36.35			32.03	*100.41*
24b	2	1	olivine	late dendrite core	Fa96, Ca4%, Mn2%		0.81	0.75	15.34				0.72	1.47			0.99	45.89			32.84	*98.79*

S	A	#	Phase	Notes	Phase nomenclature	Weight% element																
						Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	As	Ba	O	Total
24b	2	2	olivine	late dendrite core	Fa97, Ca3%, Mn2%		0.67	0.50	14.86				0.38	1.28			1.15	48.68			32.68	*100.19*
24b	2	3	olivine	late dendrite core	Fa96, Ca3%, Mn2%		0.85	0.73	15.63				0.81	1.24			1.09	45.71			33.09	*99.16*
24b	2	4	glass			0.44		2.46	22.19				1.32	13.03	0.41		0.39	20.81			39.44	*100.49*
24b	2	5	glass			0.45		2.18	21.17	0.20			1.19	12.46	0.28		0.30	22.18			38.32	*98.72*
24b	2	6	mixed	late olivine and glass	Fa98, Ca9%, Mn2%	0.37	0.32	1.84	18.45	0.17			1.67	2.84			0.72	36.88			35.47	*98.75*
24b	2	7	glass			0.50		2.17	20.85				1.09	11.68	0.30		0.35	23.44			37.76	*98.12*
24b	5	1	glass			0.69		3.15	21.44	0.22			2.24	8.16	0.28		0.35	22.24			38.13	*96.90*
24b	5	2	olivine	blocky margin	Fa98, Ca3%, Mn1%		0.46	3.73	12.52					1.00			0.72	50.58			32.98	*101.98*
24b	5	3	olivine	blocky inner	Fa96, Ca1%, Mn1%		0.95		13.21					0.54			0.63	51.38			30.80	*97.51*
24b	5	4	olivine	blocky core	Fa98, Ca2%, Mn1%		0.55		13.08					0.68			0.54	51.85			30.55	*97.25*
24b	5	5	olivine	blocky core	Fa98, Ca2%, Mn1%		0.44		13.28					0.69			0.56	51.51			30.62	*97.12*
24b	5	6	olivine	blocky margin	Fa98, Ca2%, Mn1%		0.40		13.07					0.67			0.57	51.00			30.20	*95.93*
24b	5	7	olivine	blocky inner	Fa98, Ca2%, Mn1%		0.42		12.91					0.69			0.45	51.13			30.04	*95.64*
24b	5	8	olivine	blocky margin	Fa98, Ca2%, Mn1%		0.52		13.21					0.68			0.61	50.84			30.41	*96.28*
24b	5	9	glass			0.67		3.58	20.96	0.27			2.21	9.85	0.47			18.59			37.67	*94.28*
24b	5	10	olivine	blocky margin	Fa98, Ca2%, Mn1%		0.55		13.51					0.62			0.72	51.30			30.91	*97.62*
24b	5	11	olivine	blocky core	Fa98, Ca2%, Mn1%		0.42	2.92	12.62					0.80			0.52	49.71			31.97	*98.96*
24b	6	1	iron	core to blocky olivine														#####			28.95	*130.03*
24b	6	2	olivine	blocky inner	Fa96, Ca2%, Mn2%		0.85		13.31					0.75			0.89	50.70			30.81	*97.33*
24b	6	3	olivine	blocky inner	Fa96, Ca2%, Mn2%		0.92		13.24					0.70			1.06	50.56			30.77	*97.25*
24b	6	4	olivine	blocky margin	Fa96, Ca2%, Mn2%		0.98		13.39					0.76			1.00	50.13			30.86	*97.13*
24b	6	5	fe-oxide	core to blocky olivine							0.22							65.14			18.99	*84.36*
24b	6	6	baryte					0.33	0.39		10.87			0.74				3.44		45.72	23.62	*85.12*
24b	6	7	olivine	blocky core	Fa97, Ca2%, Mn2%		0.77		13.28					0.71			0.96	50.16			30.58	*96.47*
24b	6	8	olivine	blocky core	Fa96, Ca2%, Mn2%		0.89		13.34					0.69			0.91	50.44			30.78	*97.05*
24b	6	9	olivine	to	Fa96, Ca2%, Mn2%		0.88	0.35	14.21				0.16	0.84			1.00	48.74			31.70	*97.88*
24b	6	10	olivine	to	Fa96, Ca2%, Mn2%		0.99		13.22					0.66			1.07	49.96			30.60	*96.51*
24b	6	11	olivine	blocky margin	Fa95, Ca2%, Mn2%		1.02		13.41					0.74			1.05	49.43			30.71	*96.36*
24b	6	12	olivine	mixed feather	Fa97, Ca7%, Mn2%	0.42	0.53	1.82	17.60				1.64	2.05			0.76	37.71			34.34	*96.87*
24b	6	13	olivine	mixed feather	Fa98, Ca7%, Mn1%	0.46	0.23	2.57	19.80				2.26	1.91			0.43	33.04			35.97	*96.67*
24b	6	14	olivine	mixed feather	Fa97, Ca8%, Mn2%	0.42	0.47	1.57	17.10				1.18	2.54			0.84	39.70			34.21	*98.05*
24b	6	15	glass			0.43		2.51	20.30	0.21			2.04	9.50	0.35		0.43	21.55			36.53	*93.87*
24b	6	16	glass			0.50		2.43	21.19	0.18			1.07	12.81	0.36		0.31	19.02			37.82	*95.69*
24b	7	1	fe-oxide	?oxidised fayalite?					0.51	0.27				0.30				58.93			17.93	*77.94*
24b	7	2	sediment?					2.11	1.75	3.67	0.19			11.55	0.25		0.50	10.22			16.73	*46.96*
24b	7	3	olivine	blocky external crust	Fa97, Ca21%, Mn13%		0.48		14.02					8.58			7.02	35.69			31.98	*97.79*
24b	7	4	olivine	blocky external crust	Fa96, Ca14%, Mn15%		0.71		13.48					5.68			7.90	37.33			31.09	*96.19*
24b	7	5	fe-oxide	amorphous crust?				0.75	3.56	0.76				0.82				48.65			19.97	*74.52*
24b	7	6	leucite			0.47		10.49	29.06				12.77					0.73			45.42	*98.93*
24b	7	7	quartz						44.12									0.94			50.54	*95.60*
24b	7	8	sediment?					5.32	4.01	5.85	0.21			5.47	0.34		0.49	13.99			23.75	*59.45*
24b	7	9	sediment?					7.68	4.92	7.15			0.12	6.59	0.18		0.85	16.89			29.53	*73.90*
24b	7	10	fe-oxide	amorphous crust?				0.88	0.79	1.09	0.15			2.18	0.19		0.23	27.39			12.23	*45.13*
24c	1	1	olivine	ol margin	Fa99, Ca6%, Mn2%		0.32		15.20				0.24	2.53			0.89	50.32			33.26	*102.75*
24c	1	2	olivine	ol inner	Fa99, Ca3%, Mn1%		0.29		13.63					1.27			0.75	52.11			31.37	*99.42*
24c	1	3	olivine	ol core	Fa99, Ca3%, Mn1%		0.30		14.02					1.28			0.79	52.06			31.83	*100.28*
24c	1	4	olivine	ol margin	Fa99, Ca6%, Mn2%		0.22		14.00					2.50			0.96	50.84			31.93	*100.45*
24c	1	5	glass	interstitial bright		1.09		5.70	22.17	0.69	0.25		3.56	10.33	0.75			15.49			41.78	*101.82*
24c	1	6	glass	interstitial bright		1.29		6.28	23.03	0.66	0.22		4.51	9.06	0.78			13.90			42.50	*102.25*
24c	1	7	glass	interstitial dark		1.16		5.70	22.19	0.87	0.28		3.73	10.35	0.87		0.20	16.23			42.49	*104.07*
24c	1	8	glass	interstitial dark		1.38		7.76	24.08	0.42			5.17	4.56	0.65			11.67			42.01	*97.70*
24c	1	9	glass	interstitial dark		1.42		8.05	25.23	0.37	0.13		5.55	6.15	0.58			9.38			43.73	*100.59*
24c	1	10	glass	interstitial dark		1.71		7.17	23.83				4.78	5.29	0.28		0.38	19.35			43.06	*105.86*
24c	1	11	glass	poss mixed with olivine		1.19		5.92	22.96	0.31			4.52	6.06	0.42		0.24	20.26			41.73	*103.61*
24c	1	12	olivine	ol inner	Fa99, Ca5%, Mn2%		0.22		13.94					1.98			0.86	50.56			31.55	*99.11*
24c	1	13	olivine	ol inner	Fa99, Ca3% ,Mn2%		0.34		13.79					1.21			0.86	51.26			31.35	*98.81*

S	A	#	Phase	Notes	Phase nomenclature	Weight% element															
						Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	As	Ba	O	Total
24c	1	14	olivine	ol core	Fa99, Ca6% ,Mn1%		0.33		13.96					2.24			0.79	50.57			31.74	*99.63*
24c	1	15	olivine	ol core	Fa98, Ca5% ,Mn2%		0.37		13.96					2.18			0.77	50.74			31.78	*99.81*
24c	1	16	olivine	ol inner	Fa98, Ca3% ,Mn2%		0.38		13.76					1.25			0.89	51.62			31.47	*99.36*
24c	4	1	olivine	ol core	Fa98, Ca2% ,Mn1%		0.45		13.43					0.79			0.79	51.78			30.98	*98.22*
24c	4	2	olivine	to	Fa98, Ca2% ,Mn1%		0.49		13.69					0.85			0.70	52.23			31.43	*99.40*
24c	4	3	olivine	to	Fa99, Ca3% ,Mn1%		0.34	0.64	13.53					1.01			0.67	52.34			31.81	*100.34*
24c	4	4	olivine	to	Fa100, Ca4%, Mn1%				13.67					1.51			0.72	52.01			31.29	*99.20*
24c	4	5	olivine	ol margin	Fa100, Ca6%, Mn1%			0.23	13.62					2.45			0.55	51.10			31.49	*99.44*
24c	4	6	olivine	ol margin	Fa100, Ca12%, Mn1%				13.89					4.77			0.55	48.15			31.68	*99.03*
24c	4	7	leucite	dark assoc with ol marg		0.71		11.82	23.41				12.25	0.44				6.71			42.04	*97.38*
24c	4	8	leucite	dark assoc with ol marg		0.69		12.03	24.81				13.52	0.42				4.19		0.42	43.39	*99.47*
24c	4	9	leucite	dark assoc with ol marg		0.60		11.98	24.29				14.07	0.34				3.73			42.62	*97.63*
24c	4	10	glass	bright interstitial		1.80		6.19	19.90	0.70	0.21		0.82	12.12	0.77			17.46			40.54	*100.51*
24c	4	11	glass	bright interstitial		1.75		6.23	19.56	0.62	0.20		0.92	12.07	0.78			17.49			40.08	*99.70*
24c	4	12	glass	bright interstitial		1.73		6.81	19.34	0.74	0.26		0.97	11.93	0.89			16.91			40.44	*100.01*
24c	4	13	iron					0.22										#####			29.07	*130.07*
24c	4	14	iron					0.24										99.68			28.77	*128.69*
24c	4	15	olivine	ol margin	Fa99, Ca5%, Mn1%		0.22		13.49					1.84			0.51	50.65			30.90	*97.61*
26b	4	1	olivine	ol amongst w	Fa98, Ca2%, Mn2%	0.42			13.23	0.16				0.94			1.11	51.23			30.93	*98.02*
26b	4	2	olivine	ol amongst w	Fa99, Ca3%, Mn2%	0.24			13.51					1.19			1.17	51.28			31.06	*98.45*
26b	4	3	olivine	ol amongst w	Fa98, Ca2%, Mn2%	0.42			13.03					0.93			1.17	50.41			30.27	*96.23*
26b	4	4	olivine	ol amongst w	Fa97, Ca2%, Mn2%	0.62			13.34					0.81			1.19	51.62			31.07	*98.65*
26b	4	5	olivine	vesicle fill	Fa98, Ca2%, Mn2%	0.58			13.48					0.90			1.29	52.32			31.46	*100.02*
26b	4	6	olivine	vesicle fill	Fa98, Ca2%, Mn2%	0.54			13.85					0.96			1.29	52.78			32.02	*101.45*
26b	4	7	olivine	vesicle fill	Fa97, Ca2%, Mn2%	0.63		0.35	13.22	0.16				0.77			1.02	47.71			30.26	*94.12*
26b	4	8	olivine	vesicle fill	Fa97, Ca2%, Mn2%	0.66			13.46	0.16				0.75			1.29	51.61			31.43	*99.36*
26b	4	9	olivine	ol amongst w	Fa98, Ca2%, Mn2%	0.45			13.23	0.20				0.80			1.20	51.36			31.00	*98.24*
26b	4	10	olivine	ol amongst w	Fa97, Ca2%, Mn2%	0.64			13.20	0.18				0.80			1.15	51.34			31.05	*98.36*
26b	4	11	olivine	ol amongst w	Fa99, Ca3%, Mn2%	0.21			13.37					1.37			1.06	51.11			30.86	*97.97*
26b	5	1	olivine	late dendrite	Fa100, Ca11%, Mn2%			0.37	13.46	0.46			0.14	4.21			1.00	45.33			31.24	*96.22*
26b	5	2	olivine	late dendrite	Fa100, Ca16%, Mn2%			0.26	12.12	0.49			0.20	4.54			0.69	33.69			26.39	*78.39*
26b	5	3	olivine	late dendrite	Fa100, Ca18%, Mn1%	0.81		3.41	13.50	0.54			2.35	5.15			0.57	32.25			31.35	*89.93*
26b	5	4	olivine	late dendrite	Fa100, Ca16%, Mn2%	0.47		0.70	12.75	0.54			0.29	4.67			0.59	32.74			27.49	*80.25*
26b	5	5	glass			1.99		9.74	16.13	1.91	0.48		4.86	9.47	0.26			14.78			40.09	*99.72*
26b	5	6	glass			1.89		7.47	14.86	2.07	0.14		3.59	8.02	0.14		0.21	11.15			34.40	*83.94*
26b	5	7	olivine	main margin	Fa100, Ca9%, Mn2%				13.03	0.18				2.86			0.92	41.61			28.40	*86.99*
27b	2	1	olivine	main core	Fa97, Ca7%, Mn19%		0.54		13.13					2.49			9.75	38.51			30.17	*94.58*
27b	2	2	olivine	main margin	Fa100, Ca29%, Mn12%				13.19	0.20				11.10			6.10	32.19			30.72	*93.50*
27b	2	3	olivine	late cotectic with leucite	Fa100, Ca23%, Mn10%			1.14	13.18	0.67			0.43	8.28			4.85	34.12		1.11	31.61	*95.40*
27b	2	4	leucite			1.06		12.28	15.64	1.29			11.41	3.84	0.21		1.22	6.84			37.10	*90.89*
27b	2	5	leucite			7.67		15.86	17.64	0.23			2.94	5.77			0.43	3.92			41.32	*95.77*
27b	2	6	olivine	main core	Fa97, Ca6%, Mn19%		0.56		12.65	0.16				2.23			9.88	38.59			29.80	*93.86*
27b	2	7	olivine	late	Fa100 Ca19%, Mn10%	0.32		0.47	12.68	0.59			0.12	7.02			5.30	36.65		0.47	30.66	*94.28*
27b	3	1	olivine	late	Fa100, Ca24%, Mn8%	0.38		0.82	13.00	0.77			0.22	8.89			3.88	35.33			31.51	*94.80*
27b	3	2	olivine	late	Fa100, Ca19%, Mn8%	0.34		0.57	12.95	0.58			0.15	7.24			3.99	37.77			31.28	*95.37*
27b	3	3	mixed		Fa100, Ca36%, Mn6%	2.14		6.56	14.53	2.01	0.41		2.94	9.38	0.20		2.18	21.14		1.51	37.68	*100.68*
27b	3	4	olivine	late	Fa100, Ca20%, Mn9%	0.64		3.25	10.07	0.73		0.27	0.74	5.99	0.16		3.53	29.29			27.82	*82.94*
27b	3	5	leucite?			0.45		8.76	12.08	0.84	0.24	0.48	1.16	4.18			1.35	16.72		1.44	30.41	*78.12*
27d	2	1	olivine	main core	Fa98, Ca7%, Mn18%		0.39		12.61					2.63			9.38	38.84			29.53	*93.38*
27d	2	2	olivine	main core	Fa97, Ca7%, Mn18%		0.45		12.59					2.54			9.21	37.52			29.08	*91.40*
27d	2	3	olivine	main core	Fa98, Ca7%, Mn18%		0.37		12.66					2.55			9.26	38.17			29.32	*92.33*
27d	2	4	olivine	main core	Fa98, Ca7%, Mn18%		0.33		12.60					2.63			9.24	37.95			29.18	*91.93*
27d	2	5	olivine	main margin	Fa100, Ca27%, Mn11%				12.99	0.18				10.30			5.55	32.95			30.21	*92.19*
27d	2	6	olivine	overgrowth	Fa100, Ca29%, Mn10%				12.77	0.27				10.89			4.96	32.69			30.06	*91.64*

