Hagg Farm bale site excavation – expectations from the dig

Below are a few random notes which I hope will help us with the excavation – they are personal views and are by no means comprehensive. The presence of large amounts of slag and moderate amounts of charcoal together with other metallurgical debris indicates that smelting took place at the site and the relatively compact area makes it appropriate for excavation.

Aims

The main aim of the dig from my point of view would be to identify the technology which was used for smelting. Various possibilities have been recorded and can be summarised for the post-Roman period to the end of the C16th as:

1. Wind-blown smelting on raised beds or hearths using wood or charcoal (Agricola, 'De Re Metallica').
2. Wind-blown using an open fire with wood, charcoal or peat (Murphy & Baldwin).
3. Wind-blown using open fire surrounded by stones to conserve heat (Raistrick).
4. Wind-blown, large three-sided rectangular enclosure on a slag-covered base of tree trunks (Kiernan)
5. Bellows-blown, enclosed furnace for smelting ore or reworking slags (various documentary sources).

It would be interesting to know if this site was used for primary smelting or to rework slags, possibly from the higher bales on Fremington Edge. The slags found there are very different from those at this site.

It should be possible to establish a date when the site was working and to determine the kind of wood used (see below under Finds).

Expected features

The best we can hope for is a clear outline of the smelting area, indicated by a patch of ash and debris with the remains of any structure still evident as fire-reddened sandstone. In an ideal world, this would all be clearly evident from the geophysics survey.

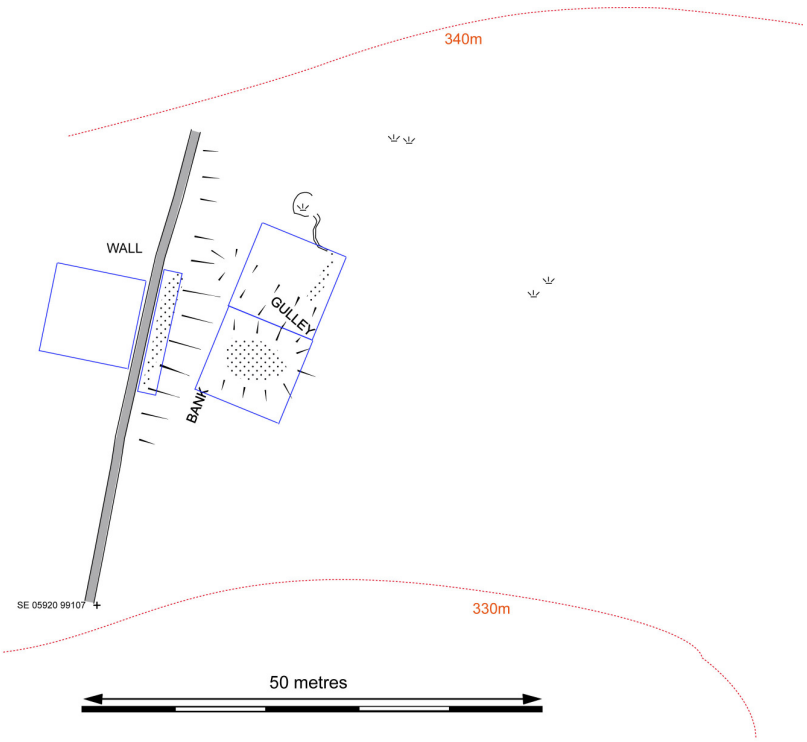
In addition to this, we might expect to find channels leading from the fire to pits used to collect the molten lead. Where these have been found on other excavated sites they are 20-30 feet in length. We might also find pits or areas used to remelt lead spatters to form an ingot.

The reality may be very different. I would expect most smelters to have destroyed the immediate smelting area in a search for lead. This might be evident in the way ash has been scattered. If stone structures have been removed, they will possibly have been replaced by soil infill, rather like 'post holes'. Any channels leading to collection pits will also be filled in a similar way.

For this reason, I expect the features to be fairly subtle and easily destroyed if great care is not taken once the turf has been removed. I expect the excavation to be shallow and some layers to be very thin indeed. For example, on a smelting site near Crackpot Hall the patch of ash has been cut through by erosion and shows clear stratification of coarse slag, ash and fine ash which has washed down into the subsoil – the whole depth is only about three inches.

Geophysics survey results

This will be carried out using a fluxgate gradiometer which gives a response dependent on the magnetic susceptibility of the covered materials. Lead slags give a weak response unless they contain iron minerals; sandstone also gives a response from contained iron. We know that slags have been scattered over a large area so some degree of 'noise' is expected. At best, there may be some evidence of the actual area used for smelting and at worst an indication of scattered slag.



