Characterisation of Iron Age and Roman Shell-filled Pottery from Earith, Cambridgeshire

Alan Vince

Excavations at Earith undertaken by Cambridge Archaeology Unit recovered a large assemblage of Iron Age and Romano-British pottery. A major element in this pottery collection was shell-filled pottery, both in the Iron Age and Roman periods.

Samples were taken of Iron Age and Roman shell-filled wares from the excavation together with samples from a previous-excavated Romano-British kiln producing similar pottery situated at Earith about 3 miles to the southwest of the CAU excavation (Table 1).

Table 1

TSNO	Form	Action	Sitecode	Context	cname	Part	Weight
V4115		ICPS	Norris 82.9	U/S	EARITH KILN	BS	18
V4114		TS;ICPS	Norris 82.9	U/S	EARITH KILN	R	26
V4113		ICPS	Norris 82.9	U/S	EARITH KILN	B	24
V4112		ICPS	Norris 82.9	U/S	EARITH KILN	B	73
V4111		ICPS	Norris 82.9	U/S	EARITH KILN	BS	25
V4110		TS;ICPS	Norris 82.9	U/S	EARITH KILN	BS	51
V4109	STORAGE JAR	ICPS	ecg01	5889	RB SHELL	BS	202
V4108	STORAGE JAR	ICPS	ecg01	6583	RB SHELL	BS	278
V4107	STORAGE JAR	TS;ICPS	ecg01	1109	RB SHELL	BS	348
V4106	STORAGE JAR	TS;ICPS	ecg01	3464	RB SHELL	BS	238
V4105	JAR	ICPS	ecg01	3420	IA SHELL	B	25
V4104	JAR	ICPS	ecg01	2529	IA SHELL	BS	26
V4103	STORAGE JAR	TS;ICPS	ecg01	2286	IA SHELL	BS	88
V4102	JAR	ICPS	ecg01	6971	IA SHELL	BS	18
V4101	JAR	TS;ICPS	ecg01	1174	IA SHELL	B	91

Thin section and chemical analyses were carried out on these samples to establish whether the Iron Age and Roman shell-filled pottery could have been produced at the Earith kiln and whether it is possible to distinguish the Earith pottery from other Iron Age and Roman shelly wares produced in Cambridgeshire (e.g. Haddon, Vince 2003) and from the pottery produced at Harrold, Bedfordshire (Brown 1994;Woods 1994).

Methodology

Offcuts of selected sherds were taken for thin section analysis. The thin sections were produced by Steve Caldwell, University of Manchester, and stained using Dickson's method (Dickson 1965). Offcuts of each of the samples were then prepared for chemical analysis. The outer few mm of each offcut were mechanically removed and the resulting block was crushed to a fine powder and submitted to Royal Holloway College, London, where Inductively Coupled Plasma Spectroscopy was carried out under the supervision of Dr J N

Walsh. The analysis produced a series of determinations of a range of major elements, expressed as percent oxides (App 1) and of a range of trace elements expressed in parts per million (App 2).

Thin Section Analysis

The six thin sections (two from each group) were examined systematically and a list of the inclusion types present was compiled. The frequency (rare/sparse/moderate/abundant), roundness, size range and sorting of each inclusion type was recorded and differences sought between the samples which would allow the sections to be assigned to separate fabric groups. The two sectioned Roman site samples have different fabrics, one being very similar to those from the kiln and the other being different. Thus there are three fabric groups present: a) the kiln samples, V4110 and V4114, and one of the Roman site samples, V4107; b) the second Roman site sample, V4106; c) the iron age samples, V4101 and V4103.

