The Petrology of some Medieval Floor Tiles from St Gregory's Priory, Canterbury.

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Contents

Introduction

Eight samples of medieval floor tile from the Canterbury Archaeological Trust excavations at St Gregory's Priory were submitted for analysis together with comparative samples of fired clay, peg tile and floor tile from Cloues Wood, floor tiles from Brian Philp's 1985 excavations at Faversham Abbey, peg tiles from a probable area of tile production at Tyler Hill and three tiles, with possible Canterbury provenances from the British Museum. Of these, all were subjected to Inductively Coupled Plasma Spectroscopy (ICPS), undertaken by Dr N Walsh, Royal Holloway College, University of London. All except those samples from the British Museum, where the sample size was too small, were also thin-sectioned. Table One shows the sample numbers, the site and the principal petrological characteristics of the sample. The samples were chosen to test the suggestion that the early sgraffito tiles were products of the Tyler Hill industry as well as to investigate variability within the products of the Tyler Hill tile industry. For ease of discussion the various samples have been assigned to Groups based on provenance and artefact type.

Group	Provenance	Description
Group 1	St Gregory's Priory	Sgraffitto-decorated floor tiles
Group 2	St Gregory's Priory	Two-colour floor tiles
Group 3	Cloues Wood	Sgraffitto-decorated floor tiles
Group 4	Cloues Wood	Peg tile

Group 5	Cloues Wood	Fired clay (re-fired before analysis)
Group 6	Faversham Abbey	Sgraffitto-decorated floor tiles
Group 7	Tyler Hill	Peg tile
Group 8	Uncertain (BM)	Floor tiles

Table One

TS No	Sample No	Sitecode	Context	Group	Details
AG11	1	1988-8B	766	Group 1	
AG12	2	1988-8B	1152	Group 1	
AG13	3	1988-8B	872	Group 1	
AG14	4	1988-8B	1657	Group 1	
AG15	5	1988-8B	766	Group 1	
AG16	6	1988-8B	U/s	Group 2	
AG17	7	1988-8B	278	Group 2	
AG18	8	1988-8B	?	Group 2	
AG19		Cloues Wood		Group 3	Untempered floor tile with white slip and sgraffito decoration and clear glaze
AG20		Cloues Wood		Group 3	Untempered floor tile with white slip and sgraffito decoration and clear glaze
AG21		Cloues Wood		Group 4	Coarse sand-tempered tile with splashed glaze
AG22		Cloues Wood		Group 4	Coarse sand-tempered tile with applied nib and splashed glaze
AG23		Cloues Wood		Group 4	Untempered pegtile
AG24		Cloues Wood		Group 3	
AG25		Cloues Wood		Group 3	
AG26		Cloues Wood		Group 5	Semi-fired clay from Cloues Wood tile dump
AG27		Cloues Wood		Group 5	Raw clay from Cloues Wood (Natural deposit c. 50m from tile kiln site)
AG28		Faversham Abbey		Group 6	Marked FSF 123
AG29		Faversham Abbey		Group 6	Marked FSA 199
AG30		Faversham Abbey		Group 6	Marked FSA 125
AG31		Faversham Abbey		Group 6	Marked FSC 135
AG32		St Gregory's Priory		Group 8	BM MLA 2214
AG33		Unprovenanced		Group 8	BM MLA 2727
AG34		Canterbury		Group 8	BM MLA 7782

AG35	Tyler Hill	Group 7	Sandtempered pegtile fragments from field to the south of Giles Lane
AG36	Tyler Hill	Group 7	
AG37	Tyler Hill	Group 7	

ICPS Analysis

The following elements were measured:

a)Oxides measured as a percentage, to two decimal places

	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
Maximum	16.27	8.74	2.34	7.03	0.73	2.78	0.81	0.31	0.09
Mimimum	13.01	6.25	1.45	0.78	0.37	2.43	0.72	0.14	0.04
Mean	14.29	7.34	1.85	2.90	0.54	2.66	0.76	0.24	0.06

b) elements measured as parts per million (ppm).

