Characterisation of a sample of Permian Yellow Sand tempered ware from the Castle, Newcastle

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The Permian Yellow Sand (PYS) occurs at the base of the Permian deposits in northeast England. It consists of fossilized sand dunes whose components are very distinctive, both by eye and in thin-section. Inclusions of PYS origin were identified at the Department of Geology, University of Durham, and that information used by Sue Mills to identify a PYS ware, primarily at Jarrow but also elsewhere in the northeast. Subsequently this ware has been identified at other sites, sometimes after visual examination by Ms Mills but sometimes after the definition of the fabric has been passed on by word of mouth.

To further complicate matters, there are a small number of coarseware imports in the northeast which originated in Lincolnshire, East Anglia or the southeast of England, where superficially similar sand grains occur, originating in the lower Cretaceous. The main difference, however, is that these grains were deposited under water and the surface of the grains is polished rather than matt. Furthermore, the broken grains, some with secondary rounding, are found in the PYS but not in the Cretaceous sands.

An accurate definition of PYS-tempered ware is important because the ware has been mooted as being of 11th-century date, and possibly pre-conquest. These claims cannot be tested until the same criteria are used for identifying the ware at all sites. This note, however, cannot fulfil this purpose since only two groups of 'PYS' sherds have been studied in detail. These are the type series for Prudhoe Castle, where fabrics 2 and 3 were said to be PYS-tempered wares, and two sherds from excavations at the castle in Newcastle-upon-Tyne.

Petrology

Permian Yellow Sand contains the following inclusion types:

- Rounded quartz grains, mainly monocrystalline
- Rounded opaque grains
- Rounded chert

All grains are not only well-rounded but have a high sphericity, which also distinguishes PYS from Cretaceous sands. Furthermore, broken grains have been noted of all types.

In addition to these grains, the two Castle samples also contain rounded calcareous inclusions of the same size and shape. These inclusions are of two types:

- non-ferroan calcite, probably shell or other fossil, with some brown staining, probably of pores within the fossil
- A micrite with grains up to 0.1mm across. These grains appear to be a mixture of dolomite and calcite

The grains are well-sorted and between 0.5mm and 1.0mm across.

Four samples have sand temper which is predominantly of PYS type. These are: two samples of Prudhoe Fabric 3 (V1303 and V1307) and the two Newcastle castle finds (V880, V1662). Calcareous inclusions are only present in the two Newcastle samples, nor is there any sign of rounded voids in the Prudhoe samples which might indicate the original presence of calcareous inclusions.

The clay matrix of the Newcastle and Prudhoe pieces also differs. That from Newcastle has a slightly silty texture, containing moderate fragments of angular quartz and sparse muscovite laths up to 0.1mm across whilst the sherds from Prudhoe Castle have a finer-textured matrix.

