The Petrology of some medieval pottery from the Tees Valley

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Introduction

Samples of some of the major local wares found at Hartlepool were selected for petrological and chemical analysis. The aims of this study were:

- To establish the validity of ware types defined by eye and used for classification of medieval pottery on sites in the Tees Valley.
- To determine whether or not any of theses wares could be characterised, ie whether a unique series of petrological and/or chemical characteristics could be used to recognise examples of the wares.

In total 29 samples were taken, initially intended to form a sample of six sherds of Tees Valley A ware, Tees Valley B ware, Tees Valley C ware, East Cleveland ware and Staxton-type ware. In the event, one sample of Tees Valley B ware was visually re-identified by the author as Scarborough ware, leaving only five Tees Valley B ware samples. The sherds were compared with a set of chemical data from the production site of Staxton, in the Vale of Pickering, and a set from the production site at Ruswarp Bank, on the outskirts of Whitby.

Geological background

The Tees Valley runs through Triassic mudstones and sandstones (the Mercian Mudstone and Sherwood Sandstone groups) with the Jurassic rocks of the North York Moors to the south and Permian overlying Carboniferous deposits to the north and west. Overlying this 'solid' geology are thick glacial tills, together with sands and gravels. Underlying deposits are exposed mainly on valley sides and in cliff faces.

Medieval pottery production is attested close to Durham (Aldin Grange), close to Whitby (Ruswarp Bank), in and around Scarborough, at a variety of sites in the Hambleton Hills and in the Valley of Pickering (Staxton and Potter Brompton). Several of these industries were sited so as to exploit white-firing clays (as used in Tees Valley A ware).

Petrological description

Tees Valley A ware

Tees Valley A ware is a white-firing sandy ware. In appearance it seems very similar to wares produced at Ruswarp Bank. Five samples were thin-sectioned, AG514 to AG518. All have a similar petrological character:

Abundant ill-sorted subangular quartz (and some microcline feldspar) up to 1.5mm across. Sparse iron-cemented sandstone fragments up to 0.8mm across. Sparse rounded opaque inclusions up to 0.2mm across and moderate clay pellets up to 2.0mm across. The clay matrix is isotropic and contains abundant quartz silt up to 0.1mm across. Two samples contained rounded ?sandstone or phosphate inclusions with quartz grains up to 0.2mm across and one sample had a reduced core and contained clay pellets high in carbon.

The inclusions in this fabric varied little in character or quantity and there is no reason to believe that the samples come from more than one source. However, statistical analysis of the chemical analysis (see below) reveals a heterogeneous group with samples falling into or close to clusters from the Hambleton Hills and Ruswarp Bank kilns, as well as samples which fell outside any clusters.

Tees Valley B and C wares

Tees Valley B ware is sometimes defined as a red earthenware with a white slip, applied whilst the pot was still on the wheel. Tees Valley C ware is defined as a similar redware without the use of white slip. Despite this definition, some of the sampled sherds of C ware had a white slip. There was, however, no petrological difference observed between any of these samples and it is concluded that the use of white slip might be a valid technological distinction but is not an indication of source in this instance. The chemical data likewise suggests that there is only one fabric group present.

Petrological analysis reveals an abundant, ill-sorted subangular quartz sand with grains up to 1.0mm across. Moderate rounded opaque inclusions up to 0.7mm across are present. Some of these opaques have a botryoidal structure, indicative of chemical or biological origin rather than being detrital grains. Moderate rounded clay pellets with a lower iron content than the matrix are also present. The clay matrix contains moderate quartz silt and muscovite up to 0.1mm across and is optically anisotropic. Where white slip is present in thin-section it was of two types, varying in the quantity of clasts present. One type had moderate subangular quartz grains in a fine-textured, highly birefringent anisotropic matrix and the other contained abundant quartz and muscovite silt.

Principal Components analysis of the ICPS data for this group shows that the data form a single elongate cluster with slipped and unslipped samples occurring randomly within the cluster. This suggests that the probable presence of white slip in some of the samples has not led to a dilution of the chemical composition of the clays.

East Cleveland ware

East Cleveland ware was defined by Blaise Vyner and is a coarse sand-tempered oxidized ware, normally with a grey or black core. Two distinct fabrics were present in the six samples submitted for analysis.

