

## **Iron isotopes for ancient iron metal tracing : comparison with trace elements analyses**

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### **A new isotopic tool for ancient iron metal tracing**

Previous provenance studies of iron materials using elemental chemical analyses proved to be successful [e.g. 1]. However, several limitations underlined the need to develop new tracers to provide complementary informations [2]. Recently, it has been demonstrated that Fe isotopes may provide a powerful tool for ancient iron metal tracing because of the absence of iron isotopic fractionation along the *chaîne opératoire* of iron smelting by bloomery process [3]. For the first time, we propose to apply this new tracer to the study of an important region of iron production during Roman times, in the South-West of France.

### **Archaeological application**

The iron isotope composition of several iron bars from Les Saintes-Maries-de-la-Mer Roman shipwrecks, along with selected iron ores, have been measured by MC-ICP-MS [4]. Overall, our Fe isotopic results tend to confirm the provenance hypotheses previously established by elemental studies on the same materials, but the use of Fe isotopes may bring supplementary information. For a first group of iron bars, the heterogeneous trace element compositions allow distinguishing sources at an intra-regional scale, whereas the homogeneous iron isotopes signature may be compared to that of other regions for provenance discrimination at an inter-regional scale. In contrast, iron bars from a second group exhibit constant trace elements ratios and distinct Fe isotope compositions, which allows refining provenance hypotheses. These results demonstrate the benefits of combining both Fe isotopes and trace elements analyses for provenance studies of ancient iron metal.

[1] Coustures *et al.* (2003) *Archaeometry* **45**, 599-613.

[2] Baron *et al.* (2014) *Archaeometry* **56**, 665-680. [3] Milot *et al.* (2016) *JAS* **76**, 9-20. [4] Poitrasson and Freydier (2005) *Chem. Geol.* **222**, 132-147.