Section G: Environmental Analysis

G.1: Environmental Samples (Archaeobotanical)

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Introduction

A total of 64 previously processed samples were submitted for archaeobotanical assessment (Appendix G.1). They were received as light and heavy fractions. The light fraction was consistent with having been extracted using a standard flotation technique retaining material to 300µm, and the heavy fraction was consistent with material being retained to at least 1mm. All the fractions were initially scanned for assessment. The heavy fractions were scanned by eye for cultural remains and archaeobotanical remains including evidence of mineralization. No heavy flot was found to contain any material of note suggesting that the flotation procedure had been thorough. The light fractions were assessed under magnification up to x 7 and recorded on a 5 point scheme indicating the abundance of material present. Because of the relatively recent derivation of the material (19th and 20th century) most of the archaeobotanical material present was in an uncharred state. Unfortunately that material which had been subjected to carbonisation had in most cases been charred beyond recognition.

All the samples contained clinker, many containing considerable quantities of this material necessitating dry–sieving to remove material >1mm in order to carry out an effective assessment. Based on this preliminary assessment 13 samples were selected as having high archaeobotanical potential and were subjected to a more detailed assessment (Appendix G.2). An initial sorting of the archaeobotanical remains at up to x45 magnification revealed that the vast majority was wild seed flora with very little potential food species present. It was determined that identifications should proceed in most cases only to genus level. For those species that were readily recognisable identification would proceed to species where possible, and for large genera a species type would be offered.

Genera and Species Present

The more detailed examination of the thirteen selected samples was undertaken using seed identification manuals (Berggren 1981; Beijerinck 1947) and the comparative collection of the University of Sheffield's Department of Archaeology. This revealed that the most frequently occurring genera are *Sambucus* spp., *Rubus* spp. and *Urtica* spp., all three occurring in all the samples, often in abundant quantities.

The predominant species for the genus Sambucus was elder (*S. nigra*). Members of the genus Rubus included raspberry (*R. idaeus*), dewberry (*R. caesius*) and occasionally blackberry (*R. fruticosis*). No distinction to species level was made for the *Urtica* genus but it commonly comprises of stinging nettle and small nettle and it can reasonably be assumed that this is the case here. All three of these genera are typical of fertile waste ground (Stace 1991) and disturbed habitats and would not be at all out of place in and around derelict or uninhabited cottages.

While many of the species present, including raspberry, blackberry, elder and nettle can be utilised as food (Cannon & Cannon, 1994, Grime et al 1988), it seems unlikely that this was the reason for the presence of these plants. Rather it would seem that as all three of these genera are competitive and ruderal strategists (Grime *et al* 1988) that they are representative of the encroachment of wild vegetation on abandonment of the tenancies. Other commonly occurring genera are *Polygonum* spp., *Carex* spp., *Rumex* spp., *Atriplex* spp. and *Chenopodium* spp. These genera are again consistently recorded in waste ground and other disturbed or artificial habitats and are typically ruderal and competitive in strategy (Grime *et al* 1988).

Two samples, F24 (context [2028] B/2) and F21 (context [2027] B/2), produced particularly diverse floras which include, albeit in very low quantities, *Prunus* spp. stones including plum, cherry and sloe; wild strawberry (*Fragaria* spp.) and grape (*Vitis* spp.). Unfortunately none of these fruits are present in significant quantities and while they may represent plants growing on the site, their low concentration cannot preclude their presence as due to artificial importation either by human or animal action. Particularly abundant in both these samples is buttercup (*Ranunculus* spp.) which as with most of the possible species remains consistent with the disturbed and abandoned nature of the site (Grime *et al* 1988), and Lady's Mantle (*Alchimilla* spp.) which is a common and widespread native (Stace 1991).

Samples F8 (context [1005] A/3), F42 (context [1023] A/3) and F45 (context [2173] B/4) also produced a sizable range of floras, all of which were rich in the *Rubus, Urtica* and *Sambucus* genera. As with F24 (context [2028] B/2) and F21 (context [2027] B/2), buttercup family, and dock family (*Rumex* spp. *Polygonum* spp.) are present in moderate quantities, as are goosefoot (*Chenopodium* spp.) and oraches (*Atriplex* spp.). Sedge (*Carex* spp.) occurs in these samples and many of the others in reasonable abundance and frequency suggesting that some areas of the site were damp much of the time. This again is not inconsistent with the nature of the site as dips and hollows will suffice to provide the damp environment favoured by many of these species (Grime et al 1988).

The monolith sample produced an assemblage consistent with the rest of the site, bramble (*Rubus* spp.), elder (*Sambucus* spp.), nettle (*Urtica* spp.) families and *Carex* cf. *obstutata* were all well represented. There was no indication of mineralization indicative of cess, nor any anomalies in the seed flora which suggests that this feature was any different botanically to the rest of the site.

