SUPPLEMENTARY MATERIAL

To be read in conjunction with

GLASS BANGLES IN THE BRITISH ISLES: A STUDY OF TRADE, RECYCLING AND TECHNOLOGY IN THE FIRST AND SECOND CENTURIES AD

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APPENDIX A: ANALYTICAL DETAILS

pXRF

The portable XRF was a Thermoniton analyser, which was used in Cu / Zn mining mode as this quantifies a broad range of elements for a matrix approximating the compositions of the glasses here. The pXRF was used in a shielded cabinet, where it points upwards, so that the bangle fragments could be placed directly against the film protecting the detector. This ensures that the bangles were in contact with the analyser, which was difficult to achieve otherwise because of the rounded surface of the fragments, and also prevents any pressure being applied to the artefacts. A spot size of 3mm was targeted for a 60 second period, comprised of 15 seconds Main, 20 seconds Low, 15 seconds Light, and 10 seconds High (each of these periods analyses a certain energy range of elements as detailed in Dungworth *et al*. 2001). These settings were selected as a compromise between the time required for analysis, and improving the detection limits, particularly for lighter elements.

The pXRF results have not been normalised and totals should not exceed 80% due to the inability to detect the light elements, particularly sodium, present as an oxide at levels of about 15wt%. Instead the analyser reports a Balance figure, which provides a reasonable estimate for the lighter elements that it is unable to otherwise quantify. It is also a good indicator of the extent of contact between the sample and the analyser. If the sample is not flat, or the sample is not correctly placed, the reported Balance is elevated and the rest of the elemental results are abnormally low; these results were discarded.

Some of the decorative features that were analysed are small or thin, such as cords or spots, so it is also likely that X-rays from the glass beneath or surrounding the feature will be detected, meaning that some analyses may actually be for a combination of colours. Broken edges exposing fresher glass were selected where possible. Although the preservation of natron glass is typically good, some surface alteration or contamination of the glass must be considered. In most cases two analyses of a particular colour were undertaken, and the average is reported. However for areas of decoration, where the feature was small and poorly accessible, there may be only one analysis.

The detection limits, accuracy and precision for pXRF are good (0.1wt% or better) for elements heavier than potassium but poor for lighter elements. The fluorescent X-rays from light elements are weak without a vacuum or helium flush, and so sodium and magnesium were not detected. For phosphorus, aluminium and silicon the accuracy and detection limits could be improved by increasing analysis times (Dungworth *et al.* 2011), but the results for these elements were also strongly affected by differences in the matrix of the sample (such as increased levels of lead in some colours) or the presence of a weathered surface, so the data for these elements are disregarded in the interpretation. The results for sulphur and arsenic are discounted because they are strongly affected by the presence of lead, due to overlap in the X-ray peaks for these elements. For example, around 30wt% of sulphur trioxide was erroneously reported for Corning standard C because it contains a high proportion of lead oxide, and the results for the light elements were suppressed. In general, where the glass had a lead-rich matrix, the quantification for the light elements was less accurate compared to known standards (see Table 4). When analysing flat, clean surfaces on homogenous, compositionally similar, glass samples in laboratory conditions, and in the absence of problematic overlaps between element X-rays, then detection limits of 0.02wt% and better can be achieved for heavier elements (from titanium) with portable XRF (Dungworth *et al*. 2011); with archaeological objects however, these ideal conditions cannot be met.

Using the pXRF, there might be an underestimation for heavier elements when thin layers of glass are analysed because the pXRF quantification assumes that the sample is infinitely thick, whereas heavy elements produce energetic fluorescent X-rays that can escape from a depth of several millimeters in a light glass matrix (Dungworth *et al.* 2011). All of the archaeological material analysed here was greater than 3mm thick however, with the exception of decorative cords and spots, in which case the underlying glass may also be detected in some cases.

EMPA

A JEOL JXA-8200 electron microprobe in the Department of Archaeology, University of Nottingham was used to analyse the samples from South Shields, which were mounted and polished. Operating conditions were the same as those in Siu *et al*. 2016. The samples were routinely analysed three times, the data were not normalised and totals exceeded 97%.

SEM-EDS

An FEI Inspect F with X-act EDS detector and INCA software, was used to analyse the Welsh samples, which were mounted in resin, polished and carbon coated. The conditions were 25KeV and at least three analyses of each area were undertaken, of a bulk area including opacifiers if these were present. The totals typically exceeded 95%, except where the glass was vesicular, and the results were normalised.

Standards

A series of Corning standards were analysed by all of the techniques used, and the results are compared below. The detection limits for the microprobe were typically 0.01wt%, versus 0.1wt% for the majority of oxides detected by SEM-EDS, and precision and accuracy were good for both (Table 1).

References

Dungworth, D and Girbal, B 2011. 'Ightham Mote, Ightham, Kent: Portable XRF Analysis of the Window Glass', Historic England Research Report 96/2011, English Heritage, Swindon

Siu, I, Henderson, J and Faber, E 2016. 'The production and circulation of Carthaginian Glass under the rule of the Romans and the Vandals (Fourth to Sixth Century AD): A chemical Investigation', *Archaeometry* **59** (2)

Table 1: Results for Corning glass standards using all three techniques against known compositions (wt% oxides), average of ‘n’ analyses, SEM-EDS and microprobe data normalized, ns = not sought, bd = below detection.