Kiln products

The following inclusion types were noted:

- Bioclastic marly limestone. Sparse subangular fragments up to 2.0mm across containing rounded fragments of thin-walled bivalve shell (both plain and finely ornamented); echinoid shell; punctate brachiopod shell up to 0.5mm across in a matrix of ferroan micrite. Also unidentifiable fragments of large non-ferroan calcite fossils, probably ammonites, non-ferroan calcite ostracods shell up to 0.3mm long and multichambered microfossils with non-ferroan calcite tests and opaque infilling up to 0.2mm long. The clasts are coated with a brown- and dark brown-stained non-ferroan micrite.
- Bioclastic dolomitic? limestone. Absent.
- Bivalve shell. Abundant fragments of non-ferroan calcite shell, some with a nacreous structure. The shell fragments are coated with a thin brown micrite skin and occasionally with a prismatic ferroan calcite layer, c.0.3mm thick. This is presumably the result of serpulid worm secretions. In other cases the entire shell is composed of ferroan calcite and retains its internal structure (as in the non-ferroan calcite fragments).
- Ornamented bivalve shell. Sparse examples as above but with fine ornamentation on the surface (with peaks c.0.2mm apart and 0.1mm deep) or coarser ornamentation (peaks c.0.3mm apart and 0.2mm deep).
- Echinoid shell. Moderate rounded fragments of echinoid shell composed of a mixture of ferroan and non-ferroan calcite.
- Echinoid spines. Sparse diadematoid spines, c.0.3mm across composed of non-ferroan calcite with a ferroan calcite filling of lumen (cf.

http://www.nhm.ac.uk/research-curation/projects/echinoid-directory/morphology/regulars/spine2.html).

- Punctate brachiopod shell. Moderate fragments up to 1.0mm long with ferroan calcite infilling of pores.
- Microfossils. None for certain but several spherical voids c.0.2mm across.
- Opaques. Sparse up to 0.4mm across. Some appear to be casts of fossils and others euhedral crystals.
- Phosphate. Moderate brown phosphate, mostly clearly lining laminae and pores and of post-burial origin.
- Quartz. Absent.
- Gypsum/selenite. Rare euhedral crystals up to 1.0mm across and moderate voids of similar outline.

The groundmass consists of optically anisotropic baked clay minerals. In one section the details of the groundmass are masked by carbon whilst in the other the carbon is either limited to the core of the vessel or the sample was completely oxidized. Sparse angular quartz up to 0.1mm across and ferroan calcite specks and opaque spherical grains up to 0.1mm across.

Romano-British

The following inclusions were noted (those also found in the kiln products are not described):

- Bioclastic marly limestone. As kiln.
- Bioclastic dolomitic? limestone. Sparse rounded fragments up to 1.5mm across. The limestone is mainly micrite but with traces of structure, which might either be fossil shell or infilling of cracks with slightly coarser-grained micrite. One larger fragment, 3.0mm across, contains fragments of bivalve shell and echinoid shell, all unstained (and therefore dolomitic?).
- Bivalve shell. As kiln.
- Ornamented bivalve shell. As kiln.
- Echinoid shell. As kiln.
- Echinoid spines. Sparse cidaroid spines up to 0.3mm across. The cortex is composed of non-ferroan calcite and the medulla is a mixture of non-ferroan and ferroan calcite.
- Punctate brachiopod shell. As kiln.
- Microfossils. None for certain.

- Opaques. As kiln.
- Phosphate. Mostly as kiln but includes one definite fish bone fragment 0.3mm by 0.1mm.
- Quartz. Sparse well-rounded grains up to 0.5mm across. The outline of some grains suggests a Lower Cretaceous origin.
- Gypsum/selenite. Absent.

Groundmass as kiln. Both samples are completely oxidized.

Iron Age

- Bioclastic marly limestone. As kiln but larger and more frequent.
- Bioclastic dolomitic? limestone. Absent.
- Bivalve shell. As kiln.
- Ornamented bivalve shell. As kiln.
- Echinoid shell. As kiln.
- Echinoid spines. None.
- Punctate brachiopod shell. As kiln.
- Microfossils. Sparse, as in bioclastic limestone fragments.
- Opaques. As kiln.
- Phosphate. As kiln.
- Quartz. Absent.
- Gypsum/selenite. Absent.

Groundmass as kiln. Both samples are completely black.

