INTERPRETING ANCIENT METALWORKING

July 29, 2011 Tim Young Commercial Archaeology, Day of Archaeology, Day of Archaeology 2011, Early Medieval, Finds, Medieval, Science Archaeology, archaeometallurgical specialist, Archaeometallurgy - slag analysis - ferrous metallurgy, Bloomery, Building materials, bulk chemical analytical data, Cement, Chemistry, early technology, Europe, Ireland, Iron, key early technology, Materials science, Metallurgy, Ray Fluoresence Spectrometry, Refining, Slag, Smelting,Steelmaking, US Federal Reserve, Virginia

The Day of Archaeology is a pretty busy one in the office – not just the usual need to get specimens analysed and reports out of the door, but also with the added urgency of being almost the last day in the office before holidays.

As an archaeometallurgical specialist, I examine assemblages of metalworking residues (mainly slag…) on behalf of field archaeologists, both in academia and in the commercial world. My particular interest is in iron – so although I undertake projects dealing with all sorts of materials, it is with iron that there is the greatest synergy between my commercial work and my research interests. You might have thought we already know all there is to to know about iron making and iron working – but nothing could be further from the truth. This is a dynamic and rapidly advancing branch of archaeometallurgy and experimental work on various techniques is a key aspect of what I do – at least when the opportunity arises.

The reports I'm completing today include two for assemblages from a pair of adjacent Early Medieval sites in central Ireland. Intepreting such material entails bringing together various strands of data:

– there is the overall make-up of the assemblage, the types of slag, their proportions and distribution within the site. Much of that information is produced during the assessment stage of the project.

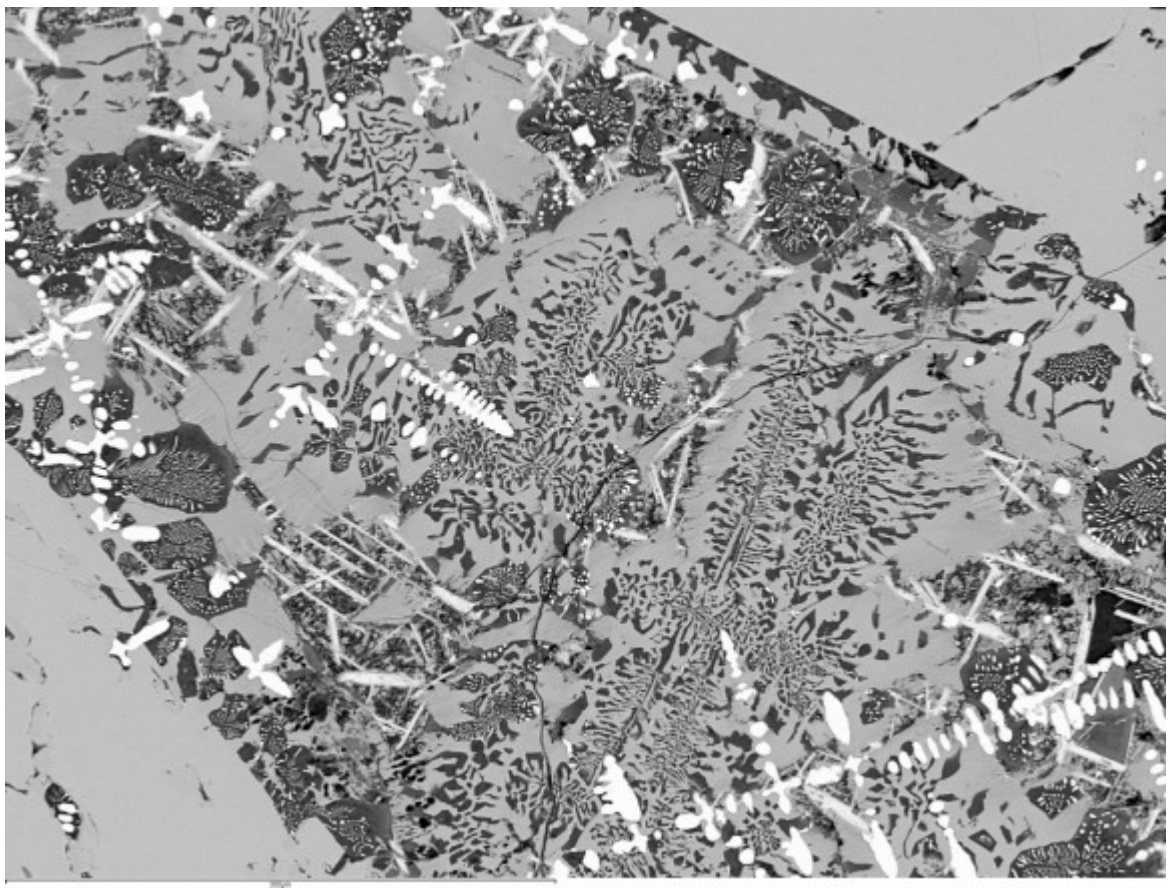
– there are detailed observations to be made about the form of individual pieces of slag. Often they can be identified to a general process or technology at this stage.

– there are bulk chemical analytical data. I use information generated by XRF (X-Ray Fluoresence Spectrometry) for the major elements and by ICP-MS (Inductively-coupled plasma – mass spectrometry) for the trace elements – thats over 50 elements altogether.

– and there are also the microstructural and microanalytical data that can be obtained by examining polished blocks of material under the SEM (scanning electron microscope). This gives information on the individual minerals within the slag: what they are, how they formed and sometimes what reactions were taking place in the slag before it solidified.

That, then, are the various sorts of data, but the challenge (and the fun) is in the synthesis of that information into an intepretation. That interpretation needs to be both scientifically rigorous and archaeologically useful. It needs to reflect the place of the metalworking activity in the lives, culture and economy of real people. Its not just a case of what was happening, chemically, within a hearth or furnace – but what that means in a human context.

So where is the synthesis of today's data going? Well, one of the key observations on the material I'm writing up today is that the morphology of the slag tells me it comes from iron working (rather than primary smelting), but it contains a high proportion of material (particularly the elements manganese and barium) that must have been derived from the original smelting of the iron ore. This means that these slags were generated during the refining of the raw iron bloom to produce a useable material.



A manganese- and barium-rich slag under the SEM

One of the great debates in early ironworking studies at the moment is whether such slags were generated during a bloomsmithing operation (thats to say the smith alternately heated the raw iron and forged it with a hammer to drive out the slag impurities) or by a remelting process (in which the smith completely melted the raw iron to allow the escape of the trapped slag). In the past it has been assumed that all bloom refining was by bloom smithing – now it seems remelting may have been much more important than we thought.

It is to debates such as this that experimental work can make a great contribution.

An experimental approach to studying bloom refining - a bloom remelting experiment run with friends in Virginia

Today's report writing was, at one level, supplying data and interpretation to a developer-funded project – and relates to the interpretation of life in 7th century Ireland. At another level it was another piece of the jigsaw in trying to understand a key early technology used in many parts of Europe. It will be a while before that all comes together as a comprehensive understanding of the technique – but when it does, that information can then be fed back again into the understanding of people's lives 1400 years ago.