Ba	Co	Cr	Cu	Li	Nb	Ni	Sc	Sr	V	Y	Zn	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb
407	27	137	35	75	15	78	18	163	177	40	102	66	58	107	52	10.2	1.7	5.6	2.6
331	16	105	28	65	12	51	14	105	125	25	85	52	46	75	37	7	1.1	3.7	1.6
374	20.1	119	30.8	71.9	13.8	62.6	15.9	137	147	29.6	92.9	59	49.8	86.6	41.4	8.03	1.33	4.21	1.94

Petrological Description

Group 1: Flint-tempered

In thin-section, the main characteristic of the Group 1 samples was an abundant quartz silt with minor quantities of subangular quartz and rare chert (showing radial extinction) up to 0.3mm across. Fresh angular fragments of flint were present but in only one sample did these approach the size of the fragments visible in the hand specimen, which were several millimetres across. Fragments of heat-altered limestone composed of non-ferroan calcite up to 1.0mm across were present in most of the samples and where absent large voids of similar size were present. The degree of alteration seen in the limestone varied with the firing temperate of the tile. In the lowest-fired sample, AG15, rounded opaque iron-rich inclusions up to 0.2mm across were present and the clay matrix was optically anisotropic whereas in the other samples these inclusions had vitrified to produce vesicular “slag” and the clay matrices were optically isotropic.

The clay matrix in all the Group 1 samples was poorly mixed and this is reflected in variations in the density of quartz silt and in the presence of relict clay pellets up to 1.0mm across. Laths of muscovite up to 0.1mm long were present in sparse quantities in the clay matrix.

Group 2: Glauconitic sand tempered

In thin-section, the three sections of Group Two were characterised by a moderate to abundant sand, composed mainly of angular to subangular fragments of quartz up to 0.4mm across together with sparse to moderate

rounded grains of altered glauconite up to 0.3mm across and sparse rounded chert (with radial extinction) up to 0.4mm across. All three samples contained moderate rounded brown clay pellets up to 0.8mm across and sparse to moderate angular flint up to 1.0mm across. Two of the samples contained rounded fragments of silty clay up to 1.0mm across. The clay matrix was optically anisotropic clay with moderate to abundant angular quartz silt and sparse laths of white mica up to 0.1mm long.

Groups 3 to 7

The principle division within the fabrics of the Group 3 to Group 7 samples is between those with quartzose sand temper (abundant in Group 3, sparse in Group 7) and those without. Variations in the character of the clay matrix were noted but are explicable entirely as being a result of variations in firing temperature (all the Group 3, 4 and 7 samples were production waste whilst the Group 5 samples were refired at c.1000 degrees C for ease of comparison with the remaining material).

The quartz sand temper in the two samples of Cloues Wood pegtiles (AG21-2) is much coarser than that in the Tyler Hill samples (AG36-7) with an average grain size of 1.0mm as opposed to 0.5mm in the Tyler Hill samples. Whether this feature is a consistent difference between the two sites or merely an artefact of the sampling process is impossible to say without further work.

The untempered samples, which include floor tiles from both Cloues Wood and Faversham Abbey, are indistinguishable in thin-section from the Group 1 tiles from St Gregory's Priory and the Tyler Hill pegtiles have an identical sand temper to that in the Group 2 tiles from St Gregory's Priory.

Group 8

The three British Museum samples were too small for thin-sectioning.

Discussion

The petrological data show differences between some of the groups, but these could be explained entirely in terms of the manufacturing techniques employed: the Group 1 tiles were untempered and not cleaned (hence the presence of the large sparse flint fragments). The Group 2 tiles, and the comparative material from Tyler Hill and Cloues Wood, were tempered with a quartzose sand, containing low quantities of glauconite. Both groups contain abundant quartz silt, which would have been naturally present in the clay as dug. Since the grain size distribution was not measured and the range of rock and mineral types present includes only widely-distributed types there is insufficient evidence from the petrology alone to demonstrate that all of the material studied came from the Tyler Hill area, although it does show that there is no petrological reason why they could not have done so.