Four samples (AG531, AG532, AG533 and AG535) contained abundant quartzose sand with grains up to 1.5mm across. The larger grains were of a coarse, loosely-packed sandstone, with overgrown quartz

grains up to 1.0mm across and small amounts of opaque materials in the interstices between the grains. It is likely that this sandstone was the source of most of the sand temper. The clay matrix was optically anisotropic and characterised by numerous laminae running parallel with the pot surfaces and sparse quartz and muscovite silt. In some samples the core of the sample was carbon-blackened.

Two samples (AG534 and AG536) had a finer quartzose sand temper. Sandstone was present here also, but the texture of the sandstone was finer than that of the sand as a whole. The clay matrices were reduced blue-grey and optically isotropic and contained moderate quartz and muscovite silt with grains up to 0.2mm across. The surfaces also had a slightly redder colour, indicating a higher firing temperature than in the first group (iron content is similar for both groups).

These two groups have similar a chemical composition but the second group has higher P2O5 and Mn and lower Cu, Zn and Zr than the first group.

Scarborough ware

A sample of Scarborough ware was inadvertently submitted for analysis (AG524). It contained abundant subangular quartz sand up to 0.5mm across and sparse to moderate muscovite flakes up to 0.3mm long in an anisotropic clay matrix with abundant quartz silt up to 0.1mm across.

This ware is distinguishable from Tees Valley B/C ware by its finer sand, the lack of opaques and the size and quantity of muscovite laths.

Staxton-type ware

Staxton-type ware, like East Cleveland ware, is an oxidized fabric with a grey or black core. The distinctive feature of the ware is the use of handforming to produce the bodies of vessels which then have rims trued-up or thrown on a wheel. A sample of six sherds of Staxton-type ware from Hartlepool (AG537 to AG542) was submitted for analysis and comparison with six sherds from the kiln site of Staxton in the Vale of Pickering.

The Hartlepool sherds all had a consistent fabric consisting of a quartzose sand with sparse to moderate sandstone fragments up to 1.5mm across, abundant subangular quartz sand up to 1.0mm across and sparse muscovite flakes up to 1.0mm across. The sandstone sometimes includes muscovite laths, confirming that these, like the quartz sand, were probably derived from the sandstone. The clay matrix is sometimes optically anisotropic and sometimes isotropic and contains moderate amounts of angular quartz up to 0.1mm across. In contrast with the East Cleveland ware (subfabric 1), the clay matrix is slightly siltier and not laminated. With this exception, the main difference between the two fabrics is the presence of the large muscovite flakes.

The chemical composition of the Hartlepool Staxton-type ware shows that it can be distinguished from actual Staxton ware through the frequency of rare earths. The Staxton examples contained lower frequencies of LI, NB, NI, V, Y, LA, ND, SM, EH, DY and YB.

Chemical analysis

Inductively-coupled plasma spectroscopic analysis was carried out on these samples by Dr N Walsh, Department of Geology, Royal Holloway College, London. The results, together with comparanda for whiteware production sites at Ruswarp Bank and the Hambleton Hills and the Staxton production site were analysed using the Principal Components Analysis module within the Bonn Archaeological Statistics Package for Windows (WinBASP).

The data were analysed in three groups:

- major elements (Appendix two)
- minor and trace elements (Appendix three)
- Rare Earths (Appendix four)

Broadly speaking, the major elements will reflect the composition of a combination of clastic inclusions (eg iron, manganese, calcium and potassium) and the clay matrix (eg iron, manganese and aluminium) whereas the Rare Earths are most likely to reflect differences in the composition of the clay matrix alone. Since petrological analysis shows that the main tempering material in all cases is sandstone-derived sand, with similar mineralogical characteristics whereas at least two distinct clay matrices are present (light-firing and red-firing) with variations depending on the amount of silt-sized quartz and muscovite it might be predicted that the clearest distinction between fabric groups would come from the third of these analyses, the Rare Earths.