The remaining samples although rich in remains display less diversity than those previously discussed and primarily the same range of species. Sample F14 (context [2040] B/4) produced an abundance of birch (*Betula* spp.), as this is considered a colonising species its presence is consistent, particularly if this context relates to a period after abandonment sufficient for birch to mature to flowering within 5-10yrs (Grime *et al* 1988). While birch is acknowledged as having the capacity for effective long-distance dispersal (ibid) its presence in only one sample tends to suggest a more localized origin.

Other plants present include:

- thistle (*Cirsium* spp.): samples F8 (context [1005] A/3), F24 (context [2028] B/2) and F21 (context [2027] B/2)
- stitchwort / chickweeds (*Stellaria* spp.): samples F24 and F21

- barren strawberry / cinquefoil (*Potentilla* spp.): samples F24 and F21.

Environmental Conclusion

The overall nature of the archaeobotanical assemblage presented is one in which common waste and disturbed ground plants are dominant. There is very little indication of food plants being present on the site, the occasional examples that do occur could just as easily have been imported to the site or be representing a wild species. There is no evidence of, for example, cultivated fruits or vegetables and none of the species or genera recorded are particularly indicative of ornamental plants. If these types of plants were grown at the site either they had been outcompeted and died before the sampled deposits were formed, or their seeds are of a form which has not been preserved or dispersed into these deposits. While most of the seed evidence is that of herbaceous medium to low growing species, some shrub - tree species are also amply represented, for example *Sambucus* spp. (elder) and *Betula* spp. (birch).

G.2: Environmental Samples (Soils)

By Laura Brenton, Manchester University.

Introduction: Metals in Archaeological Soils Samples.

Analysis of the geochemistry of archaeological soil deposits has been used in a variety of ways to give information about sites. Broadly, these types of analysis can be categorised into one of three methods.

- Firstly, geochemical analysis can be used to identify a site, through the elements that become enriched or depleted due to occupation and various land uses. This method was used experimentally by Aston et al (1998), and was successful enough to be described by the authors as a useful tool.
- Secondly, this kind of analysis can be used to delimit sites that are already known. This has been undertaken by researchers such as Bintliff et al (1992), to find the extent of the area affected by rural sites in Beotia, Greece.
- Thirdly, the technique of geophysical analysis can be used to learn more information about a site, depending on the element discovered and their concentrations. Entwistle et al (1998) have carried out a comprehensive study of the elements found in soils from sites on Skye, and Cook et al (2003) have used this kind of analysis to support evidence for mining at a Roman site in Silchester. Mighall et al (2002) have used peat cores from points near to prehistoric mines to look at the chronology of deposition fro past mining activities. This study was able to identify periods of prehistoric copper mining through traces of copper accumulated in peat through atmospheric deposition.

According to Entwistle et al (1998), to be useful to the archaeologist, chemical elements in soils have to meet three criteria. The element must be altered by human activity, and altered to a degree that it can be seen against natural background levels. In addition, this change in geochemistry needs to be fixed in the soil in question so that it can be analysed, perhaps thousands of years later. Aston et al (1998) list the processes by which humans may alter the chemical composition in the soil. Occupation of a site will lead to the enrichment of certain elements through waste and storage. This is also true of livestock kept by humans. Farming may also deplete certain nutrients in the soil, as these nutrients are taken up by crops. Fires will alter the geochemistry of soils, and metal working can add to the elements found in soils, through atmospheric deposition of substances used. Finally, other processes such as leather making may also affect the elements which are deposited in the soil.

This research into the geochemistry of archaeological deposits taken from the Alderley Sandhills Project excavation draws on this work to look at the metals evident in soil samples taken from the excavation. The aims of this piece of research are:

- to investigate whether metals can be identified in the soils samples, using AAS;
- to see if any metals identified can be related to human activity in the area;
- to see if this information can be used as a tool to indicate when samples were deposited, based on the metal content.

Methods

Samples of the various contexts were collected during the Alderley Sandhills Project excavation during the summer of 2003. A sample was taken from each archaeological context excavated on the project site. It was decided that only Trench B would be analysed for metal content, as the excavation showed that the cottage in this area had a longer history and would therefore provide a more comprehensive record of the history of mining at the site. The excavation showed various phases of occupation at the site, with evidence of occupation dating back to pre-1747. A selection of samples from each of these phases were selected for analysis to try to give a depositional history of the site.