Interpretation of thin sections

Most of the inclusions originated in a bioclastic limestone with a cement consisting of ferroan calcite, clay/iron compounds and clay minerals. In Cambridgeshire the only *in situ* sources for such a rock are of Jurassic age (although re-deposited lower Cretaceous limestone cannot be totally discounted). The fine-textured nature of the groundmass and opaque inclusions (probably naturally-occurring iron-rich concretions) suggests that this too is likely to be of Jurassic age. It is possible therefore that the raw material used to make this fabric was an exposure of shelly marl with limestone doggers surrounded by marl. Some of the larger inclusions are rounded and this might indicate that the marl contained a winnowed shell sand. These characteristics are similar in all six thin sections and suggest that similar clays were sought for each fabric group.

The selenite is a distinctive mineral and is present in both of the sections of kiln products and one of the Roman samples, but not in the others. Its presence allows the source of the clay and limestone used at the kiln to be identified, in all probability, as the Ampthill Clay (Chatwin 1961, 13) and suggests that at least one of the samples from the CAU excavation could be a kiln product (V4107).

The rounded quartz sand grains found in the second Roman section suggest the presence of detrital sand and the shape and roundness of the grains suggests that this sand contains grains of Lower Cretaceous origin. Such sands outcrop in the Ely area but are also common in cover sands in the fens (but not to any extent to the west of the fens or the western fen edge. Therefore a fenland origin is likely for this sample.

Lastly, neither rounded quartz nor selenite are present in the two Iron Age samples. Limestones characterised by bivalve shells, echinoid shell and punctate brachiopods, occur widely within the Jurassic and without identifying the fossils to species it is not possible to narrow down the potential source of this fabric. Similar shell-filled fabrics occur, for example, in Bedfordshire (e.g. Harrold, in the Roman and medieval periods and Olney Hyde in the medieval period) as well as in northwest Cambridgeshire (e.g. Haddon) and were also characteristic of the Iron Age shell-filled pottery from a number of consumer sites in northwest Cambridgeshire (Hamerton, Great Gidding and Stow Ongar, Vince 1997).

Chemical Analysis

Estimated Silica content

Silica was not measured in the ICPS analysis but can be estimated by subtracting the total measured oxides from 100%. This shows that there is a range from 53% to 62% but that there is a wide range within each of the fabric groups (referred to here as Earith kiln; Earith kiln?; Earith RB and Earith IA) with only 2% difference between the mean silica content of the Earith IA sherds (the lowest, 57%) and Earith RB sherds (the highest, 59%). However, because the overall range is large enough to produce a dilution effect on other elements the ICPS values were normalised to aluminium.

Variability within the Earith Samples

The normalised data from the Earith samples was examined to see if there were any differences between the various groups. Iron values show a strong correlation with group, as do magnesium, potassium, sodium, manganese, copper, nickel, zinc and cobalt values.

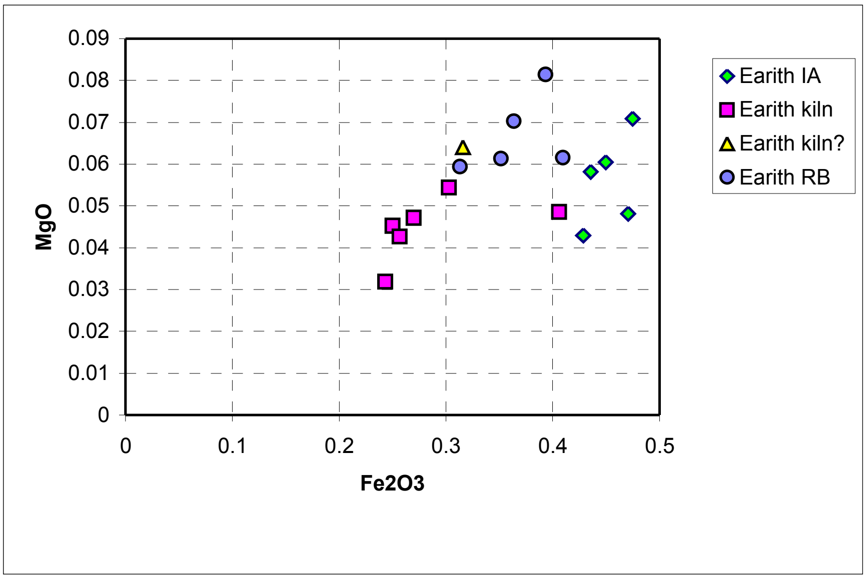

Figure 1

Fig 1 shows a plot of normalised iron against magnesium values for the Earith samples and indicates that the IA samples have a slightly higher iron content whilst the magnesium content of the kiln samples is lower than that of the RB samples. In this graph the possible kiln product plots with the other possible RB samples.