Chemical analysis

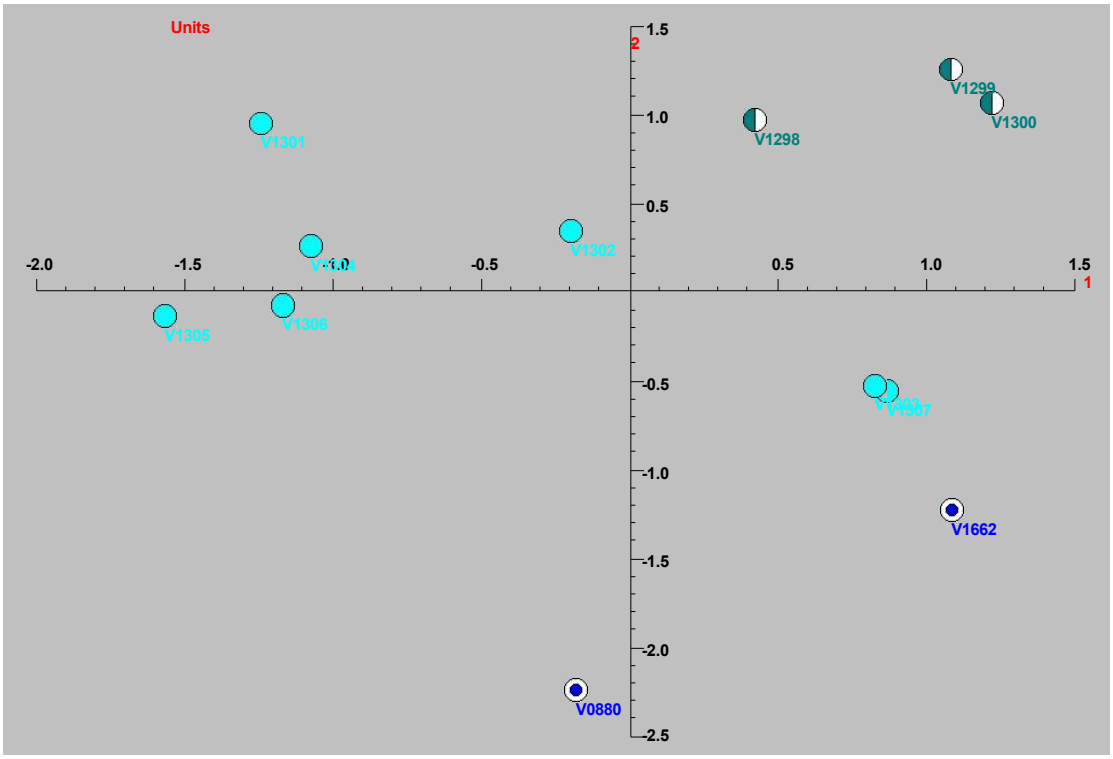

Figure 1

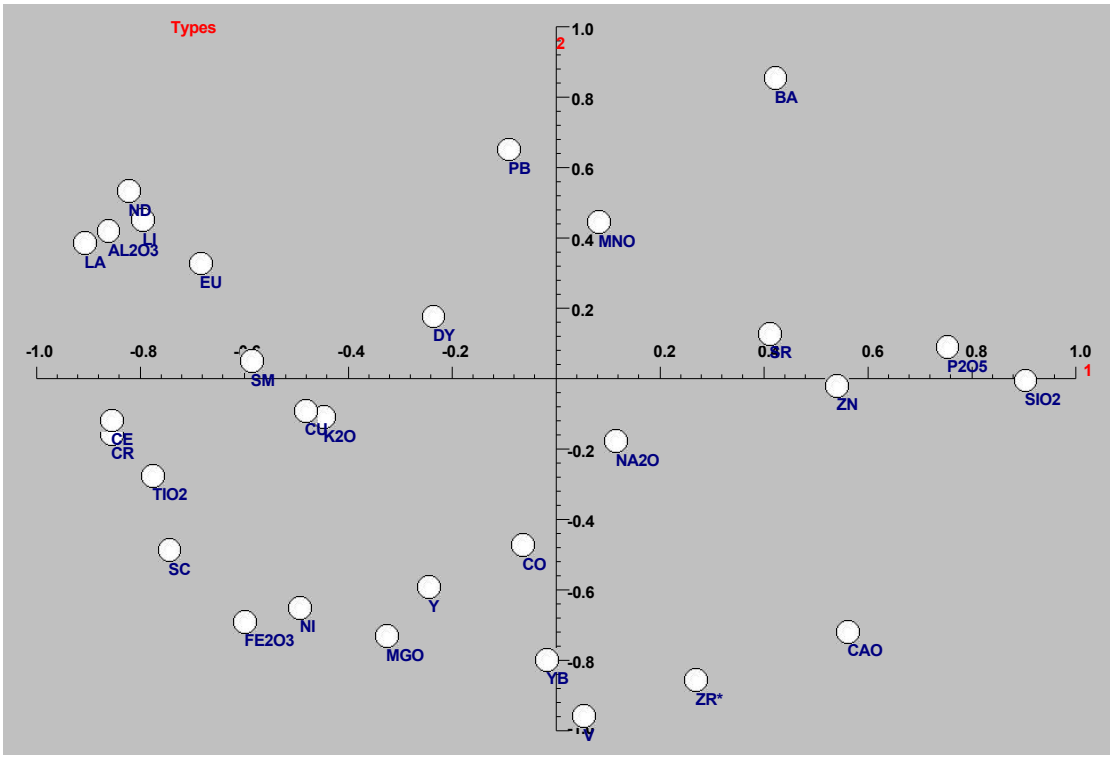

Figure 2

The Newcastle samples were analysed using Inductively-Coupled Plasma Spectroscopy and the data compared with that from Prudhoe, including all those identified by Whittingham as PYS-tempered ware. Principal Components Analysis was carried out on the dataset and a plot of the two main components, PC1 and PC2, showed that the Newcastle samples are chemically dissimilar to those from Prudhoe and that the two Prudhoe samples with PYS inclusions have very similar compositions, so similar in fact that they may possibly even come from the same vessel. The remaining Prudhoe samples form two clusters, corresponding to fabrics 2 and 3 (Fig 1). The contribution of different elements to this separation is shown in Fig 2. It indicates, as might be expected, that CaO differentiates the Newcastle from the Prudhoe pieces. It also shows, however, that Zr is associated with the PYS samples, suggesting perhaps that Zircon grains occur in the PYS sand, together with V (Vanadium) and Y (Yttrium). Yttrium is associated with Zircon and other heavy minerals (BGS, 1996, 87). Vanadium is associated with detrital Fe oxides and clay minerals and occurs in moderately high concentrations in streams crossing the Permian rocks of south Durham (BGS 1996, 85). MgO, presumably from the dolomitic limestone inclusions, is also correlated with the Newcastle samples. The remaining elements show a correlation with the Prudhoe samples, whose position on the PCA plot is clearly influenced by silica content (high silica on the right, correlating with Fabric 2, and high Al2O3 on the left, correlating with the Fabric 3 samples, excluding the two PYS sherds). The frequency of Ba (Barium) appears to be higher in Fabric 2 than in the remaining samples in the dataset. This may be due to the presence of K-feldspar grains in the sandstone inclusions.

Conclusion