The ICPS analysis is more informative. The ICPS results for all samples were analysed using Principle Components analysis (using WinBASP, the Bonn Archaeological Statistics Package). Contrary to expectations, this showed that the 27 samples divided into two clusters, one composed of samples from St Gregory's Priory

and the other composed of the remaining samples. The St Gregory's cluster includes both Group 1 and Group 2 tiles, plus one of the three British Museum samples (AG32).

The second cluster included the remaining two British Museum samples plus the samples from Cloues Wood, Tyler Hill and Faversham Abbey.

Plotting PC2 against PC4 reveals interpretable patterning within these clusters (Fig 1 and Fig 2). The sand-tempered samples, Group 2, AG21-2 and AG36-7, have high negative values for PC4). The Faversham and Cloues Wood floor tiles lie close together at the other end of the cluster (high values for PC4) and the two clay samples have high values for PC2 (in contrast to the St Gregory's samples which have negative values). The biplot showing the contribution of the different elements to these components (Fig 2) shows that both components are composed of a mixture of elements, which lessens the possibility that the differences are due to a simple post-burial contamination of the St Gregory's samples. Nevertheless, as a check the analysis was re-worked for a dataset excluding any potentially unstable or mobile elements (Figs 3 and 4). These include CaO, P2O5, Fe2O3, MnO, Na2O and Cu. The two clusters are even more clearly defined with this reduced dataset, with the exception of one of the British Museum samples, AG33, which is a stray as a result of a high PC4 value. The biplot for this dataset shows that the St Gregory's Priory cluster is characterised by higher values for the rare earths, which are often associated with accessory minerals. These are very unlikely to have been affected by burial conditions and therefore provide backing for the view that the St Gregory's Priory tiles, despite appearances, are not from the Tyler Hill/Cloues Wood tilery and neither are they produced from the same raw materials as the Faversham Abbey tiles, which are most likely Cloues Wood/Tyler Hill products.