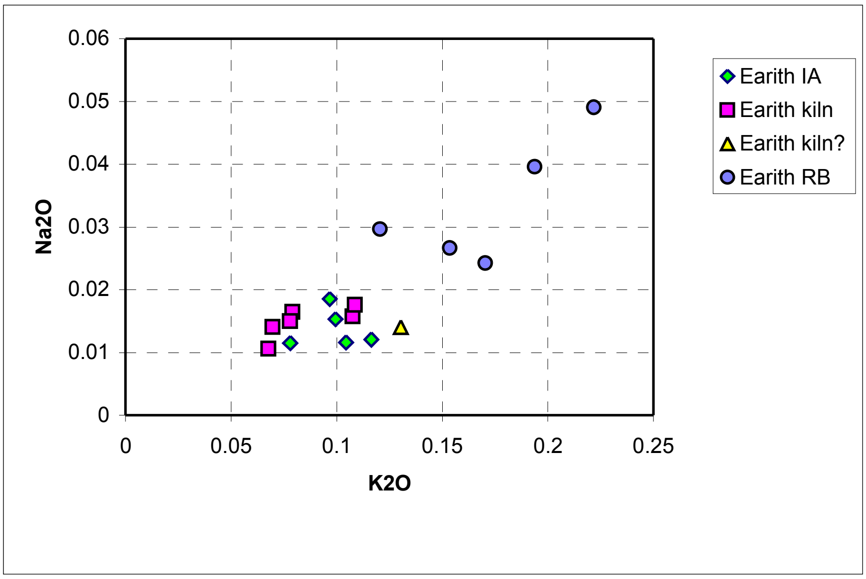

Figure 2

Fig 2 shows a graph of potassium against sodium values for the Earith samples. It indicates that the RB samples have a higher sodium and potassium content than the kiln, possible kiln and IA samples.

Similar plots for the remaining distinctive elements indicate that the RB samples (including the possible kiln product) have a lower copper content than the remainder whilst the IA samples have a higher cobalt content.

Summarising these differences, it seems that the IA, RB and kiln groups all have different compositions and that the putative kiln product sometimes follows the kiln samples (as in Fig 2) and sometimes the RB samples (as in Fig 1). This suggests that some of the chemical differences may be due to post-burial alteration (e.g. the magnesium content) whilst others reflect differences in raw materials. It does suggest, however, that only this one sample, of the 6 analysed, could possibly be a kiln product.

Comparison with Cambridgeshire and Bedfordshire Shelly wares

The Earith data was then compared with data from the analysis of a range of shelly wares (Table 2).

Table 2

Group	Description	Grand Total
Earith IA		5
Earith kiln		6
Earith kiln?		1
Earith RB		5
Haddon kiln	Samples from the Romano-British shelly pottery waste and a piece of kiln furniture	10
Harrold kiln	Samples from medieval pottery waste from Harrold Middle School	6
LHP IA	Iron Age shelly wares from the Lutton to Huntingdon pipeline (Great Gidding, Stow Longa, Old Weston, Hamerton)	13
LHP RB	Romano-British shelly wares form the Lutton to Huntingdon pipeline (Hamerton and Old Weston)	2

Simple plots of one set of element values against another show general trends but multivariate statistics are required to extract the patterning from this data. Factor analysis was carried out, omitting mobile elements such as calcium, strontium and phosphorus. In addition, zirconium is only partially dissolved during the ICPS sample preparation and this leads to the possibility of batch errors in the data and so these values too were omitted. Finally, the rare earth elements tend to be highly correlated and so including seven correlated values would tend to give undue prominence to the REE data. These too were omitted.

The factor analysis of this reduced dataset revealed three factors. Factors in this case are a series of variables which are substituted for the greater number of variables in the dataset. Each factor is calculated by multiplying each element value by a positive or negative number less than 1 and by examining a table of these weightings it is possible to see how each element contributes to each factor score.