Analyses expressed in weight% element, with oxygen determined by stoichiometry. S= sample, A = area (SOI), # = analysis

Appendix 3: Mineralogy

A3.1. Olivine compositions by EDS

sample	area	#	texture notes	phase nomenclature	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	Ba	O
CFD1B	SOI 11	1	inner main	Fa97, Ca11% Mn1%	0.00	0.72	0.19	13.91	0.00	0.00		0.00	3.07	0.00		0.16	24.94		57.00
CFD1B	SOI 11	2	margin main	Fa99, Ca26%	0.00	0.27	0.00	14.14	0.00	0.00		0.00	7.44	0.00		0.08	21.01		57.07
CFD1B	SOI 11	3	inner main	Fa97, Ca8%	0.00	0.88	0.00	14.14	0.00	0.00		0.00	2.25	0.00		0.11	25.54		57.07
CFD1B	SOI 11	4	outgrowth of main	Fa98, Ca18%	0.00	0.42	0.00	13.95	0.09	0.00		0.00	5.10	0.00		0.14	23.26		57.04
CFD1B	SOI 11	5	outgrowth of main	Fa98, Ca18%	0.00	0.39	0.17	13.71	0.12	0.00		0.00	5.18	0.00		0.12	23.30		56.99
CFD1B	SOI 13	1	coarse main inner	Fa96, Ca7%	0.00	1.06	0.00	14.12	0.00			0.00	1.93			0.13	25.70		57.06
CFD1B	SOI 13	2	coarse main inner	Fa97, Ca7%, Mn1%	0.00	0.92	0.00	14.08	0.00			0.00	1.88			0.15	25.92		57.04
CFD1B	SOI 13	3	coarse main inner	Fa97, Ca7%	0.00	0.83	0.00	14.20	0.00			0.00	2.06			0.13	25.68		57.10
CFD1B	SOI 13	4	coarse main inner	Fa98, Ca8%	0.00	0.90	0.13	14.10	0.09			0.00	2.17			0.14	25.33		57.15
CFD1B	SOI 13	5	margin main	Fa99, Ca30%	0.00	0.18	0.35	13.84	0.18			0.00	8.53			0.00	19.77		57.14
CFD6B	SOI 5	4	core	Fa98, Ca5%, Mn2%	0.00	0.43	0.24	13.78	0.00	0.00		0.00	1.31	0.00		0.64	26.65		56.95
CFD6B	SOI 5	5	core	Fa98, Ca5%, Mn3%	0.00	0.64	0.13	13.92	0.00	0.00		0.00	1.59	0.00		0.76	25.98		56.99
CFD6B	SOI 5	6	has w cotectite	Fa98, Ca6%, Mn2%	0.00	0.46	0.17	13.82	0.00	0.00		0.00	1.63	0.00		0.68	26.28		56.95
CFD6B	SOI7	1	core main	Fa98, Ca3%, Mn2%	0.00	0.60	0.17	13.69	0.00			0.00	0.91	0.00		0.52	27.23		56.89
CFD6B	SOI7	2	core main	Fa99, Ca6%, Mn2%	0.00	0.24	0.00	13.84	0.13			0.00	1.69	0.00		0.60	26.47		57.02
CFD6B	SOI7	3	margin main	Fa100, Ca9%, Mn1%	0.24	0.00	0.18	13.84	0.00			0.00	2.51	0.00		0.42	25.91		56.90
CFD6B	SOI7	4	margin of grain with W	Fa100, Ca6%, Mn2%	0.00	0.00	0.18	13.71	0.10			0.00	1.84	0.00		0.60	26.60		56.97
CFD6B	SOI7	5	margin main	Fa99, Ca8%, Mn2%	0.00	0.20	3.68	12.60	0.11			0.00	2.21	0.00		0.55	23.34		57.30
CFD6B	SOI7	6	core main	Fa97, Ca5%, Mn3%	0.00	0.82	0.00	13.86	0.00			0.00	1.37	0.00		0.95	26.08		56.93
CFD6B	SOI7	7	core main	Fa98, Ca5%, Mn3%	0.00	0.54	0.00	13.92	0.00			0.00	1.35	0.00		0.74	26.48		56.96
CFD6B	SOI7	8	core main	Fa98, Ca4%, Mn3%	0.00	0.56	0.00	13.99	0.00			0.00	1.18	0.00		0.74	26.53		56.99
CFD6B	SOI7	9	root dendrite	Fa100, Ca11%, Mn2%	0.35	0.00	1.21	14.07	0.00			0.40	3.07	0.00		0.53	23.21		57.15
CFD8B	SOI 4	1	core main	Fa97, Ca5%, Mn1%		0.76		13.97	0.00				1.34			0.36	26.57		56.99
CFD8B	SOI 4	2	core main	Fa97, Ca4%, Mn1%		0.88		13.93	0.09				1.19			0.42	26.45		57.03
CFD8B	SOI 4	3	inner main	Fa97, Ca6%, Mn1%		0.68		13.94	0.00				1.73			0.35	26.33		56.97
CFD8B	SOI 4	4	margin main	Fa99, Ca18%, Mn1%		0.28		13.95	0.00				5.16			0.32	23.32		56.97
CFD8B	SOI 4	5	margin main	Fa99, Ca25%, Mn1%		0.23		14.01	0.17				7.17			0.29	21.01		57.13
CFD8B	SOI 5	1	core main	Fa97, Ca7%, Mn1%	0.00	0.72		13.99	0.00			0.00	1.96			0.42	25.91		57.00
CFD8B	SOI 5	2	inner main	Fa98, Ca7%, Mn1%	0.00	0.63		13.91	0.00			0.00	2.16			0.42	25.92		56.95
CFD8B	SOI 5	3	inner main	Fa99, Ca16%, Mn1%	0.00	0.32		13.98	0.10			0.00	4.71			0.33	23.50		57.06
CFD8B	SOI 5	4	margin main	Fa99, Ca22%, Mn1%	0.24	0.21		13.99	0.08			0.00	6.18			0.24	22.06		57.00
CFD8B	SOI 5	5	margin main	Fa100, Ca29%, Mn1%	0.00	0.00		13.76	0.19			0.00	8.39			0.19	20.46		57.02
CFD8B	SOI 5	6	root dendrite	Fa100, Ca31%, Mn1%	0.35	0.00		13.83	0.35			0.00	8.79			0.17	19.41		57.09
CFD8B	SOI 5	7	root dendrite	Fa100, Ca32%, Mn1%	0.31	0.00		13.89	0.22			0.10	9.20			0.21	19.07		57.01
CFD8B	SOI 5	8	inner main	Fa98, Ca6%, Mn1%	0.00	0.65		14.06	0.00			0.00	1.67			0.35	26.24		57.03
CFD8B	SOI 5	9	core main	Fa97, Ca6%, Mn1%	0.00	0.68		13.98	0.10			0.00	1.68			0.32	26.17		57.07
CFD8B	SOI 5	10	inner main	Fa99, Ca12%, Mn1%	0.00	0.34		13.96	0.12			0.00	3.33			0.30	24.90		57.07
CFD8B	SOI 5	11	margin main	Fa99, Ca14%, Mn1%	0.00	0.29		13.95	0.00			0.00	4.06			0.32	24.40		56.98
CFD8B	SOI 6	1	core main	Fa98, Ca7%, Mn1%		0.58		13.97					1.94			0.35	26.18		56.98
CFD8B	SOI 6	2	inner main	Fa98, Ca12%, Mn1%		0.41		13.98					3.46			0.32	24.85		56.99
CFD8B	SOI 6	3	core in pore	Fa98, Ca8%, Mn1%		0.54		13.88					2.38			0.35	25.90		56.94
CFD8B	SOI 6	4	core in pore	Fa97, Ca6%, Mn1%		0.70		13.77					1.86			0.36	26.42		56.89
CFD8B	SOI 6	5	margin in pore	Fa99, Ca13%, Mn1%		0.29		13.93					3.89			0.31	24.61		56.96
CFD8B	SOI 6	6	margin in pore	Fa98, Ca16%, Mn1%		0.38		13.83					4.73			0.26	23.90		56.91
CFD10B	SOI 3	1	inner main	Fa97, Ca10%, Mn1%	0.00	0.71	0.00	13.95	0.00	0.00		0.00	2.81	0.00		0.27	25.27		56.98
CFD10B	SOI 3	2	core main	Fa97, Ca9%, Mn1%	0.00	0.81	0.12	13.86	0.00	0.00		0.00	2.66	0.00		0.26	25.32		56.96

