

# CHEMICAL ANALYSIS OF LATE MEDIEVAL POTTERY FROM TICKNALL AND CALKE ABBEY

By RICHARD JONES

(Archaeology, University of Glasgow)

The present writer (Jones 2016) has reported on the analysis of 44 samples of Late Medieval pottery mainly from Ticknall (Peats Close, Harpur Avenue) and its environs (Hartshorne) in Derbyshire. The pottery types were: Coal Measures Whiteware, Coal Measures Purpleware and Coal Measures Orangeware; Midlands Purple and Cistercian ware.

This report addresses questions about (a) Coal Measures sherds from Ticknall and Calke Abbey Home Farm (Calke Abbey lies c. 2km south-east of Ticknall) and (b) Martincamp Flasks from Ticknall. The sherds, which were selected by Anne Irving and are listed in Table 1 (Jones 2016, 70-74), were analysed chemically by inductively coupled plasma emission and mass spectroscopy (ICP-ES and ICP-MS); the concentrations of thirty elements were determined (here Table 2a). These analyses were carried out in the same laboratory – Earth Sciences Department, Royal Holloway University of London – as those of closely related pottery examined by Vince (2007) (here Table 2b).

As before, the chemical data set was examined with bivariate plots, not shown here, and by the multivariate technique of principal components analysis (PCA) giving a plot of the first principal components, PC1 and PC2. The data was normalised against the aluminium content to account for the effects of dilution by varying silica content in the fabric; Vince (2007) applied the same procedure to his ICP-ES data set. Average link cluster analysis was also applied to z-score data, yielding a dendrogram (using IBM SPSS v. 22).

The *first* question posed by Anne Irving is whether the Coal Measures sherds from Ticknall Narrow Lane (TNL), Calke Abbey Home Farm (CA), Narrow Lane and Ivy Leigh were made from the same clays as the Ticknall Coal Measures previously analysed (Jones 2016).

The TNL and CA sherds, which were divided according to their colour, orange and white, have a rather coarse fabric, meaning that inclusions were visually apparent and varied in size (up to 3mm), colour and roundness, and were relatively more frequent in the orange fabric. Firing was uniform in both colour fabrics apart from a few examples, usually of the thicker bodied sherds which had a very slightly darker core. This Coal Measures pottery was well fired, a product of which in a few cases, such as CA2, was a very hard, rough grey exterior surface and on CA8 a semi-vitrified red gloss layer.

Comparison of the compositions of TNLO (orange) and TNLW (white), CAO and CAW with the corresponding orange and white Harpur Avenue Coal Measures samples (TCW) and Peats Close Coal Measures white (TPCM) appears in Fig. 1. The large majority of samples belong to a broad but uniform group in Fig. 1a with TCW1 and 2 lying on the edge; TNLO9 and 10 lie outside and TNLW3 stands well apart. Reading of the dendrogram indicates that TCO4, TNLO10 and TNW3 certainly stand apart, and there is also a case for treating TCW1-5, TCO2, TNLW1 and CAW4 as a subgroup of the main group although its significance in ceramic terms is weak. The compositions within the main group share the characteristic of low Ca, Mg, Na and trace element contents; the colour difference is scarcely reflected chemically, although there is a slightly higher iron content among the orange sherds, as might be expected.

