Characterisation studies of the Anglo-Saxon pottery from Norton, Cleveland

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The Anglo-Saxon cemetery at Norton produced 19 Anglo-Saxon vessels, mostly accompanying inhumations but including two cremation vessels. The vessels have all been studied and published by Wendy Sherlock, who assigned them all to one of four fabrics, identified by eye following binocular microscope study (REF).

Binocular microscope survey

Of the 19 Anglo-Saxon vessels from the Norton cemetery, 15 were examined by the author under x20 magnification (Table 1). Their fabrics were classified into four groups:

- CHARN: angular fragments of biotite granite.
- ESAXLOC: inclusions which suggest a local origin (in this case mainly the voids from rounded limestone).
- SST: predominantly sandstone inclusions of unclassified types.
- SSTMG: inclusions mainly of Millstone Grit-type sandstone.

In addition, all inclusions over 0.1mm across which could be identified were listed. Binocular microscope study is not wholly reliable for the study of such vessels as these for several reasons:

- the complete nature of some of the vessels masks the fabric.
- The presence of carbon throughout the body of many vessels masks many of the inclusions and makes the identification of others difficult or impossible.
- Several of the inclusion types cannot easily be distinguished by eye (eg siltstones and fine-grained basic igneous rocks).

For this reason, samples were take for thin section and chemical analysis. It was only possible to sample 7 of the 15 vessels seen and on the basis of inclusions identified by eye the unsampled vessels have been tentatively assigned to a petrological subfabric (Table 1).

Table 1

REFNO	TSNO	cname	Context	Sherlock Fabric	subfabric	Subfabric
GRAVE 45		SST	SF157	1	prob 1	SSTMG >2.0MM
GRAVE		SST	SF470	1	prob new	red-coated slightly rounded SST, probably CM; biotite

107					subfabric	>2.0mm;Muscovite >2.0mm
GRAVE 2		ESAXLOC		1	prob 6	R VOIDS >2.0MM;R FEORE>2.0MM;R Q (PERMIAN)>1.0MM
GRAVE 92.2		ESAXLOC	SF374	1	prob 5	M VOIDS >5.0MM IN FINE GROUNDMASS
GRAVE 115	V1654	SST		1	4	
GRAVE 114	V1656	SST	SF97	1	3	M SSTMG >2.0MM
GRAVE 119	V1657	ESAXLOC	SF591	1	5	A R VOIDS >3.0MM;S R Q (PERMIAN?) >2.0MM;S SQ Q >2.0MM;S FINEGRAINED RED SST
GRAVE 100.2	Not seen	SST		2		
GRAVE 25	Not seen	SST		2		
GRAVE 40	Not seen	SST		2		
GRAVE 100.3		SST		2	prob 1	SSTMG;MUSC;FINE GROUNDMASS
GRAVE 11	V1652	SSTMG	SF636	2	1	A SSTMG >2.0MM
GRAVE 96.1	V1658	SST	SF390	2	3	SST - COARSE GRAINS LOOSELY-CEMENTED;FINE-GRAINED RED SST >3.0MM
GRAVE 39.1		CHARN	SF122	3	prob 2	BIOTITE >2.0MM;ANG GRANITE >4.0MM;FINE GROUNDMASS
GRAVE 36		CHARN	SF119	3	prob 2 or 3	M A BIOTITE;M A FELDSPAR
GRAVE 33	V1650	CHARN	SF152	3	prob 2	BIOTITE >2.0MM;ANG GRANITE >4.0MM;FINE GROUNDMASS
GRAVE 106.2	V1651	CHARN		3	2	M A BIOTITE;M A FELDSPAR
GRAVE 53	not seen			4		
GRAVE 86.8	V1655	ESAXLOC	SF348	4	6	ROUNDED LST;ROUNDED MEDIUM-GRAINED RED SST

Petrological analysis

Samples of seven vessels were examined in thin-section. These sections were grouped into six subfabrics (Table 2).

Table 2

TS NO:	Cname	Subfabric	Context	Form
V1651	CHARN	2		JAR/BOWL
V1652	SSTMG	1	SF636	BOWL?
V1654	SST	4		JAR?
V1655	ESAXLOC	6	SF348	JAR
V1656	SST	3	SF97	JAR?
V1657	ESAXLOC	5	SF591	JAR
V1658	SST	3	SF390	BOWL

Subfabric 1

This subfabric contains moderate inclusions of Millstone Grit-type sandstone and carboniferous chert in a fine-grained groundmass.

Subfabric 2

This subfabric contains moderate inclusions of biotite granite, fine-grained sandstone and chaff in a fine-grained groundmass.

Subfabric 3

This subfabric contains moderate inclusions of biotite granite and Millstone Grit-type sandstone in a groundmass of angular fine sand grains up to 0.3mm across.

Subfabric 4

This subfabric contains moderate inclusions of Millstone Grit-type sandstone and a fine-grained sandstone in a groundmass of angular fine sand up to 0.3mm across.

