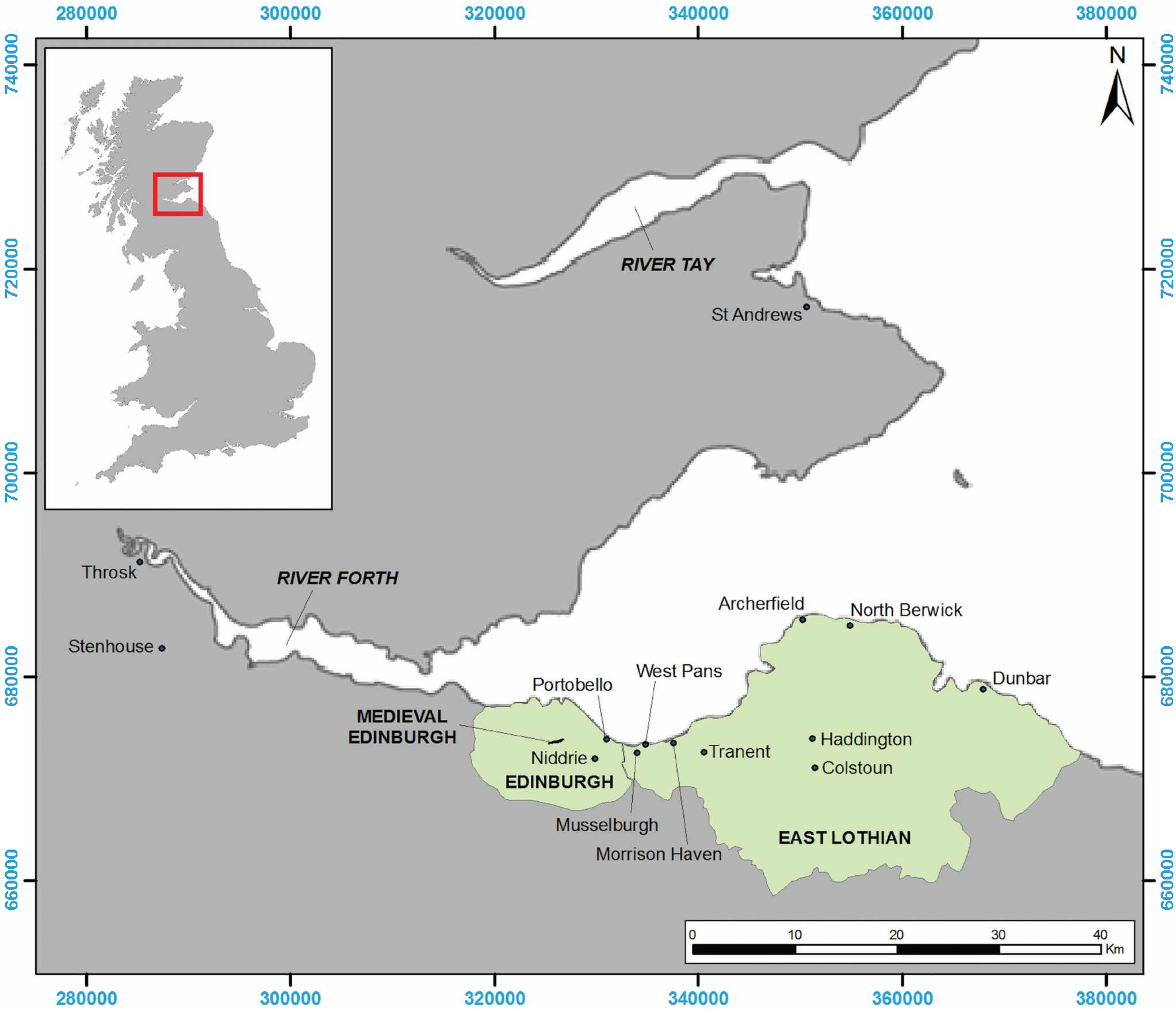

Figure 1
Site location.

The medieval and later pottery from Niddrie near Edinburgh

George Haggarty and Michael Hughes

Summary

A combination of principal components and discriminant analysis was used to interpret the ICP analyses on Niddrie pottery, following the approach used for Scottish redware (Haggerty et al 2011) and Scottish white gritty ware (Jones et al *2002/3). The patterns in the chemical analysis data of the Niddrie pottery were used to select suitable material from the respective ICP databases on Scottish pottery to compare against them. The ICP analysis of pottery from Niddrie Burn has shown definite patterns allowing probable identifications of the general location of the sources of the pottery. Of the SPMOW and SPMRW sherds, many showed an Upper Forth composition, specifically linking them to kiln material from Stenhouse and Throsk. One sherd (GH06) seemed to definitely have the Throsk element pattern, while another (GH09) fell just outside the Stenhouse/Throsk group but appears to be an Upper Forth sherd. In contrast three appeared to be from East of the city: two SPMOW sherds (GH04 and GH05) and one SPMRW (GH15) seemed associated with the West Pans kilns. Sherd (GH08) was unusual with only half the iron content and a higher alumina compared to the rest of the redware sherds and did not conform to the composition of any of the pottery from the kiln sites tested, so at present its origin is unknown.*

In contrast, all the SWGW appeared to originate in East Lothian, though without an exact match with the analysed sherds from sites in the region. There was some consistency in the composition sub-groups found among the Niddrie SWGW, and although the nearest composition was to pottery from Archerfield, there was some indication that a Colstoun sub-group had been made of similar clay to most of the Niddrie SWGW. Very similar graphs were obtained for statistical tests on the same groups of ICP analyses of Scottish pottery which had been published in earlier investigations.

Introduction

The following is a report on a medieval and later pottery assemblage recovered by AOC Archaeology during excavations, centred on NT 301 702. These were commissioned by the City of Edinburgh Council, as part of a flood alleviation scheme. This required the diverting and realignment of the Niddrie burn from its historic course within the area of the old Wauchope family estate and site of the former village of Niddrie (Figure 1), (Bradley-Lovekin and Hindmarch forthcoming). Apart from a couple of sherds, the assemblage divides easily by eye into three distinct groups. The earliest a small assemblage of Scottish white gritty ware (SWGW), deriving from the fill of a number of what is thought by the author to be mainly late 13th or 14th century sand extraction pits cut into the natural subsoil, contexts (44, 48, 64, 85 and 96). It's possible however that a very small rim sherd (from pit 45) may be earlier and date to the late 12th or early 13th centuries. Unfortunately a pinkish sandy possibly Yorkshire rim sherd, recovered during the evaluation phase (B1104) (Figure 2, Cat 1), was only recently given to the author. Carbon residue on the exterior of a sherd from context (49), the fill of pit (48), sent for C14 dating produced what would seem to be a somewhat early date of (11590 ± 40 BP, or cal BC 11527–11396 (1σ) (SUERC-38168 – GU26175), Appendix A Figure 10.

The recovery of sherds dating from the high medieval period should not be surprising, as it has been suggested that the placename Nidrof, Nidra or Niddrie, may be of Brythonic origin, nuada tref, 'new settlement', possibly signifying a long period of occupation. Although there are a number of 12th and 13th century charters pertaining to Niddrie, it's not until the reign of Robert III (1390–1406) that one Gilbert Wauchop receives a charter for the lands of Niddrie in the vicinity of Craigmillar Castle (Paterson 1858, 13). There is also a suggestion that the family may have possessed the property as early as 1249 (ibid). Later in 1502 the family erected a chapel on their estate dedicated to the Virgin Mary and by the end of the 16th century possessed either a castle or a tower capable of accommodating 100 strangers (Whyte 1792, 345, cited in Paterson 1858, 27).

In a bid to try to locate a production source and, in line with the published Scottish guidelines for Scottish

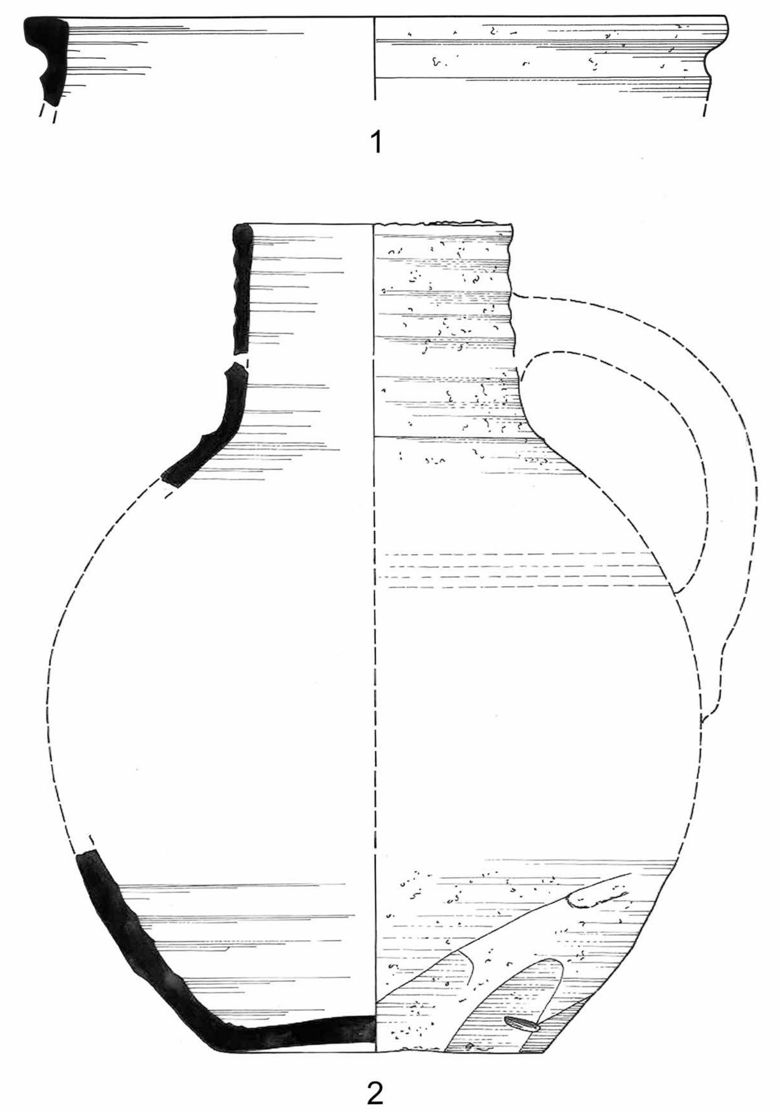

Figure 2
Cat 1 Possible Yorkshire Type Ware rimsherd B1104, Cat 2 SPMRW jug.