<b><i>SAMPLE</i></b>	<b><i>DESCRIPTION</i></b>
<b>TNL 1</b>	Ticknall Narrow Lane Coal Measures White
<b>TNL 2</b>	"
<b>TNL 3</b>	"
<b>TNL 4</b>	"
<b>TNL 5</b>	"
<b>TNL 6</b>	"
<b>TNL 7</b>	Ticknall Narrow Lane Coal Measures Orange
<b>TNL 8</b>	"
<b>TNL 11</b>	"
<b>TNL 13-9</b>	"
<b>TNL 13-10</b>	"
<b>TNL 13-12</b>	"
<b>427-76A</b>	Russell Browns Martincamp white
<b>427-76B</b>	Russell Browns Martincamp buff
<b>T#1</b>	Narrow Lane: medieval unknown
<b>T#2</b>	Ivy Leigh: CM White, green glaze roof tile
<b>T14-1</b>	Martincamp purple
<b>T14-2</b>	Martincamp purple
<b>T14-3</b>	Martincamp orange
<b>T14-4</b>	Martincamp orange
<b>CA 1</b>	Calke Abbey Home Farm Coal Measures White
<b>CA 2</b>	"
<b>CA 3</b>	"
<b>CA 4</b>	"
<b>CA 5</b>	"
<b>CA 6</b>	"
<b>CA 7</b>	Calke Abbey Home Farm Coal Measures Orange
<b>CA 8</b>	"
<b>CA 9</b>	"
<b>CA 10</b>	"
<b>CA 11</b>	"
<b>CA 12</b>	"