Subfabric 5

This subfabric contains moderate rounded fragments of micaceous siltstone, greywacke, brown-stained phosphate, opaque grains and basic igneous rocks up to 1.5mm across together with rounded voids of similar size in a groundmass of anisotropic clay minerals, sparse angular quartz silt and muscovite laths up to 0.1mm long.

Subfabric 6

This subfabric contains rounded fragments of a fine-grained dolomitic limestone, angular calcite, shelly limestone, partly altered to dolomite, fine-grained sandstone with overgrown grains up to0.2mm across, fine-grained sandstones containing angular quartz sand in an opaque matrix, rounded brown clay pellets, rounded feldspar and subangular quartz grains. The groundmass contains sparse angular quartz up to 0.1mm across.

Discussion

The un-sampled vessels could mainly be assigned to a petrological subfabric on the basis of the visible inclusions. There was one vessel, however, which appears to have a range of inclusions not seen in the thin sectioned samples (Grave 107, Table 3). These inclusions do indicate a similar range to that found in subfabrics 1 to 4.

Table 3

subfabric	CHARN	ESAXLOC	SST	SSTMG	Grand Total
1				1	1

	2	1				1
	3			2		2
	4			1		1
	5		1			1
	6		1			1
prob 1				2		2
prob 2		2				2
prob 2 or 3		1				1
prob 5			1			1
prob 6			1			1
prob new subfabric				1		1
Grand Total		4	4	6	1	15

Subfabrics 1 to 4 are examples of types known from several Anglo-Saxon sites in North Yorkshire and there is no obvious difference in petrology between these subfabrics and those, for example, from Catterick or Piercebridge. Although there are real differences between the subfabrics, which up to a point are visible by eye, the similarity in the groundmass of subfabrics 1 and 2 and of subfabrics 3 and 4 may suggest that these were made from two different parent clays to which differing inclusions were added.

This similarity may be due to the use of similar materials in both areas but might indicate that the users of the Norton cemetery obtained some of their pottery from the same sources as the inhabitants of Catterick and Piercebridge.

Subfabrics 5 and 6, however, are clearly quite different, both from each other and from these Vale of York types. In both cases, the range of inclusions suggests the use of a rounded detrital sand in a fine-grained clay. The micaceous siltstone seen in subfabric 5 is similar to those of the Jurassic strata of the North Yorkshire moors and a very similar range of rocks can be seen in beach sands from Scarborough and Robin Hood's Bay, and no doubt also further north towards the mouth of the Tees. The rounded gravel may have been obtained from the beach but similar material is present in the boulder clay exposed along the coast and similar deposits must extend some way inland. Subfabric 6 does not contain these potentially Jurassic inclusions and the limestones are partly or wholly composed of dolomite. This would suggest that they are of Permian age. This might indicate a source to the north of the Tees but Permian limestone was transported southwards both in glacial deposits and probably by recent marine action. It is not known whether Quaternary sands and boulder clays in the Tees valley itself contain similar inclusions. However, both the range of inclusions and the distribution of vessels with similar fabrics suggests a coastal origin.

Petrological analysis therefore suggests that four of the vessels may have come from a source or sources to the east of Norton whilst eleven may have been made from materials which may occur locally or may have been obtained from the Vale of York, to the west.

Chemical analysis

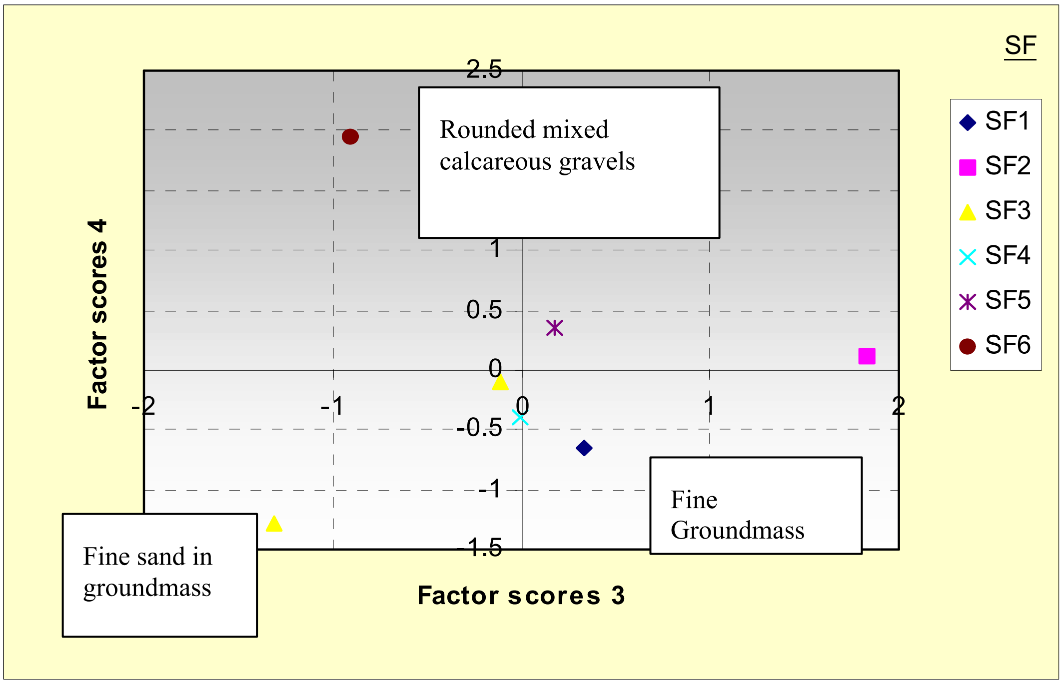
Subsamples of all the thin section samples were removed and submitted for chemical analysis using Inductively Coupled Plasma Spectroscopy. The frequency of a range of major, minor and trace elements was determined (Appendix 1). The major elements were measured as percent oxides (Appendix 1a) and the remainder as parts per million (Appendix 1b).