Standard	**Na_2O**	**MgO**	**Al_2O_3**	**SiO_2**	**P_2O_5**	**SO_3**	**Cl**	**K_2O**	**CaO**	**TiO_2**	**MnO**	**FeO**	**CoO**	**NiO**	**CuO**	**ZnO**	**SrO**	**SnO_2**	**Sb_2O_5**	**BaO**	**PbO**
A	14.3	2.66	1	66.76	0.13	0.1	0.1	2.87	5.03	0.79	1	1.09	0.17	0.03	1.17	0.04	0.1	0.19	1.75	0.56	0.12
B	17	1.03	4.36	61.52	0.82	0.5	0.2	1	8.56	0.09	0.25	0.34	0.05	0.099	2.66	0.19	0.02	0.04	0.46	0.12	0.61
C	1.07	2.76	0.87	35.88	0.13	0.1	0.1	2.84	5.07	0.79	0	0.34	0.18	0.03	1.13	0.05	0.29	0.19	0.03	11.4	36.7
D	1.20	3.94	5.30	54.65	3.93	0.2	0.2	11.3	14.8	0.38	0.55	0.52	0.02	0.05	0.38	0.10	0.06	0.10	0.97	0.29	0.24
pXRF	**Na_2O**	**MgO**	**Al_2O_3**	**SiO_2**	**P_2O_5**	**SO_3**	**Cl**	**K_2O**	**CaO**	**TiO_2**	**MnO**	**FeO**	**CoO**	**NiO**	**CuO**	**ZnO**	**SrO**	**SnO_2**	**Sb_2O_5**	**BaO**	**PbO**
B n= 2	ns	ns	ns	63.5	ns	ns	ns	0.9	8.4	0.1	0.2	0.4	bd	0.1	2.7	0.2	bd	bd	0.5	0.1	0.5
C n=2	ns	ns	ns	30.2	ns	ns	ns	1.8	3.9	0.3	0.3	0.2	0.2	bd	1.0	0.1	0.1	0.2	bd	12.0	31.9
D n=1	ns	ns	ns	65.6	4.3	ns	ns	10.2	14.0	0.4	0.5	0.5	bd	bd	0.4	0.1	bd	0.2	1.1	0.3	0.2
EPMA	**Na_2O**	**MgO**	**Al_2O_3**	**SiO_2**	**P_2O_5**	**SO_3**	**Cl**	**K_2O**	**CaO**	**TiO_2**	**MnO**	**FeO**	**CoO**	**NiO**	**CuO**	**ZnO**	**SrO**	**SnO_2**	**Sb_2O_5**	**BaO**	**PbO**
B n=10	16.84	1.17	4.57	61.09	0.91	0.50	0.17	1.03	8.90	0.08	0.26	0.31	0.05	0.10	2.84	0.20	bd	bd	0.51	bd	0.39
StD	0.12	0.02	0.05	0.25	0.04	0.04	0.01	0.01	0.14	0.01	0.01	0.01	0.00	0.01	0.04	0.01	-	-	0.03	-	0.05
C n=11	1.37	3.16	0.97	37.10	0.12	bd	0.08	2.88	5.21	1.27	bd	0.27	0.17	0.02	1.17	bd	0.19	0.04	0.12	11.72	34.08
StD	0.03	0.02	0.02	0.61	0.01	0.00	0.01	0.03	0.06	0.04	-	0.01	0.01	0.01	0.02	-	0.03	0.02	0.04	0.20	0.36
D n=11	1.31	3.99	5.45	54.08	4.36	0.20	0.15	11.24	15.07	0.38	0.55	0.43	0.00	0.05	0.38	0.09	bd	bd	1.78	0.23	0.18
StD	0.03	0.02	0.04	0.57	0.08	0.01	0.01	0.19	0.28	0.02	0.01	0.01	0.00	0.01	0.01	0.01	-	-	0.05	0.03	0.04
SEM-EDS	**Na_2O**	**MgO**	**Al_2O_3**	**SiO_2**	**P_2O_5**	**SO_3**	**Cl**	**K_2O**	**CaO**	**TiO_2**	**MnO**	**FeO**	**CoO**	**NiO**	**CuO**	**ZnO**	**SrO**	**SnO_2**	**Sb_2O_5**	**BaO**	**PbO**
A n=3	13.11	2.72	0.95	66.75	bd	bd	0.13	3.09	5.24	0.86	1.07	1.14	0.21	bd	1.30	bd	bd	bd	1.86	0.53	bd
StD	0.06	0.02	0.04	0.13	-	-	0.03	0.03	0.04	0.03	0.02	0.01	0.01	-	0.02	-	-	-	0.10	0.09	-

APPENDIX B: TABLES OF ANALYSES

Table 2: The results of the bangle analyses (in wt% oxides save for chlorine), including site, find numbers, colour description and analytical technique, ns = not sought, bd = below detection. The detection limits differ for each technique (described in Appendix A). The letters in brackets for the Welsh bangles refer to the cut sections C, D, H illustrated in fig 1