Sketch map of the site showing 4 grid boxes proposed for geophysics – in practice more will be done subject to the time available. The rectangular feature, identified later is not shown.

Areas of the site

The site comprises several features which were evident on pre-excavation inspection:

1. A wall running N-S which post-dates the smelting activity. It is built over the area with slags and has stones with smelting debris used in its construction.
2. The 'flat' area on which the wall was built and which has slag on both sides of the wall. This was possibly the area where smelting was conducted.
3. A rectangular 'structure' situated on the flat area – purpose unknown but clearly of importance.
4. A steep bank running roughly parallel with the wall and ca. 1m from the wall.
5. A grassed knoll at the foot of the bank where the main evidence of slag, charcoal and smelting debris is to be found. This area has been exposed by rabbits and was thought to have been the smelting area but is now believed to have been a 'discard' heap where slags were dumped and sorted to extract lead prills. If this is the case, there may be evidence of layering of deposits from successive smelting operations.
6. A small watercourse coming from a spring in a patch of reeds near the foot of the knoll. Slag has been found along this and this might be an indication of an area where slags have been crushed and washed to remove lead prills. It is therefore important to see if there are differences in the size of slag particles across the excavated areas.
7. A shallow 'gulley' on the N side of the knoll, running from the high bank to the watercourse. This may or may not be natural.

Possible finds

In the first instance all finds, including metallurgical debris, should be left in place.

The main finds will be metallurgical debris such as slag, part-smelted ore, galena, matte (melted galena), lead prills, charcoal and heat-affected minerals such as barytes and sandstone. This is to be expected all over the site, however, concentrations of particular types or sizes may be indications of certain activities.

In outlying areas look for 'knockstones' (anvils where slag has been broken with hammers to remove lead and showing evidence of pitting).

In addition to metallurgical debris, there may be the sort of finds expected from any excavation such as pottery fragments, coins, clay pipe fragments, animal bones, personal items, bits of broken tools etc. I have found two flint arrowheads on lead smelting sites in the past. The undersides of turves should be examined for finds other than metallugical debris.

Examination of finds

All finds are the property of the landowner, although some will be taken away for examination.

Charcoal/wood – is used to establish a radiocarbon date, particularly when found within a defined context or stratum. Ideally a piece of charcoal embedded in slag would be fairly strong proof of context. The radiocarbon date will only indicate when the tree was growing and not when the smelting took place – known as the 'old wood' effect. The best way to minimise this error is to use pieces of small diameter indicative of new wood. The wood species can also be identified and may give an indication of whether the wood was collected from indigenous trees or from a coppiced plantation. I do not know if charcoal produced by smelting can be distinguished from that produced by separate charcoal burning but if so that would be of importance in establishing the technology used at the site. Care should be taken not to sample charcoal from heather burning, although peat charcoal would be interesting.

Slag – I have examined slag from about 80 bale or smelting mill sites by scanning electron microscope/energy dispersive X-ray fluorescence and have to say that the information which can be obtained from lead slags is somewhat limited in value. It can give an indication of the temperatures reached in the fire, although much of that can be determined by inspection. The slags here appear to be of the types which start to melt from 1,000 ^{o}C and may not be fully molten at 1,200 ^{o}C. I am able to confirm this by testing.

Galena, part-smelted material, matte – this is usually identifiable by inspection and although interesting will tell little that we do not already know. Concentrations of galena may indicate where ore was kept before smelting. Secondary minerals produced by weathering are not of particular relevance although they are interesting.

Reddened sandstone – this is indicative of exposure to 600 ^{o}C or above. If a well-defined structure such as a hearth bottom is exposed and there is a reasonable indication that the pieces have remained undisturbed, a decision will be made on whether to carry out archaeomagnetic dating. This is an expensive technique and is based on the phenomenon known as 'thermo-remanent magnetism': the natural magnetism of the iron content of the sandstone becomes aligned with that of the earth at the time of smelting and therefore by determining the magnetic deviation and dip of several samples the relevant date can be obtained.

Safety

A risk assessment has been carried out and should be read and followed by all people attending the excavation. Lead is poisonous, however, the risks are low provided reasonable and sensible precautions are taken. Care should be taken not to contaminate food or cigarettes and to ensure that boots are cleaned on leaving the site. Dirty clothing should be washed at home after the dig is ended.

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