The dataset was first examined to see if any measured elements were atypical, in other words having values more than 4 standard deviations from the mean. No such values were encountered.

The dataset was then analysed using factor analysis (App 2). Four factors with eigenvalues greater than 1 were found, accounting for 93.58% of the variance in the data. Factors 1 is determined mainly by high loadings for some of the rare earth elements, principally Dy, Eu, Y and Sm, and negative values for Li. The loadings appear to have no correlation with petrological fabric. Factor 2 has high loadings for V, Cr, Fe2O3 and TiO2. This suite of elements is probably associated with iron, which may take the form of iron-rich inclusions, iron compounds in the clay fraction of the parent clay or post-burial encrustation. Thin section evidence suggests that both inclusions and clay are responsible for this iron content with no sign of iron pan or similar concretions. High Factor 2 loadings are correlated with variations in Al2O3 content suggesting that iron in the groundmass is the main determinant of factor 2.

Factor 3 has high loadings for K2O and Pb and negative loadings for Cu and Zr. There is some correlation with petrological composition here, in that the higher scores were assigned to samples with few inclusions in the groundmass. This is probably due to the presence of zircon in the fine sand fraction. Factor 4 has high loadings for Zn, CaO, Ba and Sr and separates subfabric 6 from the remainder (Fig 1), including from the other rounded mixed calcareous gravel tempered fabric.

With this one exception, little of the variation in chemical composition appears to have any correlation with the visible petrological characteristics.



Comparison with other assemblages

Since the inclusions found in most of the Norton samples are of rock types which occur widely in the fluvio-glacial deposits of the north of England the data were compared with similar analyses obtained from nearby sites whose pottery fabrics include the same range of petrological subfabrics as Norton subfabrics 1 to 4. These sites consist of three in the northern part of the Vale of York: Catterick, Piercebridge and Scorton and individual analyses from Hartlepool, Redcar and Tollesby.

Factor analysis of this dataset, including only those fabrics containing sandstone, quartz and biotite granite inclusions, shows that there is little evidence for inter-site variation in composition although the Norton samples, irrespective of their petrological characteristics, are in general more similar to each other than to samples from other sites. Furthermore, the Tollesby, Redcar and Hartlepool samples are also chemically similar (Fig 00). This is true for Factors 1, 2, 3 and 4. There are various possible interpretations of this pattern but the main competing models are:

a) that all the pottery was made in a single area and traded to these consumer sites. The presence of clusters within the data would then have to be due to post-burial alteration of the pottery fabric.

b) that there are several sources for this pottery but that the parent clays are almost identical. The similarity of the Norton, Tollesby, Redcar and Hartlepool samples would then suggest that these sites might have shared one source of clay whereas some or all of the Catterick, Scorton and Piercebridge samples might come from one or more other sources.