Site	Object no.	Colour	Type	Sub type	Method	Area	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl	K_2O	CaO	TiO_2	MnO	FeO	CoO	CuO	SnO_2	Sb_2O_5	PbO	n
Traprain Law	GV 33	Yellow	3	B	pXRF	Body	ns	ns	ns	79.78	ns	ns	ns	0.51	5.95	0.08	0.21	0.44	bd	bd	0.03	0.27	1.62	2
Traprain Law	GV 28	Yellow	3	B	pXRF	Body	ns	ns	ns	83.85	ns	ns	ns	0.47	5.41	0.12	0.67	0.67	bd	bd	0.04	0.56	2.05	2
Traprain Law	GV 36	Yellow	3	B	pXRF	Body	ns	ns	ns	83.16	ns	ns	ns	0.53	6.12	0.07	0.23	0.43	bd	bd	0.03	0.29	1.68	2
Traprain Law	GV 29	Yellow	3	B	pXRF	Body	ns	ns	ns	82.12	ns	ns	ns	0.61	6.44	0.08	0.45	0.49	bd	bd	0.02	0.35	1.53	2
Traprain Law	GV 370	Yellow	3	B	pXRF	Body	ns	ns	ns	77.23	ns	ns	ns	0.79	6.35	0.07	0.31	0.50	bd	0.01	0.03	0.35	1.59	2
Traprain Law	GV 140	Yellow	3	B	pXRF	Body	ns	ns	ns	70.62	ns	ns	ns	0.52	5.65	0.10	0.64	0.92	bd	bd	0.17	0.68	5.83	2
Traprain Law	GV 676	Yellow	3	B	pXRF	Body	ns	ns	ns	78.66	ns	ns	ns	0.68	6.83	0.07	0.38	0.53	bd	bd	0.05	0.35	1.95	2
Traprain Law	GV 145	Yellow	3	B	pXRF	Body	ns	ns	ns	81.22	ns	ns	ns	0.61	6.29	0.08	0.40	0.52	bd	bd	0.03	0.35	1.50	2
Traprain Law	GV 524	Yellow	3	B	pXRF	Body	ns	ns	ns	77.80	ns	ns	ns	0.66	5.74	0.09	0.42	0.55	bd	bd	0.02	0.41	1.34	2
Traprain Law	GV 1267	Yellow	3	B	pXRF	Body	ns	ns	ns	79.60	ns	ns	ns	0.67	6.24	0.09	0.48	0.59	bd	0.01	0.06	0.42	2.57	2
Traprain Law	GV 131	Yellow	3	B	pXRF	Body	ns	ns	ns	75.76	ns	ns	ns	0.48	6.12	0.09	0.30	0.44	bd	bd	0.03	0.34	1.72	2
Arbeia (SS)	G1379	Blue (opaque)	3	?	EPMA	Body	15.41	0.50	2.68	69.18	0.17	0.20	1.00	0.57	7.29	0.04	0.35	0.43	0.01	0.05	bd	0.76	0.04	3
Arbeia (SS)	T1585	White	3	A	EPMA	Body	16.17	0.56	2.47	68.68	0.11	0.18	1.08	0.53	7.14	0.05	0.33	0.39	bd	0.02	bd	0.27	0.03	3
Arbeia (SS)	T1584	White	3	A	EPMA	Body	15.20	0.55	2.59	68.85	0.15	0.20	0.98	0.58	7.44	0.03	0.46	0.36	bd	0.03	bd	0.96	0.09	3
Arbeia (SS)	T1586	White	3	A	EPMA	Body	15.20	0.60	2.69	68.88	0.16	0.18	1.01	0.59	7.81	0.04	0.30	0.38	0.01	0.02	bd	0.41	0.05	4
Arbeia (SS)	T1587	White	3	H	EPMA	Body	15.73	0.53	2.76	69.15	0.16	0.06	1.16	0.53	7.36	0.04	0.10	0.32	bd	0.02	bd	0.04	bd	3
Newstead	FRA 5176	Blue	3	I	pXRF	Body	ns	ns	ns	82.17	ns	ns	ns	0.51	6.42	0.07	0.33	0.37	0.02	0.02	bd	0.03	bd	1
Newstead	FRA 5176	White	3	I	pXRF	Trail	ns	ns	ns	72.31	ns	ns	ns	0.77	5.51	0.14	0.33	0.54	bd	0.03	0.03	0.77	0.14	1

Traprain Law	GV 1195	White	3	A	pXRF	Body	ns	ns	ns	75.12	ns	ns	ns	0.71	5.84	0.08	0.27	0.38	bd	bd	bd	0.22	0.03	2
Traprain Law	GV 1266	White	3	A	pXRF	Body	ns	ns	ns	62.64	ns	ns	ns	1.87	8.08	0.28	0.46	0.46	bd	bd	0.01	0.56	0.08	2
Traprain Law	GV 1193	White	3	A	pXRF	Body	ns	ns	ns	81.86	ns	ns	ns	0.62	6.28	0.12	0.50	0.54	bd	bd	bd	0.33	0.04	2
Traprain Law	GV 924	White	3	A	pXRF	Body	ns	ns	ns	81.08	ns	ns	ns	0.54	5.91	0.11	0.42	0.50	bd	bd	0.02	0.60	0.05	2
Traprain Law	GV 1134	White	3	A	pXRF	Body	ns	ns	ns	76.02	ns	ns	ns	0.30	4.87	0.12	0.27	0.58	bd	bd	0.01	0.49	0.04	2
Traprain Law	GV 975	White(bluish)	3	A	pXRF	Body	ns	ns	ns	75.89	ns	ns	ns	0.61	6.13	0.09	0.28	0.45	bd	bd	0.01	0.23	0.04	2
Traprain Law	GV 1135	White	3	A	pXRF	Body	ns	ns	ns	80.46	ns	ns	ns	0.58	6.57	0.08	0.43	0.41	bd	bd	0.01	0.96	0.06	2
Traprain Law	GV 1269	White	3	A	pXRF	Body	ns	ns	ns	78.71	ns	ns	ns	0.67	6.07	0.11	0.29	0.56	bd	bd	bd	0.35	0.04	2
Traprain Law	GV 913	White	3	A	pXRF	Body	ns	ns	ns	75.48	ns	ns	ns	0.77	5.97	0.11	0.40	0.56	bd	bd	bd	0.62	0.06	2
Traprain Law	GV 974	White	3	A	pXRF	Body	ns	ns	ns	75.83	ns	ns	ns	1.32	5.69	0.10	0.37	0.45	bd	bd	0.01	0.39	0.06	2
Traprain Law	GV 670	White	3	A	pXRF	Body	ns	ns	ns	79.12	ns	ns	ns	0.45	5.76	0.12	0.22	0.49	bd	bd	bd	0.33	0.02	2
Traprain Law	GV 1000	White	3	A	pXRF	Body	ns	ns	ns	77.72	ns	ns	ns	0.74	6.48	0.11	0.34	0.50	bd	bd	bd	0.24	0.04	2
Traprain Law	GV855	White	3	A	pXRF	Body	ns	ns	ns	80.46	ns	ns	ns	0.49	6.38	0.08	0.42	0.39	bd	bd	0.01	0.44	0.11	2
Traprain Law	GV 952	White	3	A	pXRF	Body	ns	ns	ns	77.56	ns	ns	ns	0.65	6.41	0.10	0.32	0.44	bd	bd	bd	0.24	0.04	2
Traprain Law	GV 854	White	3	A	pXRF	Body	ns	ns	ns	79.43	ns	ns	ns	0.53	5.90	0.09	0.41	0.45	bd	bd	0.01	0.58	0.05	2
Traprain Law	GV 601A	White	3	A	pXRF	Body	ns	ns	ns	77.93	ns	ns	ns	0.59	6.09	0.08	0.42	0.42	bd	bd	0.01	0.32	0.05	2
Traprain Law	GV 141	White	3	A	pXRF	Body	ns	ns	ns	73.03	ns	ns	ns	0.68	6.00	0.10	0.59	0.48	bd	bd	0.02	1.25	0.10	2
Traprain Law	GV 146	White	3	A	pXRF	Body	ns	ns	ns	75.79	ns	ns	ns	1.17	5.83	0.10	0.35	0.41	bd	bd	bd	0.26	0.06	2
Traprain Law	GV 765B	White	3	A	pXRF	Body	ns	ns	ns	79.51	ns	ns	ns	0.50	5.67	0.10	0.32	0.43	bd	bd	0.01	0.48	0.07	2
Traprain Law	GV 529C	White	3	A	pXRF	Body	ns	ns	ns	74.87	ns	ns	ns	0.55	6.71	0.11	0.35	0.45	bd	bd	bd	0.33	0.00	2
Traprain Law	GV 781	White	3	A	pXRF	Body	ns	ns	ns	77.36	ns	ns	ns	0.66	5.74	0.10	0.42	0.50	bd	bd	0.01	0.38	0.07	2
Traprain Law	GV 760B	White?	3	A	pXRF	Body	ns	ns	ns	72.68	ns	ns	ns	0.66	6.02	0.12	0.49	0.54	bd	bd	0.03	1.51	0.43	3
Traprain Law	FJ 146	Yellow	1	-	pXRF	Body	ns	ns	ns	81.19	ns	ns	ns	0.73	5.43	0.10	0.33	0.48	bd	0.00	0.04	0.37	2.01	1