*Table 1 : Pottery from Ticknall and Calke Abbey, Derbyshire*

	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	MgO	CaO	Na <sub>2</sub> O	K <sub>2</sub> O	TiO <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	MnO	Co	Cr	Li	V	Zn	Sc	Ni	Cu	As	Rb	Sr	Y	Zr	Ba	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	
TNL1	21.5	5.2	0.9	0.5	0.2	1.8	1.14	0.43	0.11	26	95	363	129	74	19	66	39	12	88	119	21	162	0	1073	56	101	50	8	2	4	2	146
TNL2	23.9	3.1	0.8	0.4	0.2	2.0	1.39	0.39	0.06	26	124	321	109	98	22	71	38	20	79	119	26	225	6	1228	55	97	44	7	2	4	2	262
TNL3	19.4	1.6	0.7	0.4	0.1	2.4	0.96	0.10	0.01	12	122	88	103	35	17	23	36	7	92	49	26	102	0	431	67	138	74	13	3	6	2	438
TNL4	24.7	3.6	0.9	0.3	0.2	2.2	1.19	0.36	0.10	19	103	269	171	78	21	43	35	24	97	102	22	183	0	1215	56	98	46	7	2	4	2	869
TNL5	20.7	1.4	0.7	0.1	0.1	1.7	1.08	0.05	0.01	14	103	334	168	36	19	38	29	3	70	57	20	189	0	383	40	72	34	6	1	3	2	1206
TNL6	25.4	3.0	0.9	0.5	0.2	2.0	1.18	0.47	0.01	20	114	283	133	66	21	60	41	14	83	104	23	239	0	1184	44	77	35	5	1	4	2	288
TNL7	27.6	3.6	1.2	0.4	0.2	2.4	0.79	0.10	0.02	20	114	474	109	64	23	61	51	19	120	96	29	186	0	729	55	96	46	8	2	5	3	1715
TNL8	29.3	4.2	1.1	0.2	0.2	2.4	1.08	0.07	0.02	21	155	727	175	58	24	69	63	11	114	104	30	203	0	861	61	106	50	8	2	5	3	175
TNL11	23.0	4.2	0.8	0.8	0.1	2.2	1.01	0.63	0.02	19	125	312	132	63	19	58	42	18	91	100	24	181	0	938	49	87	40	7	1	4	2	260
TNL13-9	19.4	4.2	0.6	0.7	0.1	1.7	0.91	1.50	0.18	18	84	186	132	104	16	53	43	21	67	87	18	157	1	823	38	67	31	5	1	3	2	826
TNL13-10	26.8	4.1	0.6	1.1	0.1	2.4	0.96	0.95	0.01	18	110	283	150	91	19	60	48	32	94	75	25	198	0	947	16	32	18	3	1	4	3	281
TNL13-12	23.8	3.7	0.9	0.2	0.1	2.2	0.96	0.15	0.01	18	124	408	138	65	20	50	55	19	109	91	24	171	1	1065	48	85	39	6	1	4	2	271
427-76A	28.4	3.8	1.2	0.1	0.1	3.0	1.23	0.05	0.01	26	143	463	178	151	25	71	70	11	164	96	40	225	0	1317	68	121	63	11	2	7	4	700
427-76B	28.1	4.2	1.2	0.1	0.2	3.0	1.16	0.09	0.02	26	139	442	166	98	26	74	58	16	169	101	44	227	0	1104	73	131	70	12	3	7	4	152
T#1	19.4	5.0	0.6	0.8	0.1	1.7	0.91	1.68	0.41	20	82	189	136	127	15	54	34	23	65	101	19	159	1	1272	38	67	31	5	1	3	2	149
T#2	20.7	2.6	0.6	0.4	0.1	1.5	0.96	0.72	0.07	20	90	188	157	63	18	40	48	10	61	72	24	189	0	852	43	79	39	7	2	4	2	878
T14-1	26.4	6.5	1.2	0.1	0.2	3.2	1.28	0.08	0.02	20	152	336	208	86	25	48	52	34	141	124	33	292	0	1217	60	103	48	8	2	5	4	190
T14-2	31.0	5.4	1.1	0.1	0.2	2.3	1.19	0.07	0.01	20	155	717	270	76	31	54	46	25	111	115	46	310	0	1016	65	104	47	8	2	7	5	930
T14-3	31.9	5.4	1.0	0.1	0.2	2.7	1.35	0.07	0.01	18	149	560	212	68	28	50	38	37	119	129	38	312	0	866	66	107	49	8	2	6	4	93
T14-4	25.5	5.3	1.1	0.1	0.2	2.9	1.31	0.07	0.02	19	134	308	187	78	24	46	54	41	132	121	28	263	0	1062	61	104	48	8	2	5	4	86
CA1	25.2	3.2	1.0	0.3	0.2	2.4	1.17	0.22	0.04	21	108	328	145	88	22	52	34	21	103	86	26	215	0	974	54	96	48	8	2	4	3	59
CA2	23.7	4.2	0.9	0.1	0.2	2.3	1.13	0.13	0.02	17	112	395	180	80	20	39	39	16	93	86	23	227	0	1390	49	87	42	7	2	4	3	67
CA3	23.6	4.2	1.1	0.4	0.1	2.5	1.04	0.24	0.04	23	119	302	154	102	20	59	30	10	117	126	24	180	0	717	55	98	48	8	2	4	2	70
CA4	24.2	4.6	1.0	0.5	0.2	2.1	1.39	0.60	0.14	34	123	348	120	100	21	77	44	13	96	161	24	191	0	3253	59	103	52	9	2	4	3	297
CA5	23.8	3.1	0.9	0.4	0.1	2.2	1.11	0.28	0.04	16	105	335	151	57	22	37	44	7	94	136	23	204	0	772	54	97	45	7	1	4	3	187
CA6	19.3	4.8	0.7	0.3	0.1	1.9	0.95	0.90	0.07	20	90	182	101	147	17	48	48	12	81	93	19	162	1	1667	42	77	37	6	2	3	2	169
CA7	24.5	4.2	1.0	0.1	0.2	2.3	0.99	0.08	0.02	20	91	326	108	63	20	49	43	17	120	87	25	163	0	770	51	90	43	7	2	5	2	71
CA8	25.8	6.0	1.0	0.3	0.2	2.4	1.14	0.14	0.02	19	132	358	158	99	23	51	49	18	110	108	28	237	0	842	56	98	45	7	2	4	3	174
CA9	23.1	3.7	1.0	0.3	0.1	2.3	1.04	0.11	0.01	19	136	397	162	86	21	46	41	22	97	88	24	234	0	1118	51	91	42	7	2	4	3	533
CA10	23.0	4.3	1.0	0.2	0.2	2.7	1.05	0.13	0.03	19	114	357	145	43	21	57	58	31	119	144	27	213	0	1458	51	95	46	7	2	5	3	939
CA11	23.6	4.0	0.9	0.1	0.2	2.1	0.96	0.18	0.02	20	102	299	105	76	20	50	44	17	112	78	27	183	0	743	51	90	44	7	2	4	3	75
CA12	24.4	4.3	0.9	0.2	0.2	2.3	1.00	0.16	0.02	20	106	335	120	61	20	50	33	18	117	85	28	186	0	967	50	89	43	7	2	4	3	83