sample	area	#	texture notes	phase nomenclature	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	Ba	O
CFD10B	SOI 3	3	inner main	Fa97, Ca10%, Mn1%	0.00	0.67	0.00	13.98	0.00	0.00		0.00	2.78	0.00		0.29	25.30		56.99
CFD10B	SOI 3	4	inner main	Fa98, Ca11%, Mn1%	0.00	0.62	0.00	14.02	0.00	0.00		0.00	3.25	0.00		0.25	24.84		57.01
CFD10B	SOI 3	5	margin main	Fa100, Ca30%	0.00	0.00	0.13	14.01	0.12	0.00		0.00	8.66	0.00		0.13	19.82		57.13
CFD10B	SOI 3	6	margin main	Fa100, Ca18%	0.00	0.00	0.00	14.02	0.21	0.00		0.09	5.00	0.00		0.08	23.45		57.14
CFD10B	SOI 3	7	late mass	Fa100, Ca36%	0.21	0.00	0.90	13.06	0.39	0.00		0.00	10.29	0.00		0.09	18.06		56.99
CFD10B	SOI 3	8	late mass margin	Fa100, Ca25%	0.00	0.00	0.24	13.93	0.27	0.00		0.12	7.10	0.00		0.13	21.01		57.20
CFD10B	SOI 3	9	late dendrite	Fa100, Ca20%	0.33	0.00	0.43	13.92	0.27	0.00		0.16	5.67	0.00		0.12	21.95		57.15
CFD10B	SOI4	1	inner main	Fa98, Ca14%. Mn1%	0.00	0.49	0.00	13.85	0.00	0.00		0.00	4.06	0.00		0.23	24.44		56.93
CFD10B	SOI4	2	inner main	Fa99, Ca21%, Mn1%	0.00	0.18	0.00	13.80	0.11	0.00		0.00	6.22	0.00		0.16	22.55		56.99
CFD10B	SOI4	4	mixed?	Fa100, Ca3%	0.00	0.00	2.68	11.79	0.22	0.00		0.10	0.72	0.00		0.00	27.79		56.70
CFD10B	SOI4	6	inner edge main	Fa99, Ca35%	0.00	0.17	0.14	13.67	0.22	0.00		0.00	10.19	0.00		0.11	18.45		57.04
CFD10B	SOI4	7	inner main	Fa98, Ca17%, Mn1%	0.00	0.37	0.00	13.79	0.15	0.00		0.00	5.03	0.00		0.19	23.46		57.01
CFD10B	SOI4	9	inner main	Fa98, Ca12%, Mn1%	0.00	0.63	0.00	13.88	0.00	0.00		0.00	3.59	0.00		0.24	24.73		56.94
CFD13b	SOI 2	1	core main	Fa97, Ca5%, Mn18%	0.00	0.76	0.00	13.93	0.10	0.00		0.00	1.46	0.00		5.32	21.38		57.04
CFD13b	SOI 2	2	core main	Fa97, Ca5%, Mn17%	0.00	0.64	0.00	14.07	0.00	0.00		0.00	1.59	0.00		4.98	21.69		57.03
CFD13b	SOI 2	3	inner main	Fa98, Ca6%, Mn17%	0.00	0.52	0.00	13.91	0.15	0.00		0.00	1.75	0.00		4.96	21.64		57.07
CFD13b	SOI 2	4	outer main	Fa99, Ca7%, Mn14%	0.00	0.25	0.00	14.07	0.00	0.00		0.00	2.13	0.00		4.18	22.34		57.04
CFD13b	SOI 2	5	margin main	Fa100, Ca10%, Mn13%	0.00	0.00	0.14	13.74	0.29	0.00		0.00	2.82	0.00		3.64	22.25		57.12
CFD13b	SOI 2	6	outer main	Fa99, Ca8%, Mn15%	0.00	0.32	0.14	13.84	0.00	0.00		0.00	2.27	0.00		4.27	22.20		56.96
CFD13b	SOI 2	7	root of o/g	Fa100, Ca12%, Mn13%	0.00	0.00	0.14	13.82	0.23	0.00		0.00	3.59	0.00		3.76	21.35		57.12
CFD13b	SOI 2	8	late o/g	Fa100, Ca18%, Mn12%	0.00	0.00	0.12	13.52	0.48	0.00		0.00	5.24	0.00		3.51	19.98		57.15
CFD13b	SOI 2	9	late interstitial	Fa100, Ca26%, Mn10%	0.40	0.00	0.38	13.78	0.50	0.00		0.22	7.08	0.00		2.75	17.68		57.21
CFD13b	SOI 2	10	late interstitial	Fa99, Ca25%, Mn10%	0.33	0.16	0.85	13.68	0.61	0.07		0.71	6.60	0.00		2.70	16.95		57.32
CFD13b	SOI 2	12	core main	Fa97, Ca5%, Mn18%	0.00	0.73	0.13	14.01	0.00	0.00		0.00	1.46	0.00		5.22	21.42		57.04
CFD13b	SOI 2	13	inner main	Fa97, Ca5%, Mn18%	0.00	0.65	0.11	14.02	0.00	0.00		0.00	1.53	0.00		5.17	21.49		57.04
CFD13b	SOI 2	14	outer main	Fa98, Ca6%, Mn17%	0.00	0.55	0.00	13.98	0.09	0.00		0.00	1.66	0.00		4.83	21.84		57.06
CFD13b	SOI 21	5	inner	Fa98, Ca7%, Mn17%	0.00	0.40	0.00	14.03	0.10	0.00		0.00	1.88	0.00		4.75	21.75	0.00	57.09
CFD13b	SOI 21	6	outer	Fa98, Ca8%, Mn15%	0.00	0.34	0.00	13.85	0.09	0.00		0.00	2.44	0.00		4.36	21.93	0.00	56.99
CFD13b	SOI 21	7	margin	Fa98, Ca14%, Mn13%	0.00	0.00	0.00	13.86	0.28	0.00		0.00	4.09	0.00		3.71	20.92	0.00	57.14
CFD13b	SOI 21	8	margin	Fa99, Ca14%, Mn14%	0.00	0.14	0.00	13.79	0.37	0.00		0.00	4.01	0.00		3.90	20.61	0.00	57.18
CFD13b	SOI 21	9	late interstitial	Fa100, Ca18%, Mn13%	0.00	0.00	0.12	13.68	0.52	0.00		0.00	5.07	0.00		3.67	19.67	0.00	57.26
CFD13b	SOI 21	10	late interstitial	Fa100, Ca20%, Mn11%	0.00	0.00	0.23	13.94	0.31	0.00		0.25	5.73	0.00		3.19	19.16	0.00	57.20
CFD13b	SOI 21	11	late interstitial	Fa99, Ca19%, Mn13%	0.00	0.19	0.16	13.59	0.55	0.00		0.00	5.31	0.00		3.59	19.36	0.00	57.25
CFD13b	SOI 24	1	main inner	Fa97, Ca6%, Mn18%		0.67	0.00	13.95	0.00			0.00	1.73	0.00		5.26	21.41		56.97
CFD13b	SOI 24	2	main outer	Fa97, Ca4%, Mn14%		0.62	0.00	13.88	0.00			0.00	1.29	0.00		4.16	23.11		56.94
CFD13b	SOI 24	3	main margin	Fa100, Ca8%, Mn13%		0.00	0.13	13.78	0.21			0.00	2.23	0.00		3.78	22.80		57.08
CFD13b	SOI 24	4	main core	Fa97, Ca4%, Mn15%		0.77	0.00	13.91	0.10			0.00	1.18	0.00		4.35	22.67		57.03
CFD13b	SOI 24	5	main inner	Fa98, Ca4%, Mn15%		0.52	0.15	14.03	0.10			0.00	1.28	0.00		4.18	22.63		57.12
CFD13b	SOI 24	6	main outer	Fa98, Ca6%, Mn15%		0.37	0.00	13.94	0.12			0.00	1.84	0.00		4.26	22.40		57.07
CFD13b	SOI 24	7	root of o/g	Fa100, Ca11%, Mn11%		0.00	0.12	13.90	0.30			0.00	4.78	0.00		3.07	20.64		57.20
CFD13b	SOI 24	8	late o/g	Fa100, Ca29%, Mn8%		0.00	0.31	13.69	0.67			0.14	8.01	0.00		2.36	17.45		57.39
CFD13b	SOI 24	9	late o/g	Fa100, Ca23%, Mn11%		0.00	0.13	13.47	0.54			0.00	6.70	0.00		3.17	18.80		57.18
CFD13b	SOI 24	13	? Main margin	Fa100, Ca18%, Mn11%		0.00	0.00	13.65	0.46			0.00	5.30	0.00		3.20	20.21		57.17
CFD14B	SOI 5	1	inner main	Fa97, Ca5%, Mn10%	0.00	0.74	0.19	13.87	0.18	0.00	0.00	0.00	1.48			2.91	23.50	0.00	57.12
CFD14B	SOI 5	2	inner main	Fa97, Ca5%, Mn10%	0.00	0.62	0.13	14.02	0.00	0.00	0.00	0.00	1.39			2.99	23.81	0.00	57.04
CFD14B	SOI 5	3	edge main	Fa99, Ca8%, Mn9%	0.00	0.34	0.15	13.85	0.19	0.00	0.00	0.00	2.19			2.52	23.67	0.00	57.10
CFD14B	SOI 5	4	edge main	Fa100, Ca14%, Mn8%	0.39	0.00	0.00	13.74	0.51	0.00	0.00	0.00	3.99			2.39	21.83	0.00	57.15
CFD14B	SOI 5	5	secondary o/g	Fa100, Ca40%, Mn5%	0.00	0.00	0.85	11.43	3.01	0.00	0.00	0.30	10.41			1.42	14.40	0.06	58.11
CFD14B	SOI 5	7	late dendrite	Fa100, Ca38%, Mn4%	0.59	0.00	2.12	11.73	2.77	0.08	0.00	0.67	8.96			1.06	13.59	0.06	58.27
CFD14B	SOI 5	8	late root	Fa99, Ca155, Mn8%	0.00	0.16	0.00	13.92	0.31	0.00	0.00	0.00	4.23			2.27	21.92	0.00	57.19
CFD14B	SOI 5	9	inner main	Fa98, Ca6%, Mn10%	0.00	0.45	0.12	13.93	0.15	0.00	0.00	0.00	1.73			2.82	23.68	0.00	57.11
CFD14B	SOI6	1	inner main	Fa98, Ca5%, Mn10%	0.00	0.53	0.20	13.99	0.13	0.00	0.00	0.00	1.32	0.00		2.90	23.78	0.00	57.14
CFD14B	SOI6	2	margin main	Fa100, Ca10%, Mn8%	0.00	0.00	0.00	14.01	0.15	0.00	0.00	0.00	2.76	0.00		2.37	23.59	0.00	57.12