white gritty ware (Jones *et al* 2003 and Haggarty *et al* 2012), ten sherds were sent for ICP chemical analysis, Appendix B. Unfortunately the forms are somewhat difficult to classify as there are only five rim sherds; the possible earlier thinly potted, cooking pot/jar sherd from pit (45) and from the evaluation phase an earlier cooking pot/jar rim sherd (B1104). There is also a small jug rim fragment from the fill of pit (96), a small jug rim from pit (64) and a cooking pot/ jug rim from pit (48) which was sent for dating. Excluding the two possible earlier sherds, all the material seem to split fairly evenly between jars/cooking pots and jugs, itself indicative of a 13th or 14th century date. Scottish 12th century medieval assemblages generally reflect a strong predominance of jars/cooking vessels. A few of the glazed jug body sherds have traces of decoration in the form of applied pellets and vertical strips in red firing clay. Interestingly, 15th and 16th century ceramic material is absent from the site.

Almost certainly associated with the later occupation and possibly demolition of a farmstead is a group of Scottish post medieval reduced wares (SPMRW), and oxidised wares (SPMOW), from contexts (08, 30, 31, 32, 36, 37, 39 55 and 87). Dating of these wares is something of a problem, as both the large (SPMRW) jugs (Figure 2 Cat 2), range of (SPMOW) crocks (Figure 3 Cats 3–5; Figure 4 Cats 6 and 7) and jugs in various sizes (Figure 4 Cats 8 and 9) all have a long life span from the late 16th through to the 18th century (Haggarty 2004; Haggarty *et al* 2011, 14–21). Many of the post-medieval pottery sherds conjoin between these contexts. For example the crock body and base fragment (Figure 3 Cat 3) contains sherds from contexts (31, 32, 36, 37, 39 and 87). I have therefore catalogued them as a small tight assemblage and, in a bid to identify a production source, sent fifteen sherds, five SPMOW (GH 1–5) and ten SPMRW (GH 6–15) for chemical sourcing, appendix B.

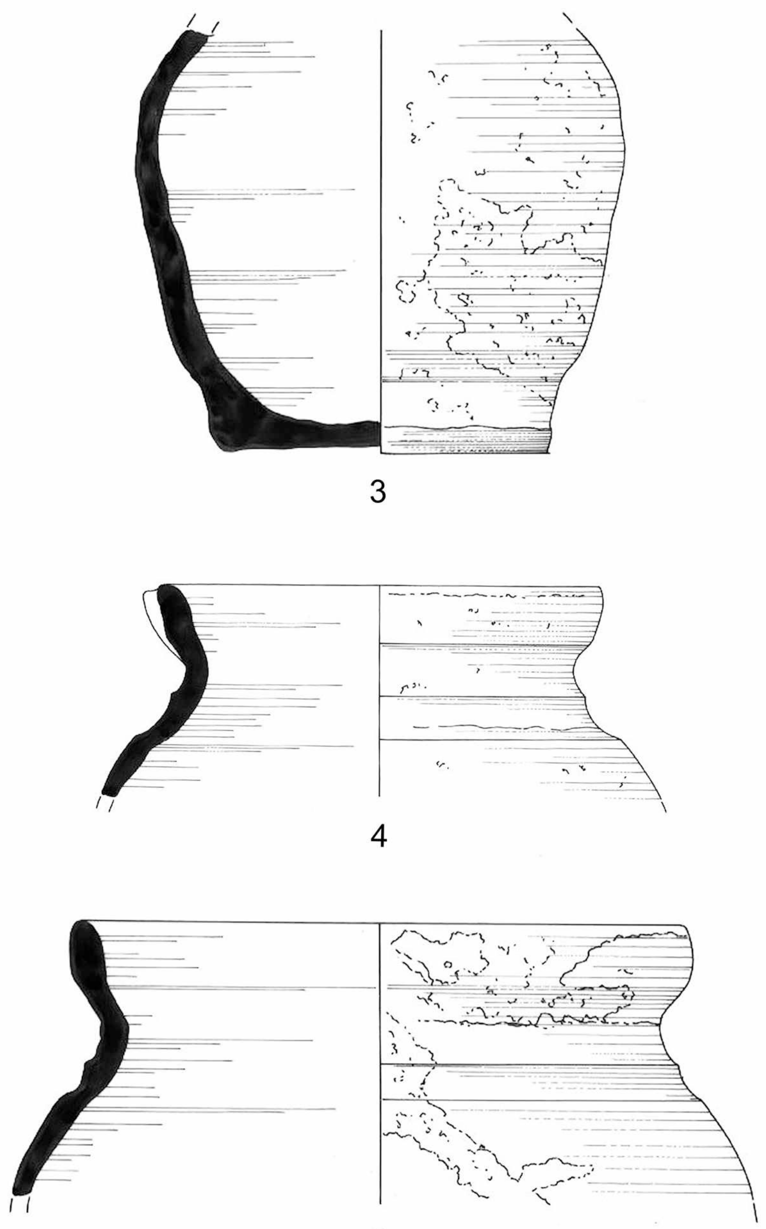

Figure 3
Cats 3-5 SPMOW crocks.

Associated with the post medieval materials are five sherds from imported vessels, and these may help contribute somewhat towards a closer date. They comprise a rim from context (37) (Figure 4 Cat 9) and a body sherd from context (31), from two different fairly common small German, Frechen salt-glazed jugs probably dating to *c* 1650–75, a basal angle fragment from an undecorated Anglo-Dutch tin-glazed earthenware albarello style jar from context (31) (Figure 5 Cat 10) and one unknown, thin, gritty, micaceous body sherd in a brick red paste from which the glaze has flaked, context (55). From a build up adjacent to the ice house another rim with part of a face mask from a third small Frechen salt-glazed, jug was recovered; associated with the ice house but its exact context not known (Figure 5 Cat 11). All in all, a date in the second half of the 17th century for this material is thought most likely, although it has been suggested that it could be associated with the rebuilding by Sir John Wauchope of the main house on a new site around 1630.

The third group consists mainly of twenty-two creamware and pearlware sherds, from contexts (07, 18, 20, 65, and 83). These derive mainly from cups and plates, except one base sherd from a large creamware preserve jar, and all of which probably date from *c* 1800 or in the case of the single white salt glazed sherd from context (1604), again associated with the ice house, the third quarter of the 18th century (Haggarty 2007). One sherd from a blue shell edged

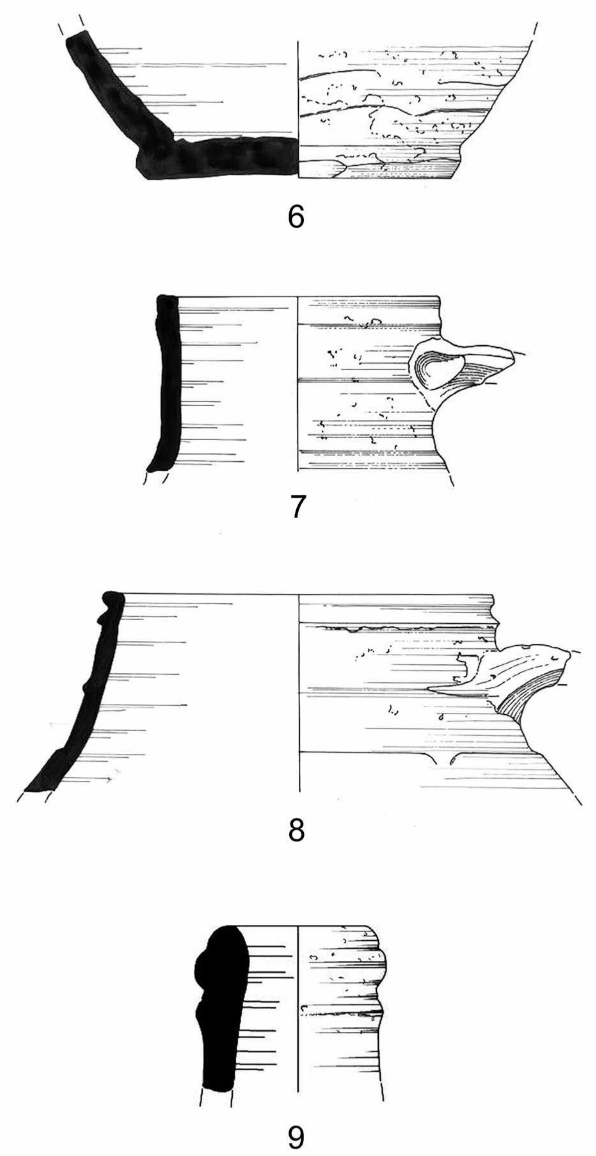

Figure 4
Cats 6-8, SMPOW crocks, 9 Frechen salt glazed jug Context 37.