To establish whether the soils collected were suitable for use in this kind of study, five randomly selected soils from the excavation were subjected to analysis in a pilot study. The samples were analysed as described by the method outlined below. This was to ensure that the levels of metals in the soils were at a level that would be able to be determined by the methods and equipment available. The pilot study showed that the metals contained within the soil samples could be detected by AAS. However, the variation of the levels of the metals (especially between cobalt and lead) suggested that ICP-MS analysis might not be suitable as it may have proved difficult to find a dilution that would allow for the study of these metals simultaneously.

In order to study how the soils were affected by human habitation, samples were compared with those taken from off the archaeological site. This data was taken from a survey carried out for the Alderley Edge Landscape Project in the summer of 1997. The whole of the area encompassed with the AELP boundary was subjected to a geochemical survey using XRF analysis. The survey was divided into various areas, and samples were taken at regular intervals over a 100m grid (as far as the environment would allow), and stored in plastic bags before analysis. Storage in plastic affects the level of phosphate in the sample, but as phosphorous is not discussed in this study, this effect can be discounted.

Due to the fact that the area around Alderley Edge has been mined and inhabited since pre-Roman times, it is difficult to find an area that can be used as a control. However, the AELP data includes sample areas that are suitably distant to the mines to be less affected by atmospheric deposition from the mining and processing. However, the whole area has been greatly disturbed and this should be recognised when using the AELP data as a comparison.

In the laboratory, the samples from the excavation were air dried for two days, before being ground using a pestle and mortar. Approximately 0.5g of each sample was taken and digested on a hot-plate at just under 100°C for four hours, using 5ml of AnalaR grade 70% HNO_3. Some methodologies (e.g. Rowell 1994) suggest using a smaller amount of the original sample. However in this instance, a comparatively large sample was used to try an eliminate variations within the soil. Many of the samples had various inclusions, and using more of the sample should have reduced the influence of any of these inclusions. The samples were monitored during this period to ensure that the heat was being evenly distributed through the samples. After digestion, the samples were filtered and made up to 25ml using distilled water. Flame Atomic Absorption Spectrophotometry using an air-acetylene flame with hollow cathode, was used to determine the concentrations of lead, copper and cobalt in all of the samples. To ensure the accuracy of the machine, blank samples were analysed, and standard solutions were measured at intervals during the analysis. Some samples were found to be above the detection limits of the machine, and so these were further diluted until they could be read. The measurements form the standard solutions were used to correct for the drift of the machine, and the parts per million measurements were converted to mg/kg, taking into account the amount of sample used and the level of dilution. Results of this analysis can be seen in Table G.1 and Figure G.1.

Analysis and results

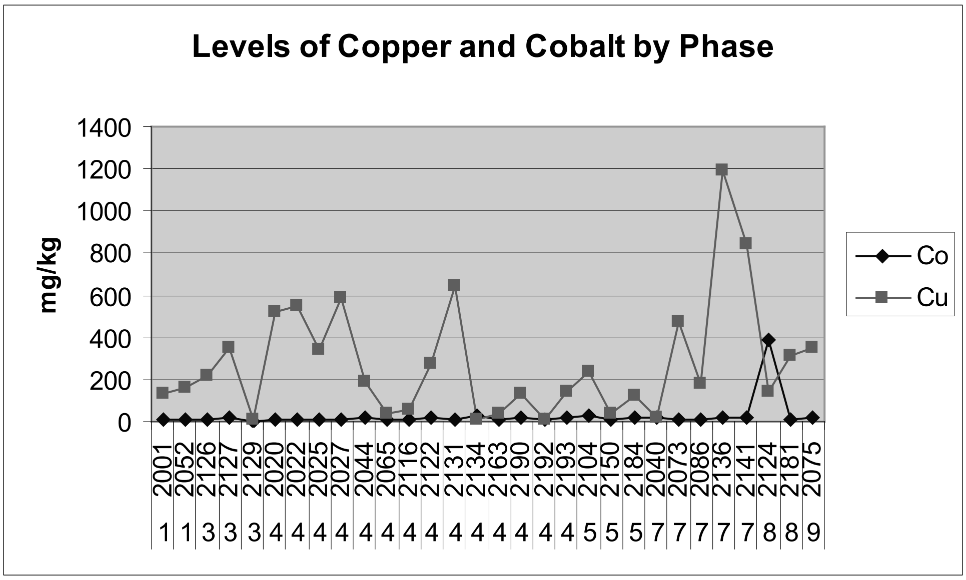
Table G.1 Results of geochemical analysis, and description of contexts.