Traprain Law	FJ 146	red	1	-	pXRF	Decoration	ns	ns	ns	64.86	ns	ns	ns	0.78	5.11	0.18	0.56	1.51	bd	1.03	0.21	1.25	10.44	1
Traprain Law	FJ 146	Yellow	1	-	pXRF	Overlay	ns	ns	ns	73.26	ns	ns	ns	0.80	4.15	0.16	0.62	1.20	bd	0.10	0.11	0.86	7.07	1
Traprain Law	FJ 146	Blue	1	-	pXRF	Decoration	ns	ns	ns	81.60	ns	ns	ns	0.81	6.23	0.11	0.85	1.06	0.09	0.24	0.05	0.48	2.27	1
Traprain Law	GV 1017	NC/C	1	-	pXRF	Body	ns	ns	ns	74.49	ns	ns	ns	0.54	6.59	0.09	0.51	0.42	bd	0.02	bd	0.07	0.02	1
Traprain Law	GV 1017	Yellow	1	-	pXRF	Overlay	ns	ns	ns	64.57	ns	ns	ns	1.00	4.04	0.18	0.43	1.22	bd	0.00	0.30	1.45	10.98	1
Traprain Law	GV 1017	NC/C	1	-	pXRF	Body	ns	ns	ns	56.97	ns	ns	ns	0.65	2.61	0.04	0.25	0.41	bd	1.19	bd	0.12	1.07	1
Traprain Law	GV 1137	Yellow overlay	1	-	pXRF	Overlay	ns	ns	ns	67.92	ns	ns	ns	1.12	3.91	0.14	0.45	1.28	bd	0.02	0.24	1.49	10.79	1
Traprain Law	GV 1137	NC/C	1	-	pXRF	Body	ns	ns	ns	56.79	ns	ns	ns	1.04	3.97	0.08	0.30	0.37	bd	0.02	bd	0.12	0.04	1
Traprain Law	GV 1137	NC/C	1	-	pXRF	Body	ns	ns	ns	67.43	ns	ns	ns	0.89	4.97	0.05	0.36	0.33	bd	0.00	bd	0.12	0.04	1
Traprain Law	GV 147	Pale yellow	1	-	pXRF	Body	ns	ns	ns	79.12	ns	ns	ns	0.65	6.02	0.10	0.51	0.51	bd	0.03	0.03	0.16	0.30	1
Traprain Law	GV 147	Yellow	1	-	pXRF	Overlay	ns	ns	ns	76.53	ns	ns	ns	0.44	4.43	0.08	0.19	0.96	bd	0.02	0.17	1.49	10.30	1
Traprain Law	GV 533	NC/C	3	F?	pXRF	Body	ns	ns	ns	80.48	ns	ns	ns	0.57	6.45	0.06	0.53	0.30	bd	bd	bd	bd	bd	1
Traprain Law	GV 1270	NC/C	3	F?	pXRF	Body	ns	ns	ns	77.80	ns	ns	ns	0.49	6.01	0.06	0.53	0.38	bd	bd	bd	bd	bd	1
Traprain Law	GV 764	NC/C	3	F	pXRF	Body	ns	ns	ns	76.10	ns	ns	ns	1.33	8.73	0.09	0.12	0.33	bd	bd	bd	bd	bd	1
Traprain Law	GV 764	BG + white	3	F	pXRF	Trail	ns	ns	ns	76.69	ns	ns	ns	1.17	5.57	0.09	0.31	0.44	bd	bd	bd	0.06	0.03	1
Traprain Law	GV 678	NC/C	3	F	pXRF	Body	ns	ns	ns	81.54	ns	ns	ns	0.37	6.86	0.06	0.10	0.23	bd	bd	bd	bd	bd	1
Traprain Law	GV 678	NC/C + white	3	F	pXRF	Trail	ns	ns	ns	78.38	ns	ns	ns	0.40	6.50	0.05	0.09	0.29	bd	bd	bd	0.02	0.01	1
Traprain Law	GV 1229	NC/C	3	F	pXRF	Body	ns	ns	ns	69.17	ns	ns	ns	0.42	4.50	0.07	0.29	0.32	bd	bd	bd	0.28	0.06	1
Traprain Law	GV 1229	NC/C + white	3	F	pXRF	Trail	ns	ns	ns	69.06	ns	ns	ns	0.27	3.35	0.09	0.21	0.38	bd	bd	bd	0.43	0.04	1
Traprain Law	GV 330	NC/C	3	F	pXRF	Body	ns	ns	ns	82.52	ns	ns	ns	0.40	6.82	0.05	0.42	0.29	bd	bd	bd	bd	bd	1
Traprain Law	GV 667	NC/C	3	F	pXRF	Body	ns	ns	ns	77.36	ns	ns	ns	1.54	6.31	0.07	0.48	0.44	bd	bd	bd	0.24	0.04	1
Traprain Law	GV 667	NC/C + white	3	F	pXRF	Trail	ns	ns	ns	73.44	ns	ns	ns	1.37	5.33	0.13	0.40	0.56	bd	bd	bd	0.27	0.08	1