Permian Yellow Sand grains occur in four samples, two from Prudhoe Castle and two from the castle at Newcastle-upon-Tyne. The differences in petrology and chemistry indicate different sources for the Prudhoe and Newcastle sherds and the presence of detrital rounded dolomitic limestone grains in the Newcastle samples also indicates an origin in a river draining Upper Permian rocks. The Wear valley at Sunderland would be a possible location.

In both cases, there is little doubt that the sherds were not locally produced. Not only do Permian rocks not outcrop at Prudhoe or Newcastle but there is no mechanism which would allow sands of these kinds to exist in the Tyne valley, unless Permian deposits which once existed to the north and west of the present outcrop were present in fluvioglacial deposits in the valley or areas drained by the Tyne. PYS-derived material is indeed probably present in sands in the Newcastle area, although it is rare in samples from the Dogbank kiln. However, in these cases the PYS grains only form a small element in a sand whose main constituents were derived from the Coal Measures deposits through which the river mainly runs.

Appendix 1

Details of samples

TSNO	SITECODE	CONTEXT	REFNO	CNAME	FORM	ACTION	DESCRIPTION	SUBFABRIC
V1662	bg92	3536	V.4	PYS	JAR	TS;ICPS	HANDMADE	
V1307	PRUDHOE CASTLE	PC74 184		PYS	JAR	TS;ICPS		PRUDHOE 3
V1306	PRUDHOE CASTLE	PC411 A1	POT 11	PYS	JAR	TS;ICPS	SOOTED EXT	PRUDHOE 3
V1305	PRUDHOE CASTLE	PC1100		PYS	JAR	TS;ICPS	SOOTED EXT	PRUDHOE 3
V1304	PRUDHOE CASTLE	PC1057		PYS	JAR	TS;ICPS	SOOTED EXT	PRUDHOE 3
V1303	PRUDHOE CASTLE	PC1240		PYS	JAR	TS;ICPS	SOOTED EXT	PRUDHOE 3
V1302	PRUDHOE CASTLE	PC76 430		PYS	JAR	TS;ICPS	SOOTED EXT	PRUDHOE 3
V1301	PRUDHOE CASTLE	PC1100		PYS	JAR	TS;ICPS	SOOTED EXT	PRUDHOE 3
V1300	PRUDHOE CASTLE	PC1126		PYS	JAR	TS;ICPS	SOOTED EXT	PRUDHOE 2
V1299	PRUDHOE CASTLE	PC411 D6		PYS	JAR	TS;ICPS	SOOTED EXT	PRUDHOE 2
V1298	PRUDHOE CASTLE	PC1104		PYS	JAR	TS;ICPS	SOOTED EXT	PRUDHOE 2
V0880	BG85	MT		PYS	JAR	PTS;ICPS	?WHEELTHROWN;DARK GREY CORE;SQUARED RIM;SOOTED EXT	POLISHED QUARTZ;ROUNDED LIMESTONE