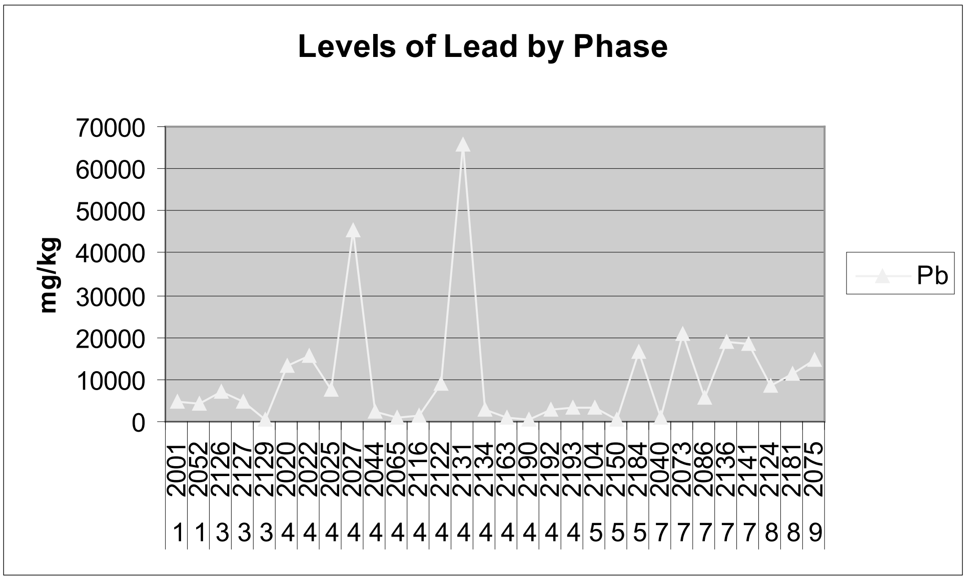
Phase	Context	Cobalt (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	pH	Description
1	2001	9.28	131.14	4533.29	6.7	topsoil
1	2052	5.63	161.37	4420.30	5.5	fills of burrows
3	2126	13.79	213.94	7158.35	na	
3	2127	14.51	349.36	4684.56	6.3	dark, humic
3	2129	4.61	12.71	290.58	na	sand fill
4	2020	9.45	516.29	13478.36	6.8	silt fill

4	2022	12.39	545.52	15640.15	6.5	clayey silt with rubble = 2006/2010
4	2025	9.94	343.59	7708.84	5.7	flowerbed
4	2027	8.40	586.13	45619.05	6.1	clayey silt with rubble
4	2044	15.21	191.25	2266.85	4.9	sandy silt - charcoal inclusions
4	2065	5.52	40.53	942.15	5.5	bedding sand for path
4	2116	6.77	55.66	1390.18	6.7	bedding for path
4	2122	21.12	271.87	9018.96	6	charcoal
4	2131	12.77	644.46	65583.07	6.8	bedding sand for path
4	2134	24.01	8.97	2675.93	4.6	sandy clay fill of boiler room
4	2163	7.32	33.76	1151.08	6.8	silty bedding sand under paved area
4	2190	16.64	133.63	650.34	6.9	mortar of brick wall
4	2192	12.09	8.57	2903.65	6	bedding sand for path
4	2193	14.39	141.06	3508.36	6	bedding sand for path
5	2104	24.44	233.98	3396.54	5.6	dark silt with charcoal
5	2150	9.78	35.01	297.11	5.3	grey clayey sand bedding for cobble path = 2191, 2195
5	2184	15.89	120.03	16453.15	5.3	clay matrix around rubble fill
7	2040	15.83	18.50	772.55	6.8	sand and brick rubble fill
7	2073	12.47	473.61	21004.57	6.3	clayey silt
7	2086	13.39	179.41	5707.46	6.6	silty clay
7	2136	16.14	1188.95	18717.24	6.2	dark sandy silt
7	2141	14.35	845.26	18640.13	5	grey silty clay = 2138
8	2124	386.53	138.35	8637.41	5	dark silty clay = 2181, 2208, 2212
8	2181	13.40	308.87	11299.74	6	clayey silt = 2124, 2208, 2212

9	2075	16.38	346.75	14833.89	6	interface with natural
	2054	15.71	275.83	5068.90	na	cancelled
Average		25.10	275.95	10272.67		