Traprain Law	GV 20	NC/C	3	F	pXRF	Body	ns	ns	ns	78.82	ns	ns	ns	0.49	4.93	0.09	0.30	0.42	bd	bd	bd	0.38	0.03	1
Traprain Law	GV 20	NC/C + white	3	F	pXRF	Trail	ns	ns	ns	80.39	ns	ns	ns	0.66	5.90	0.07	0.45	0.39	bd	bd	0.02	0.33	0.03	1
Traprain Law	GV 37	NC/C	3	F	pXRF	Body	ns	ns	ns	81.17	ns	ns	ns	0.61	5.54	0.12	0.26	0.51	bd	bd	bd	0.42	0.04	1
Traprain Law	GV 37	NC/C + white	3	F	pXRF	Trail	ns	ns	ns	71.07	ns	ns	ns	0.51	4.48	0.09	0.20	0.38	bd	bd	bd	0.49	0.03	1
Traprain Law	GV 128	NC/C	3	F	pXRF	Body	ns	ns	ns	82.02	ns	ns	ns	0.35	7.53	0.06	0.14	0.33	bd	bd	bd	bd	bd	1
Traprain Law	GV 128	White	3	F	pXRF	Trail	ns	ns	ns	78.44	ns	ns	ns	0.48	5.09	0.08	0.51	0.44	bd	bd	bd	0.07	0.02	1
Traprain Law	GV 1138	NC/C + white	3	F	pXRF	Trail	ns	ns	ns	74.60	ns	ns	ns	0.50	5.37	0.09	0.36	0.41	bd	bd	bd	0.26	0.04	1
Traprain Law	GV 1138	NC/C	3	F	pXRF	Body	ns	ns	ns	83.50	ns	ns	ns	0.47	6.08	0.07	0.40	0.41	bd	bd	bd	0.26	0.05	1
Traprain Law	TRAP RAIN	NC/C	3	F/G ?	pXRF	Body	ns	ns	ns	81.63	ns	ns	ns	0.53	7.68	0.07	0.15	0.32	bd	bd	bd	bd	bd	1
Traprain Law	TRAP RAIN	Blue streak	3	-	pXRF	Body	ns	ns	ns	63.41	ns	ns	ns	0.69	4.37	0.12	0.60	0.85	0.10	0.14	bd	0.07	0.01	1
Traprain Law	TRAP RAIN	Yellow /white trail	3	-	pXRF	Trail	ns	ns	ns	74.80	ns	ns	ns	0.56	6.27	0.07	0.13	0.40	bd	bd	0.01	0.02	0.43	1
Traprain Law	GV 40	Blue streaky	?	-	pXRF	Body	ns	ns	ns	74.53	ns	ns	ns	0.58	5.45	0.07	0.67	0.54	0.03	0.05	bd	0.10	0.01	1
Traprain Law	TRAP RAIN	NC/C	?	-	pXRF	Body	ns	ns	ns	74.01	ns	ns	ns	0.66	7.00	0.09	0.56	0.53	bd	0.04	bd	0.09	0.03	1
Trprain Law	FJ 147	Yellow	3	B	pXRF	Body	ns	ns	ns	76.28	ns	ns	ns	0.77	6.31	0.09	0.33	0.77	bd	bd	0.06	0.32	2.81	2
Traprain Law	GV 943	NC/C	2	-	pXRF	Body	ns	ns	ns	94.99	ns	ns	ns	0.69	8.08	0.09	0.50	0.56	bd	0.03	bd	0.19	0.10	1
Traprain Law	GV 943	Blue + white	2	-	pXRF	Cord	ns	ns	ns	78.31	ns	ns	ns	0.82	5.87	0.08	0.36	0.45	bd	0.01	bd	0.23	0.05	1
Crawcwe llt	CCW1 1 (H)	White		~2	SEM-EDS	Twsit ed cable	16.21	0.60	2.57	66.21	0.19	0.36	1.00	0.88	9.50	0.05	1.01	0.53	bd	0.09	0.03	bd	bd	3
Crawcwe llt	CCW1 1 (H)	Dark blue		~2	SEM-EDS	Body	16.14	0.78	2.46	66.02	bd	0.37	1.20	0.75	9.07	bd	0.74	1.25	bd	0.29	bd	bd	bd	3
Bryn y Castell	314 (D)	White	Early	~3	SEM-EDS	Twist ed cable	15.52	0.62	2.13	65.87	0.10	0.49	1.03	0.92	7.19	0.05	0.36	0.41	0.01	0.72	0.06	3.20	1.00	3
Bryn y Castell	314 (D)	Red (+ white)	Early	~3	SEM-EDS	Twsit ed cable	13.35	1.12	2.39	56.10	0.29	0.24	0.90	1.02	7.67	0.11	0.66	1.70	bd	2.58	0.23	0.56	10.4 8	3
Bryn y Castell	314 (D)	Dark green	Early	~3	SEM-EDS	Body	14.76	0.73	2.34	64.09	bd	0.25	1.03	0.93	9.30	0.06	0.84	0.56	bd	2.60	0.19	bd	1.66	3

