The Appliance of Science to Archaeological sites on Rendzina Soils

Over the past 17 years we have identified and Radiocarbon dated many archaeological sites, these are usually defined as Hut Circles, Rectangular Structures, Enclosure Walls, Cairns, Ring Cairns, Mesolithic Pits and Neolithic Hearths etc. Most of these have been situated on underlying limestone geology, which is covered with thin rendzina soils and interspersed with areas of glacial till. Unfortunately for archaeologists the activities of humans in more recent times e.g. building modern walls, removal of limestone for ornamental gardens, and general removal of stone for building, has resulted in the complete obliteration of many archaeological remains.

Given the above, the question being posed here is; has this obliteration been quite as complete as we may suppose, or could there be a way of applying modern scientific methods, and equipment, to retrieve knowledge of unknown archaeology and restoring it to the record? An extensive search through recent scientific papers and publications appears to suggest that this could be possible.

We have put together a procedure which may begin to address some of the issues stated above. It has been our experience over the years that you have to study and walk over an area many times to be aware of what is there. Our aim is to now focus on smaller areas looking for the faintest traces of features e.g. small isolated enclosures abutting limestone terraces, enclosure walls or banks, in fact anything that does not appear natural. Having identified evidence of human activity, we have to ask the question could these have some associated dwelling/s or other features as yet unrecognised? The remains of these could be no more than a hollow in the ground, or a small platform with no stone structural remains, because they may have been completely robbed, or were of transient use and never had a stone base.

Having identified something of interest we then carry out a scan of the area with a Fluxgate Gradiometer to check for anomalous magnetic readings, which may represent iron artefacts or burnt features. To differentiate between these two features we have to scan the high readings with a metal detector, as this will not detect burnt features.

The next step is to take several small soil samples with a corer from within the feature and also outside the area of the suspected archaeology, which provides a background soil reference. Fig1 (see reference note below) shows the results of one set of samples which have been analysed for multi-element soil content. These results show that all elements except Ca (calcium) are considerably higher in the samples taken within the identified feature as opposed to the background level.

What does this tell us? The substantially higher levels of Pb (lead) and Zn (zinc) represent the burning of fuel on a fire, resulting in ash and charcoal deposits. In this particular instance we have no evidence of charcoal in the samples only microscopic ash, so therefore we believe it to be peat or turf ash. Interestingly neither of these produce greatly increased levels of P (phosphorus), and this is also what the analysis shows. The 21% rise in P would seem to be low if permanent habitation was taking place, especially if cooking waste with bones mixed in had been burnt on the fire, which would also have raised the Ca levels. There is no evidence of housing livestock as this would also have raised the P levels considerably more than is shown in the table. The rest of the elements are not raised high enough to suggest any craft activities were taking place, and probably represents no more than human shelter within a confined area.

Conclusions

As can be seen from the above it may be possible to identify archaeology which would probably have remained lost for who knows how long. Geophysics and XRF have been brought together to produce what we believe to be positive results in identifying a circular feature possibly a transient use habitation site, there are also 4 more features on this particular site which are being investigated. It is early days to fully assess our research but it does appear to have opened up the possibility of identifying what is virtually invisible archaeology. The use of XRF could also help us to take our knowledge forward from the basic dating of structures, to being able to determine if particular structures had specific purposes. We have previously published information concerning several archaeological sites from the Bronze Age to the late Anglo Saxon period, and this information has been acquired without the need for excavation. Because of the methods used (keyhole archaeology) to obtain the initial information we are now able to go back to these sites and take the research forward using current scientific methods, this approach also takes into account the fact that we may have even more sophisticated scientific tools in the future. These methods, being virtually non-destructive, allow for the possibility of future research, unlike sites where complete excavation has taken place destroying the integrity of the archaeology, and making further research impossible. These procedures have only been applied on thin rendzina soils overlying limestone, and it is not implied they are suitable to every type of archaeological site.

Reference Note for Fig 1.

Results of ED-XRF (Energy-Dispersive-X-Ray-Fluorescence) analysis carried out by The Department of Geography at Durham University.

Metals in Soils by ED-XRF

Client: Arthur Batty
Report Date: 21/06/2012

Notes: Instrument : Thermo Xlabpro ED-XRF
Empirical calibration with wide range of similar matrix CRMs, analysis program "soil_rev" used
Samples were freeze dried, ball milled to < 100µm, and formed into a pellet using 5g of sample to 1g of HWC wax (15 tonnes) of pressure

Concentration (on a dry w/w weight basis)

Element	Ca	Zn	Pb	Sr	Cu	Ti	Ba	P	K
Units	%	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	%	%
Background	1.038	247.2	326.8	42.3	37	0.361	152.3	0.179	0.760
HCS 1	0.453	490.9	483.6	52.6	43.8	0.449	192.5	0.207	1.049
HCS 2	0.872	566.8	590.2	50.2	57.2	0.435	216.2	0.249	0.994
HCS 3	0.276	429.7	452.6	49.2	41.1	0.376	197.9	0.201	1.098
HCS 4	0.409	490.3	461.8	46.8	42.1	0.384	205	0.215	1.051

Uncertainty (1 sd)

Element	Ca	Zn	Pb	Sr	Cu	Ti	Ba	P	K
Units	%	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	%	%
Background	0.008	2.8	2.8	0.4	1.2	0.001	3.7	0.002	0.009
HCS 1	0.006	4	3.7	0.4	1.3	0.001	3.8	0.002	0.010
HCS 2	0.008	4.3	4	0.4	1.4	0.001	3.8	0.002	0.010
HCS 3	0.006	3.8	3.7	0.4	1.2	0.001	3.5	0.002	0.010
HCS 4	0.006	4.1	3.7	0.4	1.2	0.001	3.6	0.002	0.010

Moisture Content

Sample	% Moisture (w/w)
Background	45.67
HCS1	39.68
HCS2	45.45
HCS3	39.25
HCS4	41.61

Notes:
Samples analysed as received.
Moisture content determined as the loss of sample mass upon heating to 105 °C overnight.

Fig 1