In practice, however, the results are not so clear-cut. The major elements plot (Appendix two) shows that Tees Valley A and Tees Valley B/C wares cannot be distinguished from each other. East Cleveland ware, Hartlepool Staxton-type ware and Staxton type ware can be distinguished, although they plot very closely to each other. York Gritty ware (a coarse whiteware, somewhat similar to Tees Valley A ware plots separately, as do a range of Hambleton Hills wares (York glazed ware, Brandsby ware, Ryedale Ware, Hambleton ware). The only ware which does not cluster neatly on its major elements is in fact the samples from the Ruswarp Bank kilnsite which overlaps with the Tees valley wares, the York Gritty ware and the Hambleton Hills wares.

The minor and trace elements (Appendix three) show three major clusters - a York Gritty cluster, a Hambleton Hills cluster and one large cluster containing all other samples. Within this third cluster the individual wares do fall into more discrete areas but with some overlap between these clusters.

The Rare Earths plot (Appendix Four) in fact only shows one fabric group clearly separated from the remainder - the Staxton ware. The remainder form one large, diffuse cluster with the Ruswarp Bank samples spanning the entire cluster. As before, there is patterning within the cluster and individual pairs of fabrics can be distinguished.

Conclusions

Ceramic petrology and chemical analysis between them show that there are six distinct fabrics within the material submitted for analysis:

Tees Valley A

Tees Valley B/C

East Cleveland - sub group 1

East Cleveland - sub group 2

Scarborough

Hartlepool Staxton-type

These wares can be distinguished from each other using a combination of petrological and chemical characteristics. The fact that several of the wares do not readily form chemical clusters suggests that they may be sharing basic raw materials. In particular, the white-firing clay used at Ruswarp Bank may be similar to that used for Tees Valley A ware whilst the similarity in inclusions and in chemical composition between the two East Cleveland fabrics and the Hartlepool Staxton-type ware suggests that these too exploited similar, but distinct, raw materials.

Appendix One: ICPS analyses

a) Tees Valley A ware

TS No	AL2O3	FE2O3	MGO	CAO	NA2O	K2O	TIO2	P2O5	MNO
AG514	20.08	2.79	0.83	0.46	0.18	1.91	1.09	0.10	0.02
AG515	19.50	3.31	0.82	0.46	0.52	1.61	1.24	0.09	0.02
AG516	17.19	4.36	1.01	2.41	0.67	1.98	0.86	0.24	0.03
AG517	18.52	3.17	0.82	0.30	0.28	2.19	0.93	0.10	0.01
AG518	21.96	3.28	0.88	0.45	0.32	1.56	1.31	0.11	0.01
Mean	19.45	3.38	0.87	0.82	0.39	1.85	1.09	0.13	0.02

TS No	BA	CO	CR	CU	LI	NB	NI	SC	SR	V	Y	ZN	ZR_
AG514	278.00	5.00	134.00	32.00	97.00	26.00	36.00	16.00	77.00	148.00	18.00	37.00	58.00
AG515	238.00	9.00	137.00	32.00	138.00	33.00	55.00	15.00	56.00	159.00	19.00	41.00	64.00
AG516	390.00	12.00	121.00	80.00	71.00	20.00	49.00	16.00	181.00	176.00	41.00	49.00	74.00
AG517	313.00	8.00	127.00	25.00	74.00	22.00	38.00	15.00	77.00	159.00	28.00	40.00	48.00
AG518	242.00	8.00	147.00	36.00	266.00	30.00	58.00	18.00	78.00	195.00	22.00	59.00	80.00
Mean	292.20	8.40	133.20	41.00	129.20	26.20	47.20	16.00	93.80	167.40	25.60	45.20	64.80

TS No	LA	CE	ND	SM	EU	DY	YB
AG514	47.00	105.00	36.00	10.70	1.60	3.80	1.50
AG515	49.00	113.00	37.00	11.10	1.70	4.10	1.50
AG516	97.00	217.00	70.00	19.60	3.50	8.70	2.90
AG517	99.00	244.00	72.00	21.10	3.70	7.80	1.70