Table 2a: Chemical compositions of pottery from Ticknall and Calke Abbey. Al to Mn wt %age element oxide, the remainder ppm element

LOCALITY	ename	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	MgO	CaO	Na <sub>2</sub> O	K <sub>2</sub> O	TiO <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	MnO	Cu	Li	Sc	V	Y	Cr	Co	Ni	Sr	Zr	Ba	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb
Ticknall Cistercian	CSTN	16.58	7.14	0.98	0.21	0.16	2.91	0.86	0.06	0.029	23	132	17	113	24	86.4	14	35	125	166	715	46	78	46.154	7.144	1.2144	3.1	2.1	158.4
Ticknall Cistercian	CSTN	16.95	7.12	1.23	0.23	0.2	3.76	0.76	0.09	0.069	18	65	15	111	24	76.8	13	37	176	86	676	46	77	47	8.352	1.6152	4	2.7	250.8
Ticknall Cistercian	CSTN	14.59	6.36	0.73	0.2	0.14	2.22	0.76	0.07	0.016	17	87	14	94	16	81.6	11	30	94	54	530	42	68	41.642	7.056	1.4456	2.3	1.7	458.7
Ticknall Cistercian	CSTN	15.66	6.41	1.22	0.19	0.32	3.48	0.72	0.08	0.051	20	77	16	108	21	78	11	33	163	74	598	46	81	46.06	7.236	1.3436	3	2.4	469.7
Ticknall Cistercian	CSTN	16.67	7.11	1.19	0.15	0.2	3.74	0.79	0.06	0.031	20	71	14	108	19	75.6	10	25	171	86	557	44	73	43.428	5.356	1.0156	2.2	2.4	8245.6
Ticknall Cistercian	CSTN	15.32	6.54	1.09	0.13	0.19	3.45	0.69	0.06	0.03	25	65	13	100	16	70.8	11	26	162	81	532	41	73	40.138	4.584	0.9384	1.7	2	4137.1
Ticknall Cistercian	CSTN	19.55	5.22	0.94	0.22	0.13	2.44	1.2	0.04	0.027	19	249	19	127	31	105.6	23	74	71	81	490	59	110	60.16	12.312	2.3912	5	2.8	4236.1
Ticknall Cistercian	CSTN	17.38	7.74	0.72	0.15	0.11	1.92	1.13	0.05	0.012	26	159	18	117	35	97.2	17	51	63	85	600	56	99	57.904	10.304	2.1904	5.6	3.1	731.5
Ticknall Cistercian	CSTN	19.32	5.34	0.92	0.19	0.14	2.31	1.23	0.04	0.024	23	257	19	127	41	106.8	24	73	71	97	639	62	126	64.766	12.864	2.7864	6.9	3.5	986.7
Ticknall Cistercian	CSTN	19.75	4.6	0.96	0.21	0.15	2.45	1.19	0.05	0.023	20	245	20	128	29	106.8	24	82	66	94	461	56	97	57.528	11.06	2.216	5.2	2.9	13534.4

Table 2b: Alan Vince's ICP-MS data used in this study. Al to Mn wt %age element oxide, the remainder ppm element.