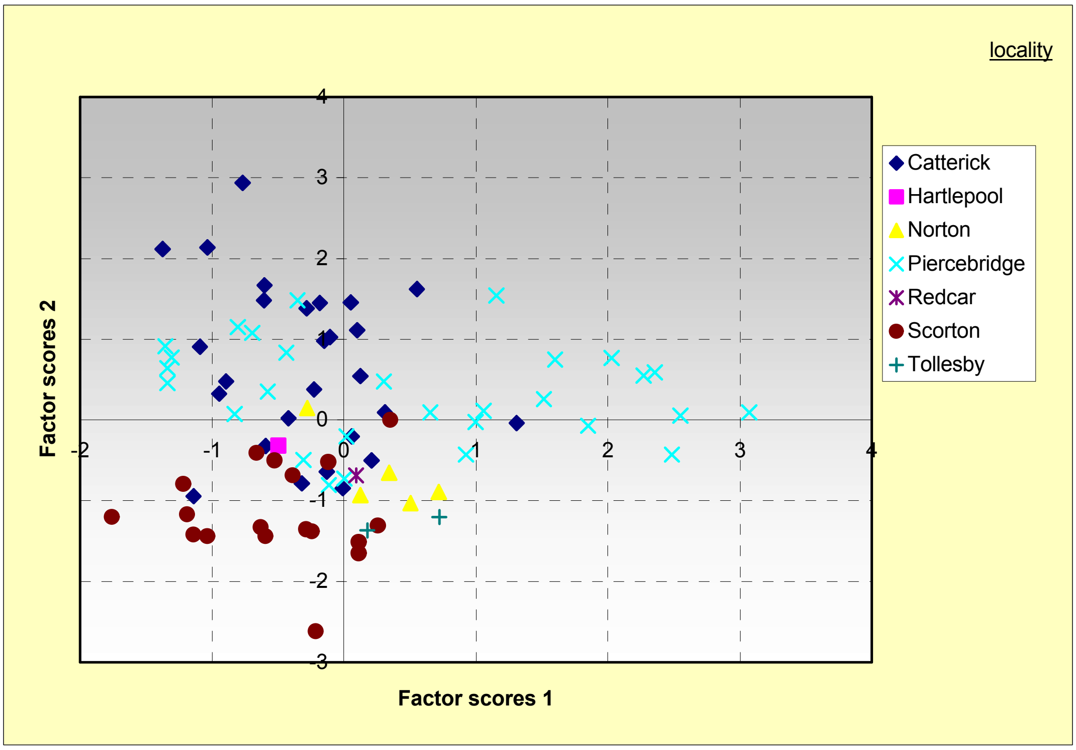


Figure 1

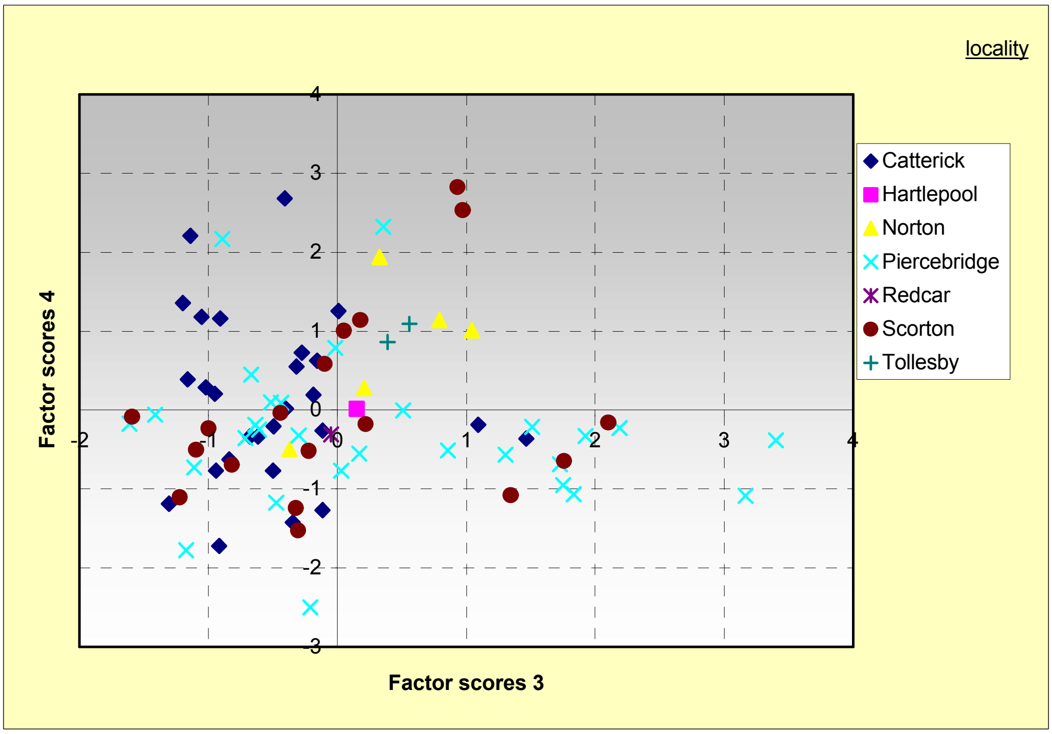


Figure 2

The factor analysis data were then grouped by broad fabric group and replotted (Fig 00). This shows that a group of Scorton SST vessels have lower Factor 2 scores than the remainder, and might therefore be from a different source. The remaining samples, however, show only slight variations in composition. The difference may perhaps be due to the contribution to the overall composition of the igneous rock temper in the CHARN fabric group compared with the sandstone inclusions found in the SST samples.