Bryn y Castell	166	NC/C	Early	-	SEM-EDS	Body	16.27	0.75	2.39	67.62	bd	0.31	1.14	0.85	9.21	bd	0.54	0.42	bd	bd	bd	bd	bd	3
Bryn y Castell	224	Dark green	Early	~3	SEM-EDS	Body	15.10	0.75	2.39	63.75	bd	bd	0.94	0.90	9.43	0.12	0.84	0.56	bd	2.69	bd	bd	1.72	3
Bryn y Castell	67	Dark green	Early	-	SEM-EDS	Body (misshapen)	14.80	0.86	2.33	64.17	bd	0.35	0.96	0.90	9.24	0.15	0.83	0.55	bd	2.58	bd	bd	1.72	3
Bryn y Castell	330 (C')	Dark green	Early	~2	SEM-EDS	Twisted cable	14.97	0.76	2.34	64.23	bd	0.25	1.01	0.92	9.18	0.07	0.85	0.55	bd	2.40	bd	bd	1.66	3
Bryn y Castell	330 (C')	Dark blue	Early	~2	SEM-EDS	Twisted cable	16.96	0.65	2.40	65.27	bd	0.36	1.15	0.70	9.04	bd	0.76	1.27	0.12	0.30	bd	bd	0.12	3
Bryn y Castell	330 (C')	Yellow	Early	~2	SEM-EDS	Twisted cable	12.44	0.50	2.06	54.12	bd	bd	0.91	0.60	6.44	bd	0.49	0.81	bd	0.36	0.87	1.00	18.36	3
Bryn y Castell	174	Dark blue	Early	-	SEM-EDS	Body	17.28	0.78	2.48	65.41	bd	0.37	1.07	0.73	9.08	0.10	0.73	1.14	0.12	0.25	bd	bd	0.17	3
Bryn y Castell	185	Dark blue	Early	-	SEM-EDS	Body	16.84	0.72	2.43	65.22	bd	0.38	1.04	0.77	9.27	0.08	0.70	1.21	bd	0.26	bd	0.38	0.31	3
Bryn y Castell	110	Dark blue	Early	-	SEM-EDS	Body	16.84	0.76	2.43	65.25	bd	0.35	1.07	0.79	9.23	0.12	0.75	1.27	0.10	0.27	bd	0.44	0.18	3
Bryn y Castell	355	Dark green	Early	~3	SEM-EDS	Body	14.99	0.73	2.35	63.81	bd	bd	0.92	0.94	9.53	0.10	0.85	0.61	bd	2.69	bd	bd	1.73	3
Bryn y Castell	355	White	Early	~3	SEM-EDS	Trail	11.28	0.51	1.87	54.37	bd	0.45	0.50	0.81	6.72	bd	0.76	0.51	bd	0.13	bd	5.23	16.54	3
Bryn y Castell	139	White	Early	~3	SEM-EDS	Trail	11.62	0.55	1.88	54.44	bd	0.48	0.56	0.74	6.49	bd	0.74	0.45	bd	bd	bd	5.12	16.55	3
Bryn y Castell	139	NC/C	Early	~3	SEM-EDS	Body	16.63	0.76	2.42	67.42	bd	0.34	1.26	0.83	8.83	bd	0.51	0.41	bd	bd	bd	bd	bd	3
Bryn y Castell	388	White	Early	~2	SEM-EDS	Twisted cord	11.29	0.56	1.86	54.09	bd	0.46	0.56	0.75	6.65	bd	0.80	0.50	bd	bd	bd	5.47	16.66	3
Bryn y Castell	388	Purple	Early	~2	SEM-EDS	Twisted cord	18.45	0.60	2.29	65.57	bd	0.46	1.05	0.68	8.49	bd	1.50	0.41	bd	bd	bd	bd	bd	3
Bryn y Castell	388	NC/C	Early	~2	SEM-EDS	Body	16.29	0.74	2.39	67.43	bd	0.34	1.15	0.84	9.10	bd	0.57	0.41	bd	bd	bd	bd	bd	3
Thearne	RF101	Dark blue	2	Trail	EPMA		15.48	0.44	2.42	70.57	0.12	0.11	1.05	0.51	6.38	0.03	0.68	0.82	0.16	0.22	bd	0.06	0.04	3
Thearne	RF101	White	2	Trail	EPMA		14.37	0.61	2.58	66.64	0.18	0.32	0.69	0.67	6.78	0.05	0.52	0.56	bd	0.04	0.02	3.88	0.86	5
Thearne	RF108	White	2	Trail end	EPMA		13.88	0.53	2.50	65.99	0.17	0.31	0.64	0.70	7.01	0.04	0.55	0.42	bd	0.03	bd	5.05	0.10	4