sample	area	#	texture notes	phase nomenclature	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	Ba	O
CFD14B	SOI6	3	late fringe	Fa100, Ca19%, Mn7%	0.00	0.00	0.40	14.04	0.28	0.00	0.00	0.10	5.43	0.00		1.89	20.56	0.00	57.30
CFD14B	SOI6	4	?margin main/late	Fa100, Ca15%, Mn8%	0.00	0.00	0.17	13.72	0.36	0.00	0.00	0.00	4.39	0.00		2.21	21.99	0.00	57.17
CFD14B	SOI6	5	late fringe	Fa100, Ca18%, Mn8%	0.26	0.00	0.24	13.65	0.39	0.00	0.00	0.00	5.16	0.00		2.28	20.90	0.00	57.11
CFD14B	SOI6	9	late dendrite	Fa100, Ca25%, Mn6%	0.28	0.00	0.25	13.57	0.60	0.00	0.00	0.10	7.04	0.00		1.63	19.33	0.00	57.20
CFD14B	SOI6	10	late dendrite	Fa100, Ca27%, Mn6%	0.38	0.00	0.49	13.52	0.59	0.00	0.00	0.20	7.35	0.00		1.56	18.73	0.00	57.18
CFD14B	SOI6	18	late o/g		0.00	0.00	0.14	13.68	0.52	0.00	0.00	0.00	6.62	0.00		1.89	19.90	0.00	57.26
CFD14C	SOI3	1	core main	Fa97, Ca5%, Mn10%	0.00	0.69	0.18	13.97	0.17				1.29			2.96	23.58		57.16
CFD14C	SOI3	2	coe main	Fa97, Ca5%, Mn10%	0.00	0.63	0.16	13.88	0.23				1.37			2.92	23.66		57.15
CFD14C	SOI3	3	core main	Fa99, Ca8%, Mn9%	0.00	0.28	0.00	14.04	0.12				2.31			2.56	23.58		57.11
CFD14C	SOI3	4	core main	Fa98, Ca6%, Mn9%	0.00	0.45	0.12	13.97	0.09				1.87			2.73	23.70		57.08
CFD14C	SOI3	5	core main	Fa98, Ca6%, Mn10%	0.00	0.42	0.15	14.08	0.11				1.66			2.74	23.67		57.16
CFD14C	SOI3	6	core main	Fa97, Ca5%, Mn10%	0.23	0.68	0.12	13.87	0.11				1.40			2.87	23.73		56.99
CFD14C	SOI3	7	margin main	Fa98, Ca6%, Mn9%	0.00	0.44	0.00	14.06	0.00				1.79			2.69	24.00		57.03
CFD14C	SOI3	8	margin main	Fa99, Ca10%, Mn8%	0.00	0.27	0.15	14.22	0.00				2.78			2.29	23.16		57.14
CFD14C	SOI3	9	margin main	Fa99, Ca10%, Mn8%	0.00	0.26	0.15	13.94	0.09				2.99			2.29	23.19		57.08
CFD14C	SOI3	10	margin/fringe	Fa100, Ca27%, Mn7%	0.00	0.00	0.00	13.86	0.26				7.69			1.91	19.16		57.12
CFD14C	SOI3	11	margin main	Fa100, Ca18%, Mn7%	0.31	0.00	4.22	12.12	0.47				4.55			1.81	19.12		57.39
CFD14C	SOI3	12	late fringe	Fa100, Ca30%, Mn6%	0.42	0.00	0.12	13.57	0.57				8.39			1.66	18.11		57.15
CFD14D	SOI 2	1	core main	Fa98, Ca5%, Mn10%	0.00	0.53	0.00	13.90	0.09		0.00	0.00	1.59	0.00		2.84	24.04		57.02
CFD14D	SOI 2	2	inner1	Fa98, Ca6%, Mn10%	0.00	0.50	0.17	14.03	0.00		0.00	0.00	1.64	0.00		2.85	23.74		57.06
CFD14D	SOI 2	3	inner2	Fa98, Ca7%, Mn9%	0.00	0.41	0.00	14.13	0.00		0.00	0.00	1.91	0.00		2.72	23.77		57.06
CFD14D	SOI 2	4	inner3	Fa99, Ca9%, Mn8%	0.00	0.22	0.00	13.98	0.15		0.00	0.00	2.73	0.00		2.40	23.43		57.10
CFD14D	SOI 2	5	margin main	Fa100, Ca18%, Mn7%	0.00	0.00	0.17	13.81	0.24		0.00	0.00	5.04	0.00		2.10	21.51		57.13
CFD14D	SOI 2	6	overgrowth	Fa100. Ca18%, Mn7%	0.00	0.00	0.20	13.86	0.37		0.00	0.00	5.11	0.00		2.01	21.18		57.26
CFD14D	SOI 2	7	inner main?	Fa99, Ca10%, Mn8%	0.00	0.34	0.00	14.09	0.00		0.00	0.00	2.86	0.00		2.40	23.26		57.04
CFD14D	SOI 2	10	late	Fa100, Ca18%, Mn8%	0.26	0.00	0.15	13.77	0.40		0.00	0.00	5.07	0.00		2.17	21.01		57.16
CFD14D	SOI 2	11	late	Fa99, Ca18%, Mn7%	0.29	0.16	0.20	13.53	0.55		0.00	0.00	5.15	0.00		1.97	21.00		57.15
CFD14D	SOI 3	4	late	Fa100, Ca20%, Mn6%	0.00		0.39	13.79	0.30	0.00	0.00	0.12	5.65	0.00		1.68	20.60	0.00	57.33
CFD14D	SOI 3	5	late	Fa100, Ca17%, Mn6%	0.30		0.68	13.80	0.31	0.00	0.00	0.22	4.72	0.00		1.69	21.11	0.00	57.17
CFD14D	SOI 3	12	margin of o/g	Fa100, Ca25%, Mn6%	0.34		1.78	13.75	0.55	0.15	0.00	0.92	6.22	0.00		1.39	17.21	0.11	57.57
CFD16B	SOI 5	1	core main	Fa98, Ca5%, Mn4%	0.00	0.52	0.00	14.01	0.00	0.00		0.00	1.56	0.00		1.13	25.78	0.00	57.00
CFD16B	SOI 5	2	core main	Fa98, Ca5%, Mn4%	0.00	0.49	0.00	13.97	0.00	0.00		0.00	1.57	0.00		1.11	25.88	0.00	56.98
CFD16B	SOI 5	3	core main	Fa98, Ca5%, Mn4%	0.00	0.55	0.00	13.96	0.00	0.00		0.00	1.58	0.00		1.08	25.85	0.00	56.98
CFD16B	SOI 5	4	inner main	Fa98, Ca7%, Mn4%	0.00	0.27	0.16	14.01	0.00	0.00		0.00	2.00	0.00		1.07	25.44	0.00	57.05
CFD16B	SOI 5	5	inner main	Fa100, Ca12%, Mn3%	0.00	0.00	0.13	14.04	0.08	0.00		0.00	3.32	0.00		0.90	24.42	0.00	57.11
CFD16B	SOI 5	6	margin main/o-g	Fa99, Ca26%, Mn2%	0.00	0.19	0.37	14.12	0.20	0.00		0.41	7.21	0.00		0.62	19.67	0.00	57.20
CFD16B	SOI 5	7	late dendrite	Fa100, Ca26%, Mn2%	0.00	0.00	0.13	13.82	0.21	0.00		0.09	7.40	0.00		0.58	20.69	0.00	57.08
CFD16B	SOI 5	8	late dendrite	Fa100, Ca28%, Mn2%	0.00	0.00	0.15	13.69	0.29	0.00		0.10	8.14	0.00		0.58	19.98	0.00	57.07
CFD16B	SOI 5	9	late dendrite	Fa100, Ca27%, Mn2%	0.00	0.00	0.00	13.83	0.27	0.00		0.11	7.69	0.00		0.63	20.39	0.00	57.09
CFD16B	SOI 6	1	main	Fa97, Ca4%, Mn4%		0.89		13.97					1.07			1.26	25.83		56.98
CFD16B	SOI 6	2	main	Fa97, Ca4%, Mn5%		0.93		14.07					1.03			1.32	25.62		57.03
CFD16B	SOI 6	3	nr W cotectite	Fa98, Ca11%, Mn4%		0.49		13.92					3.33			1.07	24.24		56.96
CFD16B	SOI 6	4	W-free zone	Fa96, Ca4%, Mn5%		0.95		13.95					1.04			1.33	25.76		56.98
CFD16B	SOI 6	5	W-free zone	Fa96, Ca3%, Mn5%		1.03		13.99					0.98			1.33	25.68		56.99
CFD16B	SOI 6	6	base of cake	Fa96, Ca3%, Mn5%		1.21		13.98					0.82			1.33	25.68		56.99
CFD16B	SOI 6	7	base of cake	Fa98, Ca6%, Mn4%		0.63		13.94					1.69			1.16	25.61		56.97
CFD16B	SOI 6	8	main	Fa96, Ca3%, Mn4%		1.05		13.97					0.96			1.23	25.80		56.99
CFD16B	SOI 6	9	W-free zone	Fa96, Ca3%, Mn5%		1.03		13.96					0.95			1.35	25.73		56.98
CFD18B	SOI 7	1	main edge	Fa100, Ca10%, Mn1%	0.00		0.12	14.01	0.00	0.00		0.00	3.02			0.25	25.56	0.00	57.04
CFD18B	SOI 7	3	main margin	Fa100, Ca37%	0.28		0.11	13.50	0.47	0.00		0.00	10.52			0.13	17.94	0.00	57.06
CFD18B	SOI 7	4	altered margin/late	Fa100, Ca20%, Mn1%	0.00		0.13	13.80	0.33	0.00		0.00	5.83			0.19	22.53	0.00	57.18
CFD18B	SOI 7	6	altered late	Fa100, Ca18%, Mn1%	0.00		0.00	14.19	0.38	0.00		0.00	5.04			0.21	22.80	0.00	57.38
CFD18B	SOI 7	7	altered late	Fa100, Ca19%, Mn1%	1.12		1.62	13.62	0.28	0.00		0.22	4.84			0.15	21.07	0.00	57.09

sample	area	#	texture notes	phase nomenclature	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	Ba	O
CFD18B	SOI 7	9	late	Fa100, Ca14%, Mn1%	0.00		0.34	14.07	0.30	0.00		0.00	4.00			0.16	23.78	0.00	57.34
CFD18B	SOI 7	11	ol late o/g?	Fa100, Ca33%, Mn1%	0.41		0.00	13.68	0.49	0.00		0.00	9.34			0.17	18.81	0.00	57.10
CFD18B	SOI 7	12	altered late	Fa100, Ca24%, Mn1%	0.00		0.19	13.71	0.37	0.00		0.00	6.80			0.21	21.53	0.00	57.18
CFD18B	SOI 8	1	core main	Fa99, Ca3%, Mn1%	0.00	0.41	0.00	14.09	0.00	0.00		0.00	0.93	0.00		0.34	27.19		57.04
CFD18B	SOI 8	2	inner main	Fa100, Ca6%, Mn1%	0.00	0.00	0.00	14.04	0.00	0.00		0.00	1.83	0.00		0.28	26.83		57.02
CFD18B	SOI 8	3	margin main	Fa100, Ca13%, Mn1%	0.00	0.00	0.13	13.92	0.12	0.00		0.00	3.80	0.00		0.26	24.68		57.09
CFD18B	SOI 8	4	altered or o-g?	Fa100, Ca38%, Mn1%	0.25	0.00	0.00	13.70	0.33	0.00		0.00	10.98	0.00		0.19	17.52		57.03
CFD18B	SOI 8	5	late dendrite	Fa100, Ca38%	0.28	0.00	0.19	13.47	0.57	0.00		0.13	10.78	0.00		0.13	17.36		57.10
CFD18B	SOI 8	7	late dendrite	Fa100, Ca32%, Mn1%	0.38	0.00	0.61	13.83	0.43	0.00		0.32	8.58	0.00		0.15	18.49		57.21
CFD18C	SOI 3	1	core main	Fa99, Ca10%, Mn1%	0.00	0.22	0.00	14.06	0.00	0.00		0.07	3.03			0.23	25.38		57.01
CFD18C	SOI 3	2	core main	Fa99, Ca5%, Mn1%	0.00	0.30	0.14	13.90	0.14	0.00		0.00	1.55			0.28	26.59		57.09
CFD18C	SOI 3	3	inner main	Fa99, Ca5%, Mn1%	0.00	0.17	0.19	13.91	0.00	0.00		0.00	1.57			0.30	26.87		57.00
CFD18C	SOI 3	4	altered or o-g?	Fa100, Ca36%	0.00	0.00	0.11	14.17	0.18	0.00		0.00	10.25			0.00	18.05		57.25
CFD18C	SOI 3	5	inner main	Fa99, Ca9%, Mn1%	0.00	0.23	0.00	14.16	0.00	0.00		0.00	2.64			0.26	25.64		57.08
CFD18C	SOI 3	6	inner main	Fa99, Ca5%, Mn1%	0.00	0.21	0.14	14.05	0.00	0.00		0.00	1.41			0.25	26.88		57.06
CFD18C	SOI 3	7	margin main	Fa100, Ca10%, Mn1%	0.00	0.00	0.00	14.21	0.00	0.00		0.00	2.87			0.22	25.59		57.11
CFD18C	SOI 3	8	altered or o-g?	Fa100, Ca35%	0.28	0.00	0.31	14.20	0.16	0.00		0.11	9.77			0.10	17.86		57.20
CFD18C	SOI4	1	inner main	Fa99, Ca3%, Mn1%		0.39	0.16	13.97					0.98			0.30	27.16		57.03
CFD18C	SOI4	2	inner main	Fa99, Ca4%, Mn1%		0.38	0.17	13.98					1.08			0.31	27.06		57.03
CFD18C	SOI4	3	inner main	Fa99, Ca3%, Mn1%		0.27	0.00	14.23					0.95			0.33	27.11		57.11
CFD18C	SOI4	4	inner main	Fa99, Ca6%, Mn1%		0.18	0.13	14.18					1.70			0.24	26.44		57.12
CFD18C	SOI4	5	inner main	Fa99, Ca4%, Mn1%		0.32	0.19	14.01					1.05			0.29	27.09		57.05
CFD18C	SOI4	6	inner main	Fa99, Ca4%, Mn1%		0.35	0.19	14.02					1.12			0.30	26.97		57.06
CFD20b	SOI 2	1	core main	Fa97, Ca4%, Mn10%		0.74		14.06					1.06			2.83	24.28		57.03
CFD20b	SOI 2	2	to	Fa97, Ca3%, Mn10%		0.86		14.05					0.72			2.86	24.48		57.03
CFD20b	SOI 2	3	to	Fa97, Ca3%, Mn9%		0.74		14.08					0.74			2.71	24.69		57.04
CFD20b	SOI 2	4	to	Fa97, Ca3%, Mn10%,		0.70		14.08					0.74			2.93	24.51		57.04
CFD20b	SOI 2	5	margin or late	Fa100, Ca14%, Mn6%				14.14					4.09			1.83	22.86		57.07
CFD20b	SOI 2	6	margin or late	Fa100, Ca36%, Mn4%				13.86	0.20				10.31			1.27	17.27		57.08
CFD20b	SOI 4	1	core = SOI-1	Fa98, Ca3%, Mn10%		0.62		14.19					0.87			2.76	24.47		57.09
CFD20b	SOI 4	2	to	Fa97, Ca4%, Mn9%		0.70		14.17					1.14			2.68	24.23		57.09
CFD20b	SOI 4	3	to	Fa96, Ca2%, Mn10%		0.98		14.13					0.67			2.81	24.35		57.06
CFD20b	SOI 4	4	to	Fa97, Ca3%, Mn10%		0.67		14.11					0.78			2.84	24.56		57.05
CFD20b	SOI 4	5	near margin	Fa100, Ca6%, Mn8%				14.26					1.74			2.28	24.60		57.13
CFD20b	SOI 4	6	near margin	Fa100, Ca8%, Mn7%				14.25					2.39			2.06	24.17		57.13
CFD20b	SOI 4	7	margin or late	Fa100, Ca37%, Mn4%				13.94	0.22				10.52			1.26	16.92		57.13
CFD20b	SOI 5	1	near margin	Fa100, Ca12%, Mn7%				14.20					3.36			1.94	23.41		57.10
CFD20b	SOI 5	2	margin main	Fa100, Ca38%, Mn4%			0.17	13.88	0.30				10.89			1.17	16.39		57.20
CFD20b	SOI 5	4	late dendrite	Fa100, Ca31%, Mn4%	0.43		0.55	13.78	0.48			0.25	8.53			1.07	17.69		57.22
CFD20b	SOI 5	5	late dendrite	Fa100, Ca29%, Mn4%	0.39		0.43	13.48	0.52			0.10	8.24			1.06	18.66		57.11
CFD20b	SOI 8	1	late dendrite	Fa100, Ca33%, Mn3%		0.41		13.73	0.58			0.20	9.11			0.96	17.67		57.35
CFD20b	SOI 8	2	late dendrite	Fa100, Ca32%, Mn3%		0.91		13.88	0.62			0.37	8.58			0.83	17.28		57.54
CFD20b	SOI 8	3	late dendrite	Fa100, Ca39%, Mn3%	0.50	0.75		13.76	0.77			0.35	10.22			0.81	15.42		57.43
CFD20b	SOI 8	12	margin main	Fa100, Ca12%, Mn5%				13.98	0.22				3.54			1.49	23.61		57.15
CFD20c	SOI 1	2	core main	Fa98, Ca4%, Mn9%		0.60		13.91					1.03			2.68	24.83		56.95
CFD20c	SOI 1	3	core main	Fa99, Ca6%, Mn8%		0.28		13.92					1.67			2.38	24.78		56.96
CFD20c	SOI 1	4	core main	Fa97, Ca3%, Mn10%		0.71		13.85					0.78			2.85	24.89		56.93
CFD20c	SOI 1	5	inner main	Fa98, Ca4%, Mn9%		0.49		13.84					1.26			2.55	24.94		56.92
CFD20c	SOI 1	6	to	Fa97, Ca3%, Mn10%		0.73		14.01					0.83			2.84	24.58		57.01
CFD20c	SOI 1	7	to	Fa98, Ca3%, Mn10%		0.58		13.90					0.92			2.78	24.87		56.95
CFD20c	SOI 1	8	margin main	Fa100, Ca10%, Mn7%				13.98					2.83			2.00	24.19		56.99
CFD20c	SOI 2	1	late dendrite	Fa100, Ca30%, Mn3%	0.39		0.84	13.64	0.47			0.38	8.26			0.94	17.89		57.19
CFD20c	SOI 2	2	near margin main	Fa100, Ca8%, Mn7%				14.06					2.44			2.02	24.45		57.03