Figure G.1: Results of geochemical analysis by phase



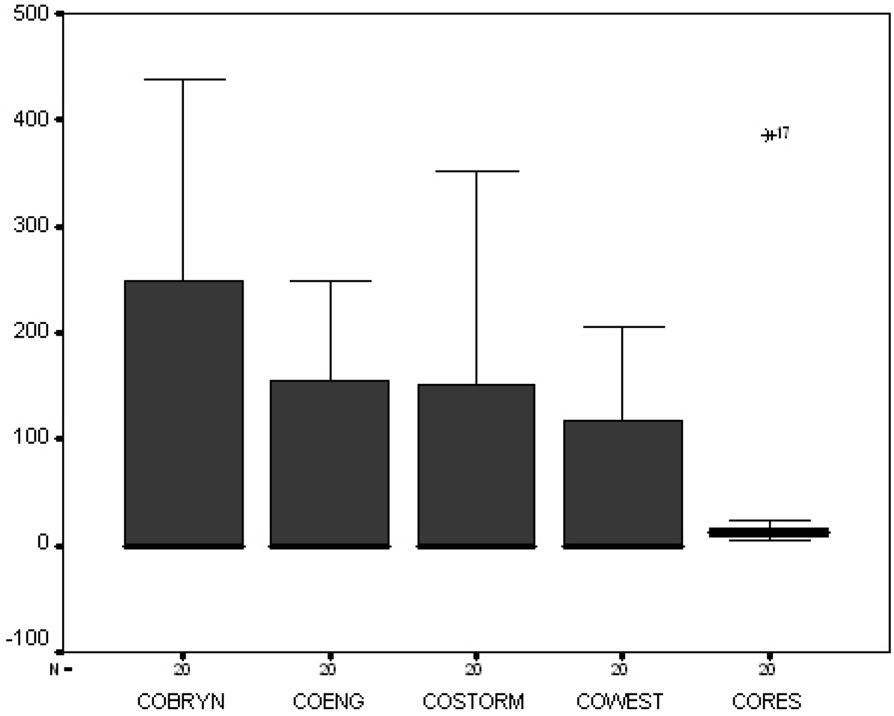


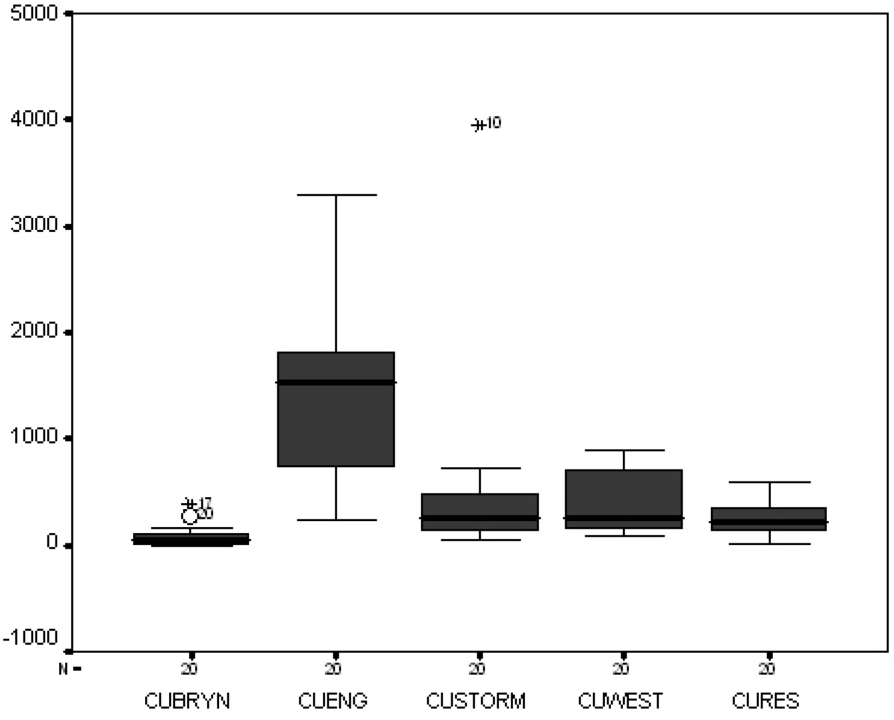
The background data, XRF measurements from the Alderley Edge Landscape Project area, were collected in the summer of 1997. Box plots (Figure G.2) were made to visually interpret the distribution of the data. The box represents the data that fall within the 25th and 75th percentile, with the line representing the median value. 'Whiskers' are drawn to the upper and lower adjacent values and outlying values are represented circles and asterisks. The data, in raw format was tested for a normal distribution using the Kolmogorov-Smirnov test in SPSS. The on-site data was also tested in this way, and the results of these tests are shown in Table G.2. A number of the data sets were shown to have a distribution that was not normal. The data from all off-site locations was amalgamated to see if this would produce a normal distribution, however, as shown in Table G.3, this was not the case.

Figure G.2: Box plots of Cobalt, Copper and Lead, by site.

(Bryn – Bryn Field, Eng – Engine Vein, Storm – Stormy Point, West – West Mine,

Res – On-site results.)

