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Multi analytical approach for in situ non-invasive analyses on orichalcum ingots from Mediterranean Sea

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In February 2016, 47 ingots were found in the seabed of Contrada Bulala (Gela, CL, Italy) near the site where in 2014 40 ingots had previously been recovered. The ingots composition was determined to be a Cu - Zn alloy [1], dated by the archaeologist to the VI century B.C. This specific alloy was then identified as orichalcum. From an archaeological point of view, the interest was to define the relation between the two discoveries and the origin of primary sources of metals. In previous studies, fundamental information was achieved by applying chemometric treatment of the analytical results obtained on microsamples from ingots from first and second discovery [2,3]. Starting from this database and from availability of microsamples taken from the ingots, we discuss the feasibility to obtain elemental and spectroscopic information from the investigated area by using a non-invasive approach.
A recently commercialized portable instrumentation dedicated to synchronous and co-registered XRF and Vis-SWIR hyperspectral measurement, with non-destructive and contactless approach to the samples, has been used to analyze three microsamples taken from three different ingots of the 2016 group.
With the purpose to build a non-invasive in situ protocol, the XRF obtained results are compared with the literature data [1-3] and they match. Moreover, the hyperspectral measurements are cross-checked with diffuse reflectance spectra acquired with a spectrophotometer in the UV-vis region, where the response related to the Cu transition in the alloy can be detected. The spectra of the three samples look very similar, with a broad minimum from about 250 nm up to 450 nm and a shoulder at about 600 nm; both these features, typical of brass, are known to vary as a function of Cu and Zn concentrations [4], which are indeed very close for the three samples (Cu ≥70% and Zn ≤20%). In addition, the spectra of the samples with the same Pb-isotope ratio are nearly identical.

References

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