A plot of F1 against F2 (Fig 3) indicates that the Harrold kiln waste has lower F1 scores than any of the Cambridgeshire shelly ware samples and Harrold can thus be discounted as a source for any of the sampled pottery. The Earith RB samples have higher F2 scores than most of the Cambridgeshire shelly samples but most of the F1 and F2 scores cluster in the same part of the graph and it is thus not possible to distinguish any of the other groups.

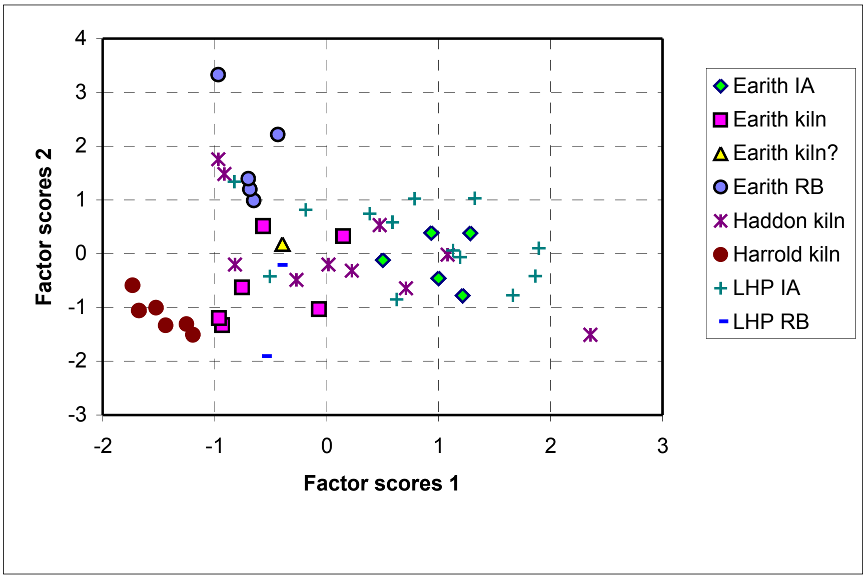

Figure 3

Fig 4 shows a plot of F1 against F3 and in this graph the Haddon kiln samples, the Earith IA samples and the LHP IA samples are all separated by differing F3 scores.

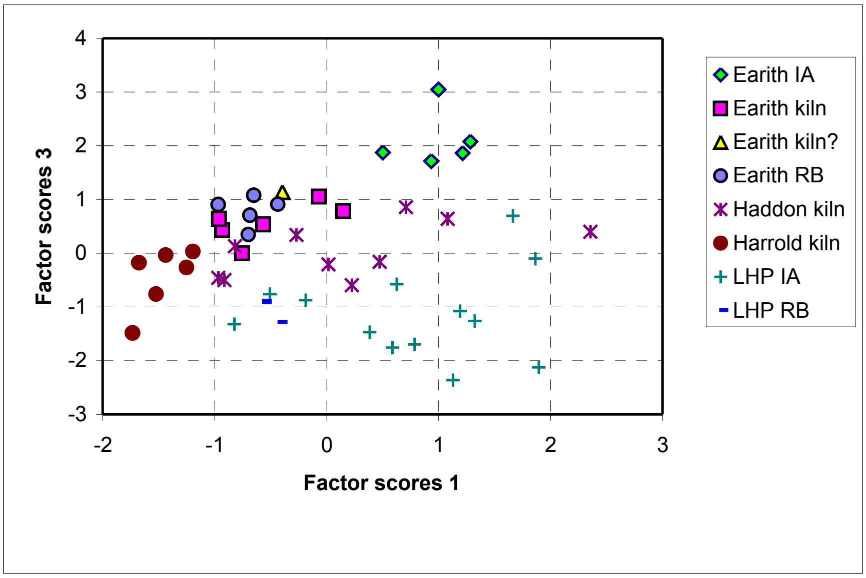

Figure 4

Fig 5 shows a plot of the F2 against F3 scores which makes the separation of the three Earith groups clearer. F2 scores are mainly dependent on high sodium and potassium weightings whilst F3 scores are due mainly to high barium weightings and negative vanadium, lithium and scandium scores. The putative kiln product from the CAU excavations has F2 and F3 scores which place it nearer to the kiln products than to the other Earith RB samples.