AG518	49.00	106.00	33.00	9.30	1.50	3.90	1.90
Mean	68.20	157.00	49.60	14.36	2.40	5.66	1.90

b) Tees Valley B/C ware

TSNO	AL2O3	FE2O3	MGO	CAO	NA2O	K2O	TIO2	P2O5	MNO
AG519	21.52	5.92	0.93	0.37	0.23	1.91	1.24	0.08	0.03
AG520	19.44	5.83	0.91	0.46	0.16	1.84	1.12	0.12	0.01
AG521	18.69	7.22	0.85	0.43	0.17	1.81	1.05	0.10	0.03
AG522	18.27	4.99	0.73	0.25	0.17	1.33	1.18	0.11	0.02
AG523	18.04	7.51	0.93	0.38	0.18	1.69	0.96	0.18	0.02
AG525	19.30	6.53	0.96	0.45	0.18	2.13	1.20	0.17	0.02
AG526	19.24	7.64	0.96	0.38	0.22	1.87	1.02	0.21	0.02
AG527	18.25	5.89	0.94	0.37	0.19	1.89	1.22	0.14	0.03
AG528	19.47	7.57	0.81	0.39	0.17	1.68	1.02	0.13	0.01
AG529	20.40	5.51	1.12	0.43	0.23	2.34	1.11	0.23	0.02
AG530	15.99	3.66	0.84	0.30	0.23	2.42	1.37	0.09	0.01
Mean	18.96	6.21	0.91	0.38	0.19	1.90	1.14	0.14	0.02

TSNO	BA	CO	CR	CU	LI	NB	NI	SC	SR	V	Y	ZN	ZR_
AG519	302.00	7.00	149.00	38.00	85.00	29.00	45.00	18.00	75.00	146.00	20.00	50.00	67.00
AG520	236.00	8.00	133.00	118.00	70.00	28.00	47.00	15.00	71.00	137.00	25.00	48.00	71.00
AG521	272.00	8.00	133.00	475.00	57.00	25.00	38.00	17.00	62.00	134.00	12.00	68.00	64.00
AG522	213.00	5.00	130.00	80.00	100.00	28.00	37.00	13.00	57.00	117.00	12.00	52.00	64.00
AG523	272.00	8.00	128.00	429.00	74.00	23.00	40.00	15.00	76.00	127.00	11.00	122.00	58.00

AG525	350.00	9.00	132.00	39.00	82.00	28.00	42.00	16.00	107.00	127.00	20.00	65.00	69.00
AG526	282.00	8.00	135.00	220.00	74.00	24.00	31.00	14.00	111.00	121.00	13.00	92.00	54.00
AG527	318.00	10.00	132.00	45.00	73.00	31.00	35.00	15.00	98.00	134.00	13.00	70.00	65.00
AG528	252.00	8.00	136.00	33.00	97.00	25.00	40.00	15.00	71.00	143.00	16.00	49.00	58.00
AG529	310.00	8.00	143.00	37.00	89.00	26.00	43.00	17.00	106.00	166.00	16.00	80.00	60.00
AG530	427.00	6.00	123.00	37.00	48.00	36.00	34.00	14.00	85.00	122.00	16.00	61.00	71.00
Mean	294.00	7.73	134.00	141.00	77.18	27.55	39.27	15.36	83.55	134.00	15.82	68.82	63.73

TSNO	LA	CE	ND	SM	EU	DY	YB
AG519	53.00	118.00	32.00	9.70	1.60	3.90	1.60
AG520	63.00	141.00	40.00	11.40	1.90	4.70	1.70
AG521	41.00	86.00	21.00	6.90	1.10	2.30	1.10
AG522	35.00	70.00	18.00	5.40	0.90	1.70	0.90
AG523	34.00	68.00	13.00	5.20	0.80	1.70	0.90
AG525	51.00	109.00	28.00	8.10	1.40	3.30	1.50
AG526	46.00	94.00	19.00	6.90	1.10	2.10	0.90
AG527	46.00	94.00	24.00	7.20	1.10	2.40	1.00
AG528	36.00	74.00	17.00	6.80	1.00	2.70	1.20
AG529	50.00	103.00	27.00	8.10	1.30	2.80	1.30
AG530	51.00	102.00	31.00	8.60	1.40	3.20	1.20
Mean	46.00	96.27	24.55	7.66	1.24	2.80	1.21

c) East Cleveland Ware

TSNO	AL2O3	FE2O3	MGO	CAO	NA2O	K2O	TIO2	P2O5	MNO
AG536	14.80	4.36	1.18	0.44	0.48	2.05	0.71	0.15	0.02
AG532	15.79	5.10	1.15	0.68	0.64	1.99	0.76	0.23	0.07