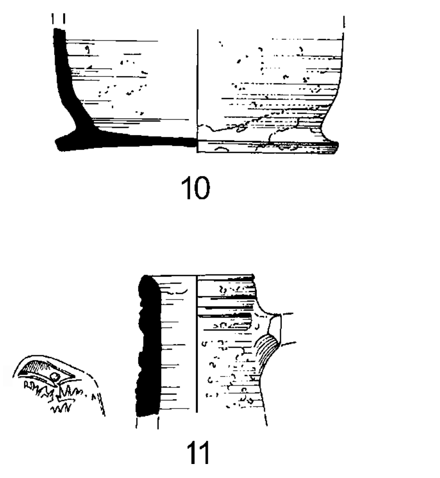

Figure 5
Cat 10 basal angle from Anglo Dutch albarello style jar Context 31.

pearlware plate is impressed 'WEDGWOOD' and interestingly none of the edges from this group of sherds; probably representing eight or nine vessels, show signs of abrasion.

There is also one well-thrown, thinly potted, pink/red sherd from context (55) which would seem to be an unidentified import of uncertain date, but probably post-medieval. From context (08) there is sherd from an industrial produced redware vessel, probably of late 18th century date. This is visually similar to much of the material being produced at that time in the Portobello–Prestonpans area, and, on current evidence, especially at the Morrison's Haven kiln site (Haggarty 2009).

One 19th century sherd from the evaluation phase (1205) has in red the letters [––ON] within a ribbon. Research suggests that this is probably a cup from 'THE LONDON' a ship belonging to the Honourable East India Company. For a somewhat similar example also decorated in red and produced by Spode, see (Laister 2006, vol 2 304). It's interesting to speculate that this may relate to a number of trips made to South Africa by Major-General Andrew Gilbert Wauchop (05/07/1846 – 11/12/1899), killed while commanding his brigade at the battle of Magersfontein during the South African War.

Plasma spectrometry analysis (ICP) of post-medieval pottery from the Niddrie Burn Restoration Project, Edinburgh

Introduction

Twenty five sherds of post medieval pottery recovered during the excavations at Niddrie Burn were submitted for chemical analysis with the aim of determining the source of the material. Three types of pottery were represented: five sherds of Scottish Post Medieval Oxidised Ware (SPMOW), ten sherds of Scottish Post Medieval Reduced Ware (SPMRW) and ten sherds of Scottish White Gritty Ware (SWGW) Appendix A. Databases of analyses of Scottish redware and gritty ware respectively were available for comparison against the results.

Chemical analysis by ICP, Inductively-Coupled Plasma Atomic Emission Spectrometry (ICP-AES) and Mass Spectrometry (ICP-MS)

The analysis technique used was the same as that applied for the Scottish database of redwares, namely inductively coupled plasma spectrometry (ICP), consisting of a combination of two instruments, Atomic Emission Spectrometry (ICP-AES) and Mass Spectrometry (ICP-MS) (Haggerty *et al* 2011, 5). Powdered samples for analysis were obtained from the sherds by drilling with a 2 or 3mm diameter tungsten carbide drill. In addition, the samples sent for ICP analysis included several portions of a Certified Reference Material (NBS679 Brick Clay – produced by the US National Institute for Standards and Technology, Washington DC) spaced out in the analysis batch but without identification to the laboratory as such; these acted as analysis quality control samples. The analysis results on these control samples gave entirely satisfactory results. The powdered samples were analysed at Royal Holloway, Department of Earth Sciences, University of London, using their standard techniques for ICP-AES and ICP-MS.

Results and discussion

The results of the analyses are given in Table 1, grouped according to the three types of pottery analysed. Visual examination of the data shows a majority of the SPMRW pottery has a similar chemical analysis, suggesting one source, as does most of the SWGW. The SPMOW showed a more mixed picture, although sherds 1 and 2, and 4 and 5 appeared to form pairs of very similar analyses, thought the pairs differed; these pairs may be from the same kiln batch, or even parts of the same pot.

Principal Components Analysis of the ICP results: general aspects

Detailed interpretation of the ICP analyses was carried out with multivariate statistics, which simultaneously considers the concentrations of many elements in each sample. The multivariate statistics technique of Principal Components Analysis (PCA) was used (Manly 2005; Tabachnick and Fidell 2007). The Principal Component analyses were carried out in a series of stages, whereby samples with analyses significantly different from the rest were systematically removed and the PCA re-run in their absence. Descriptions of its application to archaeology have been given elsewhere (see for example, Baxter 1994 and 2003; Shennan 1997). The program MINITAB version 16 was used with the 'PCA' procedure (Ryan *et al* 2005). The Excel file containing the original analysis data was read into MINITAB and natural logarithms were taken of all elements before subjecting the data to multivariate statistics – taking logs is regularly used in such applications. This pattern was followed in all the subsequent tests in this report; it differs from the approach used by Haggerty *et al* (2011) and Jones *et al* (2002–3) where the elements were scaled to aluminium. However, the two approaches appear to produce very similar results (see below for the discriminant analysis of the SWGW sherds). Plots of pairs of the resulting principal components are effectively chemical 'maps' for the items analysed, and we expect that pottery made of the same clay will plot in the same part of the figure.

A representative selection of the elements analysed was used in all the tests on the Redwares except the first Principal Components Analysis – see below – omitting elements which may be subject to leaching during burial or tend to show poor correlation with other elements. The elements selected include: aluminium, iron, sodium, potassium, calcium, magnesium, manganese, titanium, lithium, chromium, cobalt, copper, zinc, nickel, vanadium, scandium, yttrium, rubidium, strontium, caesium, lanthanum, cerium, samarium, europium, niobium, neodymium, praseodymium, gadolinium, dysprosium, terbium, holmium, erbium, ytterbium, lutetium, uranium and thorium (36 elements). The Scottish Gritty Ware ICP database was obtained using ICP-atomic emission (ICP-AES) alone that is without the extra elements added by mass spectrometry (ICP-

Figure 11–12 *see pages 8–9*
The results from Al2O3 to MnO inclusive are given as the oxide, in weight percent; all the rest are given as the element, in parts per million. The zirconium results (Zr*) were not used in the statistical tests since the laboratory indicated possible incomplete dissolution of this element from the powder sample.

Al2O3 aluminium	Fe2O3 iron	MgO magnesium	CaO calcium	Na2O sodium	K2O potassium
TiO2 titanium	P2O5 phosphorus	MnO manganese	Co cobalt	Cr chromium	Cu copper
Li lithium	Ni nickel	Sc scandium	Sr strontium	V vanadium	Zn zinc
Y yttrium	Ba barium	As arsenic	Rb rubidium	Zr* zirconium	Nb niobium
Mo molybdenum	Cd cadmium	Sb antimony	Cs caesium	Tl thallium	Pb lead
Bi bismuth	Th thorium	U uranium			

Rare earth elements

La lanthanum	Ce cerium	Pr praesodymium	Nd neodymium	Sm samarium	Eu europium
Gd gadolinium	Tb terbium	Dy dysprosium	Ho holmium	Er erbium	Tm thulium
Yb ytterbium	Lu lutetium				