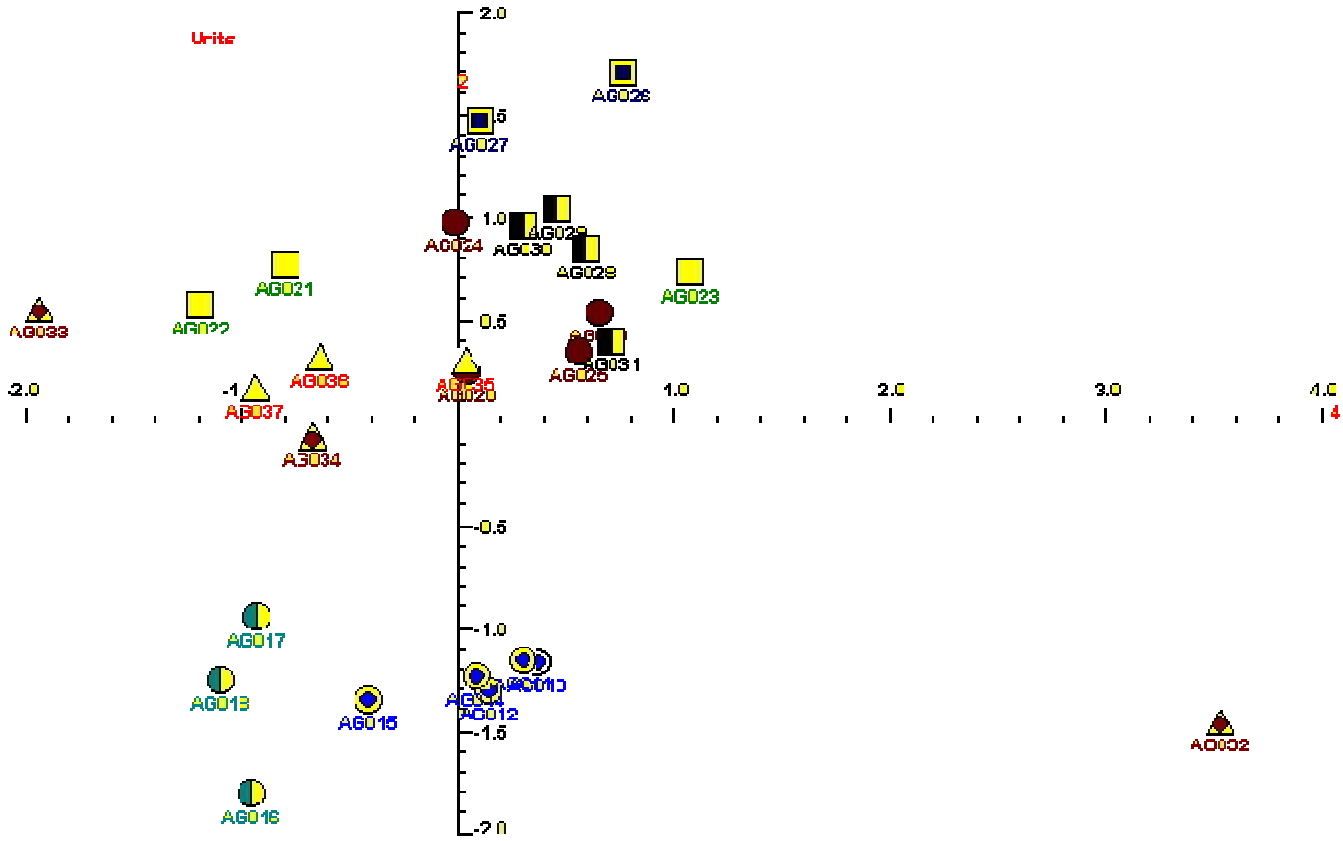

Figure 1. PCA plot of components 2 vs 4

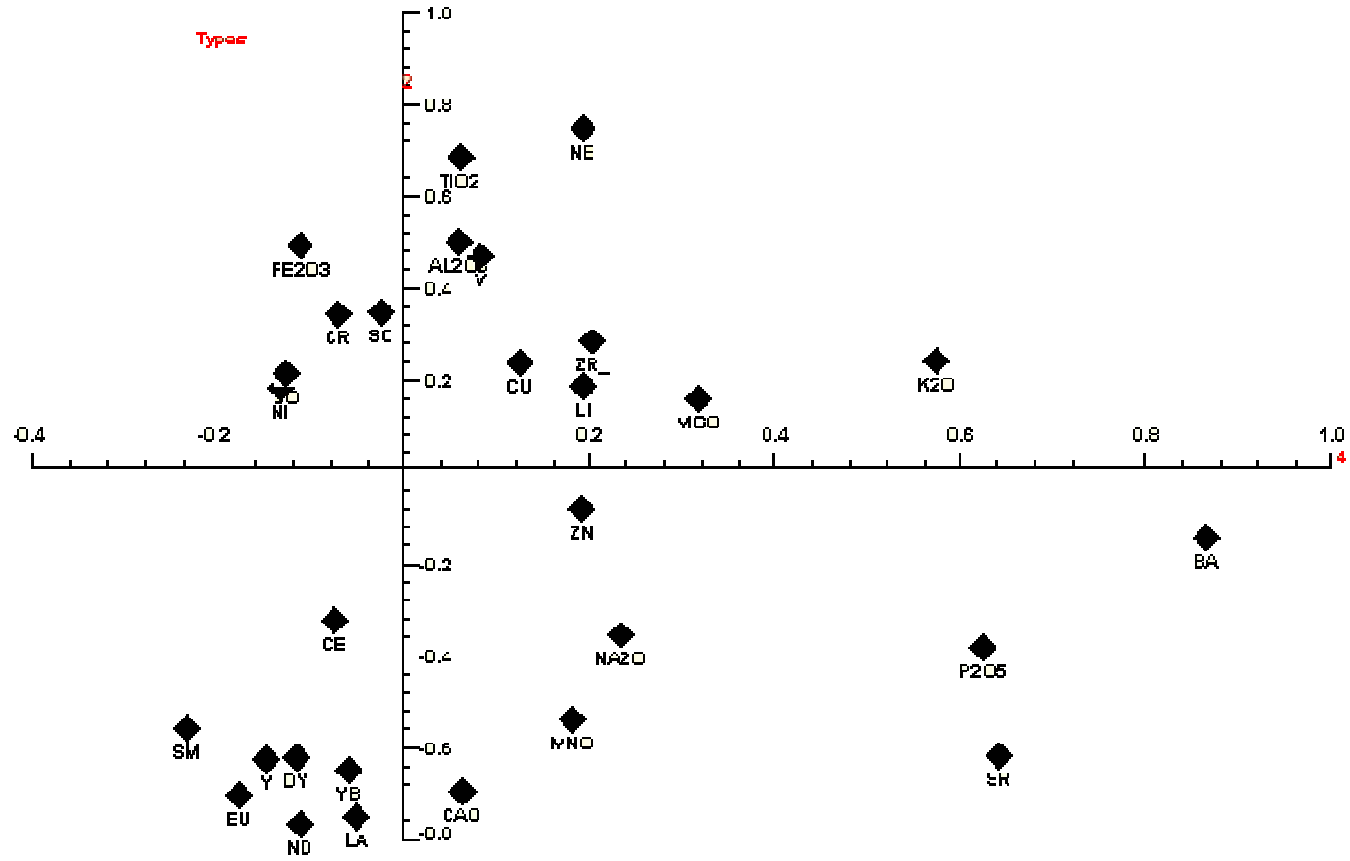

Figure 2. Biplot of elements contributing to PC2 and PC4

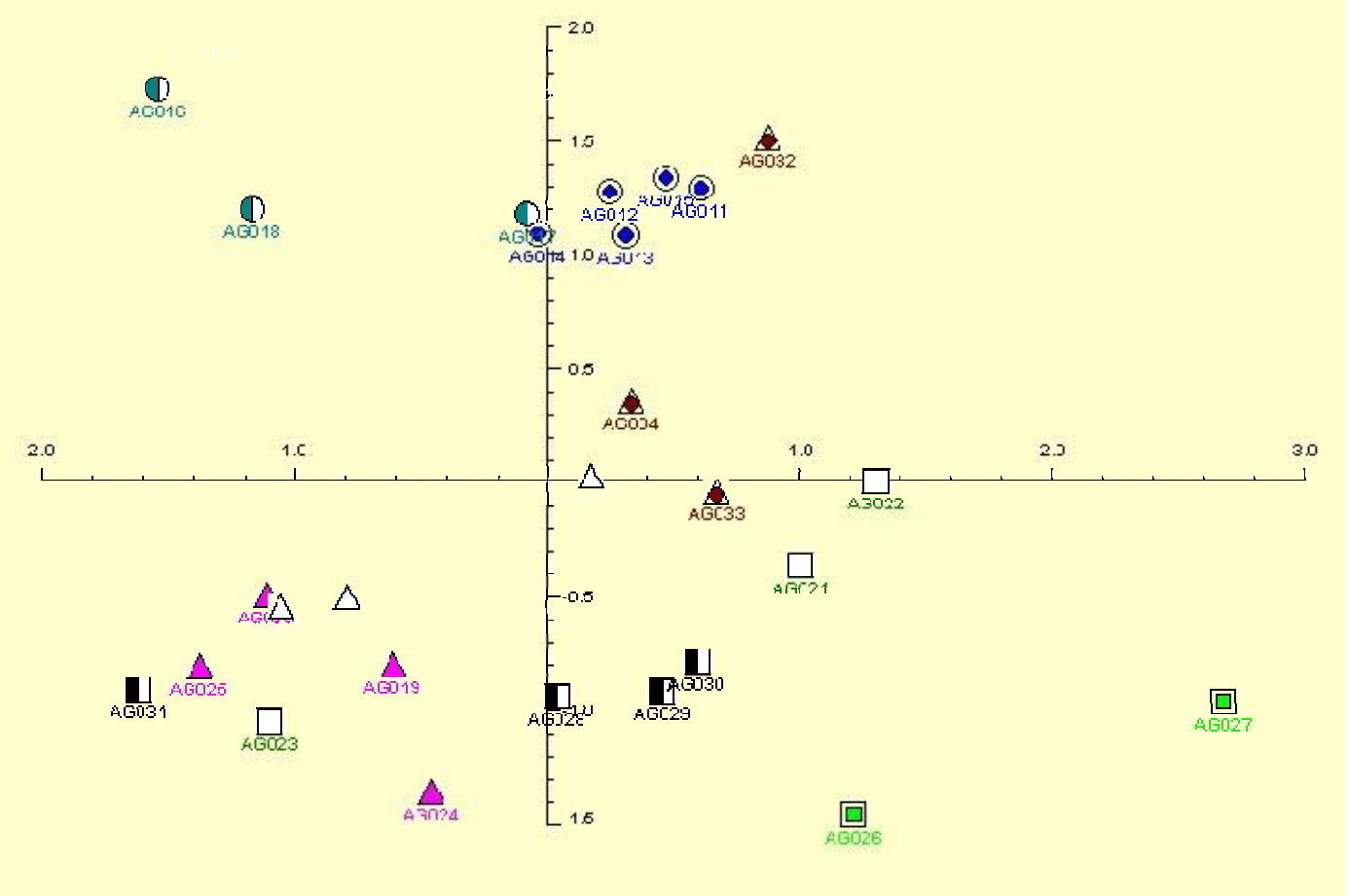

Figure 3. Plot of PC1 vs PC2 for reduced dataset

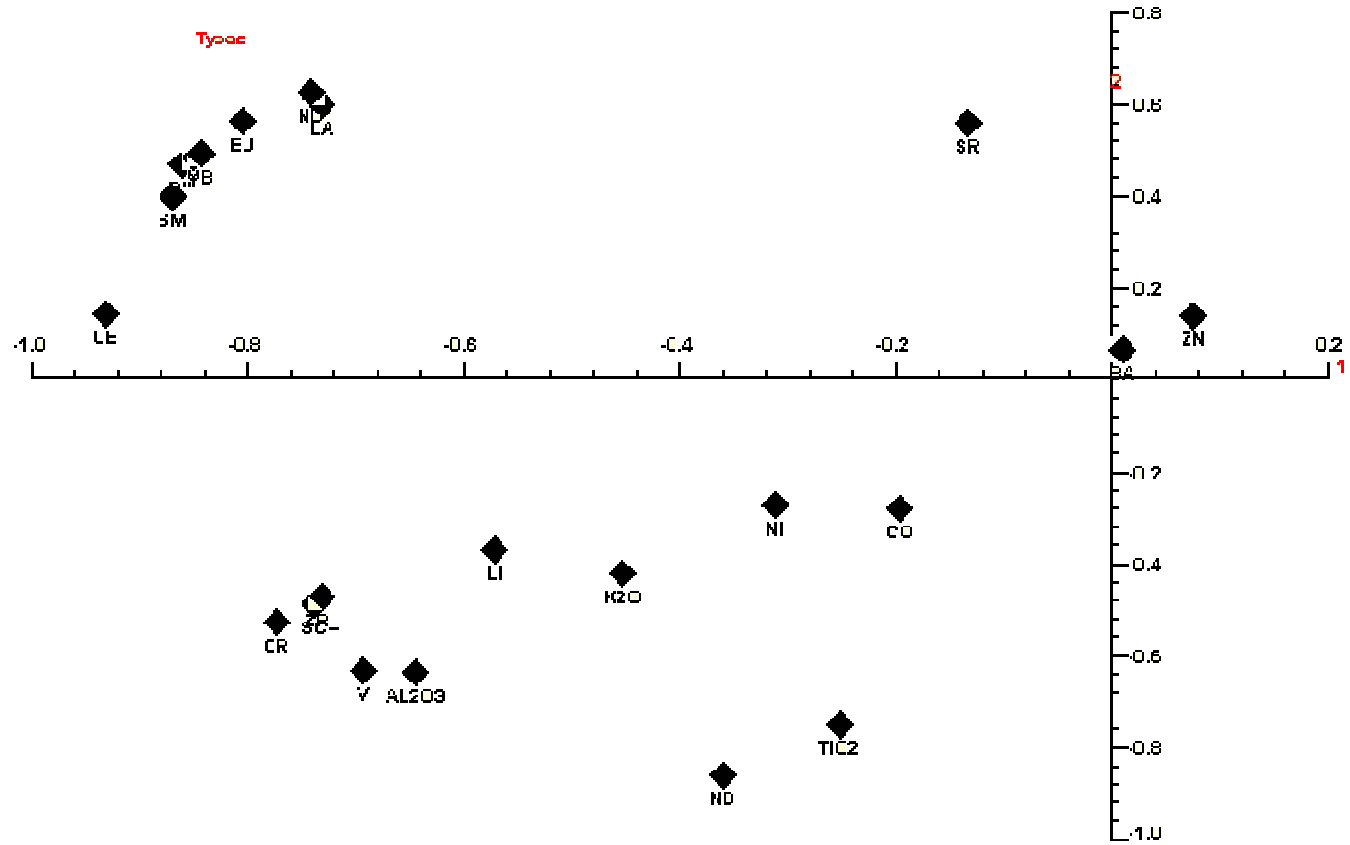

Figure 4. Biplot of elements contributing to PC1 and PC2 for reduced dataset

Acknowledgements

I would like to thank Mark Horton for suggesting that I undertake this analysis. Alison Oliver of AG Petrolology produced the thin-sections and the ICPS analyses were