AG534	16.24	4.49	1.14	0.59	0.50	1.54	0.74	0.15	0.03
AG533	16.91	4.29	0.90	0.79	0.57	2.13	0.70	0.81	0.06
AG531	16.42	4.27	0.75	0.66	0.35	1.51	0.73	0.19	0.03
AG535	13.26	3.95	0.67	0.90	0.43	1.46	0.63	0.79	0.08
mean	15.57	4.41	0.97	0.68	0.50	1.78	0.71	0.39	0.05

TSNO	BA	CO	CR	CU	LI	NB	NI	SC	SR	V	Y	ZN	ZR_
AG536	460.00	10.00	98.00	808.00	66.00	15.00	42.00	13.00	87.00	100.00	15.00	70.00	43.00
AG532	557.00	14.00	104.00	52.00	99.00	16.00	44.00	13.00	96.00	100.00	16.00	98.00	45.00
AG534	590.00	11.00	104.00	89.00	69.00	15.00	44.00	13.00	91.00	100.00	18.00	60.00	43.00
AG533	933.00	9.00	107.00	26.00	69.00	15.00	44.00	13.00	119.00	103.00	13.00	85.00	49.00
AG531	522.00	16.00	104.00	25.00	78.00	16.00	39.00	13.00	73.00	103.00	14.00	85.00	60.00
AG535	1190.00	10.00	87.00	86.00	82.00	13.00	36.00	11.00	111.00	71.00	13.00	77.00	46.00
mean	708.67	11.67	100.67	181.00	77.17	15.00	41.50	12.67	96.17	96.17	14.83	79.17	47.67

TSNO	CE	ND	SM	EU	DY	YB
AG536	85.00	22.00	7.70	1.10	2.90	1.20
AG532	87.00	25.00	7.70	1.10	3.00	1.30
AG534	89.00	27.00	8.40	1.40	3.30	1.30
AG533	86.00	24.00	7.10	1.10	2.40	1.10
AG531	80.00	22.00	6.10	0.90	2.30	1.30
AG535	72.00	19.00	6.20	0.90	2.40	1.10
mean	83.17	23.17	7.20	1.08	2.72	1.22

