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New insights on Late Bronze Age Cu-metallurgy from Coles de Samuel hoard (Central Portugal): A combined multi-analytical approach

Carlo Bottaini [a,*], Raquel Vilaça [b], Nick Schiavon [c], José Mirão [c], António Candeias [c], Rui Bordalo [d], Giovanni Paternoster [e], Ignacio Montero-Ruiz [f]

[a] CIDEHUS and HERCULES Laboratory, University of Evora, Largo do Marquês de Marialva, 8, 7000-809 Evora, Portugal
[b] Faculdade de Letras da Universdidade de Coimbra and Centro de Estudos em Arqueologia, Artes e Ciências do Património, 3004-530, Coimbra, Portugal
[c] HERCULES Laboratory, University of Evora, Largo do Marquês de Marialva, 8, 7000-809 Evora, Portugal
[d] HERCULES Laboratory, University of Évora, Largo Marquês de Marialva, 8, 7000-809 Évora, Portugal and Laboratório José de Figueiredo, Direção Geral do Património Cultural, Rua das Janelas Verdes, 37, 1300-001 Lisbon, Portugal
[e] Dept. of Physics "E. Pancini" - Naples University "Federico II and INFN Naples Div., via Cintia 80126 Italy
[f] Instituto de Historia-CSIC, Albasanz 26-28, 28037-Madrid, Spain

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ABSTRACT

The hoard from Coles de Samuel is one of the largest Cu-based metal collections from the Late Bronze Age (LBA) (13th–8th centuries BC) ever found in Central Portugal, consisting of 18 artefacts which typologically display a strong regional identity. In the present study, an integrated multi-analytical approach combining Energy Dispersive X-Ray Fluorescence (EDXRF) analysis, Optical Microscopy (OM) and Scanning Electron Microscopy with Energy Dispersive X-ray spectroscopy (SEM-EDS) has been used to characterise the artefacts both from a chemical and microstructural point of view with the aim to unravel their elemental composition and technological features.

Results show that all artefacts are made of binary bronze (Cu-Sn) alloys, with a Sn content in the range of 8.7 ± 0.9 and 13.0 ± 1.0 wt%, with minor elements (Pb, As and Fe) never exceeding 1.1 wt% in total. The microstructure of the vast majority of the metal objects (13 out of 18) shows the presence of equiaxial α-copper grains with annealing twins and slip bands suggesting that, in the manufacturing process, they were subjected to forging plus annealing cycles. The remains of the objects present an as-cast microstructure constituted by dendritic structures, suggesting that metals did not suffer any thermo-mechanical operation after being removed from the mould. Pb, Ag and Au-rich globules together with Cu–S and unalloyed Cu-inclusions have been observed as well, resulting from impurities from ores.

The typological characterisation of these metals and their archaeometallurgical data are consistent with an indigenous LBA Iberian metallurgical production supporting the hypothesis of a regional/local production and use of the artefacts from Coles de Samuel.

1. Introduction

1.1. Archaeological context

Hoarding objects is a common and cross-cultural human practice all throughout the European Prehistory (Hamon and Quilliec, 2008). In general terms, a hoard may be defined as a collection of one or more archaeological objects with distinct functional and typological characteristics, intentionally and selectively collected and either buried or deposited in underwater environment in specific sites in the absence of a clear archaeological context (Bottaini, 2013; Bradley, 1990; Delibes De Castro, 2007; Levy, 1981; Vilaça, 2006).

The visual characteristics of the objects inside the hoards (typology, number and state of preservation) as well as the context where the items were deposited (wet or dry places, close to a settlement or a prominent element in the landscape, inside caves, mines, etc.) are the two main parameters traditionally taken into account for their classification and interpretation.

Based on these elements, a distinction is traditionally made between utilitarian (or non-ritual) and votive (or ritual) hoards: the former would reflect processes within the production and the circulation of metal and are usually considered as temporarily buried trade stocks (i.e. reserve of raw material or newly-made objects). The latter, linked to metal consumption, would be associated with the social position of the depositary and are considered ways of express wealth, status and ritual offerings to divinities or secular people. In contrast with the utilitarian hoards, the ritual ones are composed of objects with special

* Corresponding author.

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symbolic values that would have been buried permanently, without the intention of being recovered (Taylor, 1993).

Since the first studies on hoards, in the second half of the 19th century, this bipolar classification – utilitarian vs. ritual hoards – has given rise to many interpretative problems and prolonged debates and discussions among researchers, proving that this approach is too paradigmatic and schematic to explain an archaeological evidence as complex as prehistoric hoards are: in fact, it is nowadays generally accepted that a hoard can no longer be viewed in terms of utilitarian or votive deposition and new and stimulating alternative perspectives have been adopted (Fontijn, 2002; Gosden and Marshall, 1999; Kopytoff, 1986; Osborne, 2004; Whitley, 2002; York, 2002).

Notwithstanding in the pre-industrial societies, technology does not correspond to a simply transformation of matter but it is embedded in social and cultural dynamics, the methodologies of physical, chemistry and material sciences can provide significant data for a more complete understanding of the hoarding phenomenon. To contribute to this scientific debate, the 18 artefacts from the Coles de Samuel collection were analysed by Energy Dispersive X-Ray Fluorescence (EDXRF) spectrometry to determine major and minor elements and thus provide their chemical composition and by Optical Microscopy (OM) and Scanning Electron Microscopy with Energy Dispersive X-ray spectroscopy (SEM-EDS) to characterise the microstructural features of the alloys and to reconstruct the technical chain of sequential operations by which natural resources were physically turned into cultural commodities (Dobres and Hoffman, 1994). Through the reconstruction of the technology applied in the production of these objects, the technological choices that ancient metalworkers did in the manufacturing of an object will be investigated.

More concretely, this paper seeks to: a) identify the chemical composition of the metals in order to compare the results with other data present in the literature; b) focus on the production technique used in the manufacturing of the metal artefacts; c) timeframe the results from Coles de Samuel collection within the LBA metallurgy from Western Iberia, in order to infer about metallurgical parallels.

Fig. 1. Map of Central Portugal, with the location of the Coles de Samuel hoard.