carried out by Nick Walsh, Royal Holloway College, University of London. The WinBASP software is copyright to the Unkelbach Valley Software Works.

Appendix One: ICPS Data

	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
Group 1									
AG11	13.01	6.25	1.67	1.97	0.61	2.73	0.76	0.3	0.07
AG12	13.38	6.46	1.84	4.23	0.56	2.77	0.76	0.28	0.06
AG13	13.38	7	1.87	2.55	0.58	2.76	0.76	0.27	0.09
AG14	13.95	6.84	2.07	3.02	0.56	2.78	0.79	0.23	0.08
AG15	13.18	6.39	2.34	7.03	0.5	2.43	0.72	0.2	0.05
Group 2									
AG16	16.27	8.72	1.72	2.39	0.37	2.62	0.81	0.21	0.05
AG17	15.03	8.3	1.45	0.78	0.73	2.48	0.74	0.14	0.04
AG18	16.1	8.74	1.83	1.24	0.38	2.73	0.77	0.31	0.06
Group 3									
AG019	18.55	9.29	2.82	1	0.39	3.42	1	0.17	0.05
AG020	18.64	9.77	2.48	0.38	0.39	3.33	1	0.14	0.05
AG024	16.69	8.62	2.34	0.81	0.37	3.05	0.91	0.17	0.05
AG025	19.78	10.09	2.96	0.74	0.34	3.39	1.04	0.17	0.06
Group 4									
AG021	15.55	8.24	1.82	0.27	0.36	2.67	0.82	0.09	0.04
AG022	14.26	7.85	1.7	0.29	0.33	2.4	0.74	0.09	0.04
AG023	19.25	9.84	2.81	0.75	0.36	3.36	1.08	0.15	0.05
Group 5									
AG026	17.41	9.59	1.96	0.3	0.43	3.05	0.92	0.08	0.03
AG027	12.47	6.08	1.01	0.17	0.54	2.64	0.98	0.09	0.04
Group 6									
AG028	18.09	8.92	2.08	0.42	0.47	3.32	1.01	0.12	0.04
AG029	17.53	8.49	2.01	0.31	0.44	3.05	0.96	0.09	0.03
AG030	16.09	12.92	2.1	0.69	0.44	3.08	0.99	0.23	0.06
AG031	19.53	9.51	3	0.92	0.36	3.53	1.07	0.23	0.05
Group 7									
AG035	17.83	9.36	2.73	0.46	0.36	3.39	0.97	0.17	0.05
AG036	16.15	11.12	2.17	0.64	0.25	2.89	0.8	0.21	0.07
AG037	14.95	7.72	1.79	0.46	0.22	2.67	0.75	0.17	0.05
Group 8									
AG032	13.22	6.51	1.51	2.4	0.4	2.84	0.65	1.92	0.07
AG033	17.48	10.53	0.69	0.89	0.16	1.05	1.1	0.4	0.06
AG034	14.62	6.57	2.08	1.69	0.29	2.71	0.77	0.15	0.03