sample	area	#	texture notes	phase nomenclature	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	Ba	O
CFD20c	SOI 2	3	margin main	Fa100, Ca12%, Mn5%				13.59	0.25				3.58			1.54	24.05		56.98
CFD20c	SOI 2	4	margin main	Fa100, Ca21%, Mn5%				13.78	0.15				6.07			1.54	21.45		57.01
CFD20c	SOI 2	5	inner main	Fa100, Ca6%, Mn8%				14.17					1.76			2.28	24.70		57.09
CFD20c	SOI 2	6	late dendrite	Fa100, Ca28%, Mn4%			0.44	13.82	0.30			0.16	7.86			1.09	19.13		57.21
CFD20c	SOI 2	7	late dendrite	Fa100, Ca31%, Mn4%	0.96		3.52	13.89	0.66	0.15		0.95	6.65			0.79	14.32	0.11	57.99
CFD21b	SOI 1	1	core main	Fa97, Ca3%		0.72		14.11					0.78				27.33		57.06
CFD21b	SOI 2	3	core main	Fa97, Ca3%		0.71		14.10					0.82				27.32		57.05
CFD21b	SOI 2	4	core main	Fa99, Ca5%		0.27		14.09					1.35				27.26		57.04
CFD21b	SOI 2	5	core main	Fa98, Ca4%		0.48		14.12					1.03			0.12	27.20		57.06
CFD21b	SOI 2	6	core main	Fa98, Ca3%		0.66		14.08					0.87			0.13	27.22		57.04
CFD21b	SOI 3	2	core main	Fa97, Ca2%		0.87		14.00					0.69				27.44		57.00
CFD21b	SOI 3	3	inner main	Fa97, Ca3%, Mn1%		0.74		13.77					0.79			0.15	27.66		56.89
CFD21b	SOI 3	4	margin main	Fa100, Ca27%			0.33	14.20					7.74				20.54		57.18
CFD21b	SOI 3	5	margin main	Fa100, Ca33%			0.26	14.18					9.47				18.93		57.16
CFD21b	SOI 3	6	late dendrite	Fa100, Ca33%				14.24					9.37				19.27		57.12
CFD21b	SOI 3	7	late dendrite	Fa100, Ca29%				14.01	0.13				8.46				20.31		57.10
CFD21c	SOI 4	1	late ol - dendrite core	Fa100, Ca22%				13.98					6.38				22.65		56.99
CFD21c	SOI 4	3	dendrite core	Fa100, Ca25%				14.22					7.04				21.63		57.11
CFD21c	SOI 4	4	marginal ol (with W?)	Fa100, Ca27%			0.19	13.90					7.71				21.21		57.00
CFD21c	SOI 4	5	marginal ol (with W?)	Fa100, Ca26%				13.99					7.51				21.51		56.99
CFD21c	SOI 4	6	marginal ol (with W?)	Fa100, Ca29%			0.20	13.90	0.18				8.39				20.19		57.14
CFD21c	SOI 4	7	marginal ol (with W?)	Fa100, Ca35%			0.19	13.94					10.17				18.68		57.02
CFD21c	SOI 4	9	marginal ol (with W?)	Fa100, Ca30%				13.94				0.12	8.82				20.18		56.94
CFD21c	SOI 4	10	marginal ol (with W?)	Fa100, Ca26%			0.49	14.38	0.19			0.21	7.12				20.21		57.40
CFD21c	SOI 4	13	cotectic with L	Fa100, Ca33%			1.11	14.18	0.16			0.93	8.72				17.64		57.25
CFD21c	SOI 4	16	cotectic with L	Fa100, Ca28%			0.20	13.80	0.30			0.14	7.91				20.52		57.14
CFD21c	SOI 5	1	marginal	Fa100, Ca23%				13.92	0.16				6.74				22.09		57.08
CFD21c	SOI 6	1	core main	Fa100, Ca9%				13.86					2.59			0.14	26.49		56.93
CFD21c	SOI 6	2	margin main	Fa100, Ca20%			1.90	13.12					5.52			0.12	22.29		57.04
CFD21c	SOI 6	3	margin main	Fa100, Ca11%				13.98					3.16				25.87		56.99
CFD21c	SOI 6	4	inner main	Fa100, Ca8%				14.21					2.27				26.41		57.11
CFD21c	SOI 6	5	late dendrite	Fa100, Ca31%			0.71	14.07					8.66				19.34		57.21
CFD21c	SOI 6	6	late dendrite	Fa100, Ca29%			0.31	13.81	0.18			0.17	8.14				20.32		57.07
CFD21c	SOI 6	7	late dendrite	Fa100, Ca24%			0.20	13.95					6.98				21.85		57.03
CFD21c	SOI 7	1	inner main	Fa100, Ca6%, Mn1%				15.13					1.56			0.14	25.61		57.56
CFD21c	SOI 7	2	inner main	Fa99, Ca5%		0.26		13.99					1.41			0.10	27.24		57.00
CFD21c	SOI 7	3	inner main	Fa99, Ca5%		0.37		14.01					1.48			0.12	27.01		57.01
CFD21c	SOI 7	4	inner main	Fa100, Ca7%				14.03					1.96			0.13	26.87		57.02
CFD21c	SOI 7	5	margin main	Fa100, Ca35%				14.00	0.20				10.00				18.65		57.15
CFD21c	SOI 7	6	late blocky	Fa100, Ca36%				13.94					10.52				18.56		56.97
CFD21c	SOI 7	7	cotectic with L	Fa100, Ca34%				13.95	0.24			0.10	9.81				18.76		57.13
CFD21c	SOI 7	16	inner main	Fa100, Ca6%				14.12					1.87				26.95		57.06
CFD21c	SOI 7	17	inner main	Fa99, Ca5%		0.31		14.01					1.54				27.13		57.01
CFD21c	SOI 8	1	core late	Fa100, Ca20%				13.92	0.14				5.73				23.16		57.06
CFD21c	SOI 8	2	margin late	Fa100, Ca34%				14.13					9.82				18.98		57.07
CFD21c	SOI 8	5	cotectic with leucite	Fa100, Ca32%				14.31					9.11				19.43		57.15
CFD21c	SOI 8	6	inner main	Fa100, Ca10%				14.06					2.78				26.14		57.03
CFD21c	SOI 8	7	margin main	Fa100, Ca16%				13.96					4.58				24.48		56.98
CFD21c	SOI 8	10	cotectic with leucite	Fa100, Ca25%			0.79	14.27	0.15			0.84	6.66				20.06		57.23
CFD21d	SOI 3	1	main	Fa98, Ca2%, Mn1%		0.70		13.94					0.60			0.24	27.56		56.97
CFD21d	SOI 4	1	main	Fa98, Ca3%, Mn1%		0.68		13.88					0.80			0.23	27.47		56.94
CFD21d	SOI 4	2	near vesicle margin	Fa99, Ca3%, Mn1%		0.42		14.02					0.96			0.23	27.36		57.01
CFD21d	SOI 6	1	core main	Fa98, Ca4%, Mn1%		0.46		13.94					1.05			0.30	27.28		56.97

sample	area	#	texture notes	phase nomenclature	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	Ba	O
CFD21d	SOI 6	2	inner man	Fa98, Ca3%, Mn1%		0.48		14.03					0.94			0.21	27.33		57.02
CFD21d	SOI 6	4	near margin main	Fa99, Ca8%, Mn1%		0.25		14.01					2.25			0.25	26.23		57.01
CFD21d	SOI 6	5	margin main	Fa100, Ca5%			3.03	12.83	0.44				1.28				24.66		57.63
CFD21d	SOI 6	6	margin main	Fa100. Ca9%			0.59	14.33	0.16				2.35			0.14	25.01		57.43
CFD21d	SOI 6	8	margin main	Fa100, Ca7%				14.15					2.13			0.12	26.53		57.07
CFD21d	SOI 6	9	late?	Fa100, Ca5%			4.91	13.23	0.51	0.12			1.14				21.75		58.34
CFD21d	SOI 6	10	late?	Fa100, Ca7%			0.93	14.48	0.44				1.74				24.61		57.80
CFD22b	SOI 2	1	inner main	Fa100, Ca5%, Mn6%				14.90					1.46			1.78	24.40		57.45
CFD22b	SOI 2	2	inner main	Fa100, Ca5%, Mn6%				13.86	0.22				1.38			1.76	25.69		57.09
CFD22b	SOI 2	3	near margin main	Fa100, Ca8%, Mn6%			0.20	13.70	0.20				2.19			1.72	24.93		57.05
CFD22b	SOI 2	4	inner main	Fa100, Ca5%, Mn6%				13.92	0.16				1.41			1.82	25.62		57.08
CFD22b	SOI 2	5	inner main	Fa100, Ca3%, Mn7%				14.02					0.99			2.03	25.95		57.01
CFD22b	SOI 2	6	core main	Fa99, Ca3%, Mn7%		0.34		13.93					0.76			2.17	25.84		56.96
CFD22b	SOI 5	1	inner main	Fa97, Ca2%, Mn9%		0.66		15.08					0.60			2.58	23.53		57.54
CFD22b	SOI 5	2	inner main	Fa99, Ca3%, Mn9%		0.36		14.90					0.77			2.37	24.15		57.45
CFD22b	SOI 5	3	inner main	Fa99, Ca3%, Mn9%		0.36		14.84					0.79			2.41	24.19		57.42
CFD22b	SOI 5	4	near margin main	Fa100, Ca3%, Mn8%				15.17					0.95			2.22	24.07		57.59
CFD22b	SOI 5	5	main outgrowth	Fa100, Ca4%, Mn8%				14.94	0.20				1.01			2.17	24.06		57.62
CFD22b	SOI 5	6	distal main outgrowth	Fa100, Ca6%, Mn8%			0.87	15.06	0.23			0.40	1.55			1.94	22.13		57.82
CFD22b	SOI 5	7	distal main outgrowth	Fa100, Ca4%, Mn8%			0.19	13.75	0.30				1.26			2.21	25.15		57.15
CFD22b	SOI 5	8	late dendrite	Fa100, Ca5%, Mn7%				14.03					1.46			2.15	25.35		57.01
CFD22b	SOI 5	9	late dendrite	Fa100, Ca6%, Mn7%				13.88	0.19				1.68			2.06	25.12		57.08
CFD22b	SOI 5	16	small dendrite		0.97		4.12	15.28	1.30			1.97	3.65	0.11		1.10	12.53		58.96
CFD23b	SOI 3	1	near vesicle	Fa98, Ca8%, Mn25%	0.00	0.33	0.00	14.04	0.13			0.00	2.37	0.00		7.22	18.80		57.12
CFD23b	SOI 3	2	near vesicle	Fa99, Ca11, Mn22%	0.00	0.16	0.00	14.16	0.00			0.00	3.23	0.00		6.45	18.91		57.08
CFD23b	SOI 3	3	transect across complex	Fa98, Ca11%, Mn22%	0.00	0.38	0.00	14.00	0.00			0.00	3.05	0.00		6.45	19.12		57.00
CFD23b	SOI 3	4	to	Fa97, Ca8%, Mn26%	0.00	0.50	0.00	13.82	0.20			0.00	2.18	0.00		7.41	18.82		57.06
CFD23b	SOI 3	5	to	Fa97, Ca8%, Mn25%	0.00	0.55	0.00	13.85	0.14			0.00	2.20	0.00		7.37	18.85		57.03
CFD23b	SOI 3	6	to	Fa98, Ca8%, Mn26%	0.00	0.44	0.00	13.97	0.13			0.00	2.28	0.00		7.45	18.64		57.09
CFD23b	SOI 3	7	to	Fa97, Ca8%, Mn25%	0.00	0.48	0.00	13.99	0.11			0.00	2.30	0.00		7.29	18.76		57.07
CFD23b	SOI 3	8	to	Fa98, Ca12%, Mn22%	0.00	0.29	0.00	14.06	0.00			0.00	3.50	0.00		6.45	18.66		57.03
CFD23b	SOI 3	9	to	Fa98, Ca8%, Mn25%	0.00	0.35	0.00	13.95	0.16			0.00	2.40	0.00		7.26	18.78		57.10
CFD23b	SOI 3	10	to	Fa99, Ca12%, Mn21%	0.00	0.19	0.00	14.02	0.00			0.00	3.42	0.00		6.03	19.32		57.01
CFD23b	SOI 3	11	margin	Fa100, Ca22%, Mn17%	0.00	0.00	0.00	14.01	0.11			0.00	6.24	0.06		4.85	17.60		57.12
CFD23b	SOI 3	12	margin	Fa100, Ca27%, Mn15%	0.00	0.00	0.00	13.84	0.32			0.00	7.77	0.00		4.35	16.56		57.16
CFD23b	SOI 3	13	late	Fa100, Ca23%, Mn13%	0.37	0.00	0.00	13.57	0.64			0.10	6.36	0.00		3.74	18.07		57.15
CFD23b	SOI 3	14	late	Fa100, Ca21%, Mn14%	0.42	0.00	0.00	13.60	0.81			0.18	5.93	0.00		3.96	17.83		57.26
CFD23b	SOI 4	6	close to iron	Fa97, Ca7%, Mn27%		0.66	0.11	13.98	0.08	0.00			1.98			7.74	18.37		57.08
CFD23b	SOI 4	7	close to iron	Fa96, Ca6%, Mn31%		0.75	0.00	14.06	0.09	0.00			1.82			9.03	17.15		57.10
CFD23b	SOI 4	8	moderately close to iron	Fa97, Ca6%, Mn28%		0.52	0.00	14.01	0.13	0.00			1.82			8.00	18.42		57.10
CFD23b	SOI 4	9	fairly close to iron	Fa96, Ca6%, Mn27%		0.72	0.17	13.90	0.19	0.00			1.84			7.87	18.18		57.13
CFD23b	SOI 5	1	blocky outer	Fa97, Ca7%, Mn27%		0.53		14.16	0.09				1.97			7.64	18.46		57.15
CFD23b	SOI 5	2	blocky outer	Fa97, Ca7%, Mn27%		0.61		13.97	0.14				1.91			7.84	18.44		57.09
CFD23b	SOI 5	3	blocky outer	Fa97, Ca6%, Mn27%		0.62		14.08	0.00				1.87			7.73	18.65		57.04
CFD23b	SOI 5	4	dense	Fa96, Ca6%, Mn27%		0.76		14.05	0.15				1.73			7.76	18.42		57.13
CFD23b	SOI 5	5	dense	Fa96, Ca6%, Mn27%		0.73		13.89	0.21				1.79			7.91	18.36		57.11
CFD23b	SOI 5	6	dense	Fa97, Ca6%, Mn27%		0.66		13.89	0.21				1.80			7.85	18.48		57.10
CFD23b	SOI 5	7	blocky outer	Fa97, Ca6%, Mn27%		0.64		14.01	0.12				1.83			7.70	18.61		57.09
CFD23b	SOI 5	8	blocky outer	Fa96, Ca6%, Mn27%		0.68		14.00	0.00				1.83			7.82	18.66		57.00
CFD23b	SOI 5	9	blocky outer	Fa96, Ca6%, Mn27%		0.68		14.02	0.09				1.82			7.80	18.51		57.08
CFD23b	SOI 5	10	dense	Fa96, Ca6%, Mn27%		0.72		14.02	0.17				1.83			7.77	18.35		57.14
CFD23b	SOI 5	11	dense	Fa96, Ca6%, Mn27%		0.69		13.98	0.10				1.86			7.76	18.55		57.06
CFD24b	SOI 2	1	late dendrite core	Fa96, Ca4%, Mn2%		0.93	0.78	15.37				0.51	1.03			0.51	23.12		57.75