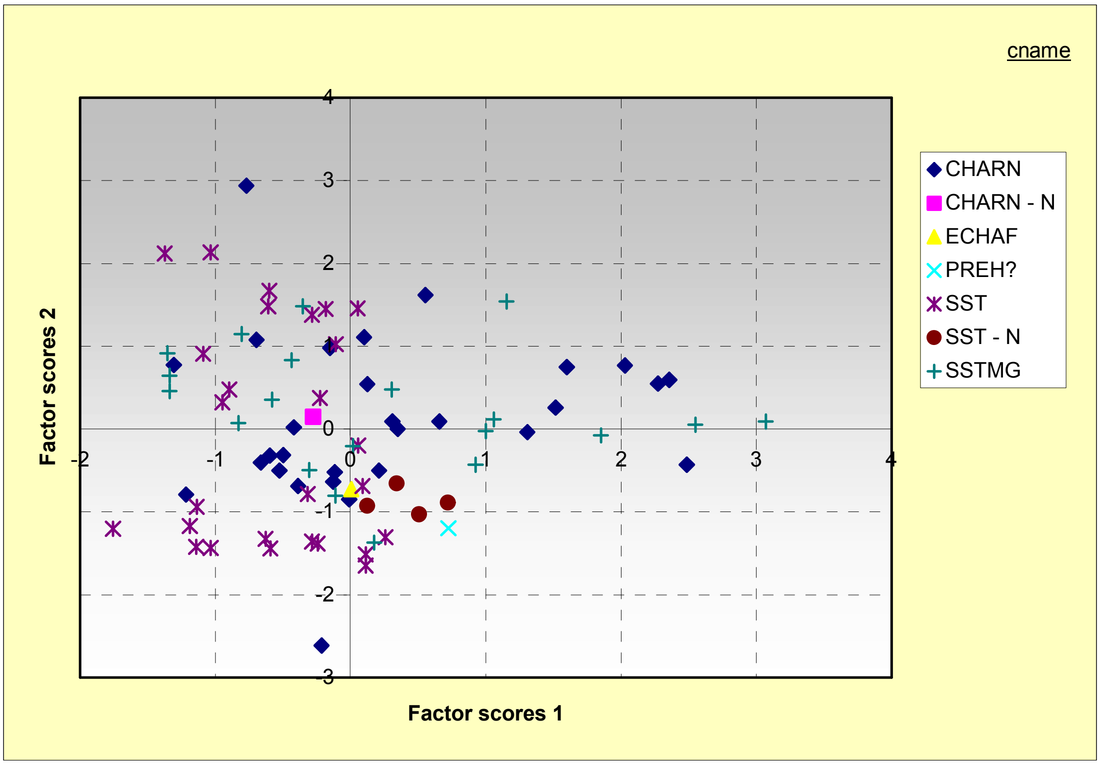


Figure 3

A final attempt to distinguish between local and centralised production was made by carrying out a factor analysis for the least mobile elements. This analysis excluded P2O5, Fe2O3 and its associated trace elements (V, Co and Ni), CaO (and Sr), Ba and the rare earth elements. The results show only one factor and when this factor is plotted against the unmeasured fraction of the sample ('silica', chemically-combined water, organic matter) the result is a straight line (Fig 6).