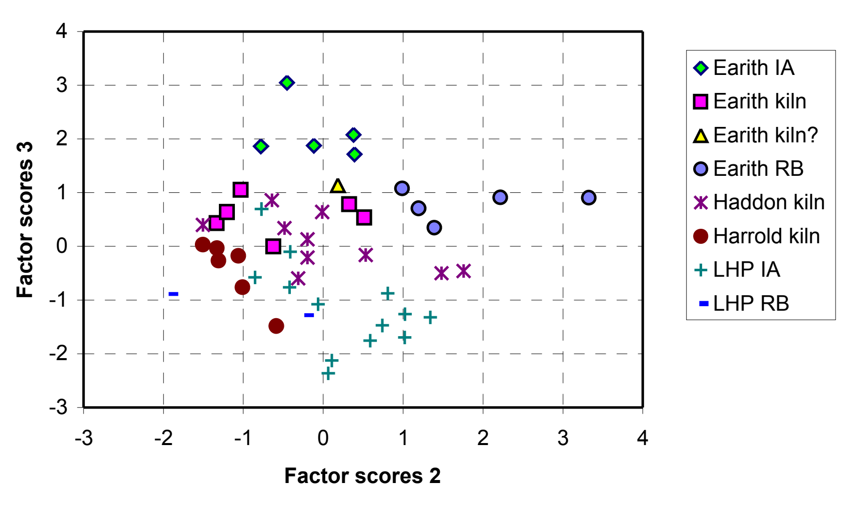

Figure 5

Fig 6 shows a plot of barium versus sodium values for the entire dataset. It is clear that the Earith samples have higher barium values than any of the remaining samples and this might suggest that all the Earith groups have a similar source.

Barium can substitute for calcium and might therefore possibly have been present in the limestone (or any surviving selenite). However, there is no correlation of barium and calcium in these samples and it is therefore likely that is it present through some other route. A plot of barium against phosphorus shows a correlation and the highest barium value comes from a sample with more than twice the phosphorus level of the next highest sample. Therefore, it is likely that barium is present through post-burial contamination.

Conclusions

The Earith kiln lies on an outcrop of Ampthill clay (BGS 1:50000 map sheet 187). It is very likely, therefore, that the pottery was produced from clay dug on site.

The CAU excavations at Earith, however, are on a site where the Ampthill clay is masked by terrace sands. Depending on the thickness of gravel and the water table, it might have been possible to quarry clay on the site, but it is much more likely that pottery was brought to the site for use.

The thin section of a sample of Iron Age and Roman shelly ware from the CAU Earith excavations shows that only one vessel contains the selenite voids which characterise the Roman Earith kiln and this conclusion is confirmed by the chemical analysis. It is clear from the thin section and chemical data that the Iron Age and Roman shelly wares from Earith have different petrological and chemical compositions from each other and that neither is identical to the kiln waste.

The chemical data also show that none of the samples were produced in the large shelly ware producing area at Harrold, Bedfordshire, nor at Haddon, about 30 miles to the northwest of Earith. The data also indicate that the Earith Iron Age and Roman shelly wares have different chemical compositions from those of Iron Age and Roman shelly wares from the Lutton to Huntingdon pipeline. These various sites lie between 20-30 miles to the west and northwest of Earith.

The quartz grains found in the Romano-British shelly ware suggest a fenland source and it is quite possible that this ware was produced from a slightly different outcrop of Ampthill clay, from which selenite was absent (or had been removed by weathering). Ampthill clay outcrops as islands of earlier strata in the fens, for example at Chatteris, 9 miles to the north of Earith, and at various localities on the fen edge to the south of the Ouse. Weathering of Ampthill clay would also explain the presence of sparse rounded quartz grains, which would clearly not have been present in a freshly quarried Jurassic clay.

The source of the Iron Age samples, however, remains unclear since the main difference between them and those from northwest Cambridgeshire can be shown to be due to post-burial contamination.