sample	area	#	texture notes	phase nomenclature	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	Ba	O
CFD24b	SOI 2	2	late dendrite core	Fa97, Ca3%, Mn2%		0.78	0.52	14.90				0.27	0.90			0.59	24.54		57.51
CFD24b	SOI 2	3	late dendrite core	Fa96, Ca3%, Mn2%		0.98	0.76	15.56				0.58	0.87			0.56	22.88		57.82
CFD24b	SOI 5	2	blocky margin	Fa98, Ca3%, Mn1%		0.52	3.83	12.35					0.69			0.36	25.10		57.13
CFD24b	SOI 5	3	blocky inner	Fa96, Ca1%, Mn1%		1.16		13.92					0.40			0.34	27.22		56.96
CFD24b	SOI 5	4	blocky core	Fa98, Ca2%, Mn1%		0.67		13.89					0.51			0.30	27.69		56.95
CFD24b	SOI 5	5	blocky core	Fa98, Ca2%, Mn1%		0.55		14.10					0.52			0.30	27.49		57.05
CFD24b	SOI 5	6	blocky margin	Fa98, Ca2%, Mn1%		0.49		14.06					0.51			0.32	27.59		57.03
CFD24b	SOI 5	7	blocky inner	Fa98, Ca2%, Mn1%		0.52		13.95					0.52			0.25	27.78		56.98
CFD24b	SOI 5	8	blocky margin	Fa98, Ca2%, Mn1%		0.65		14.12					0.51			0.34	27.33		57.06
CFD24b	SOI 5	10	blocky margin	Fa98, Ca2%, Mn1%		0.67		14.22					0.46			0.39	27.15		57.11
CFD24b	SOI 5	11	blocky core	Fa98, Ca2%, Mn1%		0.49	3.10	12.87					0.57			0.27	25.49		57.21
CFD24b	SOI 6	2	blocky inner	Fa96, Ca2%, Mn2%		1.04		14.03					0.55			0.48	26.88		57.02
CFD24b	SOI 6	3	blocky inner	Fa96, Ca2%, Mn2%		1.12		13.97					0.52			0.57	26.83		56.99
CFD24b	SOI 6	4	blocky margin	Fa96, Ca2%, Mn2%		1.20		14.10					0.56			0.54	26.55		57.05
CFD24b	SOI 6	7	blocky core	Fa97, Ca2%, Mn2%		0.95		14.12					0.53			0.52	26.81		57.06
CFD24b	SOI 6	8	blocky core	Fa96, Ca2%, Mn2%		1.09		14.08					0.51			0.49	26.78		57.04
CFD24b	SOI 6	9	to	Fa96, Ca2%, Mn2%		1.05	0.37	14.66				0.12	0.61			0.52	25.27		57.39
CFD24b	SOI 6	10	to	Fa96, Ca2%, Mn2%		1.22		14.03					0.49			0.58	26.67		57.01
CFD24b	SOI 6	11	blocky margin	Fa95, Ca2%, Mn2%		1.25		14.20					0.55			0.57	26.33		57.10
CFD24b	SOI 6	12	mixed feather	Fa97, Ca7%, Mn2%	0.50	0.59	1.84	17.11				1.14	1.40			0.38	18.44		58.60
CFD24b	SOI 6	13	mixed feather	Fa98, Ca7%, Mn1%	0.53	0.25	2.51	18.64				1.53	1.26			0.21	15.64		59.43
CFD24b	SOI 6	14	mixed feather	Fa97, Ca8%, Mn2%	0.50	0.53	1.59	16.62				0.83	1.73			0.42	19.41		58.38
CFD24b	SOI 7	3	blocky external crust	Fa97, Ca21%, Mn13%		0.57		14.26					6.12			3.65	18.26		57.13
CFD24b	SOI 7	4	blocky external crust	Fa96, Ca14%, Mn15%		0.86		14.09					4.16			4.22	19.63		57.04
CFD24c	SOI 1	1	ol margin	Fa99, Ca6%, Mn2%		0.36		14.95				0.17	1.74			0.45	24.90		57.43
CFD24c	SOI 1	2	ol inner	Fa99, Ca3%, Mn1%		0.35		14.12					0.92			0.40	27.15		57.06
CFD24c	SOI 1	3	ol core	Fa99, Ca3%, Mn1%		0.36		14.35					0.92			0.41	26.79		57.17
CFD24c	SOI 1	4	ol margin	Fa99, Ca6%, Mn2%		0.26		14.27					1.78			0.50	26.06		57.13
CFD24c	SOI 1	12	ol inner	Fa99, Ca5%, Mn2%		0.26		14.40					1.43			0.45	26.26		57.20
CFD24c	SOI 1	13	ol inner	Fa99, Ca3% ,Mn2%		0.40		14.33					0.88			0.46	26.77		57.16
CFD24c	SOI 1	14	ol core	Fa99, Ca6% ,Mn1%		0.40		14.32					1.61			0.41	26.09		57.16
CFD24c	SOI 1	15	ol core	Fa98, Ca5% ,Mn2%		0.44		14.30					1.56			0.40	26.14		57.15
CFD24c	SOI 1	16	ol inner	Fa98, Ca3% ,Mn2%		0.45		14.22					0.90			0.47	26.84		57.11
CFD24c	SOI 4	1	ol core	Fa98, Ca2% ,Mn1%		0.55		14.09					0.58			0.42	27.32		57.04
CFD24c	SOI 4	2	to	Fa98, Ca2% ,Mn1%		0.58		14.17					0.62			0.37	27.18		57.08
CFD24c	SOI 4	3	to	Fa99, Ca3% ,Mn1%		0.40	0.68	13.83					0.72			0.35	26.91		57.09
CFD24c	SOI 4	4	to	Fa100, Ca4%, Mn1%				14.22					1.10			0.38	27.19		57.11
CFD24c	SOI 4	5	ol margin	Fa100, Ca6%, Mn1%			0.25	14.06					1.78			0.29	26.54		57.09
CFD24c	SOI 4	6	ol margin	Fa100, Ca12%, Mn1%				14.27					3.44			0.29	24.88		57.13
CFD24c	SOI 4	15	ol margin	Fa99, Ca5%, Mn1%		0.27		14.19					1.36			0.27	26.81		57.10
CFD26b	SOI 4	1	ol amongst w	Fa98, Ca2%, Mn2%		0.51		13.91	0.15				0.69			0.59	27.08		57.07
CFD26b	SOI 4	2	ol amongst w	Fa99, Ca3%, Mn2%		0.30		14.14					0.87			0.62	26.99		57.07
CFD26b	SOI 4	3	ol amongst w	Fa98, Ca2%, Mn2%		0.52		13.97					0.70			0.64	27.19		56.99
CFD26b	SOI 4	4	ol amongst w	Fa97, Ca2%, Mn2%		0.75		13.94					0.59			0.64	27.12		56.97
CFD26b	SOI 4	5	vesicle fill	Fa98, Ca2%, Mn2%		0.69		13.90					0.65			0.68	27.13		56.95
CFD26b	SOI 4	6	vesicle fill	Fa98, Ca2%, Mn2%		0.64		14.05					0.68			0.67	26.93		57.03
CFD26b	SOI 4	7	vesicle fill	Fa97, Ca2%, Mn2%		0.78	0.39	14.27	0.15				0.58			0.56	25.90		57.35
CFD26b	SOI 4	8	vesicle fill	Fa97, Ca2%, Mn2%		0.78		13.92	0.15				0.55			0.68	26.84		57.07
CFD26b	SOI 4	9	ol amongst w	Fa98, Ca2%, Mn2%		0.55		13.87	0.19				0.59			0.65	27.09		57.08
CFD26b	SOI 4	10	ol amongst w	Fa97, Ca2%, Mn2%		0.77		13.81	0.17				0.59			0.62	27.01		57.03
CFD26b	SOI 4	11	ol amongst w	Fa99, Ca3%, Mn2%		0.25		14.07					1.01			0.57	27.06		57.04
CFD26b	SOI 5	1	late dendrite	Fa100, Ca11%, Mn2%			0.40	14.10	0.44			0.11	3.09			0.54	23.88		57.45
CFD26b	SOI 5	2	late dendrite	Fa100, Ca16%, Mn2%			0.34	15.19	0.56			0.18	3.99			0.44	21.24		58.06

sample	area	#	texture notes	phase nomenclature	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	Ba	O
CFD26b	SOI 5	3	late dendrite	Fa100, Ca18%, Mn1%	1.04		3.72	14.16	0.52			1.77	3.78			0.30	17.00		57.69
CFD26b	SOI 5	4	late dendrite	Fa100, Ca16%, Mn2%	0.70		0.88	15.36	0.58			0.25	3.94			0.37	19.82		58.10
CFD26b	SOI 5	7	main margin	Fa100, Ca9%, Mn2%				15.07	0.19				2.32			0.54	24.20		57.68
CFD27b	SOI 2	1	main core	Fa97, Ca7%, Mn19%		0.67		14.14					1.88			5.37	20.87		57.07
CFD27b	SOI 2	2	main margin	Fa100, Ca29%, Mn12%				13.97	0.19				8.24			3.31	17.15		57.13
CFD27b	SOI 2	3	late cotectic with leucite	Fa100, Ca23%, Mn10%			1.24	13.66	0.63			0.32	6.02			2.57	17.79	0.24	57.53
CFD27b	SOI 2	6	main core	Fa97, Ca6%, Mn19%		0.70		13.78	0.16				1.70			5.50	21.15		57.01
CFD27b	SOI 2	7	late	Fa100, Ca19%, Mn10%	0.42		0.51	13.47	0.57			0.09	5.22			2.88	19.57	0.10	57.16
CFD27b	SOI 3	1	late	Fa100, Ca24%, Mn8%	0.48		0.88	13.48	0.72			0.16	6.46			2.06	18.42		57.34
CFD27b	SOI 3	2	late	Fa100, Ca19%, Mn8%	0.43		0.62	13.53	0.55			0.11	5.30			2.13	19.84		57.35
CFD27b	SOI 3	4	late	Fa100, Ca20%, Mn9%	0.92		3.95	11.79	0.77		0.25	0.62	4.91	0.11		2.12	17.24		57.16
CFD27d	SOI 2	1	main core	Fa98, Ca7%, Mn18%		0.50		13.84					2.02			5.26	21.45		56.92
CFD27d	SOI 2	2	main core	Fa97, Ca7%, Mn18%		0.58		14.06					1.99			5.26	21.08		57.03
CFD27d	SOI 2	3	main core	Fa98, Ca7%, Mn18%		0.48		14.02					1.98			5.25	21.26		57.01
CFD27d	SOI 2	4	main core	Fa98, Ca7%, Mn18%		0.42		14.02					2.05			5.26	21.24		57.01
CFD27d	SOI 2	5	main margin	Fa100, Ca27%, Mn11%				14.00	0.18				7.78			3.06	17.85		57.13
CFD27d	SOI 2	6	overgrowth	Fa100, Ca29%, Mn10%				13.82	0.27				8.26			2.75	17.79		57.11

Analyses quoted in atom%

A3.2. Apatite compositions by EDS

sample	area	#	phase	notes	Na	Al	Si	P	Cl	K	Ca	Mn	Fe
CFD14B	SOI 5	6	apatite	mixed	0.42	1.51	4.11	6.00	0.08	0.59	12.66	0.18	1.65
CFD14B	SOI6	6	apatite	mixed	0.00	0.22	2.46	6.00	0.08	0.09	11.73	0.10	1.03
CFD14B	SOI6	7	apatite	mixed	0.00	0.24	2.43	6.00	0.09	0.13	11.87	0.11	1.03
CFD14B	SOI6	8	apatite	mixed	0.26	1.40	4.80	6.00	0.07	0.54	12.14	0.20	2.78
CFD14B	SOI6	12	apatite	mixed	0.61	2.12	3.41	6.00	0.00	0.79	9.65	0.07	1.61
CFD14B	SOI6	13	apatite	mixed	0.41	1.05	2.08	6.00	0.00	0.51	9.27	0.15	1.67
CFD14B	SOI6	14	apatite	mixed	0.18	0.32	1.44	6.00	0.00	0.09	10.31	0.08	0.65
CFD14D	SOI 2	9	apatite	mixed	0.17	0.83	2.79	6.00	0.07	0.45	11.42	0.11	1.05
CFD14D	SOI 2	12	apatite	mixed	0.00	0.05	1.08	6.00	0.09	0.04	10.85	0.08	0.54
CFD14D	SOI 2	13	apatite	mixed	0.00	0.05	1.01	6.00	0.08	0.02	10.74	0.07	0.48
CFD14D	SOI 3	1	apatite	mixed	0.23	1.85	4.13	6.00	0.06	0.72	12.01	0.11	1.40
CFD14D	SOI 3	6	apatite	mixed	0.38	1.27	2.61	6.00	0.00	0.56	10.61	0.12	1.36
CFD14D	SOI 3	7	apatite	mixed	0.38	1.61	2.87	6.00	0.00	0.65	10.54	0.12	1.14
CFD14D	SOI 3	8	apatite	mixed	0.78	4.40	6.14	6.00	0.00	1.58	11.52	0.13	1.82
CFD14D	SOI 3	10	apatite	mixed	0.31	1.04	2.09	6.00	0.00	0.46	10.27	0.10	1.00
CFD14D	SOI 3	11	apatite	mixed	0.45	2.16	4.11	6.00	0.00	0.96	11.00	0.13	1.79
CFD18B	SOI 7	10	apatite	mixed	1.03	2.05	3.22	6.00	0.00	0.40	11.10	0.00	1.06

Analyses given as atoms based on P=6.