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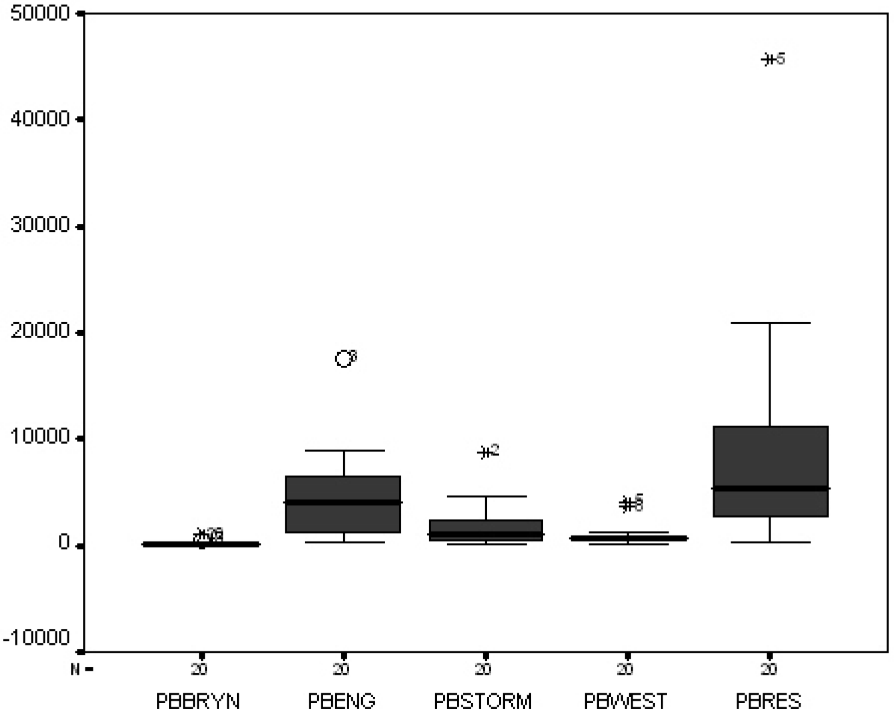
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Table G.2: Results of Kolmogorov Smirnov test for normality of data

		K S 'Z' value	Two tailed p	Significance
On Site	Cobalt	2.626	0.000	Significant
	Copper	0.933	0.348	Not significant
	Lead	1.285	0.074	Not significant
Bryn Field	Cobalt	2.831	0.000	Significant
	Copper	1.133	0.153	Not significant
	Lead	1.784	0.003	Significant
Engine Vein	Cobalt	2.021	0.001	Significant
	Copper	0.564	0.908	Not significant
	Lead	0.693	0.723	Not significant
West Mine	Cobalt	2.575	0.000	Significant
	Copper	1.228	0.098	Not significant
	Lead	1.285	0.074	Not significant
Stormy Point	Cobalt	1.731	0.005	Not significant
	Copper	1.517	0.020	Not significant
	Lead	0.954	0.323	Not significant

Significance determined to 0.005 level. A 'Not Significant' result indicates that the data are from a normal distribution.

Table G.3: Results of Kolmogorov Smirnov test for normality of data when all off site data was amalgamated.

	K S 'Z' value	Two tailed p	Significance
Cobalt	4.510	0.000	Significant
Copper	2.653	0.000	Significant
Lead	3.518	0.000	Significant

Significance determined to 0.005 level. A 'Not Significant' result indicates that the data are from a normal distribution.

Following the methods of Entwistle et al (1998) and Aston et al (1998), the off site data was then compared with the onsite data using a Student's t test to compare the means. Results from this analysis are shown in Table G.4.

Table G.4: Results of Student's t test to compare on and off site data.

Compare;		t value	Critical value	Is t critical?
Cobalt	Bryn Field	2.46	1.99	no
	Engine Vein	1.31	2.01	yes
	Stormy Point	1.63	2.01	yes
	West Mine	0.77	2.00	yes
Copper	Bryn Field	4.62	1.99	no
	Engine Vein	7.22	2.01	no
	Stormy Point	1.32	2.01	yes
	West Mine	1.76	2.00	yes
Lead	Bryn Field	4.87	1.99	no
	Engine Vein	1.76	2.01	yes

	Stormy Point	2.69	2.01	no
	West Mine	2.81	2.00	no

Yes = no significant difference

In terms of analysis, it would seem that the XRF data collected as part of the AELP does not act as ideal background data, since it is not normally distributed and is not always significantly different from the on-site data. The comparison using a t test (Table G.4) shows that in only six instances is the on-site data significantly different from the off-site data. Of these, only four of these comparisons have been made using two sets of data with a normal distribution – copper compared with Bryn Field, copper compared with Engine Vein and lead when compared with Stormy Point and West Mine. This suggests that the XRF data is of little use for quantitative analyses, but can be used for descriptive comparisons.

The on-site data was then compared with the historical record of mining at the site. Historical data was collected from the Derbyshire Caving Club, who have researched the history of the mines. From this, it can be established which metals were being mined at any period. In theory, based on the archaeological phase from which the context was recovered, an estimation of the metals likely to be found in each context was made. This was done qualitatively, taking a reading above average for the site to represent an enriched context.