Major elements

TSNO	SIO2	AL2O3	FE2O3	MGO	CAO	NA2O	K2O	TIO2	P2O5	MNO
V0880	73.110	13.620	6.630	1.480	1.570	0.420	2.100	0.730	0.290	0.050
V1298	74.800	16.460	3.390	0.780	0.880	0.420	1.930	0.670	0.320	0.350
V1299	77.290	14.610	2.830	0.610	0.980	0.400	1.780	0.600	0.720	0.180
V1300	73.200	16.410	3.460	0.980	1.150	0.190	2.680	0.610	1.280	0.040
V1301	70.390	19.890	5.990	0.570	0.250	0.140	1.900	0.660	0.170	0.040
V1302	69.970	18.120	5.580	1.080	1.030	0.220	2.440	0.730	0.750	0.080
V1303	75.180	13.890	4.740	0.920	1.550	0.150	2.250	0.710	0.570	0.040
V1304	68.020	21.160	5.010	1.190	0.580	0.360	2.670	0.820	0.140	0.050
V1305	64.700	22.040	6.200	1.360	1.180	0.250	3.130	0.850	0.200	0.090
V1306	66.500	20.910	5.930	1.320	1.090	0.240	2.770	0.820	0.310	0.110
V1307	74.450	14.400	4.860	0.950	1.720	0.200	2.250	0.720	0.410	0.040
V1662	74.749	11.252	6.120	1.240	2.230	0.340	2.300	0.620	1.120	0.029

Minor and trace elements

TSNO	BA	CO	CR	CU	LI	NI	SC	SR	V	Y	ZN	ZR*	LA	CE	ND	SM	EU	DY	YB	PB
V0880	370	22	99	38	68	56	17	111	158	28	96	86	39	79	31.6	7.2	1.9	5.6	2.8	78.5
V1298	925	26	89	18	108	41	13	129	74	18	116	49	45	66	48.1	4.0	1.8	6.2	1.8	259.8
V1299	1073	12	82	20	93	40	12	143	64	18	124	45	42	54	44.4	4.7	1.9	5.2	1.7	201.6
V1300	1134	7	87	22	87	37	12	189	64	16	131	46	38	47	39.1	2.2	1.3	3.6	1.6	181.1
V1301	759	15	100	27	114	39	15	71	79	24	75	32	65	83	66.8	15.7	3.5	6.1	2.0	130.8
V1302	699	15	98	22	110	49	13	189	78	19	87	43	51	71	51.9	6.3	2.0	4.2	1.7	106.5
V1303	636	18	92	19	56	41	12	106	118	18	95	64	34	46	36.0	5.4	1.5	4.3	2.2	50.4
V1304	638	11	124	21	114	45	16	118	107	18	71	56	57	68	57.6	6.6	1.9	4.3	1.8	283.3
V1305	600	18	113	392	156	54	16	135	90	18	104	46	59	84	59.5	5.6	2.1	4.3	1.8	114.4
V1306	734	19	110	30	146	57	16	145	87	19	122	46	58	96	58.7	6.0	2.0	4.4	1.8	77.7
V1307	653	21	94	22	59	41	12	138	123	17	92	62	33	43	35.1	1.9	1.6	4.3	2.1	51.9
V1662	633	18	90	37	43	51	15	161	130	22	150	59	33	62	34.4	5.8	1.0	3.6	1.9	55.1