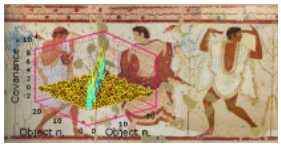

The Bronze Plates of Golden Globe on Saint Peter Dome in Rome; Comparison of Alloy Composition Using *in situ* X-Ray Fluorescence

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Abstract

The use of portable EDXRF systems is spreading over and over even in cases unthinkable up to few years ago. The Golden Globe on top of Saint Peter in Rome is just one of these cases. Availing of a portable EDXRF system more than 40 measurements have been fulfilled and analysed.

Chemometrics methods have proven indispensable for gathering information from a so big set of data.

Introduction

Nowadays the field portable energy dispersive equipment achieved stability and portability that could not be foreseen only few years ago. A concrete example of this state of the art is the campaign of measurement performed in the July 2005 inside and outside the bronze golden globe placed on the top of the San Peter Dome (see Figure 1). The golden globe was placed in site in 18 November 1593 by Giacomo della Porta, famous Italian architect that ended the Michelangelo work on the Dom. The globe is placed at a height of 131 meter having a 2.5 meter diameter and a weight of 1862 Kg. This large bronze artefact is composed of 36 plates soldered together (we now know with autogenic soldering) in situ. Several signs of thunderbolt shots are evident. During the last restoration/maintenance work on the globe the Fabbrica di San Pietro gave us the possibility to perform some archaeometric investigations. In order to perform these measurement a big work of organisation was needed and Dr. Gabrielli and Zander of the Fabbrica di San Pietro, together with the staff (Sanpietrini) of the fabricate gave us a big support.

Figure 1: The arrow indicates the place where the EDXRF analysis were fulfilled.

Materials & Methods

To analyse the alloys 2 portable EDXRF systems were used [1]. About the EDXRF system used inside we worked with an X Ray tube tension of 35 kV and a tube current of 0.2 mA; the detector is a SDD (Silicon Drift Detector) with a resolution of 150 eV at 6.4 KeV. The analysed areas on the surfaces have a diameter of 2 mm [2]. For the out side an Eclipse II X ray tube was used, and a SPIN detector with 180 eV resolution at 6.4 KeV.
A cluster analysis was performed in order to put in evidence similarities among plates.

Figure 2: EDXRF measurements outside of the Golden Globe.

Results

The measurements carried out in such extreme conditions showed the high level of stability and reliability of the new generation of portable instruments equipped with miniaturised low power x ray tubes and SDD detectors. Inside the globe we performed 31 quantitative measures, 21 on the plates, 7 on the solders and 3 on the repairs. Several measures were also performed on the outside gilded surface to drive the restoration procedure. The globe was regilt several times since the first time therefore it was practically impossible to detect the original gold leaf.

Conclusions

With the EDXRF measurements it was possible to reach to the following conclusions:

a) the bronze alloy has 85.8 ± 0.5 % copper, 10.1 ± 0.3 % tin and 2.8 ± 0.1 % lead average composition, the uncertainties include the measures error and the variability of the alloys production.
b) some other minor elements were detected in the alloy: iron, zinc, silver and antimony.
c) the solders are autogenic, i.e. made with an alloy having a composition very similar to the plates soldered together (88.2 ± 0.4 % copper, 8.5 ± 0.3 % tin and 2.3 ± 0.1 % lead). Therefore, the plates were soldered in site.
d) multivariate analysis show a single group showing an excellent control of melting and, probably, the use of pure metal for all of the 36 plates without refusing spare parts (the observed variability is small).

References

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