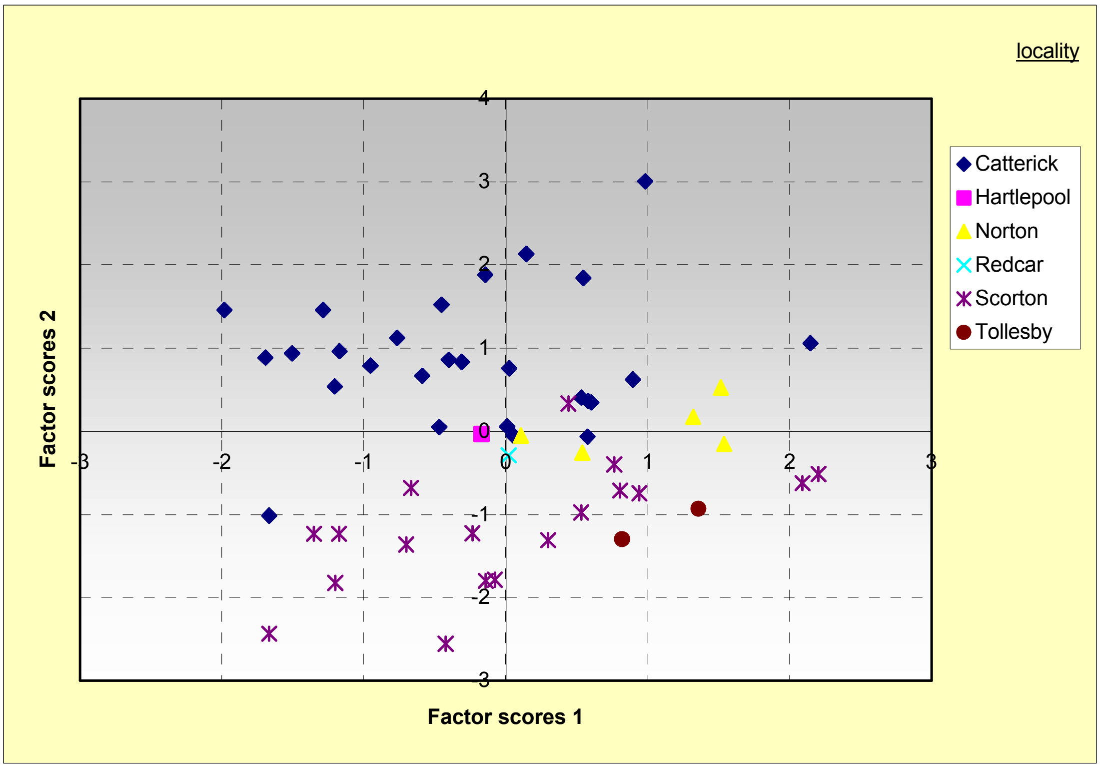


Figure 4

However, simple scatterplots of some pairs of elements in this dataset shows that there are indeed intersite differences between the samples. In particular the ratio of Zr to TiO2 shows a slight difference between sandstone and granitic tempered vessels. Both elements are more common in the latter and TiO2 is higher relative to Zr in the granitic wares. However, Zr is much less common in the samples from Catterick than in the other samples, no matter what petrological characteristics they have. Zirconium (Zr) is normally found in zircon, a heavy mineral which survives erosion well and is normally concentrated in detrital sands. However, the 'silica' content of the Catterick samples is high, comparable with Scorton, and yet the Scorton samples have much higher Zr levels. This difference is likely to be due to the sand and silt fractions of these samples. The proportion of Zircon to quartz and other siliceous minerals is likely to decline as the material is sorted during transport. Gravels will have a higher proportion than sands, which will have a higher proportion than silts, which will have a higher proportion than clays.

