Ancient Iron Metals Tracing by Iron Isotopes Analysis

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The development of precise and accurate analytical techniques over the last few decades has allowed us to expand the range of methods for ancient metal tracing. Elemental and isotopic analyses are now widely used for this purpose. Generally, isotopic methods were employed for non-ferrous metal tracing in the past (e.g. Klein et al. 2009), while elemental analyses were used for ferrous metal tracing (e.g. Coustures et al. 2003). Both methods, however, show limitations. For example, overlaps of isotopic or elemental composition can occur between objects of different provenance. Moreover, elemental analyses performed on slag inclusions contained in the metal may require an important sampling of archaeological artefacts. These limitations underline the need to develop new methods for provenancing as a complement to the existing ones (Baron et al. 2011).

For the first time, we used Fe isotopes as a new tool for ancient iron metal tracing. Isotopic ratios 57Fe/54Fe and 56Fe/54Fe were quantified using a plasma source mass spectrometer after sample dissolution and Fe purification (Poitrasson & Freydier 2005). We first developed this approach by analysing materials from two archaeological experiments on iron ore reduction performed in the Montagne Noire massif (SW of France), which was a major region of iron production during the Roman period. Ore, slag and metal samples were analysed in order to estimate the possible influence of the bloomery process on Fe isotope composition. This approach was subsequently evaluated through the analysis of archaeological iron bars from Les Saintes-Maries-de-la-Mer Roman shipwrecks (SE of France) whose provenances have already been studied by elemental analyses (Baron et al. 2011). In addition, some materials coming from a different region of iron production (Bassar region, Togo) were analysed to investigate the inter-regional variability of Fe isotope compositions.

Our results show that the Fe isotope composition of metal and slag reflects that of their corresponding ore (Fig. 1a). We noted a slight isotopic heterogeneity in non-refined metal which may be due to the difficulty in homogenizing the iron bloom during the bloomery process. However, the purification and smithing steps allow us to assess the isotopic homogenization of the metal. Thus, we can conclude that the chaîne opératoire of iron production does not induce significant Fe isotope fractionation.

Trace element analyses performed on iron bars from Les Saintes-Maries-de-la-Mer led to establish two groups with different provenances: a first group of bars coming from the Montagne Noire, and a second group with bars of other provenance (Baron et al. 2011). Our results show that the Fe isotope composition of the bars from the first group is similar to that of archaeological ore from la Montagne Noire, which validate their provenance assumption (Fig.1b). However, the isotopic composition of several bars from the second group corresponds to that of the Montagne Noire. This underlines the possible overlaps in Fe isotope compositions between materials from different regions.

Finally, the comparison of the Fe isotope composition of materials from the Montagne Noire and that of iron objects from Togo demonstrates that these two distinct regions of iron production can be easily distinguished by their isotopic signature (Fig. 1c). The results obtained so far