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Appendix 1

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V4101	13.07	5.69	0.76	19.76	0.2	1.3	0.59	1.04	0.095
V4102	14.66	6.28	0.63	18.56	0.17	1.53	0.61	4.29	0.194
V4103	9.73	4.62	0.69	27.2	0.18	0.94	0.42	1.26	0.126
V4104	14.75	6.94	0.71	14.19	0.17	1.15	0.64	1.16	0.059
V4105	18.2	8.18	1.1	4.9	0.22	2.12	0.81	1.55	0.046
V4106	12.38	4.5	0.87	17.85	0.33	1.9	0.57	1.4	0.105
V4107	13.58	4.29	0.87	18.86	0.19	1.77	0.55	1.41	0.074
V4108	17.32	6.81	1.41	8.85	0.85	3.84	0.8	0.85	0.301
V4109	16.41	6.72	1.01	10.86	0.65	3.18	0.79	0.99	0.14
V4110	15.25	4.62	0.83	14.13	0.24	1.64	0.77	1.05	0.074
V4111	17.32	4.45	0.74	15.69	0.26	1.35	0.54	1.14	0.059
V4112	17.84	4.34	0.57	17.57	0.19	1.21	0.6	0.94	0.113
V4113	17.58	4.75	0.83	15.02	0.29	1.39	0.58	1.58	0.063
V4114	16.34	4.09	0.74	16.37	0.23	1.14	0.68	0.89	0.054
V4115	16.47	6.69	0.8	12.22	0.29	1.79	0.75	1.35	0.096
V4116	16.51	5.17	0.98	12.83	0.49	1.99	0.79	1.45	0.089
V4117	14.85	5.22	0.91	15.56	0.36	2.53	0.6	1.23	0.12

Appendix 2

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V4101	627	85	23	40	61	10	386	81	23	80	37	74	37.788	6.593	1.3448	3.2	2.2	10.93	56	22
V4102	976	91	27	42	73	12	760	79	69	77	64	158	70.594	19.916	4.1976	11.1	3.7	10.34	70	21
V4103	688	63	27	31	52	9	546	57	31	58	36	94	38.258	9.014	1.7304	4.7	2.5	7.27	64	15
V4104	685	97	27	59	89	11	343	94	26	87	38	75	39.01	7.218	1.4448	3.5	2.4	15.25	102	30
V4105	1261	156	31	51	80	17	261	111	31	82	49	100	50.196	9.046	1.7456	4.4	2.9	9.8	219	23
V4106	536	87	19	37	33	12	430	84	21	73	36	69	37.036	6.95	1.34	3.4	2	12.62	62	13
V4107	582	87	19	41	40	11	473	90	23	90	36	73	36.754	6.813	1.2568	3.1	2.1	10.42	85	14
V4108	671	121	24	64	47	15	403	107	23	115	45	84	47.282	7.057	1.5552	5.3	2.5	55.68	77	17
V4109	775	120	24	60	55	14	388	115	28	102	41	81	42.582	7.584	1.5624	4.3	2.8	15.59	102	22
V4110	687	119	25	44	36	14	374	102	21	79	39	72	39.292	6.214	1.2304	2.8	2.3	13.75	93	13
V4111	508	101	30	38	42	16	479	96	32	102	39	87	42.018	10.665	2.244	5.7	2.9	14.68	69	12
V4112	457	113	32	33	46	17	555	119	27	107	35	69	37.412	8.898	1.8528	4.8	2.7	17.16	54	11
V4113	887	102	40	43	72	17	574	106	36	115	51	116	53.862	12.475	2.42	6.3	3.5	14.42	90	20
V4114	518	109	31	51	45	15	505	118	28	100	31	64	33.652	7.773	1.5728	4.8	2.6	8.66	65	15
V4115	797	137	30	58	77	16	328	100	42	72	52	94	54.332	10.493	2.1648	5.8	3	9.53	97	19
V4116	892	123	26	48	34	15	412	119	22	97	41	66	41.36	6.549	1.1864	3	2.4	12.49	94	16
V4117	707	96	20	43	39	13	437	101	20	106	41	82	41.83	6.834	1.3824	3.5	2.1	13.15	76	15