Thearne	RF225	Dark blue	2	Rod	EPMA		14.33	0.48	2.73	67.14	0.10	0.17	1.02	2.28	7.48	0.03	0.86	0.68	0.19	0.18	bd	0.16	bd	3
Thearne	RF226	Dark blue	2	Rod	EPMA		15.70	0.50	2.39	69.42	0.14	0.12	1.03	0.57	6.40	0.05	1.10	0.79	0.16	0.17	bd	0.10	0.09	6
Thearne	RF266	Yellow	2	Trail end	EPMA		16.44	1.87	2.03	63.96	0.61	0.30	0.99	0.68	6.09	0.12	0.76	1.22	0.07	0.32	0.11	1.30	1.72	3
Thearne	RF290	White	2	Rod	EPMA		14.78	0.53	2.45	67.62	0.10	0.37	0.65	0.61	6.15	0.06	0.45	0.51	bd	0.05	bd	4.81	0.07	5
Thearne	RF308	Dark blue	2	Aii	EPMA		15.96	0.52	2.41	68.55	0.16	0.13	1.06	0.58	7.74	0.04	0.60	1.07	0.22	0.44	bd	0.05	0.04	3
Thearne	RF315	Dark blue	2	Rod	EPMA		16.00	0.51	2.38	68.68	0.14	0.17	1.08	0.55	6.81	0.04	0.64	0.59	0.12	0.15	bd	0.12	0.05	6
Thearne	RF315	Dark blue	2	Rod	EPMA		15.08	0.53	2.59	66.76	0.09	0.17	1.04	0.48	7.41	0.03	1.47	1.96	0.47	0.59	bd	bd	bd	2
Thearne	RF315i	Opaque blue?	2	Rod pinched	EPMA		14.34	0.46	2.34	67.94	0.12	0.30	0.83	0.51	7.30	0.05	0.57	0.58	0.08	0.12	bd	3.14	0.04	1
Thearne	RF328	Dark blue	2	Rod pinched	EPMA		14.83	0.53	2.47	67.61	0.24	0.17	0.94	0.59	8.78	0.03	0.66	0.88	0.13	0.19	bd	0.04	0.05	4
Thearne	RF328	White	2	Rod pinched	EPMA		14.83	0.51	2.56	67.80	0.12	0.37	0.72	0.61	6.72	0.05	0.47	0.45	bd	0.03	bd	4.07	0.05	3
Thearne	RF352	Dark blue	2	Rod	EPMA		14.76	0.50	2.12	67.97	0.17	0.12	0.99	0.59	7.92	0.05	0.65	0.78	0.12	0.19	bd	0.07	0.04	3
Thearne	RF352	White	2	Rod	EPMA		13.80	0.53	2.31	66.21	0.17	0.24	0.77	0.59	7.57	0.05	0.47	0.50	0.04	0.10	bd	3.89	0.04	3
Thearne	RF352	Yellow	2	Rod	EPMA		10.15	0.35	1.88	49.81	0.13	0.27	0.51	0.46	4.92	0.02	0.35	1.62	0.03	0.10	0.46	2.78	19.37	4
Thearne	RF355	Dark blue	2	Ai (no twist)	EPMA		15.16	0.56	2.69	68.97	0.17	0.25	0.88	0.52	7.31	0.03	0.44	0.50	0.04	0.15	bd	1.49	0.08	3
Thearne	RF363	Dark blue	2	Aii (no twist)	EPMA		14.62	0.46	2.69	69.73	0.13	0.14	1.08	0.52	7.20	0.05	0.50	0.84	0.14	0.14	bd	0.04	0.04	3
Thearne	RF368	White	2	Ai	EPMA	Dotted stripe	15.21	0.56	2.58	67.79	0.11	0.40	0.63	0.68	6.37	0.07	0.37	0.60	bd	0.10	bd	4.44	bd	3
Thearne	RF368	Dark blue	2	Ai	EPMA	Stripe	16.07	0.52	2.38	67.55	0.15	0.12	1.16	0.55	6.65	0.04	1.87	1.18	0.34	0.27	bd	0.04	bd	3
Thearne	RF371	Dark blue	2	Rod	EPMA	Twists	15.95	0.43	3.42	69.33	0.16	0.12	1.08	0.78	5.55	0.04	0.82	0.63	0.16	0.18	bd	0.25	0.06	5
Thearne	RF371	White	2	Rod	EPMA	Twists	13.47	0.53	2.75	64.57	0.15	0.34	0.64	0.64	7.71	0.04	0.16	0.47	0.03	0.03	bd	6.82	0.10	6

Thearne	RF266	Dark blue	2	Rod end	EPMA	-	15.92	0.41	2.29	68.91	0.14	0.13	1.12	0.60	6.13	0.03	0.44	0.75	0.17	0.13	bd	0.05	bd	3
Thearne	RF326	Dark blue		Drip	EPMA	-	14.74	0.48	2.73	67.64	0.11	0.19	1.08	0.50	7.57	0.05	0.46	0.85	0.14	0.18	bd	0.03	0.09	3
Thearne	RF108	Purple(+white)	2	Rod end	EPMA		15.58	0.66	2.51	66.17	0.13	0.16	0.99	0.70	6.67	0.05	2.93	0.45	bd	0.04	bd	0.16	0.04	3
Thearne	RF114	NC/C	3	I	EPMA	Body	16.94	0.65	2.72	68.94	0.18	0.16	0.98	0.76	6.92	0.06	0.49	0.54	0.01	0.10	bd	0.21	0.06	3
Thearne	RF150	NC/C	2	Aii (var)	EPMA	Body	16.06	0.46	2.35	70.72	0.19	0.13	1.09	0.72	5.88	0.06	0.20	0.37	bd	0.04	bd	0.09	0.03	3
Thearne	RF150	Brown +white	2	Aii (var)	EPMA	Cord	15.25	0.65	2.82	66.74	0.11	0.43	0.62	0.80	6.04	0.10	0.37	0.63	bd	0.05	bd	4.50	0.09	3
Thearne	RF156	NC/C	?		EPMA	Body	16.34	0.49	2.60	69.33	0.15	0.15	1.17	0.62	7.20	0.04	0.46	0.38	bd	0.02	bd	0.03	bd	3
Thearne	RF201	NC/C	2	Aii	EPMA	Body	16.29	0.56	2.59	68.90	0.17	0.16	1.03	0.68	7.69	0.04	0.38	0.41	bd	0.04	bd	0.09	0.06	4
Thearne	RF210	NC/C	2	Aii	EPMA	Body	16.59	0.58	2.63	69.27	0.17	0.16	1.03	0.69	7.16	0.06	0.49	0.43	bd	0.04	bd	0.15	0.05	3
Thearne	RF211	NC/C	2	Bii	EPMA	Body	16.88	0.44	2.48	68.16	0.09	0.17	1.23	0.49	7.73	0.03	0.50	0.26	bd	0.02	bd	0.04	bd	3
Thearne	RF216	NC/C	2	Aii (var)	EPMA	Body	15.50	0.45	3.22	69.74	0.14	0.11	1.10	0.70	6.98	0.04	0.27	0.28	bd	0.02	bd	0.05	0.05	4
Thearne	RF225	Light blue	2	Rod	EPMA		16.86	0.48	2.41	65.18	0.22	0.25	1.41	2.11	8.11	0.03	0.11	0.27	0.00	0.80	bd	0.18	0.08	2
Thearne	RF226	Dark blue	2	Rod	EPMA		15.70	0.50	2.39	69.42	0.14	0.12	1.03	0.57	6.40	0.05	1.10	0.79	0.16	0.17	bd	0.10	0.09	6
Thearne	RF266	Blue	2	Rod end	EPMA		15.92	0.41	2.29	68.91	0.14	0.13	1.12	0.60	6.13	0.03	0.44	0.75	0.17	0.13	bd	0.05	bd	3
Thearne	RF266	White	2	Rod end	EPMA		16.44	1.87	2.03	63.96	0.61	0.30	0.99	0.68	6.09	0.12	0.76	1.22	0.07	0.32	0.11	1.30	1.72	3
Thearne	RF274	NC/C	2	Ciii (var)	EPMA	Body	15.96	0.56	2.60	69.11	0.18	0.14	1.00	0.72	7.76	0.06	0.39	0.43	bd	0.04	bd	0.13	0.05	3
Thearne	RF274	Brown +white	2	Ciii (var)	EPMA	Cord	14.51	0.59	2.65	66.12	0.18	0.48	0.58	0.74	7.34	0.04	0.37	0.54	bd	0.04	bd	6.07	0.07	3
Thearne	RF290	Blue/white	2	Rod	EPMA		14.78	0.53	2.45	67.62	0.10	0.37	0.65	0.61	6.15	0.06	0.45	0.51	bd	0.05	bd	4.81	0.07	5
Thearne	RF295	NC/C		Drip	EPMA		15.73	0.55	2.60	67.47	0.18	0.14	0.98	0.79	7.41	0.05	0.48	0.44	bd	0.06	bd	0.14	0.09	3
Thearne	RF308	NC/C	2	Aii	EPMA		15.99	0.47	2.52	70.29	0.11	0.11	1.19	0.45	7.47	0.04	0.27	0.31	bd	bd	bd	0.04	bd	3
Thearne	RF311	White		Rod end	EPMA		14.18	0.50	2.24	66.23	0.15	0.33	0.68	0.66	7.27	0.04	1.04	0.44	bd	0.04	bd	5.35	0.08	4
Thearne	RF311	Purple		Rod end	EPMA		15.73	0.64	2.57	66.99	0.14	0.16	0.95	0.71	6.58	0.05	3.45	0.52	bd	0.06	bd	0.16	0.09	3