A3.3. Glass compositions by EDS

Sample	Area	#	phase	notes	Compound% Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	TiO_2	MnO	FeO	BaO	*Total*
CFD1B	SOI 11	9	glass	interstitial	3.15	0.00	16.02	43.20	2.11	0.99	0.00	10.89	6.23	0.47	0.00	20.04	0.00	*103.10*
CFD1B	SOI 11	10	glass	interstitial	2.96	0.00	15.76	39.18	2.72	0.86	0.00	9.53	8.71	0.17	0.00	21.97	0.00	*101.86*
CFD6B	SOI 6	2	glass	medium	0.00	0.00	5.64	20.15	0.00	0.37	0.42	0.00	0.78	0.00	0.00	50.23	0.00	*77.58*
CFD6B	SOI 6	3	glass	dark	0.00	0.00	5.93	50.27	0.82	0.00	0.00	0.80	2.02	0.00	0.31	28.73	0.00	*88.88*
CFD6B	SOI 6	4	glass	medium	0.00	0.00	4.27	18.99	0.00	0.45	0.47	0.00	0.67	0.00	0.00	51.34	0.00	*76.18*
CFD10B	SOI 3	10	glass	glass	2.75	0.00	17.31	37.82	3.01	0.95	0.00	6.98	9.99	0.63	0.00	22.49	0.00	*101.93*
CFD10B	SOI 3	11	glass	glass	2.66	0.00	15.63	33.73	3.67	3.16	0.00	5.63	11.13	1.04	0.00	26.94	0.00	*103.60*
CFD10B	SOI 3	12	glass	glass	3.09	0.00	16.03	36.15	4.15	0.58	0.00	6.89	11.38	0.66	0.00	20.83	0.00	*99.75*
CFD10B	SOI4	3	glass	may be mixed	2.47	0.00	12.53	34.91	2.87	1.48	0.00	5.93	12.22	0.40	0.00	26.35	0.00	*99.18*
CFD10B	SOI4	8	glass	may be mixed	3.02	0.00	17.33	36.00	3.27	1.00	0.00	6.72	11.98	0.43	0.00	21.33	0.00	*101.09*
CFD13b	SOI 2	11	glass	interstitial	2.15	0.00	14.58	35.54	6.91	0.78		7.92	14.15	0.47	2.16	16.64		*101.31*
CFD13b	SOI 2	21	glass	interstitial	1.62	0.00	12.51	40.21	1.32	0.36		5.26	8.25	0.36	3.06	28.44		*101.41*
CFD14D	SOI 3	2	glass	mixed?	2.18	0.00	23.39	37.14	4.38	0.00	0.00	7.05	13.71	0.50	0.57	14.36	1.58	*104.88*
CFD14D	SOI 3	3	glass	mixed?	2.46	0.00	23.95	37.32	2.18	2.93	0.00	6.92	10.24	0.47	0.67	19.28	1.77	*108.18*
CFD14D	SOI 3	9	glass	mixed?	2.84	0.00	26.28	38.63	1.17	2.18	0.00	8.19	9.02	0.34	0.60	14.97	2.24	*106.45*
CFD14B	SOI6	11	glass	mixed?	3.38	0.00	18.51	30.08	11.43	1.47	0.00	7.89	16.31	0.00	0.67	12.71	1.67	*104.11*
CFD14B	SOI6	15	glass	mixed?	0.27	0.00	9.94	22.70	14.15	0.00	0.00	1.18	21.75	0.00	1.79	11.54	0.67	*83.99*
CFD14B	SOI6	16	glass	mixed?	0.61	0.17	14.84	33.66	3.59	0.24	0.00	2.50	10.12	0.31	1.38	11.61	0.86	*79.88*
CFD14B	SOI6	17	glass	mixed?	0.24	0.00	15.86	16.54	6.21	0.00	0.00	0.29	11.70	0.00	4.96	23.70	0.00	*79.50*
CFD16B	SOI 5	10	glass	mixed?	2.45	0.00	16.32	39.01	2.20	1.20	0.00	9.19	6.79	0.59	0.21	17.41	1.22	*96.60*
CFD16B	SOI 5	11	glass	mixed?	2.43	0.00	13.97	37.84	2.69	0.58	0.00	7.38	10.90	0.00	0.38	23.39	1.13	*100.69*
CFD16B	SOI 5	12	glass	mixed?	2.72	0.00	15.32	37.41	2.70	0.77	0.00	7.65	9.98	0.33	0.38	23.40	1.15	*101.81*
CFD18B	SOI 8	6	glass/leucite	mixed?	2.77	0.00	21.38	42.80	1.74	0.57	0.00	12.12	6.29	0.38	0.16	12.44	0.00	*100.66*
CFD18B	SOI 7	8	glass?	mixed!	5.00	0.00	23.78	35.99	4.95	0.38	0.00	4.96	13.95	0.00	0.00	11.99	1.45	*102.45*
CFD20b	SOI 5	3	glass/leucite		2.65		17.04	37.26	4.28	0.60		6.11	14.00	0.85	0.58	19.13		*102.50*
CFD20b	SOI 5	6	glass/leucite		2.61		14.09	35.42	5.42	1.36		6.05	14.68		0.70	18.89	1.31	*100.53*
CFD20b	SOI 5	7	glass/leucite		2.57		12.60	35.00	2.93	2.29		5.12	14.21	0.68	0.95	24.64		*100.98*
CFD20b	SOI 5	9	glass/leucite		2.13		12.66	35.99	3.04	1.12		5.02	13.40		1.09	23.82	1.93	*100.20*
CFD21c	SOI 4	14	glass		0.35		17.40	23.93	0.35			0.48	11.30	5.03		33.90		*92.73*
CFD21c	SOI 4	18	glass		3.20		15.44	35.23	1.56	0.64		2.95	12.90	0.34		18.00		*90.27*
CFD21c	SOI 4	19	glass		4.16		15.43	35.80	1.56	0.53		3.45	12.90			18.76		*92.59*
CFD21c	SOI 4	20	glass		1.83		18.70	27.05	0.99			0.46	12.17	3.48		30.77		*95.46*
CFD21c	SOI 4	21	glass		4.67		18.20	34.51	1.23	0.59		2.46	12.46			14.37		*88.50*
CFD21c	SOI 5	5	glass		4.83		19.74	36.96	2.30	0.79		1.47	13.95	0.55		18.42		*99.02*
CFD21c	SOI 6	8	glass		2.59		21.22	37.95	1.21	0.34		7.25	8.93	0.62		16.39		*96.49*
CFD21c	SOI 6	9	glass		2.89		21.66	40.26	1.23			9.31	7.60	0.58		10.82		*94.86*
CFD21c	SOI 7	10	glass		4.79		18.44	37.53	1.97	0.70		2.40	15.29	0.29		18.85		*100.25*
CFD21c	SOI 7	11	glass		0.56		20.01	27.11	0.51				12.84	2.18		40.10		*103.31*
CFD21c	SOI 8	8	glass		5.99		22.26	37.52	2.47	2.33		1.68	13.78	0.28		16.54		*102.86*

Sample	Area	#	phase	notes	Compound% Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	TiO_2	MnO	FeO	BaO	*Total*
CFD21c	SOI 8	9	glass		4.42		23.96	35.46	1.99	1.57		1.56	13.86			17.38		*100.21*
CFD22b	SOI 5	13	glass		0.65		8.14	37.14	3.21	1.27		1.49	19.60	0.94	1.57	23.25		*97.24*
CFD22b	SOI 5	14	glass		0.69		8.59	36.42	3.37	0.94		1.42	18.50	1.11	1.44	25.38		*97.85*
CFD24b	SOI 2	4	glass		0.59		4.65	47.48				1.59	18.24	0.68	0.50	26.77		*100.49*
CFD24b	SOI 2	5	glass		0.60		4.12	45.30	0.46			1.43	17.43	0.46	0.39	28.53		*98.72*
CFD24b	SOI 2	7	glass		0.67		4.09	44.61				1.31	16.34	0.50	0.45	30.15		*98.12*
CFD24b	SOI 5	1	glass		0.93		5.95	45.88	0.50			2.70	11.41	0.47	0.45	28.61		*96.90*
CFD24b	SOI 5	9	glass		0.91		6.77	44.84	0.62			2.66	13.78	0.79		23.92		*94.28*
CFD24b	SOI 6	15	glass		0.59		4.74	43.43	0.49			2.46	13.30	0.58	0.56	27.72		*93.87*
CFD24b	SOI 6	16	glass		0.67		4.58	45.34	0.41			1.29	17.93	0.60	0.41	24.47		*95.69*
CFD24c	SOI 1	5	glass?	interstial bright	1.47		10.78	47.42	1.59	0.63		4.28	14.45	1.26		19.93		*101.82*
CFD24c	SOI 1	6	glass?	interstial bright	1.74		11.86	49.27	1.52	0.55		5.43	12.68	1.30		17.89		*102.25*
CFD24c	SOI 1	7	glass?	interstitial dark	1.56		10.77	47.48	1.99	0.71		4.49	14.48	1.46	0.26	20.88		*104.07*
CFD24c	SOI 1	8	glass?	interstitial dark	1.87		14.65	51.52	0.96			6.22	6.39	1.08		15.02		*97.70*
CFD24c	SOI 1	9	glass?	interstitial dark	1.92		15.20	53.98	0.85	0.33		6.68	8.60	0.96		12.06		*100.59*
CFD24c	SOI 1	10	glass?	interstitial dark	2.31		13.56	50.98				5.76	7.40	0.46	0.49	24.90		*105.86*
CFD24c	SOI 1	11	glass?	poss mixed with olivine	1.60		11.18	49.12	0.71			5.44	8.48	0.70	0.31	26.07		*103.61*
CFD24c	SOI 4	10	glass	bright interstitial	2.43		11.69	42.56	1.61	0.53		0.99	16.95	1.29		22.46		*100.51*
CFD24c	SOI 4	11	glass	bright interstitial	2.35		11.78	41.84	1.43	0.50		1.11	16.89	1.30		22.50		*99.70*
CFD24c	SOI 4	12	glass	bright interstitial	2.33		12.87	41.37	1.69	0.66		1.17	16.69	1.49		21.75		*100.01*
CFD26b	SOI 5	5	glass		2.68		18.40	34.51	4.38	1.19		5.86	13.25	0.44		19.02		*99.72*
CFD26b	SOI 5	6	glass		2.55		14.11	31.78	4.74	0.35		4.32	11.23	0.23	0.27	14.35		*83.94*