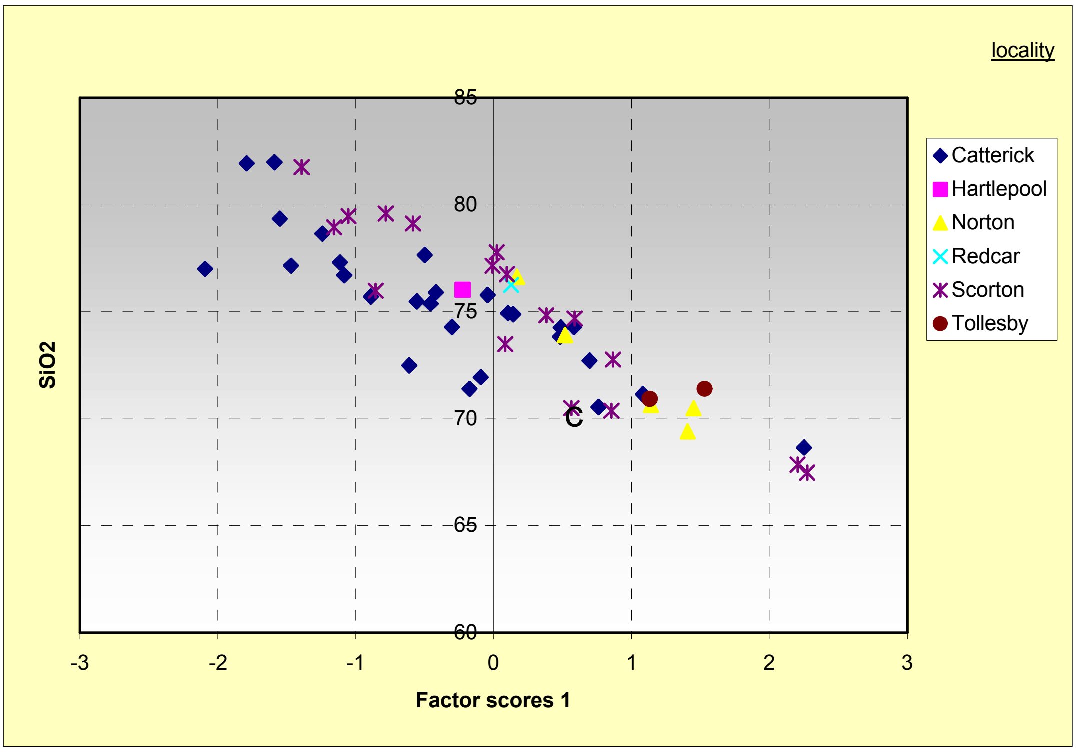


Figure 5

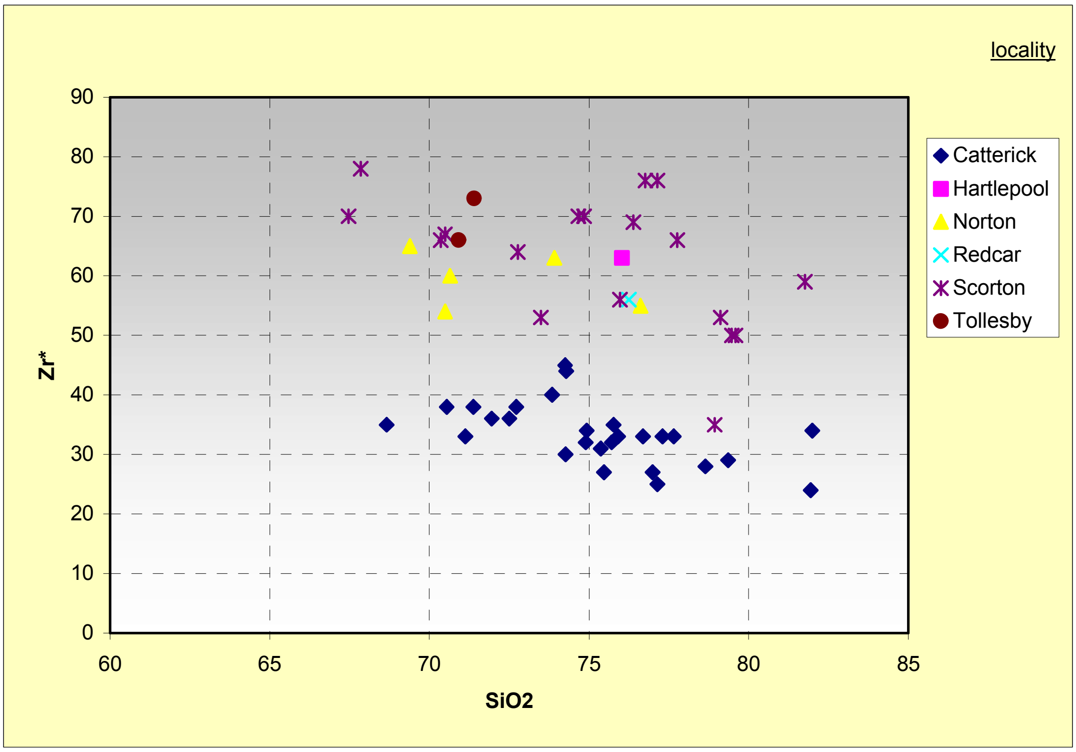


Figure 6

Figure 6 shows a plot of 'silica' versus Zr, grouped by locality. The Catterick samples not only have a lower frequency of Zr than the remaining samples but there is a clearer correlation with 'silica' frequency in those samples. This is consistent with the Zr in the other samples being in the form of larger, and thus less evenly distributed, fragments. Since this difference is very unlikely to be due to post-burial alteration and since the Catterick samples include both granitic and sandstone tempered examples this seems to be clear evidence that both of these fabric groups were made from the same parent clay and that this clay (with its sand and silt content) contains less Zr than that found in the remaining samples. There is just one Scorton sample with a similar low Zr content, V1128. This result has several implications, since Catterick and Scorton are extremely close together and the samples are probably similar or overlapping in date. This suggests that the Catterick and Scorton communities hardly exchanged pottery but nevertheless produced wares with a very similar visual appearance and tempered with the same restricted range of inclusions.

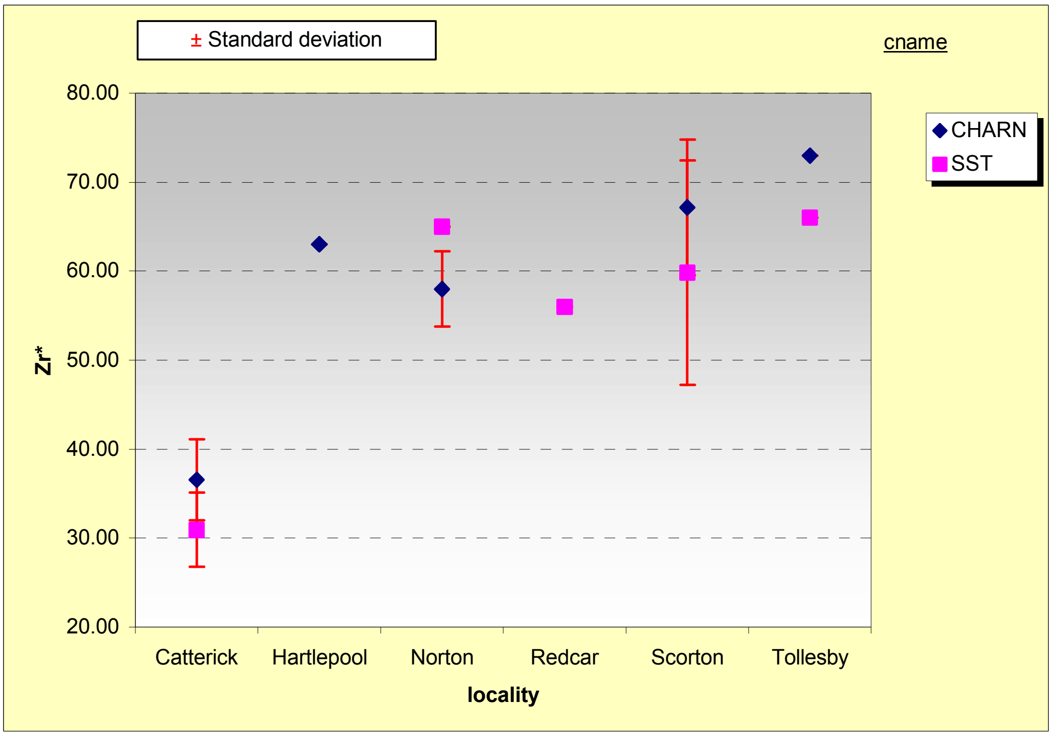


Figure 7

Fig 7 demonstrates clearly that the mean Zr frequency for the Catterick sites is much lower than at Norton, where the samples have a similar Zr content to those from other local sites, but also those from Scorton. By contrast, two Scorton samples are of calcite-tempered ware and almost certainly were made in the Vale of Pickering. Their Zr content is not depleted and is within the range found for this ware at West Heslerton.