d) Hartlepool Staxton-type ware

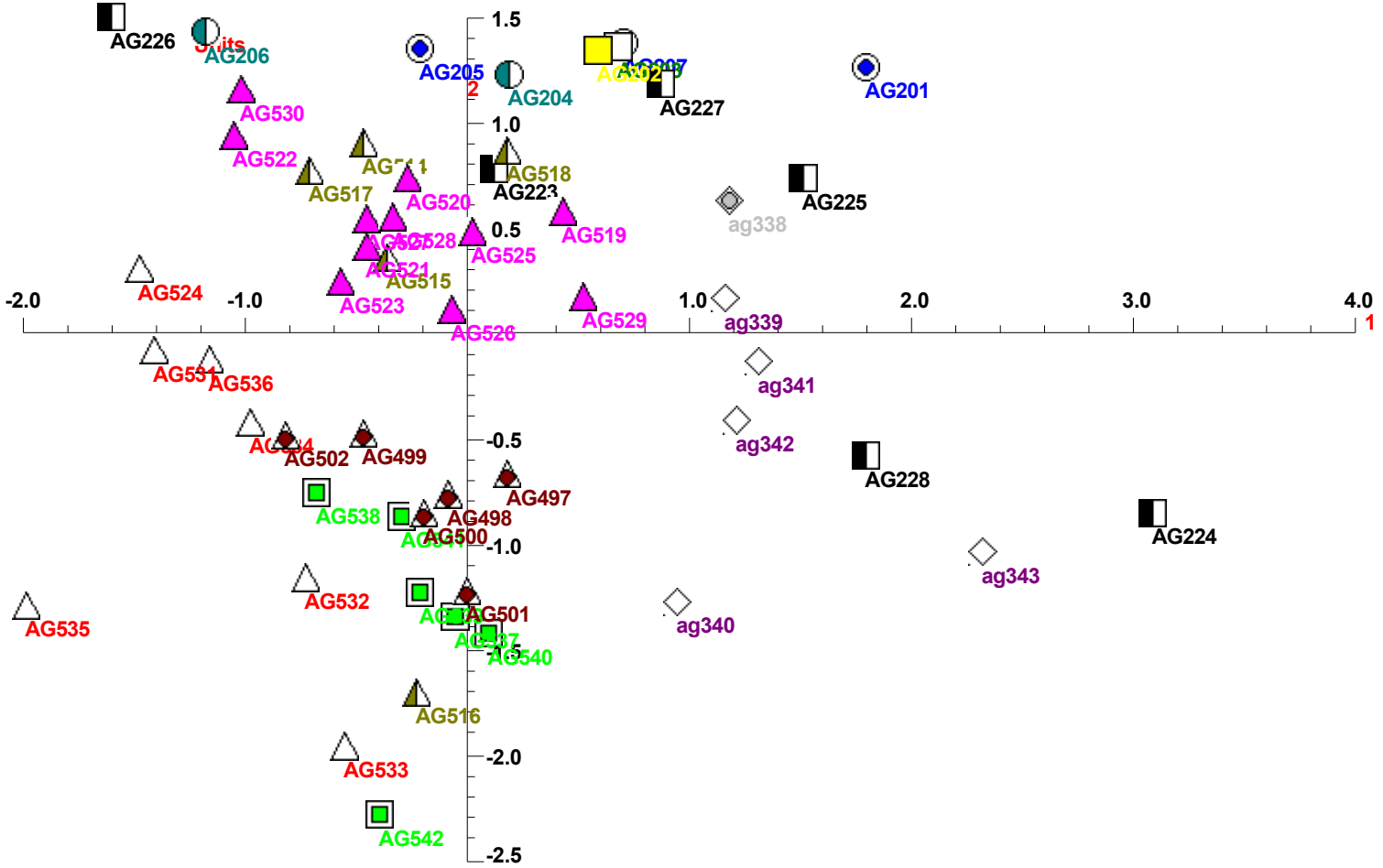
TSNO	AL2O3	FE2O3	MGO	CAO	NA2O	K2O	TIO2	P2O5	MNO
AG540	16.39	5.18	1.76	0.84	0.46	2.32	0.69	0.49	0.03
AG537	16.68	5.70	1.56	0.77	0.50	2.05	0.75	0.40	0.04
AG539	16.66	4.56	1.45	0.83	0.49	2.32	0.67	0.32	0.05
AG541	16.81	4.53	1.31	0.70	0.49	2.43	0.73	0.21	0.05
AG538	16.44	3.64	1.25	0.74	0.42	2.05	0.69	0.37	0.03
AG542	17.50	6.06	1.19	0.57	0.37	2.04	0.75	0.14	0.21
Mean	16.75	4.95	1.42	0.74	0.46	2.20	0.71	0.32	0.07

TSNO	BA	CO	CR	CU	LI	NB	NI	SC	SR	V	Y	ZN	ZR_
AG540	452.00	13.00	114.00	27.00	62.00	14.00	50.00	14.00	160.00	102.00	17.00	70.00	69.00
AG537	635.00	11.00	112.00	61.00	72.00	15.00	53.00	14.00	141.00	103.00	22.00	86.00	67.00
AG539	509.00	11.00	107.00	42.00	66.00	14.00	53.00	13.00	142.00	100.00	17.00	66.00	58.00
AG541	473.00	9.00	112.00	31.00	71.00	15.00	42.00	13.00	120.00	100.00	18.00	53.00	59.00
AG538	707.00	9.00	100.00	32.00	61.00	13.00	43.00	13.00	143.00	92.00	21.00	46.00	47.00
AG542	485.00	19.00	114.00	22.00	78.00	15.00	34.00	14.00	111.00	104.00	14.00	53.00	55.00
Mean	543.50	12.00	109.83	35.83	68.33	14.33	45.83	13.50	136.17	100.17	18.17	62.33	59.17