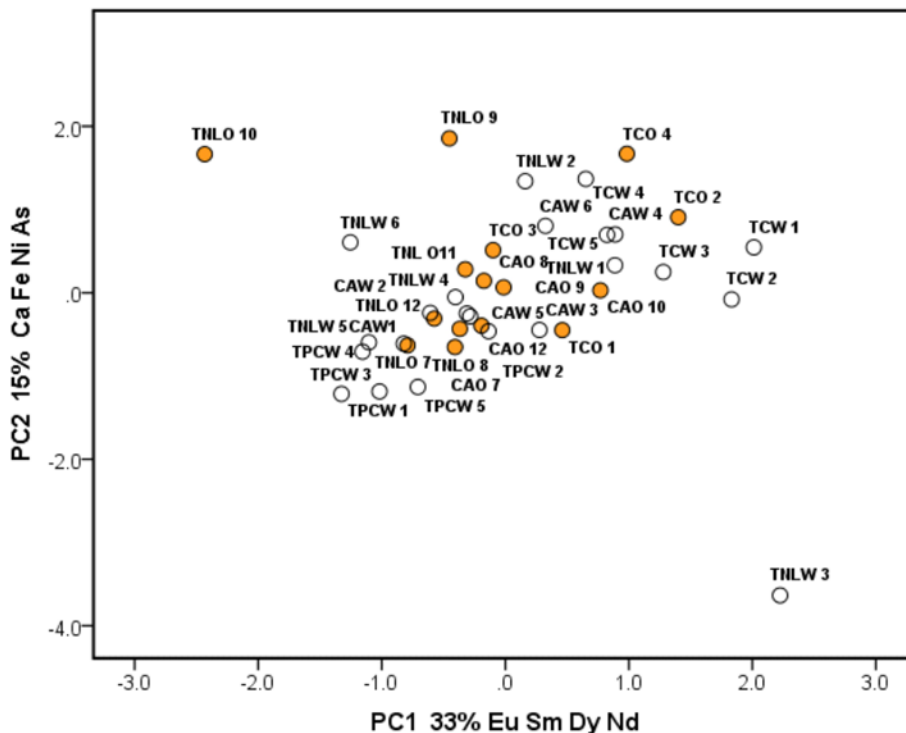


Fig. 1a: PC plot of Al-normalised data for Ticknall: TNLO (orange) (TNL 7-13 in Table 1), TCO Harpur Avenue CM (orange), TNLW (white) (TNL 1-6 in Table 1), TCW Harpur Avenue CM white and TPCW Peats Close CM (white); Calke Abbey: CAW (CA 1-6 in Table 1), CAO (CA 7-12 in Table 1). All elements except Zn, As, Rb and Cd.

In terms of production, this may simply mean that more than one local clay source was used and one of the clays was naturally slightly richer in iron. The manner in which the Calke Abbey samples are distributed across the broad group should support the view that they share the same origin as the Ticknall material. As for both TNLO10 and TNLW3, there is nothing macroscopically evident to indicate that they are different other than to note that the latter has a finer whiter fabric than the other white examples.

Adding T1#1 and T#2 to the data set (Fig. 1b) reveals T1 lying well outside the main group owing to high Mn, V, Co and low Cr and Cu contents. All that can be said at this stage is that it is foreign to Ticknall. T2, the roof tile, on the other hand, despite similarly low Cr and Cu and high Co, belongs to the main group, albeit as an atypical member of that group.

The *second* question is whether the examples of Martincamp flasks (Brown and Spavold 2019, 39-49) were chemically similar to the Ticknall Coal Measures wares and/or to the Ticknall Cistercian wares. Visual inspection of the individual compositions of the Martincamp flasks reveals that they are similar to those of the Coal Measures, yet there are subtle differences: the flasks' Al and Fe contents are slightly higher (for the former element perhaps as a result of the high temperature firing) and the Sr and Zr contents are certainly higher than in the Coal Measures sherds.

Turning to a multivariate view, Figs. 2a, b show the relationship between the compositions