Table I

lab.no.	ICP no.	type	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Co	Cr	Cu	Li	Ni	Sc	Sr	V	Zn	Y	Ba	As	Rb
RL 41	**GH01**	SPMOW	17.8	7.17	2.38	0.80	1.21	3.56	0.96	0.18	0.13	30	127	13	76	53	17	154	142	112	27.5	564	13.4	139
RL 42	**GH02**	SPMOW	18.3	7.26	2.41	0.91	1.11	3.54	0.95	0.55	0.09	24	128	18	68	52	18	170	126	130	26.1	585	13.7	143
RL 43	**GH03**	SPMOW	16.3	6.06	2.14	0.67	1.31	3.18	0.88	0.16	0.10	22	114	13	60	46	16	146	110	128	24.0	520	11.8	124
RL 44	**GH04**	SPMOW	21.3	7.75	1.63	1.03	0.63	2.51	1.13	0.16	0.08	40	134	31	79	74	19	149	120	97	27.0	623	10.7	106
RL 45	**GH05**	SPMOW	20.1	7.43	1.66	0.97	0.59	2.37	1.06	0.14	0.09	36	141	32	81	78	19	137	123	112	24.6	553	10.4	103
RL 46	**GH06**	SPMRW	20.2	6.96	2.80	0.54	0.99	3.78	1.06	0.20	0.07	26	142	86	88	52	20	148	182	124	24.3	542	7.3	155
RL 47	**GH07**	SPMRW	19.0	7.23	2.62	0.73	1.05	3.62	1.02	0.22	0.06	27	132	13	74	53	18	157	156	115	26.5	550	6.5	143
RL 48	**GH08**	SPMRW	21.0	3.52	1.51	0.30	0.70	2.68	1.22	0.17	0.04	29	128	24	66	30	18	148	139	77	21.5	562	3.3	107
RL 49	**GH09**	SPMRW	19.4	6.47	2.38	0.80	1.14	3.66	1.06	0.26	0.05	26	148	17	71	52	19	164	161	109	30.1	584	5.8	141
RL 50	**GH10**	SPMRW	19.1	7.32	2.60	0.74	1.12	3.73	1.05	0.16	0.08	28	162	15	76	54	18	159	155	109	25.3	552	4.8	142
RL 51	**GH11**	SPMRW	19.2	7.39	2.51	0.79	1.10	3.68	1.01	0.41	0.12	26	147	13	76	56	18	170	163	128	30.2	611	6.7	149
RL 52	**GH12**	SPMRW	19.7	8.31	2.67	0.70	1.01	3.77	1.04	0.28	0.20	30	154	13	84	59	18	155	166	123	29.0	535	6.1	154
RL 53	**GH13**	SPMRW	18.5	6.20	2.30	0.77	1.18	3.57	1.01	0.32	0.05	21	132	10	69	48	17	164	150	112	26.1	619	5.6	146
RL 54	**GH14**	SPMRW	19.7	7.55	2.55	0.71	1.04	3.79	1.06	0.19	0.10	30	147	14	75	55	18	158	164	118	30.8	555	6.9	154
RL 55	**GH15**	SPMRW	18.2	6.20	1.41	0.24	0.70	2.10	1.05	0.12	0.05	28	101	24	61	55	15	103	119	64	24.4	526	6.5	86
RL 56	**GH16**	SWGW	25.2	1.84	0.94	0.49	0.24	2.49	0.91	0.28	0.01	19	118	9	95	56	18	180	123	105	20.4	338	4.6	159
RL 57	**GH17**	SWGW	24.7	2.21	0.59	0.42	0.09	1.90	1.07	0.56	0.02	19	124	47	129	43	17	110	107	31	25.4	537	2.9	92
RL 58	**GH18**	SWGW	29.5	3.17	0.88	0.55	0.10	2.11	1.20	0.21	0.05	31	141	22	205	60	23	138	152	33	32.7	487	3.9	133
RL 59	**GH19**	SWGW	29.9	3.04	0.65	0.29	0.22	2.23	1.27	0.13	0.03	32	139	21	111	52	19	242	130	48	32.6	383	6.2	116
RL 60	**GH20**	SWGW	26.8	4.11	0.51	0.26	0.10	1.31	1.09	0.07	0.02	25	122	26	162	45	18	77	110	31	18.9	271	6.2	64
RL 61	**GH21**	SWGW	29.5	2.83	0.86	0.24	0.11	2.07	1.00	0.06	0.01	23	116	39	171	52	21	74	111	40	60.9	348	4.0	126
RL 62	**GH22**	SWGW	26.5	4.48	0.51	0.28	0.13	1.33	1.08	0.08	0.02	23	125	24	131	47	18	76	116	35	18.4	272	5.1	65
RL 63	**GH23**	SWGW	23.0	3.10	0.77	0.37	0.21	2.05	1.04	0.06	0.03	29	115	31	162	73	16	76	137	49	26.5	363	5.5	113
RL 64	**GH24**	SWGW	23.6	2.77	0.59	0.18	0.11	1.53	1.25	0.07	0.02	23	124	13	125	32	17	100	105	27	19.2	327	3.3	80
RL 65	**GH25**	SWGW	26.5	2.18	0.50	0.42	0.06	1.14	1.12	0.29	0.05	28	124	65	186	53	16	83	135	46	26.4	447	4.9	57

Table 2

lab.no.	Zr *	Nb	Mo	Cd	Sb	Cs	Tl	Pb	Bi	Th	U	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
RL 41	165	19	4.1	0.17	0.8	7.4	1.0	179	0.10	12.9	4.0	54	101	12.1	50	8.8	2.00	7.1	1.23	5.2	1.03	2.76	0.44	2.47	0.39
RL 42	197	19	1.9	0.17	0.9	7.7	1.6	395	0.22	13.1	4.7	53	100	11.7	49	8.4	1.91	6.6	1.16	4.9	0.97	2.64	0.43	2.42	0.39
RL 43	174	18	0.9	0.14	0.7	6.6	1.0	118	0.21	11.9	3.1	47	91	10.6	44	7.7	1.76	6.1	1.06	4.6	0.89	2.47	0.40	2.25	0.36
RL 44	160	20	0.4	0.16	1.0	6.5	1.5	820	0.19	20.9	2.7	68	129	14.8	61	10.2	2.07	7.9	1.29	5.1	0.98	2.67	0.40	2.23	0.35
RL 45	152	20	0.4	0.36	1.0	6.5	1.6	832	0.19	12.3	2.5	54	103	11.9	50	8.7	1.99	6.8	1.16	4.7	0.91	2.41	0.38	2.02	0.33
RL 46	159	21	1.9	0.06	1.0	8.8	1.8	1135	0.00	13.9	3.7	54	101	12.0	49	8.6	1.94	6.6	1.15	4.8	0.92	2.50	0.40	2.42	0.34
RL 47	150	20	1.3	0.21	0.9	8.0	1.4	678	0.00	13.3	3.1	54	103	12.2	51	8.9	2.04	7.0	1.21	5.0	0.97	2.61	0.41	2.24	0.36
RL 48	228	22	0.2	0.09	0.9	5.5	2.0	1554	0.05	12.3	2.6	51	97	11.1	45	7.7	1.85	5.9	1.03	4.4	0.81	2.13	0.34	1.83	0.27
RL 49	163	20	1.2	0.09	0.8	8.0	1.4	729	0.01	14.1	3.5	60	114	13.6	57	10.0	2.26	7.9	1.38	5.6	1.08	2.91	0.45	2.42	0.39
RL 50	207	21	1.5	0.09	0.6	7.8	1.1	257	-0.01	13.0	3.1	53	101	12.0	50	8.6	1.94	6.8	1.15	4.8	0.92	2.48	0.39	2.15	0.33
RL 51	218	21	2.1	0.20	0.8	8.3	1.3	437	0.02	14.2	3.9	56	107	12.7	53	9.4	2.11	7.4	1.31	5.3	1.08	2.98	0.49	2.65	0.43
RL 52	200	21	3.2	0.14	1.1	8.7	1.5	697	0.00	14.0	5.2	57	108	12.9	54	9.5	2.14	7.4	1.29	5.2	1.04	2.84	0.45	2.48	0.40
RL 53	208	21	1.6	0.13	0.6	7.8	1.4	582	0.07	13.3	3.5	50	95	11.3	47	8.2	1.88	6.5	1.13	4.7	0.94	2.63	0.43	2.46	0.41
RL 54	172	22	2.0	0.27	0.7	8.5	1.3	464	0.01	14.1	4.3	59	111	13.3	56	9.9	2.24	7.8	1.37	5.5	1.10	2.95	0.47	2.59	0.42
RL 55	242	20	0.4	0.04	1.9	5.0	1.3	823	0.00	11.2	2.3	49	93	10.6	44	7.5	1.85	6.0	1.07	4.5	0.86	2.43	0.39	2.10	0.36
RL 56	212	18	0.5	0.08	0.4	10.6	1.2	182	0.00	16.2	3.4	57	100	10.8	40	6.0	1.26	4.6	0.77	3.4	0.73	2.29	0.43	2.48	0.40
RL 57	180	18	0.3	0.06	0.4	13.1	1.8	1453	0.17	15.0	3.7	56	104	11.4	46	7.7	1.77	5.9	1.01	4.4	0.91	2.73	0.46	2.60	0.43
RL 58	268	22	0.6	0.08	0.5	16.7	1.1	210	0.04	17.9	4.5	71	123	14.0	56	9.3	2.08	7.3	1.28	5.6	1.19	3.38	0.58	3.17	0.54
RL 59	229	21	0.3	0.12	0.3	12.3	1.3	34	0.01	19.9	5.4	87	153	17.3	69	11.2	2.33	8.4	1.43	5.6	1.14	3.18	0.51	2.89	0.45
RL 60	179	20	0.3	0.11	0.6	9.9	0.9	188	0.43	18.6	3.8	52	91	9.8	39	6.1	1.25	4.8	0.77	3.4	0.69	1.94	0.34	1.92	0.32
RL 61	120	17	0.1	0.04	0.3	15.9	1.0	66	0.04	16.5	3.4	68	117	13.5	56	9.5	2.26	8.4	1.59	7.3	1.75	5.07	0.85	4.72	0.80
RL 62	161	21	0.3	0.07	0.7	10.0	1.4	854	0.24	16.4	3.8	45	81	9.1	36	6.0	1.26	4.5	0.77	3.4	0.67	1.90	0.31	1.83	0.31
RL 63	190	19	0.4	0.12	0.5	10.6	1.1	62	0.07	15.9	3.3	54	100	11.9	49	8.5	1.80	6.2	1.06	4.6	0.94	2.68	0.45	2.54	0.42
RL 64	214	21	0.2	0.09	0.4	12.4	0.8	123	0.22	14.7	3.5	52	88	9.2	34	5.2	1.15	4.1	0.72	3.5	0.70	2.11	0.37	2.11	0.36
RL 65	199	20	0.6	0.17	0.6	11.1	2.1	1636	0.08	15.8	5.5	73	114	14.4	57	9.1	1.99	7.0	1.16	4.7	0.94	2.61	0.43	2.48	0.39

MS). Thus the tests on comparing the Niddrie SWGW to the gritty wares database used a smaller list of 25 elements (see SWGW section below). The zirconium results (Zr*) were not used in the statistical tests since the laboratory indicated possible incomplete dissolution of this element from the powder sample.