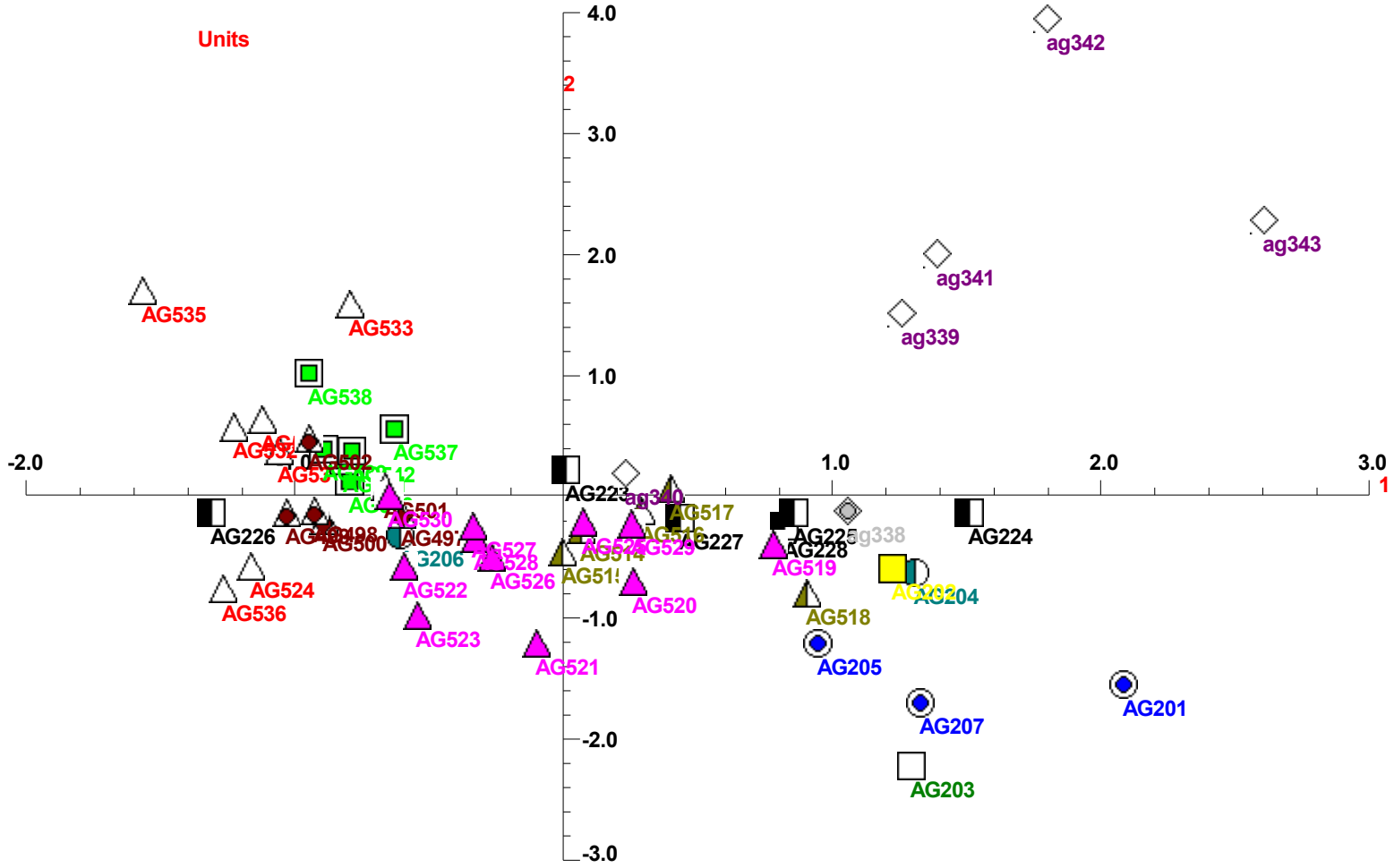
TSNO	LA	CE	ND	SM	EU	DY	YB
AG540	42.00	87.00	23.00	7.90	1.10	3.00	1.60
AG537	49.00	96.00	27.00	8.90	1.40	3.80	1.80
AG539	46.00	91.00	25.00	7.30	1.20	2.90	1.30
AG541	47.00	93.00	27.00	8.40	1.30	3.30	1.50
AG538	50.00	101.00	30.00	9.20	1.50	3.60	1.50

AG542	47.00	94.00	22.00	7.60	1.10	2.70	1.30
Mean	46.83	93.67	25.67	8.22	1.27	3.22	1.50

Appendix Two



Appendix Three



Appendix Four