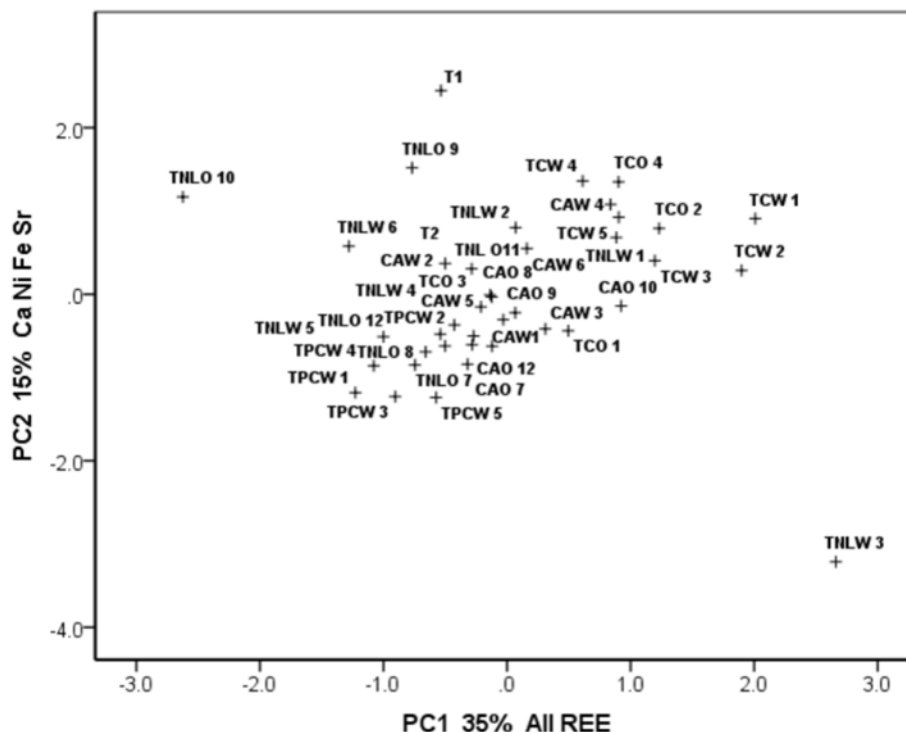


Fig. 1b: PC plot of Al-normalised data for the same samples as in Fig. 1a but with the addition of T#1 and T#2. All elements except Zn, As, Rb and Cd. REE are rare earth elements.

of the Ticknall, Calke Abbey, Harpur Avenue and Peats Close Coal Measure wares, the Martincamp flasks and Harpur Avenue and Ticknall Cistercian, the data for the last of these having been obtained by Vince (2007). It is readily apparent that the central broad group is maintained and moreover the Martincamp flasks belong to it, but the Cistercian from Harpur Avenue and Ticknall are different. The classification by cluster analysis gives a broadly similar view.

The Martincamp flasks are notably well fired, the reduced fired examples, T14-1 and 2, being especially hard. The flasks have a uniform fabric which macroscopically appears finer textured than that of the Coal Measures wares. Nevertheless, as just mentioned, chemically the flasks are similar to the Coal Measures wares, although on removal of the Cistercian wares from the data set it is noted that the Martincamp flasks continue to belong to the main group, while some TCW CM sherds stand apart. Whether this observation has an archaeological significance is doubtful.

In answer then to the second question, the clays of Martincamp flasks are related, but not identical to those of the Coal Measures. Such a statement does not contradict the assertion that Ticknall was producing Martincamp flasks.