Comparison of the levels of metals in the on site data with the metals that would be expected from the historical data shows that seven contexts appear to support the theory that these contexts should show the metals that were being mined at the time of deposition, with a further fifteen possibly showing the level of metals expected. Seven contexts do not show the levels of metals that would be expected from the historical data. The chronology of the site can be seen in Table G.5, expected metals in Table G.6, and a table showing contexts matching the expected levels in Table G.7.

Table G.5: Chronology of the site

Date	Cobalt	Copper	Lead
Bronze age	-	*	-
Roman period	-	*	~
Post-Roman period to 1690	-	-	-
1690 - 1791	-	*	~
1791 - 1805	-	*	~

1805 - 1815	*	*	*
1815 - 1877	-	*	*
1877 -1926	Little mining activity		
1926	End of mining		

* Likely to be found

\- Unlikely to be found

~ May be found in small quantities

Table G.6: Expected metals by phase

Phase		Period	Expected metals
1	Topsoil	Post 1950	Little/none
2	Recycling	c. 1950s	Little/none
3	Abandonment/Demolition	1940s - 1950s	Little/none
4	Construction	1872 - 1940s	Small amount copper/lead
5	Construction	1828 - 1872	Copper, Lead
6	Construction	1808 - 1828	Cobalt, Copper, Lead
7	Construction	1747 - 1808	Cobalt, Copper, Lead
8	Construction	Pre 1747	Copper, Lead
9	Natural		Little/none

Table G.7: Metals found in each context in relation to chronology

Context	Period	Cobalt	Copper	Lead	Match?
2001	1				y
2020	4		*	*	?
2022	4		*	*	?
2025	4		*		?
2027	4		*	*	?
2040	7				n
2044	4				y
2052	1				y
2054	?				-
2065	4				?
2073	7		*	*	?
2075	9		*	*	n
2086	7				n
2104	5				n
2116	4				?
2122	4				?
2124	8	*			n

Context	Period	Cobalt	Copper	Lead	Match?
2126	3				y
2127	3		*		?
2129	3				y
2131	4		*	*	y
2134	4		*		?
2136	7			*	?
2141	7			*	?
2150	5				n
2163	4				n
2181	8		*	*	y
2184	5			*	y
2190	4				?
2192	4				?
2193	4				?

* metal found in quantity larger than average

y metals found match expected metals

n metals found do not match

? probable match, although quantities may not match exactly

Discussion

Firstly, it should be stated that the values for copper and lead found in the soil samples are significantly higher than might be expected for a site that hasn't been affected by mining. Cobalt, however, when compared with other studies, seems to be lower than might be expected.

According to Bowen (1979), values for 'normal soil' are;

- cobalt – 8mg/kg
- copper – 30mg/kg
- lead – 10mg/kg.

Using these figures to compare with the on site data, it would appear that contexts from phases 1 and 4 show less cobalt than would be expected in normal soil. For the other metals, all other contexts show vastly elevated figures. Entwistle et al (1998) finds off-site values for copper of the equivalent of 35 mg/kg, higher than would be expected for a site unaffected by anthropogenic activity. The study states that the 'off-site' data could have been affected by habitation, but this variation could also be due to the differing geologies of Alderley Edge and the study site used by Entwistle et al. The relative lack of cobalt in the more recent deposits seems to support the theory that the proportion of the metals in the soils can give clues to the time of their deposition. According to the archaeological evidence, these deposits were made after cobalt mining had been abandoned in the area, which may explain why the cobalt is not evident in these samples. However, context [2124] has the highest reading for cobalt, but comes from a phase dated to before 1747, before the mining of cobalt took place. This suggests that using cobalt as an indicator of date may not work in all circumstances. Values for copper and lead detected on site are consistently high, perhaps reflecting the ongoing mining of these two elements over the period of occupation of the cottage.

The comparison of on-site data with off-site data did not show the differences that might have been expected. There are a number of possible reasons for this. The first is that it is probable that the whole of the area encompassed by the AELP boundary has been inhabited and therefore disturbed since prehistoric times. It is therefore likely that the areas surrounding the cottages may have been subjected to a similar amount of disturbance and deposition, making contrasts difficult. It is also possible that the 'control' area is too close to the site being studied, and has therefore been subjected to the same amount of atmospheric deposition as the site itself. The wealth of ores that occur naturally in the area may also be affecting the results. It can be assumed that soils formed from the parent materials in the area will have relatively high contents of the metals found in the surrounding rocks. In addition to this, the disturbance caused by the mining and processing or ores at the site will also have affected the soils. As identified by Shimwell (pers com.) the dumping of waste materials may artificially alter the composition of the soils.