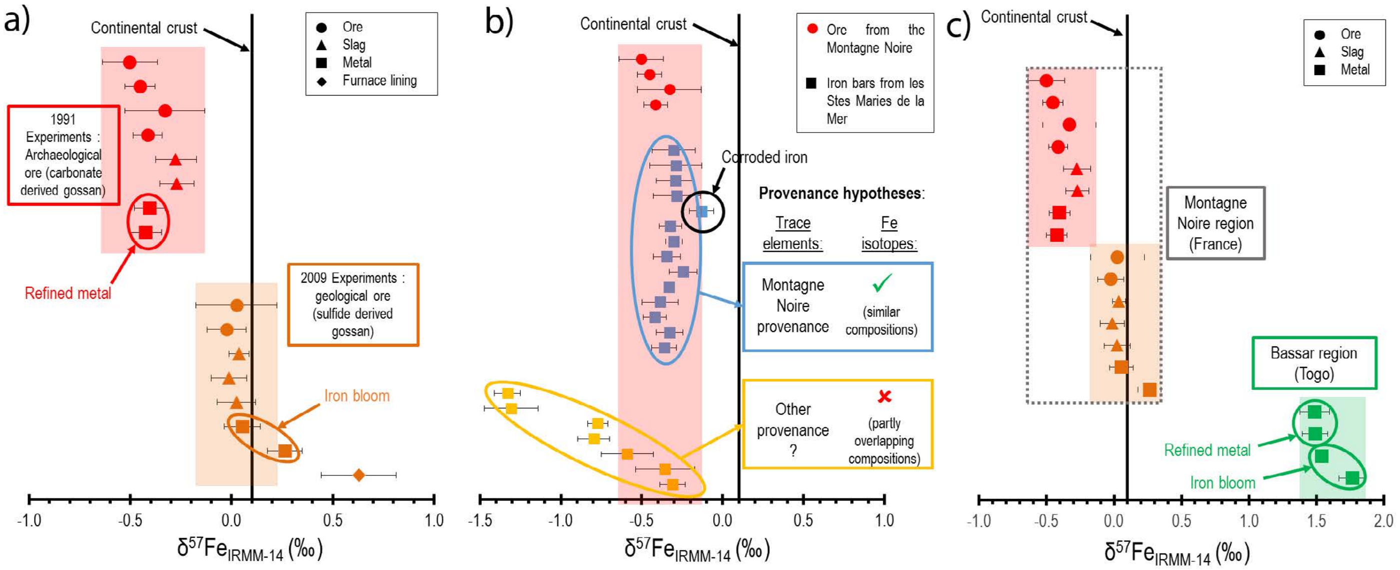

Fig. 1 Fe isotope composition of materials from a) experiments performed in Montagne Noire massif, b) Les-Saintes-Maries-de-la-Mer Roman shipwrecks and archaeological ores from the Montagne Noire massif, c) Montagne Noire and from the Bassar region (Togo).

suggest that Fe isotopes are an effective tracer for ancient iron metals which offer many perspectives for future provenance studies.

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MEETING OF HISTORIANS IN LATIN AMERICAN MINING

The 13th Meeting of Historians in Latin American Mining (MHLM) titled "Interdisciplinary dialogues and challenges around past and present Latin American mining" will be held from the 4th to 7th April, in Buenos Aires, Argentina. The Organizing institution is the Ethnohistory Section of the Institute of Anthropology from the University of Buenos Aires. This meeting aims to gather various disciplinary approaches and issues related to mining. Presentations are expected to consider technological and organizational dimensions of mining but also the religious-symbolic, spatial, economic and political aspects linked to these activities. For more information visit http://www.13reunionmineria.wordpress.com

THE STAFFORDSHIRE HOARD

The Staffordshire Hoard was discovered in 2009, north of Birmingham, in England. It is the largest ever single find of Anglo-Saxon gold (c. 5 kg) and silver (c. 1 kg) metalwork. The majority of the assemblage consists of war equipment; however there are no weapon blades. The objects range in date from the mid/late 6th century to the mid/late 7th century, giving the find a terminus post quem date of c. 675. The Staffordshire Hoard is owned by Birmingham City Council and Stoke-on-Trent City Council on behalf of the nation, and cared for by Birmingham Museums Trust and the Potteries Museum & Art Gallery, Stoke-on-Trent.

For the last few years a large English Heritage (now Historic England) funded research and analysis project has been carried out managed by Barbican Research Associates (Cool 2015). This has reached the end of the analysis phase of the project. Analysis of the gold, silver and copper alloys in the Hoard have been carried out at the British Museum, Birmingham Museum and Art Gallery and Birmingham University.

Gold objects of the Staffordshire Hoard.

The largest quantitative survey of Anglo-Saxon gold, to date, revealed no reliable relationship between the fineness of alloy used and object date, although the low copper content is consistent with the use of recycled coinage as a source of gold. However, over 100 components on the objects appear to be deliberately depleted in silver at their surface which, it has been argued, was the result of a deliberate and probably widespread Anglo-Saxon