	Ba	Co	Cr	Cu	Li	Nb	Ni	Sc	Sr	V	Y	Zn	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb
Group 1																				
AG11	396	17	105	30	68	13	51	14	153	125	25	95	52	46	80	37	7.2	1.1	3.7	1.6
AG12	396	18	110	29	75	13	60	15	140	133	26	88	58	49	80	40	7.5	1.3	3.8	1.7
AG13	407	20	114	34	74	14	58	15	131	140	25	96	56	47	81	38	7.5	1.2	3.8	1.7
AG14	382	22	115	31	74	14	61	16	132	141	27	89	65	48	83	40	7.7	1.3	4	2
AG15	331	18	109	29	72	12	58	15	156	134	26	86	58	47	75	39	7	1.2	3.7	1.7
Group 2																				
AG16	367	23	136	30	73	15	74	18	163	177	40	102	65	58	101	52	10.2	1.7	5.6	2.6
AG17	372	16	129	28	65	14	61	16	105	147	30	85	52	49	86	40	8.1	1.3	4.2	1.9
AG18	338	27	137	35	74	15	78	18	115	177	38	102	66	54	107	45	9	1.5	4.9	2.3
Group 3																				
AG019	366	23	138	37	95	21	71	20	130	210	25	105	75	44	88	34	7.1	1.1	3.6	1.6
AG020	363	25	140	47	74	22	86	21	105	195	32	110	85	45	99	36	7.4	1.2	4.5	2.2
AG024	381	646	161	51	82	25	419	18	115	186	23	108	74	40	81	27	7.7	1	3.3	1.5
AG025	384	44	150	38	94	22	102	22	120	213	29	121	83	47	106	38	7.9	1.2	4.3	1.9
Group 4																				
AG021	326	18	120	27	60	17	53	17	82	146	20	92	63	33	77	22	5.4	0.8	2.8	1.3
AG022	311	19	111	28	64	15	53	16	80	147	20	86	54	33	72	22	5.2	0.8	2.9	1.2
AG023	413	21	145	94	94	23	74	22	120	222	28	110	86	44	93	35	7.4	1.2	4	1.8
Group 5																				
AG026	405	14	130	40	85	19	39	17	97	197	13	81	62	34	66	19	4.1	0.6	1.6	0.7
AG027	370	9	102	15	54	19	31	12	81	131	8	76	49	27	53	15	2.8	0.4	0.9	0.4
Group 6																				
AG028	404	22	135	29	82	21	58	19	104	184	21	102	67	38	85	29	6.1	1	3.1	1.4
AG029	411	19	130	42	79	20	55	19	99	180	19	96	63	35	75	26	5.9	0.9	2.9	1.3
AG030	359	19	123	38	68	21	57	17	108	174	21	104	70	36	73	24	5.5	0.9	3	1.3
AG031	363	25	152	66	92	24	77	22	132	235	30	118	92	46	99	39	8.5	1.3	4.6	2.1
Group 7																				
AG035	348	113	147	54	88	20	106	21	114	209	32	120	80	42	87	35	8.4	1.2	4.6	2
AG036	354	392	150	58	78	21	304	19	105	210	29	118	75	42	88	32	8.8	1.2	4.3	1.7
AG037	361	253	130	29	39	20	140	17	85	149	27	106	79	38	78	30	7.7	1	3.8	1.8
Group 8																				
AG032	499	19	95	51	37	15	58	15	268	116	26	335	66	39	77	29	5.9	1	3.8	1.8
AG033	287	27	109	88	33	17	87	21	76	142	22	368	66	34	82	28	6.8	1.1	3.4	1.4
AG034	300	17	119	35	70	17	63	17	158	177	25	98	62	39	78	32	6.8	1.1	3.7	1.5