Bronze artefacts were buried in large quantities in isolated hoards in the Atlantic façade of Europe, between the Bronze Age and the beginning of Iron Age. This practice was particularly intense, and despite many years of research, even today we do not understand what motivated such disparate and widespread communities to express themselves in this way (Armeda and Martinón-Torres, 2016; Montero Ruiz et al., 2015). This presentation is focused on the totally non-invasive characterisation of leaded bronze unused (as-cast) axes from NW Iberia using neutron probe. Our main focus is the presence and distribution of high quantities of lead in the axes, which raises interesting questions about their manufacture as well as challenges for conventional analytical techniques (Harrison et al. 1981; Gutierrez Neira et al., 2011). The sample includes a diversity of compositions and states of preservation, as well as an enigmatic palstave that has a thick lead core as well as a large lead ball inside the casting sprue. Our specific objectives are (1) study the manufacturing processes of these axes; (2) study the inner morphology; (3) quantify their bulk chemical composition without analytical biases derived from sampling uncertainty. The experiments were performed at ISIS pulsed neutron and muon source in Oxfordshire UK exploiting complementary techniques such as neutron tomography and radiography, prompt gamma activation analysis and neutron diffraction. Neutrons are a unique probe for the investigation of metal objects because of their weak interaction with matter and high penetration power allowing the study of the features of the objects in their bulk in a non-destructive and non-invasive way (Festa et al, 2018). Results from the neutron tomography study provide new insight into the inner morphology of the axes, including 3D rendering and segmentation of their various inner parts, and leading to new hypotheses about their manufacturing techniques. The presence of a sphere of pure lead in the core of one of the axes opens multiple scenarios on the manufacturing processes of this object, suggesting the presence of a double casting or the occurrence of a massive lead segregation. Through neutron diffraction and prompt gamma activation analysis, it is possible to perform a thorough chemical characterisation in the bulk of the objects as well as the multiphase analysis thus allowing to study the corrosion patinas present on the surface of the axes. We discuss the implications of our study for the analysis of leaded bronze objects using conventional techniques.

References