Appendix 1 ICPS Results

Appendix 1a Major elements (percent oxides)

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V1651	17.37	4.22	1.48	1.32	1.14	2.89	0.71	0.30	0.08
V1652	17.52	4.60	1.59	1.46	0.61	2.54	0.72	0.27	0.05
V1654	18.01	5.62	1.68	1.11	0.43	2.19	0.78	0.74	0.05
V1655	16.56	4.61	2.03	4.18	0.47	1.71	0.74	1.39	0.05
V1656	16.51	4.24	1.22	1.08	0.45	1.65	0.63	0.28	0.02
V1657	17.62	5.91	1.25	1.33	0.48	2.10	0.78	2.01	0.05
V1658	15.27	3.02	0.86	1.03	0.42	1.90	0.58	0.29	0.02

Appendix 1b Minor and trace elements (ppm)

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn
V1651	884	94	16	102	44	14	191	87	20	54	42	84	43	7	1	4	2	47	105
V1652	737	108	32	83	60	15	126	95	22	60	48	92	49	8	1	4	2	39	92
V1654	747	115	28	98	61	16	113	106	25	65	47	89	48	9	1	5	2	41	103
V1655	972	98	27	89	43	14	224	94	21	65	44	79	45	7	1	4	2	34	132
V1656	701	98	58	97	45	14	117	86	21	63	46	76	47	7	1	4	2	35	81
V1657	854	115	29	77	53	16	150	102	27	63	50	96	52	9	2	5	2	42	98
V1658	672	90	34	72	41	15	99	77	29	55	47	91	49	10	2	6	2	36	110

Appendix 2 Factor Loadings

Element	Factor 1	Factor 2	Factor 3	Factor 4	Communality
Dy	0.994897284	-0.040044641	-0.087646257	-0.081938472	1
Eu	0.961217629	-0.283080873	-0.018145677	0.035652201	1
Y	0.958994973	-0.022699938	-0.068609937	-0.053884389	0.927797497
Sm	0.955660094	-0.154189025	0.093853466	-0.135034248	0.964103192
Li	-0.853912149	0.174881943	0.162869314	-0.141926553	0.806419212
Nd	0.8209345	0.37621735	-0.241896816	-0.265185262	0.944310241
Ce	0.814153704	0.336128166	0.427578549	-0.073199755	0.964010018
Yb	0.755966238	0.492067778	-0.370754926	0.066472458	0.955493454
La	0.731922493	0.463315405	-0.2680421	-0.297359204	0.910640764
Sc	0.723628835	0.634324297	0.100467072	-0.153942207	0.959797841
MgO	-0.546751334	0.474523271	-0.034698114	0.530414308	0.806652653

V	-0.001090061	0.987180926	0.020520836	0.14401853	0.99568981
Cr	0.21248296	0.973573326	-0.004553534	-0.112291114	1
Fe2O3	-0.013958751	0.965765096	0.03057163	0.115049404	0.947068057
TiO2	-0.112099757	0.896628235	0.238399114	0.365360045	1
Al2O3	-0.252751175	0.883734082	0.391641846	-0.094062582	1
Ni	0.14775907	0.820956752	0.128935653	-0.318640843	0.813959121
Zr*	-0.13432446	0.708262494	-0.667665497	0.175175279	0.996142416
K2O	-0.148417073	0.132339883	0.939404555	-0.142879863	0.942437045
Pb	-0.058887433	0.296107641	0.910796389	-0.083466216	0.927664136
Na2O	-0.485311102	-0.195386441	0.840441242	0.026034526	0.980722004
Cu	-0.08150132	-0.148827411	-0.762452774	-0.56813223	0.932900527
MnO	-0.411733295	0.421122797	0.722993596	0.364216926	1
Zn	0.048143249	-0.168848443	0.007724381	0.89723296	0.83591422
CaO	-0.307706175	0.007844359	-0.318337764	0.857296458	0.931040774
Ba	-0.370745242	0.210292784	0.199340861	0.850539931	0.944830042
Sr	-0.508891766	0.019400348	0.179709902	0.816849206	0.958885477
P2O5	0.273040506	0.528659381	-0.151879352	0.589485088	0.724591865
Sum of Squares	8.909268573	7.786586979	4.902914554	4.605591992	26.2043621
Percent of Variance	31.81881633	27.80923921	17.51040912	16.44854283	93.58700749