Scottish (SPMOW and SPMGW)

Principal Components Analysis of the ICP results on Niddrie Burn SPMOW and SPMRW pottery analysed in the project

A principal components analysis was carried out on the SPMOW and SPMRW sherds alone, to look for patterns among the sherds. Principal components requires that there are more samples than elements in the calculations, so with only 15 samples, it was necessary to prune the list of elements used in the test to 14, which were: aluminium, iron, magnesium, calcium, sodium, manganese, nickel, vanadium, chromium, lanthanum, europium, dysprosium, ytterbium and thorium. The first principal component (not plotted) accounted for 45% of the variation in composition, and was correlated positively with the concentrations of all the elements – *ie* it is a 'dilution' effect. The first principal component is often associated, in studies of archaeological and historic ceramics, with the concentrations of many elements and is an approximate measure of 'total element concentrations'. It reflects the percentage of diluting temper in the body fabric (natural or added, often quartz silt or sand). Pottery with higher concentrations of elements (ie with more positive values on that component or axis in a plot) represents fabrics with less quartz temper. One major difference in chemistry between the analyses of the pottery is therefore simply the total concentration of elements, which is a measure of the proportion of diluting temper. Two SPMRW sherds 8 and 15 stood out with similar low scores on this component, suggesting higher temper levels than the rest of the pottery.

It was more useful to consider the plot of the second and third components (PC2 and PC3) in which by definition the 'diluting' effects extracted with the first principal component play no part. The second and third components contained a further 22% and 14% respectively of the chemical variation, cumulative total of 81% of the chemical variation in the pottery samples were therefore summarised in just these three components. The second and third components show the real differences in chemistry between the pottery sherds other than the temper effect. The third component separated the SPMOW and SPMRW sherds, except for no.15 which falls among the SPMOW sherds. This indicates a small difference in analysis between these two fabrics, with the SPMOW (being low on PC3) containing generally higher concentrations than the SPMRW sherds of nickel, iron, manganese (transition elements) and calcium, but lower concentrations of vanadium, chromium and to a lesser degree aluminium. The rest of the SPMRW sherds apart from no.8 seemed to form a reasonably compact analytical group, suggesting a common source for this pottery.

Principal Components Analysis of the ICP results on Niddrie Burn SPMOW and SPMRW pottery together with comparative analyses from the Scottish Redware ICP Database

A selection was made of comparative pottery analyses of production and consumer sites in the surrounding region, drawn from the Scottish Redware ICP Database. The sites chosen for comparison were: kiln sites at Portobello, Morrison's Haven, West Pans, Stenhouse and Throsk, and consumer sites of Edinburgh Cannongate and Chambers St. Not all the pottery analyses from these sites in the Database could be included in the comparison: the analyses of the major elements were missing from Throsk samples TH10–19 and West Pans WP1–9. Samples ES8 and 9 from Chambers St were omitted as probably Dutch (Haggerty *et al* 2011, 48). Titanium was also removed from the element list for principal components as there were missing values from the West Pans samples.

Principal components analysis on the combined dataset showed that the first principal component was again correlated positively with all elements, and so represents a 'temper proportion'. It did indicate there was significantly more variation in temper proportion among the Edinburgh Cannongate samples than any of the kiln sites, all of which were relatively compact groups, indicating relatively little variation in temper proportion among the products of each kiln site. Again it was more useful for interpreting the ICP data to consider the second and third components, which are shown in Figure 6. There is a marked splitting along the second component (horizontal axis) into groups on the left and right of the Figure, indicating different analyses between kiln groups. Figure 6 showed a pronounced grouping of kiln group samples by site, indicating a consistency in chemical composition for each of the kiln groups, some of which overlapped. There was good consistency in the overlapping of specific kilns – the Forth Estuary sites at Morrison's Haven and Portobello formed one pair in the lower left of Figure 6, while the Stenhouse and Throsk kiln sites were on the lower right, overlapping with the pottery from Edinburgh, Chambers St. All but three of the Niddrie Burn pottery samples also fell among this latter group; sherd RL48 (no 9) fell just outside this group. Three sherds (RL 44, 45 and 55: nos 4 and 5 (both SPMOW) and 15 (SPMRW)) plotted amongst the West Pans kiln site sherds.

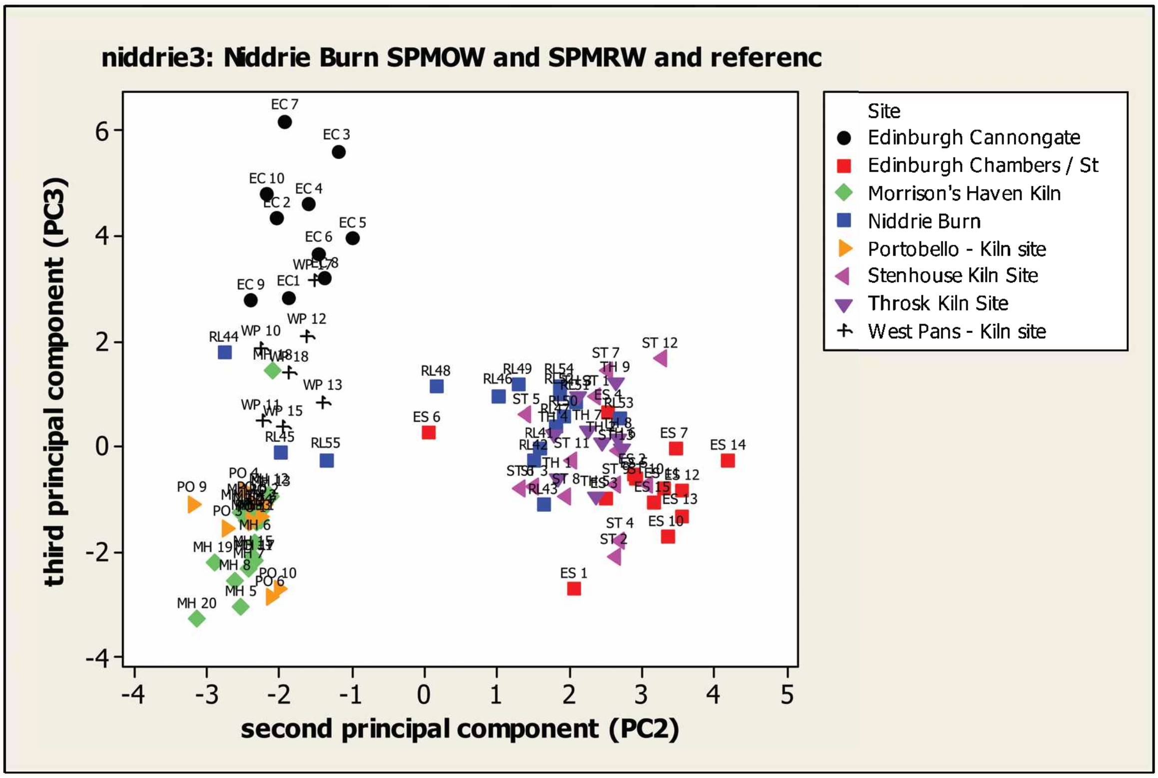

Figure 6

Graph showing the plot of the second and third Principal Components arising from ICP analysis of the SPMOW and SPMRW pottery from Niddrie Burn analysed in the project, combined with pottery from seven production sites, based on 33 chemical elements. The symbol type and colour indicates the site, while the annotation alongside the symbol is the analysis number (see Table 1 for key).

Principal Components Analysis of the ICP results on Niddrie Burn SPMOW and SPMRW pottery compared to pottery from the Stenhouse and Throsk kilns

Given that many of the Niddrie redware sherds seemed associated with Upper Forth kiln sites, the principal components analysis was repeated with those Niddrie sherds which appeared to be Upper Forth composition plus the kiln material from Stenhouse and Throsk only. This indicated that sherd RL48 (sample 8) was very unlike the rest on the third component. Sherd 8 has only half the iron content (3.5%) and a higher alumina (21%) compared to the rest of the sherds in this test and the third component was correlated with these elements. It does not conform to the composition of any of the pottery from the kiln sites tested and at present its origin is unknown.

It was removed from the test and principal components re-run; the resulting plot of the second and third components is shown in Figure 7. The three SPMOW sherds (RL41, 42 and 43: GH1, 2 and 3 respectively) plot on the far left not far from the Niddrie SPMRW but slightly separate, indicating a slightly different origin for them. All except one of the SPMRW plot adjacent to but not overlapping a group of the Stenhouse kiln site sherds. This is suggestive of their origin although not exactly of the same clay as used for the Stenhouse sherds. However the Stenhouse material is not itself entirely uniform in composition – three sherds plot on the far right, suggesting slightly different clay used at different times at Stenhouse. Sherd RL46 (no.6) plots in the lower centre, among Throsk sherds, and suggests it was produced there. Again, some of the Stenhouse sherds plot among the Throsk sherds so there may be overlap in the use of clay resources by the two kilns, or the clays at the two locations may be very similar in chemistry.

Scottish White Gritty Ware (SWGW)

The earlier analytical project on SWGW (Jones *et al* 2002–3) was used as a basis for the strategy in comparing the Niddrie SWGW sherds with analyses from the Gritty Ware ICP database. In the latter publication, the gritty ware analyses were considered by region, and of relevance to the present study were those of East Lothian, Forth Valley, Tay Valley and St Andrews. Inspection of the database suggested it would be most useful to compare the Niddrie material with material from East Lothian.