Despite the fact that some of the contexts appear to contain amounts of metals that match the chronology, Table G.6 shows at least seven that do not. For example, contexts from phase five are from a period of fairly intense copper and lead mining, and yet the contexts do not show significantly elevated levels of these metals.

Again, there are a number of reasons why the expected proportions of metals may not show up in the on site data. Firstly, it has been difficult to determine what kind of levels of these metals might be found in this area, without human activity in the area. Secondly, the archaeology shows that the cottage in question has been through a number of building and recycling phases. This means that it is possible that depositions may be recycled and found in later phases than they were formed in. Entwistle et al (1998) note that soils are like 'a palimpsest' and accumulate enrichments over time. This means that they may not take on the qualities of any particular time period. Again, the natural variability of the soils in the area may be a factor that affects the metals present, but in an area where there has been so much human activity, human influence is more likely to be a factor. For instance, people working in the mines will have brought home traces of the ores and elements on their clothes, which will then have become embedded in the contexts of the cottages. A number of the contexts were found to have inclusions of rubble and charcoal which will affect the metal contents if they comprise metals themselves. In addition, phasing may not be absolute and does not necessarily match with periods of activity in the mines.

In addition to problems with the samples themselves, one must also take into account experimental error. The small amount of sediment taken from the air dried sample may not have been representative of the whole sample, and the soil sample taken on site may not have been representative of the whole context. This is evidenced to an extent by contexts [2124] and [2181], which are archaeologically the same and yet have differing contents of lead, copper and cobalt. Incomplete digestion of the samples may have affected the outcome, as well as any slight variation in the dilutions that were made up. Although an attempt was made to compensate for instrumental drift, the AAS readings may not have been completely accurate, and any slight contamination of the apparatus used may also have affected the result. However, the execution of a pilot study ensured that any potential problems were identified and steps were taken to minimise their input.

Conclusions

Firstly, it can be said that human use of the site seems to have led to enrichments in archaeological contexts of copper and lead, and in some cases, cobalt. However, the source of this enrichment is difficult to pinpoint. The soils could be naturally enriched as a result of being sourced from parent material with high contents of metal ores. Secondly, the metals could be due to the atmospheric deposition of particles generated from the mining and processing which has occurred at the site. In addition, the enrichment could be due to occupation at the site with metals accumulating in the soils from waste and other processes. However, Entwistle et al (1998) suggest that cobalt copper and lead show no significant enrichment through habitation alone, but, Aston et al (1998) find that lead is enriched on archaeological sites, with cobalt and copper less so. From these other studies, it seems likely that habitation of the site alone does not account for the enrichment found in this study. Elevated levels of metals may also be due to the simple addition of metals to the soil through various means by people, such as through discarded mining debris, and other deliberate and accidental additions, such as through building materials. Plants that have grown on the site since its abandonment in the 1950s may also have diminished or added to the levels of metals in the soils through uptake and subsequent decomposition. Also, the mobility of metals in soils has been called into question by various studies such as that by Livett et al (1979).

Comparisons with off site data that is less affected by disturbance, and an actual chronology of deposition, rather than a theoretical one based on historical data, may make it easier to see patterns in the metal deposition at Alderley Edge. There is a small peat bog at Adder's Moss, just over a kilometre from the site which may provide evidence of the atmospheric deposition over time. A core has already been taken from this site by the AELP, with the results of the analysis currently awaiting publication.

This study does appear to have shown that there is potential for the dating of contexts through the metals contained within them, if a suitable reference chronology is available. Routine multi-element geochemical testing of all contexts may give a more reliable signature which can be better related to any known timeline. This technique is worth consideration on industrial-period sites where other dating techniques such as radiocarbon dating is not available, and where evidence from artefacts may be absent or inexact. It may also give an indication of localised activities taking place at the site, such as rubbish dumping or ore processing.

This study also has implications outside of archaeological interpretation. According to Defra guidelines, lead in soils should not be more than 450 mg/kg in gardens and allotments, and not more than 750mg/kg at industrial sites. The Soil Guideline Values For Lead Contamination document states that these value may present “risks to human health from chronic exposure to soil contaminated with lead.” All but three of the on-site contexts analysed show levels that lead that are higher than 750 mg/kg. Context [2131] for instance, contains nearly one hundred times this amount of lead. This amount of contamination has implications for people working at the site and visitors to it. Although the site has now been made a scheduled monument, and the majority of the remains are subsurface, limiting the risk to visitors to the site, any future work carried out at Alderley Edge should be undertaken with the presence of potentially harmful levels of lead in mind. This study has indicated that there is potential for the study of metals in archaeological soil samples, both at Alderley Edge in the future, and also at other mining sites.