Linking Bronze Age copper smelting slags from Pentrwyn on the Great Orme to ore and metal

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ABSTRACT: Linking the Great Orme Bronze Age copper mine to British metalwork by analysing ores, copper prills from Pentrwyn and particles of bronze found in the mine is an on-going project. This paper focuses on the smelting slags and prills recovered during the 2011 excavations from the Pentrwyn site, the only smelting site known from the British Bronze Age. They indicate the use of a simple smelting process which used secondary carbonate ores with only residual sulphides. The unusual slags are low in silica, like the ores, and lack any additives which resulted in only a small amount of glassy phase being produced. Hence, the copper prills must have been recovered by crushing, which matches the small size of the slag pieces. Lead isotope results link the slags to the Great Orme ores. The analyses of the copper prills show variable trace element levels, sometimes with significant levels of arsenic and nickel, consistent with a proportion of British Bronze Age metalwork.

Great Orme Bronze Age Mine Research Project

The Great Orme mine is situated on a Carboniferous Limestone headland on the coast of North Wales and is the largest known Bronze Age copper mine in Britain (Dutton and Fasham 1994; Timberlake 2009) or Ireland. The Great Orme has extensive surface workings and over 6km of accessible underground Bronze Age workings. They were discovered in 1987 and since then over 2,400 stone tools and about 30,000 bone tools or fragments have been recovered. The radiocarbon dates range from around 1884 to 406 cal BC but most dates cluster around the late EBA to the early MBA (James 2011).

Linking the Great Orme mine to British Bronze Age metalwork by analysing ores from all parts of the mine, copper prills from the nearby Pentrwyn smelting site and particles of bronze found in the mine (possibly from mining tools made locally), is an on-going research project. Tracing Bronze Age artefacts back to specific mines or regions can help reveal centres of production, exchange networks, and important social and technological implications. Ideally, this is achieved by using a combination of two independent techniques – a chemical ‘signature’ from trace elements and a lead isotope ‘signature’ (Pernicka 2004). However, these types of studies have to deal with the many factors involved (ore types, ore variability, ore roasting, smelting conditions, smelting additives, volatilization, trace element partitioning between metal and slag, geochemical and isotopic data overlaps between ore deposits and metal recycling). Research in this area could be significantly improved by a deeper understanding of ore geology and ore mineralogy and how it links to extractive metallurgy. In recent years, the modern mining industry has created a new discipline called geometallurgy to bridge the gap between geosciences (ore geology, ore mineralogy and geochemistry) and metallurgy (Bowell et al. 2011). An appropriate term for the new research approach being used by the Great Orme project is archaeogeometallurgy. Killick (2014) recently pleaded for more training of archaeological specialists in ore geology to improve our understanding of the development of metallurgy because ‘the literature is full of poorly informed speculation about ores used in the past’.