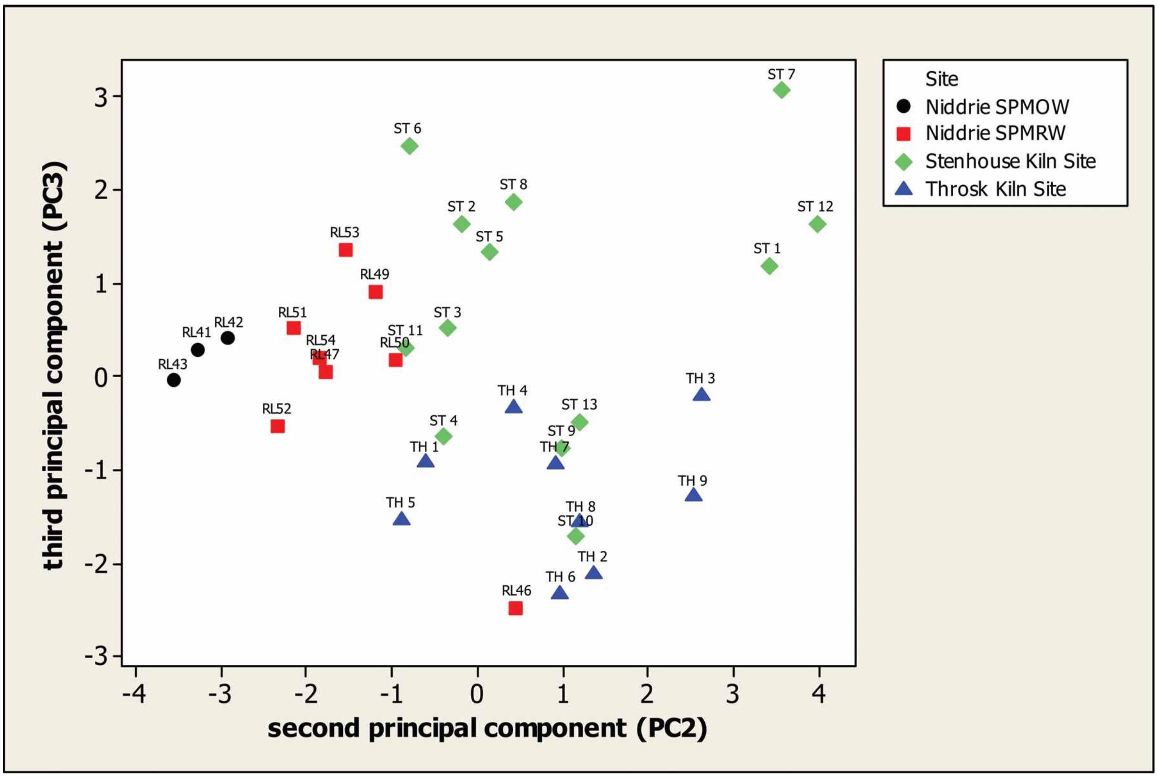

Figure 7

Graph showing the plot of the second and third Principal Components arising from the ICP results on Niddrie Burn SPMOW and SPMRW pottery compared to pottery from the Stenhouse and Throsk kilns.

Principal Components Analysis of the ICP results on Niddrie Burn SWGW compared to SWGW pottery from East Lothian

The East Lothian group comprised (as in the 2002–3 paper) pottery from Colstoun (the only known kiln site in the region), Dunbar, North Berwick, Haddington and Archerfield. There were two separate groups of Colstoun pottery – that included in Jones *et al* (2002–3 – designated 'Edwards': blue triangles) and a smaller number analysed later (green diamonds). The Scottish White Gritty Ware database from which the results were drawn was based on analyses carried out by ICP-atomic emission (ICP-AES), *ie* on a smaller range of elements than that forming the Redware database which used in addition ICP-mass spectrometry (ICP-MS). Although the Niddrie SWGW was analysed by both techniques, for the comparison with the database results, the smaller number of elements selected for the principal components were: aluminium, iron, sodium, potassium, calcium, magnesium, manganese, titanium, lithium, chromium, cobalt, copper, zinc, nickel, vanadium, scandium, yttrium, rubidium, strontium, lanthanum, cerium, samarium, europium, neodymium, dysprosium and ytterbium (26 elements; cf 36 used for the redwares).

A plot of the first two principal components arising from this test is shown in Figure 8; in the PCA of the redware, the first principal component was correlated positively with all elements. Rather unusually, here it was correlated positively with many elements, but negatively correlated with iron, and to a lesser degree calcium. Thus SWGW pottery with higher iron (and calcium) will tend to plot towards the left of Figure 8, such as some of the Colstoun pottery and a sub-group of three Haddington sherds (lower left). Two Colstoun sub-groups show this pattern, but are slightly different in position, indicating slight differences in chemical composition. Other Colstoun sherds plotted among the main scatter of points to the right of centre, together with the Niddrie sherds and those from Berwick and Haddington. Three Niddrie sherds (20, 22 and 24 plotted on the edge of the Dunbar sherds to left of centre in the Figure, indicating sub-groups present in the Niddrie SWGW. A plot of the second and third components (not shown) separated the Dunbar from the rest on the third component, but the small group of Colstoun Edwards sherds (blue triangles) which were on the left of Figure 8 now plotted with the rest of the same, while the later Colstoun analyses remained separate, indicating sub-groups among the Colstoun analyses.

The presence of the Niddrie sherds among the East Lothian SWGW groups lends strong support to the conclusion that they are products of that region, but the ambiguity present in the PCA results as to which group they are most similar to, leads to the need for further discriminant analysis to try to shed light on this problem.

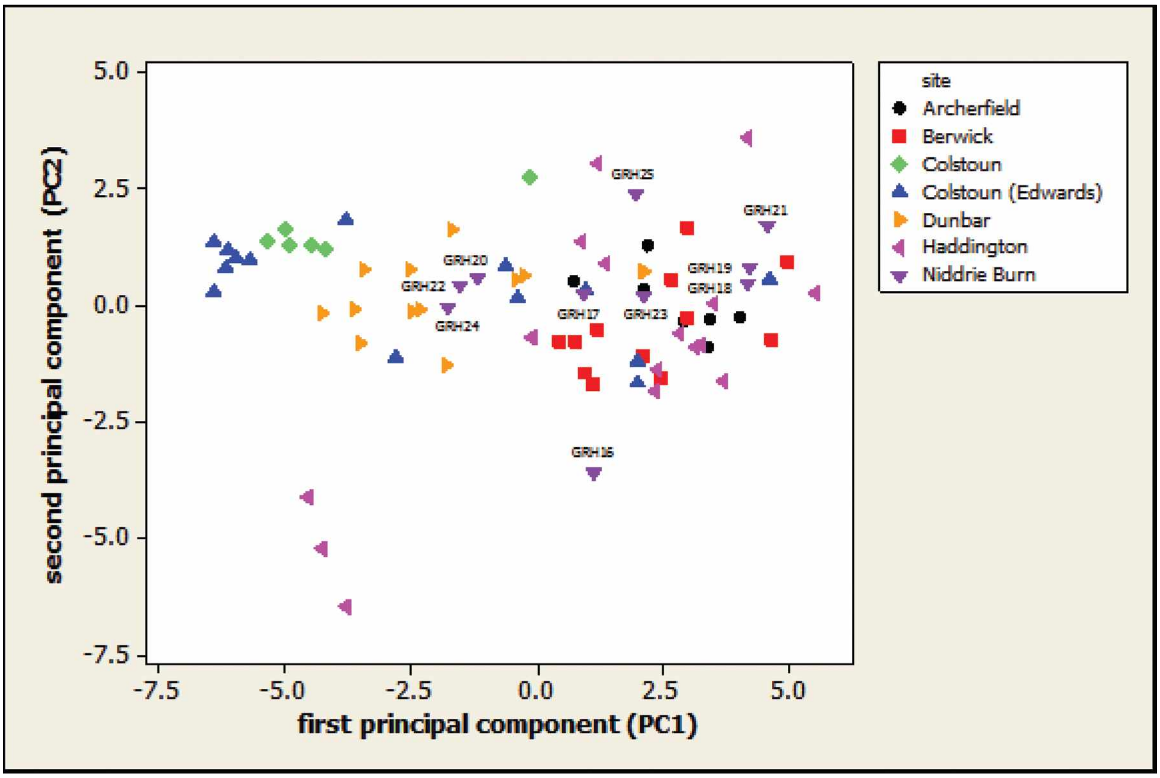

Figure 8

Graph showing the plot of the first and second Principal Components arising from the ICP results on Niddrie Burn SWGW compared to SWGW pottery from East Lothian: Colstoun (the only known kiln site in the region), Dunbar, North Berwick, Haddington and Archerfield.