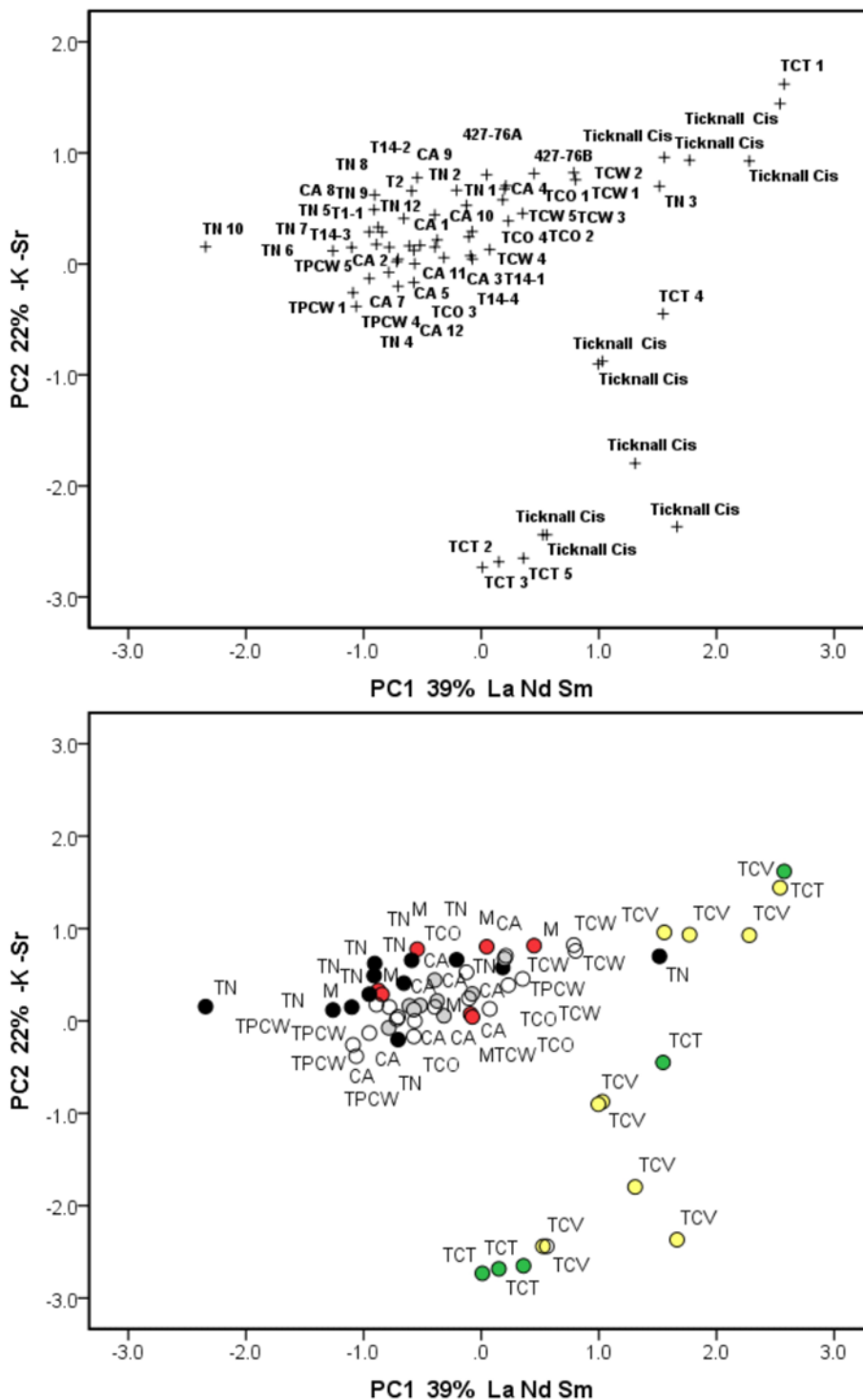


Fig. 2a, b: PC plots of the compositions of (1) the Ticknall (TN in black), Calke Abbey (CA in beige), Harpur Avenue and Peats Close Coal Measure sherds, (2) Martincamp flasks from Ticknall (M in red), and (3) Cistercian from Harpur Avenue (TCT in green) and Ticknall (TCV in yellow). Al-normalised data, all elements except Zn, As, Rb and Cd. (a) with sample numbers and (b) colour coded.

### ACKNOWLEDGEMENTS

The Ticknall Archaeological Research Group would like to acknowledge the receipt of a generous grant from Derbyshire County Council, without which the following work and article would not have been possible. Richard Jones, Sue Brown, Janet Spavold and Anne Irving would particularly like to thank Dave Barrett for his interest and support.

### REFERENCES

- Brown, S. and Spavold, J. (2019) Excavation at Staunton Lane End Cottage, Ticknall, Derbyshire (TSL 14). Ticknall Archaeological Research Group.
- Jones, R.E. (2016) Chemical analysis of Late Medieval pottery from Ticknall. *DAJ* 136: 66-82.
- Vince, A. (2007) Characterisation of Late Medieval/Transitional Pottery from Ticknall, Derbyshire. Available at - <http://archaeologydataservice.ac.uk/archiveDS/archiveDownload?t=arch-1000-1/dissemination/pdf/AVACreports/2007/avac2007114.pdf>