Analyses given in wt% oxides

A3.4. Pyroxene, rhönite and unknown silicate compositions by EDS

sample	area	spot	notes	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	Mn	Fe	Ba	O		
uncertain				*O=24*															
CFD20b	SOI 8	4	late dark	0.99	0	3.51	5.92	0.77	0.18	0	1.55	2.02	0	0	1.01	0.14	24		
CFD20b	SOI 8	7	late dark	0.70	0	2.46	5.80	0.63	0.18	0	1.07	2.54	0	0.12	2.96	0.10	24		
CFD20b	SOI 8	9	late dark	0.71	0	3.06	6.11	0.56	0.09	0	1.63	2.31	0	0.08	1.82	0.15	24		
CFD20b	SOI 8	10	late dark	0.97	0	3.41	6.55	0.17	0.08	0	1.41	1.26	0	0.10	2.50	0.08	24		
CFD20b	SOI 8	11	late dark	0.94	0	3.62	6.14	0.45	0.10	0	1.59	1.65	0.14	0.05	1.65	0	24		
Pyroxene?				*O=6*														*Al+Si*	*Mn+Fe+Ca*
CFD23b	SOI 4	4	(Mn,Fe, Ca, Mg)SiO3	0	0.07	0.01	1.97	0	0	0	0	0.33	0	0.89	0.75	0	6	1.98	1.98
CFD23b	SOI 4	5	(Mn,Fe, Ca, Mg)SiO3	0	0.07	0.01	1.95	0.01	0	0	0	0.39	0	0.89	0.7	0	6	1.97	1.98
Rhönite				*O=20*														*Al+Si*	*Fe+Mn+Mg+Ti*
CFD20b	SOI 5	12		0.29	0.00	2.58	4.06	0.07	0.09	0.00	0.23	1.97	0.33	0.11	4.56	0.00	20.00	6.65	5.00
CFD20b	SOI 5	8		0.11	0.00	2.78	3.81	0.07	0.00	0.00	0.14	1.90	0.40	0.10	5.00	0.00	20.00	6.59	5.50
CFD20b	SOI 8	5	late rosette	0.12		2.72	3.91	0.00	0.00	0.00	0.10	1.94	0.42	0.08	5.12	0.00	20.00	6.63	5.62
CFD20b	SOI 8	6	late rosette	0.00		2.79	3.68	0.00	0.10	0.00	0.04	1.89	0.48	0.10	5.19	0.00	20.00	6.47	5.77
CFD20b	SOI 8	8	late rosette	0.26		2.93	4.04	0.14	0.03	0.00	0.26	1.85	0.31	0.08	4.27	0.00	20.00	6.97	4.66
CFD21c	SOI 4	2	equant	0.12	0.00	2.98	3.69	0.00	0.00	0.00	0.06	1.96	0.70	0.00	4.71	0.00	20.00	6.67	5.41
CFD21c	SOI 4	8	equant	0.32	0.00	3.53	4.06	0.17	0.00	0.00	0.12	2.17	0.18	0.00	3.44	0.00	20.00	7.58	3.62
CFD21c	SOI 4	15	needle	0.55	0.00	3.17	3.95	0.12	0.03	0.00	0.10	1.86	0.48	0.00	3.81	0.00	20.00	7.12	4.29
CFD21c	SOI 4	17	needle	0.87	0.00	3.18	4.44	0.16	0.04	0.00	0.22	1.91	0.12	0.00	3.15	0.00	20.00	7.61	3.27
CFD21c	SOI 5	2	equant	0.11	0.00	3.72	3.63	0.05	0.00	0.00	0.00	1.92	0.27	0.00	4.53	0.00	20.00	7.34	4.80
CFD21c	SOI 5	4	needle	0.34	0.00	3.32	3.75	0.12	0.19	0.00	0.09	1.79	0.41	0.00	3.85	0.00	20.00	7.07	4.26
CFD21c	SOI 5	6	needle	0.22	0.00	3.68	3.88	0.09	0.05	0.00	0.10	1.86	0.20	0.00	3.92	0.00	20.00	7.56	4.13
CFD21c	SOI 7	9		0.31	0.00	3.30	3.92	0.08	0.00	0.00	0.07	1.90	0.41	0.00	4.11	0.00	20.00	7.21	4.52
CFD21c	SOI 7	12		1.26	0.00	2.94	4.96	0.16	0.07	0.00	0.55	2.05	0.05	0.00	1.99	0.00	20.00	7.91	2.04
CFD21c	SOI 7	15		0.14	0.00	3.28	3.73	0.00	0.00	0.00	0.04	1.97	0.33	0.00	4.81	0.00	20.00	7.01	5.14
CFD21c	SOI 8	3		0.22	0.00	3.69	3.70	0.07	0.00	0.00	0.03	1.88	0.36	0.00	4.15	0.00	20.00	7.39	4.51
CFD21c	SOI 8	4		0.17	0.00	3.76	3.66	0.05	0.00	0.00	0.03	1.98	0.24	0.00	4.36	0.00	20.00	7.42	4.59
CFD22b	SOI 5	10	o/g on late dendrite	0.20	0.00	0.96	5.28	0.14	0.00	0.00	0.44	0.95	0.04	0.48	5.84	0.00	20.00	6.24	6.36
CFD22b	SOI 5	11	small in interstitial area	0.16	0.00	1.52	4.61	0.20	0.00	0.00	0.22	2.07	0.22	0.13	5.16	0.00	20.00	6.13	5.52
CFD22b	SOI 5	12	small in interstitial area	0.23	0.00	1.40	5.01	0.35	0.00	0.00	0.44	2.32	0.13	0.18	3.89	0.00	20.00	6.41	4.20
CFD22b	SOI 5	15	small in interstitial area	0.00	0.00	1.55	4.60	0.14	0.00	0.00	0.26	1.85	0.19	0.14	5.62	0.00	20.00	6.14	5.96
CFD21d	SOI 6	12	late lath	0.10	0.00	2.66	5.74	0.23	0.00	0.00	0.53	0.74	0.04	0.00	2.81	0.00	20.00	8.40	2.85
CFD22b	SOI 3	4	bright	0.27	0.00	1.93	3.84	0.54	0.13	0.00	0.49	2.11	0.11	0.16	4.82	0.00	20.00	5.77	5.09

Analyses cast as numbers of atoms per unit cell as indicated.

A3.5. Iron and iron oxide compositions by EDS

Sample	Area	Spot	notes	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	As	O	Total
Iron metal																			
CFD21b	3	1	metal bleb in olivine													104.30			104.30
CFD24b	6	1	core to blocky olivine													101.07			101.07
CFD24c	4	13	metal bleb in olivine			0.22										100.78			100.78
CFD24c	4	14	metal bleb in olivine			0.24										99.68			99.68
Oxidised iron																			
CFD6B	6	1	oxidised iron		0.00	0.00	0.16	0.00	0.09	0.09	0.00	0.00			0.00	68.45	0.84	20.19	89.83
CFD6B	6	6	oxidised iron		0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00			0.00	69.86	0.88	20.29	91.13
CFD23b	4	1	oxidised iron		0.00	0.00	0.00	0.00	0.15			0.00			0.16	67.44		19.59	87.33
CFD23b	4	2	oxidised iron		0.00	0.00	0.10	0.09	0.20			0.00			0.00	65.69		19.36	85.44
CFD23b	4	3	oxidised iron		0.00	0.00	0.00	0.00	0.27			0.14			0.43	65.83		19.45	86.12
CFD24b	6	5	oxidised iron						0.22							65.14		18.99	84.36
Wustite																			
CFD1B	11	11	dendrite	0.00	0.19	0.22	0.18	0.00	0.00		0.00	0.14	0.00		0.00	76.70		22.55	99.98
CFD1B	11	12	dendrite	0.00	0.00	0.29	0.22	0.00	0.00		0.00	0.09	0.00		0.00	75.95		22.31	98.87
CFD6B	5	1	oxidised iron?	0.00	0.00	0.28	0.13	0.00	0.00		0.00	0.00	0.13		0.51	76.00		22.40	99.45
CFD6B	5	2	oxidised iron?	0.00	0.00	0.24	0.16	0.00	0.00		0.00	0.00	0.00		0.52	76.77		22.54	100.23
CFD6B	5	3	small dendrite	0.00	0.00	0.28	0.22	0.00	0.00		0.15	0.27	0.30		0.20	74.86		22.34	98.61
CFD6B	6	5	spheroid in inclusion		0.23	1.46	0.26	0.00	0.00	0.00	0.00	0.00			0.47	73.89	0.00	23.05	99.36
CFD10B	4	5	dendrite	0.00	0.00	0.39	0.25	0.00	0.00		0.08	0.16	0.64		0.00	73.14		22.09	96.76
CFD13b	2	15	dendrite	0.00	0.17	0.32	0.14	0.00	0.00		0.00	0.11	0.14		2.44	73.07		22.34	98.73
CFD13b	2	16	bleb (dendrite?)	0.00	0.00	0.28	0.00	0.00	0.00		0.00	0.00	0.00		3.78	72.10		22.00	98.16
CFD13b	2	17	scale outer	0.00	0.00	0.28	0.10	0.00	0.00		0.00	0.00	0.12		2.52	72.60		21.97	97.58
CFD13b	2	18	scale inner	0.00	0.00	0.24	0.11	0.00	0.00		0.00	0.00	0.10		2.44	72.72		21.95	97.57
CFD13b	2	19	scale inner	0.00	0.00	0.30	0.11	0.00	0.00		0.00	0.00	0.00		2.61	72.62		21.96	97.59
CFD13b	2	20	scale outer	0.00	0.00	0.29	0.10	0.00	0.00		0.08	0.00	0.12		2.62	72.17		21.90	97.28
CFD13b	21	1	wustite outside lump	0.00	0.00	0.28	0.18	0.00	0.00		0.00	0.00	0.00		3.04	70.91		21.65	96.06
CFD13b	21	2	wustite outside lump	0.00	0.00	0.23	0.12	0.00	0.00		0.00	0.00	0.25		2.00	71.35		21.53	95.47
CFD13b	21	3	dense clot	0.00	0.00	0.41	0.13	0.00	0.00		0.00	0.11	0.18		2.59	73.54		22.50	99.47
CFD13b	21	4	dense clot	0.00	0.00	0.34	0.12	0.00	0.00		0.00	0.00	0.00		2.76	73.59		22.32	99.13
CFD13b	24	10	blebby dendrite		0.00	0.30	0.11	0.00			0.00	0.00	0.24		2.04	71.13		21.52	95.34
CFD13b	24	11	blebby dendrite		0.00	0.32	0.14	0.00			0.00	0.00	0.26		1.62	71.21		21.49	95.04
CFD13b	24	12	fine dendrite on bleb		0.00	0.32	0.13	0.00			0.00	0.12	0.32		1.37	71.06		21.45	94.76
CFD14d	2	8	dendrite	0.00	0.00	0.44	0.11	0.00		0.00	0.00	0.08	0.37		1.33	74.55		22.55	99.44
CFD20b	8	13	dendrite			0.23	0.23					0.20			0.57	72.84		21.58	95.65
CFD21d	3	2				0.41										75.35		21.95	97.71
CFD23b	3	15		0.00	0.00	0.00	0.12	0.00			0.00	0.17	0.31		2.25	71.94		21.67	96.46
CFD23b	3	16		0.00	0.00	1.18	0.13	0.00			0.00	0.17	1.02		2.83	67.38		22.07	94.77
CFD23b	3	17		0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.24		2.43	72.40		21.61	96.68

Sample	Area	Spot	notes		Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	V	Mn	Fe	As	O	Total
Magnetite																				
CFD20b	5	10	interstitial cruciform dendrite				5.36	2.07					1.43	2.33	0.33	0.57	56.59		25.90	94.59
CFD20b	5	11	interstitial cruciform dendrite				4.68	1.34	0.14	0.26		0.28	0.85	2.53	0.37	0.45	59.40		25.79	96.09
Secondary oxides																				
CFD6B	6	7	altered? pore margin			0.20	2.52	0.41	0.00	0.00	0.00	0.00	0.13			0.00	56.61	0.00	19.11	78.98
CFD21d	6	11	vesicle fill				0.52	0.14		0.13							65.86		19.69	86.34
CFD24b	7	1	?oxidised fayalite?					0.51	0.27				0.30				58.93		17.93	77.94
CFD24b	7	5	amorphous crust?				0.75	3.56	0.76				0.82				48.65		19.97	74.52
CFD24b	7	10	amorphous crust?				0.88	0.79	1.09	0.15			2.18	0.19		0.23	27.39		12.23	45.13
CFD10B	3	13	secondary		0.00	0.00	0.70	10.98	0.09	0.10		0.00	0.47	0.00		0.00	43.06		25.91	81.30
CFD21d	6	7	secondary				0.78	3.84		0.13	0.32						52.56		20.31	77.94
CFD21d	4	4	weathering					0.18									68.58		19.85	88.60
CFD21d	4	5	weathering				1.43	10.86			0.17		0.23				35.60		23.94	72.23
CFD21d	6	3	weathered					0.32									66.66		19.46	86.45

Analyses given in wt% oxides

A3.6. Leucite compositions by EDS

Sample	Area	spot		Na	Al	Si	P	S	Cl	K	Ca	Ti	Mn	Fe	Ba	O	Na/(Na+K)
CFD24b	SOI 7	6		0.04	0.82	2.19				0.69	0.00			0.03		6.00	0.06
CFD18B	SOI 7	2		0.04	1.09	1.91	0.01	0.00		0.92	0.00		0.00	0.04	0.01	6.00	0.04
CFD18B	SOI 7	5		0.03	1.07	1.92	0.00	0.00		0.94	0.01		0.00	0.05	0.01	6.00	0.03
CFD21c	SOI 4	11		0.07	1.07	1.93				0.94	0.00			0.02		6.00	0.07
CFD21c	SOI 4	12		0.07	1.04	1.90				0.88	0.04			0.12		6.00	0.07
CFD21c	SOI 5	3		0.08	1.07	1.93				0.94	0.00			0.03		6.00	0.08
CFD21c	SOI 7	8		0.05	1.08	1.93				0.94	0.00			0.04		6.00	0.05
CFD21c	SOI 7	13		0.06	1.09	1.92				0.94	0.00			0.03	0.01	6.00	0.06
CFD21c	SOI 7	14		0.05	1.06	1.89	0.01			0.91	0.00			0.11		6.00	0.05
CFD21c	SOI 8	11		0.07	1.04	1.86				0.85	0.12			0.15		6.00	0.08
CFD21c	SOI 8	12		0.06	0.85	1.77				0.70	0.26	0.01		0.51		6.00	0.08
CFD21c	SOI 8	13		0.07	1.04	1.89				0.87	0.06			0.14		6.00	0.07
CFD24c	SOI 4	7		0.07	1.00	1.90				0.72	0.03			0.27		6.00	0.09
CFD24c	SOI 4	8		0.07	0.99	1.95				0.77	0.02			0.17	0.01	6.00	0.08
CFD24c	SOI 4	9		0.06	1.00	1.95				0.81	0.02			0.15		6.00	0.07

Analyses presented as atoms with O=6

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