Thearne	RF315	Yellow / blue	2	Rod	EPMA		16.03	1.84	2.28	63.83	0.66	0.23	0.99	1.28	5.77	0.14	0.81	1.30	bd	2.04	0.09	0.42	2.13	6
Thearne	RF332	NC/C	2	Ci	EPMA	Body	15.77	0.46	2.66	69.43	0.12	0.15	1.12	0.51	7.22	0.04	0.36	0.29	0.01	0.02	bd	bd	0.05	3
Thearne	RF348	NC/C	2	?	EPMA	Body	16.13	0.59	2.60	68.53	0.17	0.17	1.03	0.71	7.44	0.05	0.38	0.42	bd	0.04	bd	0.14	0.03	4
Thearne	RF351	NC/C	2	Ai (no twist)	EPMA	Body	15.49	0.47	2.72	70.08	0.11	0.11	1.10	0.47	7.61	0.03	0.01	0.28	bd	0.01	bd	0.05	bd	3
Thearne	RF351	Turq blue	2	Ai (no twist)	EPMA	Body streak	16.23	0.65	2.74	68.57	0.18	0.17	0.97	0.82	7.00	0.06	0.48	0.57	bd	0.11	bd	0.21	bd	2
Thearne	RF353	NC/C	?Plain		EPMA	Body	16.67	0.43	2.65	68.93	0.13	0.15	1.17	0.57	7.17	0.03	0.21	0.33	bd	bd	bd	0.05	0.05	3
Thearne	RF355	NC/C	2	Ai (no twist)	EPMA	Body	14.47	0.43	2.71	71.08	0.12	0.12	1.05	0.54	7.63	0.02	0.05	0.26	bd	bd	bd	0.05	bd	3
Thearne	RF360	NC/C	?3		EPMA	Body	15.61	0.47	2.50	70.64	0.12	0.15	1.08	0.50	7.69	0.02	0.11	0.29	bd	0.02	bd	0.03	bd	3
Thearne	RF363	Pale blue	?		EPMA	Body	17.00	0.42	2.21	69.20	0.14	0.12	1.24	0.46	5.96	0.03	0.77	0.29	bd	0.03	bd	0.04	0.06	4
Thearne	RF365	Pale blue		Rod	EPMA		14.08	0.09	0.25	68.89	0.05	0.47	0.13	4.75	7.24	0.02	0.01	0.06	0.01	0.02	bd	0.37	0.23	5
Thearne	RF368	NC/C	2	Ai	EPMA	Body	15.85	0.47	2.45	68.82	0.17	0.14	1.04	0.61	7.01	0.03	0.63	1.03	0.14	0.22	bd	0.09	bd	3
Segedunum	WSG114	NC/C	2	Ai	EPMA	Body	16.43	0.61	2.57	67.88	0.15	0.21	1.07	0.63	6.97	0.05	0.74	0.43	bd	0.02	bd	0.23	0.12	3
Bainbridge	269E14gl	NC/C	2	?A	EPMA	Body	15.86	0.61	2.56	67.85	0.17	0.20	0.92	0.69	7.95	0.05	0.39	0.43	bd	0.03	bd	0.17	0.05	3
Arbeia (SS)	G1382	NC/C	2	?Ai	EPMA	Body	16.53	0.57	2.44	66.56	0.12	0.19	1.15	0.52	8.44	0.03	0.78	0.41	bd	0.02	bd	0.03	0.05	3
Bainbridge	XXI26B74	NC/C	?2	-	EPMA	Body	16.27	0.57	2.72	67.42	0.17	0.17	0.99	0.71	8.19	0.05	0.38	0.50	0.08	0.07	bd	0.09	0.04	4
Arbeia (SS)	T1625	NC/C?	2	-	EPMA	Body	15.53	0.54	2.66	69.21	0.15	0.10	1.07	0.61	7.40	0.03	0.50	0.34	bd	0.02	bd	0.07	0.04	3