Hammerscale

What is hammerscale?

Flake hammerscale is small (typically 1-3mm) "fish-scale" like fragments of the oxide/silicate skin dislodged by mechanical or thermal shock when iron is forged.

Spheroidal hammerscale (aka slag spheres) results from the solidification of small droplets of liquid slag expelled from within the iron during hot working. This happens particularly when two components are fire welded together, but also during the primary smithing of the bloom into a bar or billet.

Both types generally survive well in archaeological deposits and often retain their original metallic-lustrous sheen. They are generally too small to be recognised by the excavator, but can be recovered from soil samples as they are strongly magnetic. Sometimes thick deposits become concreted together with iron hydroxides and may be dismissed as iron-panning.

Why is it important?

Hammerscale is important in interpreting a site, firstly because it is diagnostic of a specific process, the smithing of iron, and secondly, because it is often found in the immediate vicinity of the smithing hearth and anvil, it helps to locate the activity precisely. By contrast 'bulk' smithing slags may have been transported elsewhere for purposes such as road metalling.

How can it be detected?

The equipment for detecting hammerscale can be as simple as a magnet, or as specialised as a magnetic susceptibility meter. The techniques are described below. More important for the field and post-excavation worker is an awareness of the existence of hammerscale and the adoption of a strategy for its identification.

Magnet

A simple bar magnet provides the cheapest and most convenient means of determining the presence of hammerscale. However, not everything that sticks to a magnet is hammerscale! As well as the obvious ferrous objects, flakes from corroded iron containing some metallic iron, oxidised iron-rich stone (especially roasted ores) and iron-rich fired clays may be attracted.

Practical tip: put your magnet inside a small polythene bag so attracted scale can easily be removed.

On site - check:

- Around hearths that may havebeen used for metalworking.
- Contexts that contain charcoal, fired clay or industrial debris.
- Concentrations of 'iron panning' which may include conglomerated hammerscale.

Off site - check:

- Ideally, when ironsmithing has been identified, or suspected, by the field worker 'industrial'soil samples should have been saved for examination.
- Otherwise, look at environmental soil samples. NB: spheroidal hammerscale will often float (due to air voids) whereas flake hammerscale will sink and be retained on the sieves.
- As a last resort, even when no soil samples have been saved, check the finds bags. If slag has not been washed, test the attached soil and any loose material with the magnet.

X-radiography

Although it is possible to look for hammerscale in soil samples by this method, it is not as rapid as using a magnet, nor is it quantitative like magnetic susceptibility. It might, however, provide some advantage in distinguishing between flake hammerscale (which appears as bright flecks) and the spheroidal hammerscale. Additionally, no sample preparation of the soil, such as drying or crushing, is required.

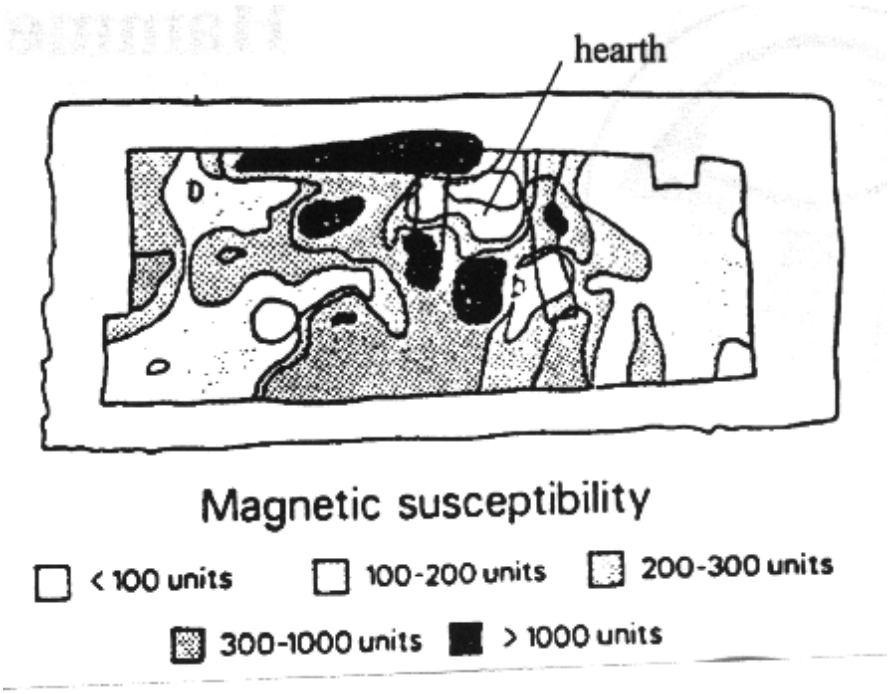
The more important aspect of x-radiography is that the hammerscale trapped in corrosion layers or conglomerations, may be visible when an artefact or unknown material is x-rayed for identification purposes.

Magnetic Susceptibility
This can be defined as a measure of the magnetic moment induced in a sample when placed in a magnetic field, or more simply the magnetisability of a material.

The technique has other applications in archaeological survey, where human activity may enhance the susceptibility of surrounding soils. However, values given by hammerscale, which contains the ferrimagnetic mineral magnetite, greatly exceed those of almost all other archaeological materials, (although fired clay will also give a strong response). Magnetic susceptibility values are largely proportional to the weight of hammerscale in a sample and provide a rapid means of quantification.

Measurements may be made either on the soil *in situ* using a field loop, which is sensitive to a depth of about 10cm, or using a bench sensor on samples taken on site (about 100g each should be sufficient).

Magnetic susceptibility not only allows the location of smithing sites, but if carried out in a systematic way -- for instance by taking samples at close, regular, intervals across a working surface -- allows the spatial arrangement of the working area to be determined.



The illustration above is an example of a magnetic susceptibility survey. The interior of a medieval smithy at Burton Dasset, Warwickshire (which was 10m long) was gridded out and samples taken at 25cm intervals. High levels of hammerscale were found surrounding the location of the hearth (the low magnetic susceptibility region between the internal walls at top centre) and along the inside of the adjacent external wall. The hearth itself would have been at waist height and after demolition no structural remains survived.

References

Mills, A and J G McDonnell (1992) The identification and analysis of the hammerscale from Burton Dassett, Warwickshire. Ancient Monuments Laboratory Report 47/92.

Unglik, H (1991) Observations on the structures and formation of microscopic smithing residues from Bixby Blacksmith shop ... Massachusetts, 1824-55. *Historical Metallurgy* 25(2), 92-8

David Starley
Ancient Monuments Laboratory
English Heritage

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