Contribution ID: **49** Type: **Talk**

Unveiling Brass Workshops in Ancient Roman Mediolanum with Epithermal and Thermal Neutrons

Friday, November 24, 2023 11:15 AM (25 minutes)

The combined use of different neutron techniques has been employed for the non-destructive compositional investigation of Roman crucible fragments discovered during an excavation in Milan (Italy) conducted by the Soprintendenza Archeologica, Belle Arti e Paesaggio of Milan in 2009.
The excavation unearthed numerous fragments of metals and crucibles related to bronze and brass production, datable between the end of I and the beginning of II century CE and which may constitute the first evidence of brass production in Italy during the Roman Empire [1,2]. So far, historical documentation of brass production in the Roman Empire [3] has only been found in England, Germany, and France [4-6].

Several crucible fragments do not show any metallic traces on their surface; therefore, standard investigations with X-rays or ion beams could not be adequately sufficient to disclose brass traces and composition. In the context of a non-destructive characterisation, the crucible samples have been analysed using thermal and epithermal neutrons to determine and quantify their elemental and phase composition within the volume. Epithermal neutrons were employed to obtain elemental information through the resonance absorption techniques NRTI (Neutron Resonance Transmission Imaging) and NRCA (Neutron Resonance Capture Analysis) which are based on the measurements of transmitted neutrons and gamma radiation following neutron absorption reactions with the samples. Thermal neutron diffraction has been exploited to quantify the zinc content in the brass traces.

The combined use of these different neutron techniques, available at the INES beamline of the ISIS spallation source (UK), allowed for a comprehensive and non-destructive understanding of the composition of the metallic alloys present in the bulk of the crucibles. This approach takes advantage of the complementarity between thermal and epithermal neutrons to overcome the limitations of each technique, such as their different detection limits on specific elements (e.g., lead).

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Session Classification: Production Techniques

Track Classification: Default track