Discriminant Analysis of the ICP results on Niddrie Burn SWGW compared to SWGW pottery from East Lothian

Continuing with the strategy of following Jones *et al* (2002–3), the ten SWGW from Niddrie Burn were analysed by linear discriminant analysis, using the same chemical elements used for PCA on the same dataset, and comparing them with the same East Lothian SWGW pottery groups. All the samples from the five comparison groups were taken as 'training' examples used to calculate the discriminant functions. The resulting analysis showed that the first three discriminant functions contained respectively 70%, 13% and 9% of the discrimination among the pottery from these sites. Thus the first two functions contained a cumulative total of 83% of the discrimination, which is entirely satisfactory, and means that a graph of the first two discriminant functions (Figure 9) gives a good representation of the discrimination between the sites. It is most satisfying that this Figure is very similar indeed in its layout to the discriminant analysis plot of East Lothian samples in Jones *et al* (2002–3 figure 7, 73), even though the latter standardised the analyses to aluminium before processing, and used a different statistical program (SPSS). As in Jones *et al* (2002–3), the Archerfield samples plot in the lower part of the figure, Haddington plots in the upper right and Colstoun plots in the upper left corner. The Niddrie Burn samples (GH16–25) mostly plot in the centre of the Figure; (GH18, 20 and 22) and (GH23) plot around the spread of Archerfield sherds, though the probability of them being typical members of this group is negligible. The Archerfield sherds have Mahalanobis distances to the centre of the group in the range 20–28, while these four Niddrie samples have distances of 99–124, and 19 is nearest to Archerfield though at distance 264. None of the Niddrie sherds (apart from GH25) plot in the same part of the Figure as the sherds from Colstoun, North Berwick or Dunbar. Niddrie (GH17) and (GH25) distances 116 and 212, have a distant relationship with Berwick sherds as has (GH24) to Haddington distance 263.

Only one sherd from the 'training groups' (D1 from Dunbar) was classified as closer to another site (Berwick) in the discriminant analysis, and the main discriminating elements to the first discriminant function (horizontal axis) were higher concentrations of cerium, ytterbium and europium to the right and higher dysprosium, neodymium and vanadium to the left (*ie* the rare earth elements dominated the main discriminators). The vertical discrimination arose from samples with higher concentrations of chromium, neodymium and rubidium towards the top and higher potassium, iron and titanium towards the bottom of the Figure.

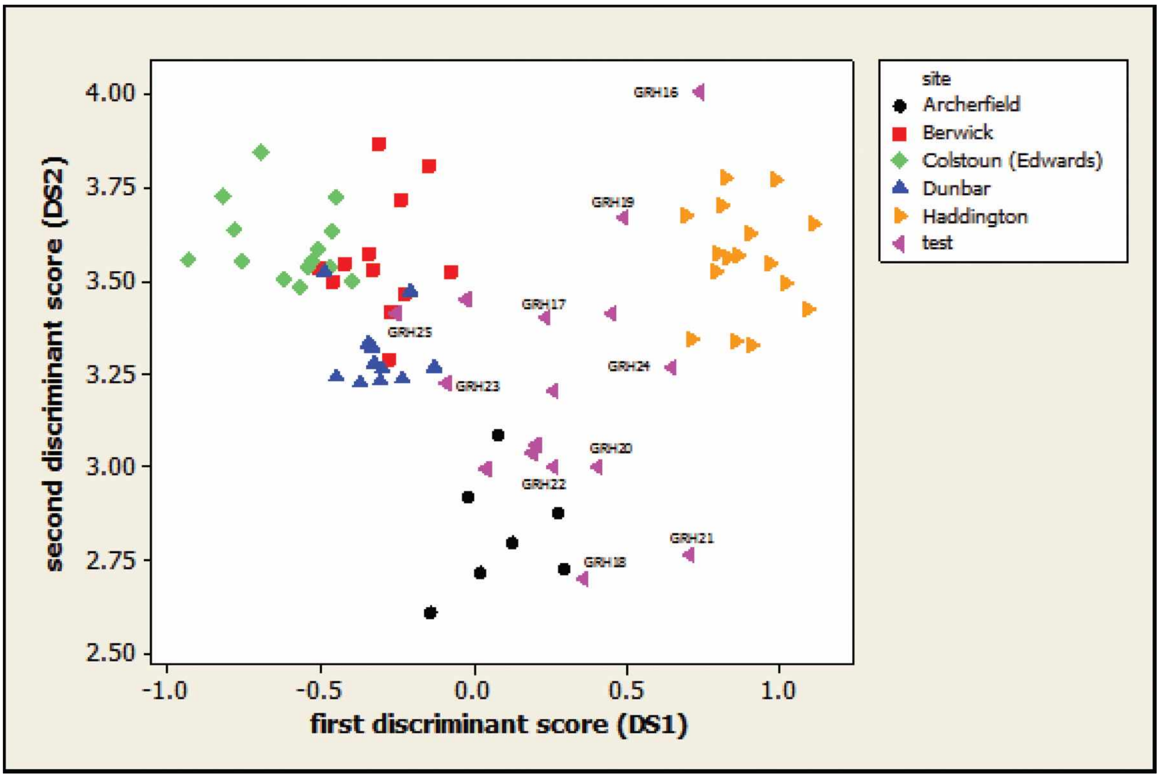

Figure 9
Graph showing the plot of the second and third discriminant functions arising from ICP analysis of the SWGW pottery from Niddrie Burn analysed in the project, combined with pottery from six sites in East Lothian.

The other 'test' samples in Figure 9 comprise the six samples from Colstoun (COLS1–6) analysed since the 2002–3 paper, and plot well away from the main Colstoun group but intermingle with some Niddrie sherds. The COLS1–6 sherds are characterized by much lower aluminium than the Niddrie sherds, whereas the Archerfield sherds have comparable levels of aluminium to the Niddrie SWGW. However, the Colstoun and Niddrie sherds must have similar inter-element ratios since they plot in similar parts of the Figure. Principal components analysis (Figure 8) showed that when the diluting effects of temper were removed, these two groups of sherds (COLS1–6 and Niddrie SWGW) were similar in clay chemistry (plotted in the same part of Figure 8). It is possible that this particular Colstoun group (low aluminium) is significantly more tempered than the Niddrie sherds (which reduces the clay and hence aluminium percentage), but the clay component itself of their respective fabrics is similar in chemical composition. As noted in the 2002–3 paper, the analysed Colstoun sherds split into at least two groups: one was characterised by high aluminium and rare earths (C1–8); the other (C9–14) by low potassium and rubidium, lower aluminium than the other group and a mid-range concentrations of rare earths. The COLS1–6 sherds also have low potassium and rubidium (but slightly higher than the second group), similar aluminium to the second group, but low rare earth elements. While confident assignment of the Niddrie SWGW cannot be made to a specific site in East Lothian, it can be concluded that the sherds are from this region, and that the majority share some features with Archerfield sherds. The latter is a rural consumer site, implying that material derived from similar local clays supplied both sites. The similarity to some Colstoun material (given the variety of clay compositions so far found for this site) may suggest a link to this known kiln site, even though no material of a similar chemical composition has been analysed from this site.

Conclusions

The most surprising thing about the results of the ICP analysis carried out on the medieval SWGW sherds from Niddrie (Appendix B GH16–25) is that they clearly demonstrate an East Lothian rather than a good deal nearer Edinburgh source. Contacts with the important Colstoun kilns near Haddington for at least some of the Scottish white gritty wares (Figures 3 and 4) are important although the site has been subjected to a number of archaeological interventions (Brooks 1980, 364–403; Hall 2004, 34–73). Previously we had no real indication of the inherent distribution pattern of its ceramic material and certainly the ICP results seem to suggest that it was probably more important than previously thought and suggesting that villages like Tranent and small towns like Musselburgh, lying between the kiln site and Niddrie, may have been distribution points for its wares. A Colstoun source might also support my suggested late 13 or early 14th century date for most of the Niddrie medieval sand extraction and sherd material. As work carried out at Colstoun by Dr Mark Noel demonstrated, the mean archaeomagnetic vector in the kiln with the UK Master Curve suggests that the last firing of kiln C (and remagnetisation) took place during the period 1320 AD to 1350 AD (Hall 2004, 40). Certainly there is no evidence that the 12th century straight sided, white gritty wares recovered (but as yet unpublished) from places like Haddington and Leith were ever produced at Colstoun.

Documentary evidence suggests that by the middle of the 17th century a number of potters including Robert Pate had almost certainly been producing typical Scottish post medieval forms in the Potterrow area of Edinburgh (Haggarty and Lawson forthcoming). However due to the towns expansion they were being ousted, and Pate had moved down the coast to the Musselburgh/West Pans area (Forbes and Haggarty 2005, 31: Haggarty *et al* 2011, 16), sherd (GH08). West Pans was to become one of the many later redware pottery production sites clustered along the south bank of the Forth estuary which have been identified especially in the area between Portobello and Prestonpans (Haggarty *et al* 2011, 17–21) sherds (GH 4 and 5). More importantly, what the Niddrie ICP results also seem to be signifying (Figures 1 and 2), is just how wide spread and dominant the coastal trade down river of the Scottish post medieval oxidised and reduced wares produced in the upper Forth region had become (Harrison 2002 and Haggarty *et al* 2011, 14–17). This distribution and its mechanism requires a lot more work and we know that some of the potters in and around the production site at Throsk had interests in ships and shipping. This trade is almost certainly the reason why, in 1714, James Pollock, a recently deceased Throsk potter's estate, was owed £80. This large sum, thought to equate to somewhere in the region of 1000 pots, was owed by two men in Fisherrow (Caldwell and Dean 1992, 31; Harrison 2002, 465). Interestingly the harbour at Fisherrow is only 1.8 kilometres from Niddrie.

