



## EDXRF and Multivariate Analyses of the Golden Globe on the San Peter's Dome in Rome, Italy

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### Abstract

The restoration and maintenance works of the famous golden globe placed on the top of San Peter's dome in Rome have been an unique opportunity to access the inside and outside of it and verify some aspects of the ancient production technologies and set up of the big bronze artefacts. The huge globe is made up of 50 dissimilar plaques, uniquely crafted on the ground and soldered on the top of the dome. The analyses were fulfilled with a portable EDXRF (Energy Dispersive X Ray Fluorescence) system on 31 different spots. Outliers were searched availing of Cluster Analyses (CA).

### Introduction

After the death of Michelangelo (1564 C.E.) the building of the major cupola of the Vatican Basilica was still far to be ended. Only in 1593 C.E. the architect Giacomo della Porta finished to build the lantern over which he placed the gold gilded bronze globe (Figure 1). In the succeeding centuries there had been several maintenance interventions on the lantern to remedy mostly lightning damages.

The globe went under restoration [1], the outer side of the globe was therefore reachable with scaffolds. Scientific analyses had to be fulfilled to support the work of art historians and restorers.

31 different plates and restoration sections were analysed availing of a portable EDXRF system and quantitative calculation was fulfilled. Multivariate CA was fulfilled on the results to highlight outsiders.



Fig. 1; the golden globe on top of Saint Peter in Rome

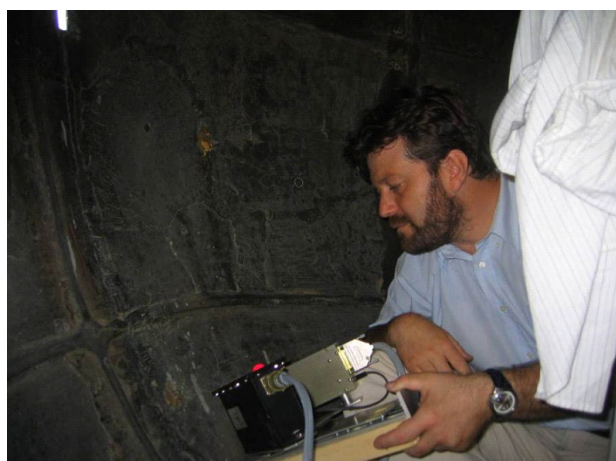


Fig. 2; inner part of the globe during EDXRF measurements, it is evident the structure of the globe.

### Materials & Methods

The large globe is formed by means of the assembly of 50 bronze plates of different sizes. This is easily highlighted from inside the artwork, with a division in meridians and parallels quite similar to the subdivision of the terrestrial globe (Figure 2). A circular cover closes the work in the high part, while the lack of the lower cover allows access to the interior of the globe through a metal ladder.

The globe weighs 1862 kg and his diameter measures 2.5 m. It is put right on top of the dome and just below the cross at 130 m from the floor of the Basilica. The globe is composed by 50 panels mutually soldered, numbered in longitudinal by letters and in latitudinal by numbers (starting from the 1 element top). The panels are composed of bronze and the external surface is gilded.

Non invasive analyses were fulfilled with a portable EDXRF systems composed of a (SDD, Silicon Drift Detector) Peltier cooled detector and a miniaturized X Ray tube as a source. The measurements lasted 5 minutes each and the analysed spot was cleaning by the surface patina to allow quantitative calculation [2]. CA was fulfilled with XLSTAT software.

## Results

In Table I we report the quantitative results on the 31 measurements.

Table 1; Composition (%w/w) of the different panels calculated by EDXRF. The outsider is evidenced in red

	Zn	Pb	Sn	Fe	Ag	Sb	Cu
4a	0,9	2,9	9,3	0,2	0,1	0,5	86,2
5a	0,5	3,1	10,5	0,1	0,1	0,6	85,1
Welding 5a-6a	0,3	2,3	8,6	0,0	0,1	0,4	88,2
6a	0,4	2,9	9,5	0,1	0,1	0,6	86,5
3b	0,5	2,2	8,5	0,1	0,1	0,5	88,1
Welding 3b-4b	0,9	2,8	8,5	0,2	0,1	0,5	87,1
4b	0,4	4,3	13,0	0,1	0,1	0,9	81,3
Welding 4b-5b	0,2	2,5	9,4	0,1	0,1	0,5	87,3
5b	0,4	2,0	9,1	0,1	0,1	0,6	87,8
Welding 5b-6b	0,4	2,0	7,0	0,1	0,1	0,4	90,0
6b	0,3	3,4	10,7	0,1	0,1	0,6	84,8
Restoration in 3b	0,5	2,4	9,8	0,1	0,1	0,7	86,5
3d	0,7	3,0	10,9	0,2	0,1	0,6	84,5
4d	0,5	3,4	11,8	0,2	0,1	0,7	83,4
5d	0,3	3,6	13,5	0,1	0,1	0,6	81,7
Welding 5d-6d	0,3	2,3	8,8	0,1	0,1	0,5	87,9
6d	0,4	3,7	11,7	0,1	0,1	1,1	83,0
Restoration in 5d	0,5	2,5	11,1	0,1	0,1	0,6	85,1
5e	0,3	2,9	10,7	0,1	0,1	0,8	85,0
Welding 5e-6e	0,3	2,1	8,8	0,1	0,1	0,6	88,0
6e	0,3	2,5	9,0	0,1	0,1	0,5	87,5
4g	0,5	2,6	9,7	0,2	0,1	0,6	86,3
5g	0,4	2,3	9,0	0,1	0,1	0,5	87,6
4h	0,4	2,1	9,6	0,1	0,1	0,5	87,2
5h	0,4	2,6	9,0	0,1	0,1	0,6	87,4
Restoration in 5h	0,5	0,7	0,5	0,1	0,1	0,7	97,4
4l	0,4	2,1	8,6	0,1	0,1	0,5	88,2
5l	0,4	3,0	9,9	0,1	0,1	0,6	85,9
4m	0,5	2,3	8,4	0,1	0,1	0,5	88,2
Welding 4m-5m	0,5	1,8	8,4	0,1	0,1	0,5	88,7
5m	1,4	4,2	22,9	0,3	0,2	1,2	69,9

## Conclusions

EDXRF analyses confirmed that the alloy has a very good mechanical strength. The high homogeneity of the alloy of the different plates and welding indicate the use of autogenous welding. CA evidenced an outsider, probably revealing an ancient maintenance; the results obtained was useful in the restoration process.

## References

- 1) N. Gabrielli et al., Il restauro della sfera bronzea sulla cupola della basilica di San Pietro. In: *Materiali e Strutture, nuova serie anno III numeri 5-6*, Nuova Argos, 2005, 38-87. ISSN 1121-2373
- 2) *Conservation Science for the Cultural Heritage. Applications of Instrumental Analysis*. Ed. E.A. Varella, Springer Heidelberg, New York, 2013. ISBN: 978-3-642-30984-7