Catalogue

Context? 1 sherd, German Frechen, c 1675

1 Frechen bellarmine stoneware neck and rim sherd with typical brown orange peel salt glazed surface, with a handle scar and traces of an applied moulded face mask

Context 007 4 sherds 4, mid 19th century

2 standard white earthenware sherds from a cup

Context 008 1 sherds 1, mid 18th century

One industrially produced redware body sherd possibly from a small crock which has been lead glazed on both surfaces

Contexts 08, **30**, **31**, **32**, **36**, **37**, **39**, **55**, **87**, later 17th century

1 light grey Frechen stoneware rim sherd with typical light brown salt glazed surface (37)

1 small probably Frechen stoneware body sherd in an of white fabric and with a typical brown salt glazed surface (31)

66 sherds of which four are rims and of which 2 conjoin and four basal-angle sherds of which 2 conjoin; There are also fifty eight body sherds of which 4, 3 and 2 conjoin, all from a minimum of three large SPMRW jugs

8 Conjoining SPMOW sherds forming a substantial fragment of an open abraded vessel probably a jar with traces of lead glaze on both surface (31, 32, 36, 37 and 87)

3 Conjoining SPMOWS sherds making up a fragment from the base of an open vessel lead glazed on both surfaces (31 and 36).

1 basal angle sherd from a (SPMOW) jug

1 basal angle sherd from a (SPMOW) open vessel lead glazed on both surfaces

1 basal angle sherd from a (SPMOW) vessel glazed on its exterior

2 basal angle sherds from a (SPMOW) open vessel lead glazed on both surfaces

1 rim sherd from a (SPMOW) jug covered in a thick lead glaze and with part of its handle attached

2 rim sherds from an open (SPMOW) vessel glazed on its interior and with traces over its rim 6 rim and body sherds of which 2 conjoin from an open (SPMOW) vessel lead glazed on its interior (31, 36, 39 and 87)

14 rim and body sherds of which 2 and 2 conjoin from an uncommon wide necked squat jug (8, 30, 32, 37, 55 and 87)

1 basal angle sherd from an Anglo-Dutch tin-glazed earthenware vessel; possibly a drug jar (31)

36 sherds of which 2 and 2 conjoin from a number of vessels: amongst these are small sherds from seven different strap handles.

Context 018 6 sherds, mid 19th century

5 standard white earthenware sherds from a mug with traces of hand painted leaves in green and a gilt mark on base.

1 rim sherd from a press moulded dish with a pie crust edge and slip decorated in white with brown marbling; Not Scottish – probably from the London area, late 17th or early 18th century.

Context 020 2 sherds, mid 19th century

2 standard white earthenware sherds from a small mug

Context 045, fill of pit 44 1 sherd, late 12th or 13th centuries
1 small rim sherd from a small jar/cooking pot in a smooth off-white sandy paste and red oxidised inclusion: not the usual east coast SWGW

Context 049, fill of pit 48, Finds No 36 3 sherds, late 13th or early 14th century
3 abraded SWGW jug sherds one glazed and one of which is a rim.

Context 049, Finds No 38 18 sherds, late 13th or early 14th century
17 (SWGW) sherds of which 3 have traces of sooting and seem to be from globular vessels and 11 are almost certainly from lead glazed jugs

Context 055 1 sherds, ?date
One small well potted body sherd from an open vessel in a pink/red very finely gritted fabric with traces of external lead glaze.

Context 064 2 sherds, late 13th or early 14th century (stone discarded)
1 SWGW flat based sherd with traces of black sooting and spots of glaze: cooking pot
1 pink, thickly green glazed rim sherd from a jug (this fabric is sandy with white inclusions)

Context 065 3 sherds, late 18th or early 19th century
2 small creamware body sherds, ?bowl
1 small pearlware body sherd, ?plate

Context 083 8 sherds, late 18th or early 19th century
1 large creamware base sherd from what may be a 2lb preserve jar
7 sherds from two blue shell edged pearlware plates, one which is impressed 'WEDGWOOD' on its base

Context 87 17 sherds, late 13th or early 14th century
13 small SWGW sherds; eleven body and two conjoining from a basal angle; It is difficult to be sure but the material may all come from cooking pots/jars although five of the sherds show no signs of fuming

Context 98, upper fill of 96 20 sherds, late 13th or early 14th century
20 (SWGW) sherds of which 15 would seem to be from jugs and of these 10 are glazed or have traces of glaze and one is a rim sherd. 3 sherds also have traces of applied decoration in the form of vertical strips. Of the 5 cooking pot sherds one is a rim from a globular vessel; four show traces of sooting.

Sherds from evaluation phase

Context B1104 2 sherds, 13th century
1 abraded rim sherd in a pinkish finely gritted fabric covered in a white slip

Context B1602 1 sherd, 18th century
1 basal sherd from a thinly potted white salt glazed stoneware bowl. (Although these were produced in Staffordshire from the 1740s sherds are not common in Scotland until the third quarter of the century. Almost certainly this is due to its production from 1750 at the old Kirk pottery in Prestonpans (Haggarty 2007).

Context 1205 2 sherds, 19th century
1 rim sherd from a standard white earthenware cup decorated with red banding and part of a transfer printed banner with the letters [–––on].

Appendix A

laboratory code SUERC-38168 (GU26175)
site reference
Niddrie Burn Restoration
context reference 49
sample reference 38/ri
material carbon residue
pot sherd
radiocarbon age BP11590 ± 40

The above 14C age is quoted in conventional years BP (before AD 1950). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standards, background standards and the random machine error.

The calibrated age ranges are determined using the University of Oxford Radiocarbon Accelerator Unit calibration program OxCal 4.1 (Bronk Ramsey 2009). Terrestrial samples are calibrated using the IntCal09 curve while marine samples are calibrated using the Marine09 curve.

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the radiocarbon laboratory should also quote the GU coding given in parentheses after the SUERC code.

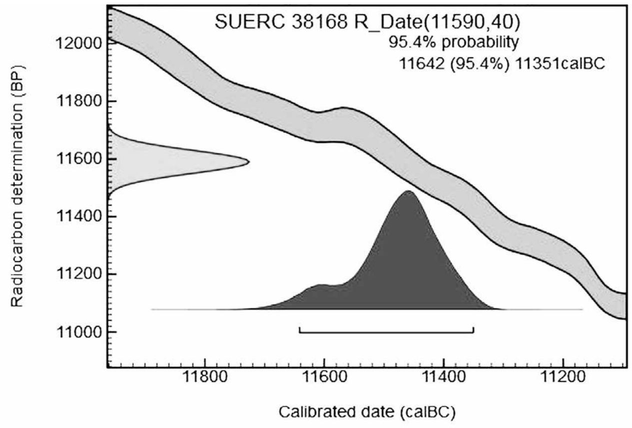

Figure 10
C14 calibration plot for carbonised residue on pot sherd from context 49. (OxCal v4 .2.2 Bronk Ramsey [2013[; r:5; Atmospheric data from Reimer et al [2009]).

Appendix B

Table 2
ICP Sample Numbers descriptions and contexts.

sherd	sample	description	vessel	context
GH01	SPMOW	internally and externally glazed body sherd	jug	Context 08
GH02	SPMOW	internally glazed body sherd		Context 08
GH03	SPMOW	internally glazed body sherd		Context 31
GH04	SPMOW	glazed body sherd		Context 31
GH05	PMOW	glazed body sherd		Context 32
GH06	SPMRW	green glazed body sherd	jug	Context 32
GH07	SPMRW	green glazed body sherd	jug	Context 32
GH08	SPMRW	green glazed body sherd	jug	Context 55
GH09	SPMRW	green glazed body sherd	jug	Context 55
GH10	SPMRW	green glazed body sherd	jug	Context 87
GH11	SPMRW	green glazed basal angle sherd	jug	Context 87
GH12	SPMRW	green glazed base sherd	jug	Context 87
GH13	SPMRW	green glazed body sherd	jug	Context 87
GH14	SPMRW	green glazed body sherd	jug	Context 87
GH15	SPMRW	green glazed strap handle sherd	jug	Context 87
GH16	SWGW	jar/cooking pot rim sherd		Context 87
GH17	SWGW	lead glazed rim sherd	jug	Context 87
GH18	SWGW	basal angle sherd	jug	Context 49, upper fill Pit 48
GH19	SWGW	cooking body sherd with burnt exterior		Context 49, upper fill Pit 48
GH20	SWGW	lead glazed body sherd	jug	Context 49, upper fill Pit 48
GH21	SWGW	body sherd	jug	Context 49, upper fill Pit 48
GH22	SWGW	cooking pot base sherd		Context 49, upper fill Pit 48
GH23	SWGW	lead glazed body sherd	jug	Context 49, upper fill Pit 48
GH24	SWGW	lead glazed body sherd with applied strip	jug	Context 49, upper fill Pit 48
GH25	SWGW	lead glazed body sherd	jug	Context 49, upper fill Pit 48

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Résumé

Il est ici traité d'un assemblage de poterie médiévale et postérieure recouvré par AOC Archaeology pendant des fouilles réalisées dans le cadre d'un programme de défense contre les crues. L'analyse chimique (ICP) d'échantillons de poterie en pâte blanche granuleuse d'Écosse, et d'objets écossais post-médiévaux réduits et oxydés a apporté de nouvelles informations importantes concernant la distribution et la production de ces structures.

Zusammenfassung

Es wird über eine Ansammlung von mittelalterlicher und späterer Keramik berichtet, die von AOC Archaeology während Ausschachtungsarbeiten für ein Programm zur Hochwasserminderung geborgen wurden. Die chemische Analyse (ICP) von Proben von schottischer weißer grobkörniger Keramikware, schottischer nachmittelalterlicher reduziert gebrannter und oxidierter Keramikware haben wichtige neue Informationen über die Verteilung und Herstellung dieser Materialien ergeben.