

## A NEW LIGHT INTO OLD GOLD

A. Bidarra<sup>1\*</sup>, M.O. Figueiredo<sup>2</sup>, J. Coroado<sup>1,3</sup>, T.P. Silva<sup>2</sup> and F. Rocha<sup>1</sup>

<sup>1</sup> Geobiotec/Departamento de Geociências - Campus Universitário de Santiago - 3810-193 Aveiro, Portugal, bidarra.ana@gmail.com, frocha@geo.ua.pt

<sup>2</sup> LNEG, Unidade de Recursos Minerais & Geofísica, Apartado 7586, 2610-999 Amadora, Portugal, ondina.figueiredo@lneg.pt

<sup>3</sup> Departamento de Conservação e Restauro, Instituto Politécnico de Tomar - Quinta do Contador, Estrada da Serra - 2300-313 Tomar, Portugal, jcoroado@ipt.pt

The city of Porto witnessed in 1727, to the introduction of a roman aesthetic into the baroque language of altarpiece production. The main altarpiece of Porto's cathedral represents the turning point into the adoption of this majestic and complex way of architecture. With a new and innovative approach to the construction schemes and decorative language, it was the first exemplar of its kind.

This work aims to provide a new insight into one of the most magnificent works of the Portuguese Baroque period, particularly into the study of its gold and gilding technique. This research is also part of a project that will allow defining a methodology for the analysis of the gold-leaf, assigning a specific data to a specific work by fingerprinting each altarpiece.

The qualitative and semi-quantitative analyses of the samples collected from the main altarpiece were performed by several analytical techniques. The physical features of the gold-leaf and the bole and ground layers were analysed through optical microscopy of cross-sections using reflected and polarised light and by SEM-EDS. It was possible to identify the presence of a traditional gilding technique with three distinct layers. The EDS analysis identified the presence of the major elements - Au, Ag and Cu in the gold leaf, Al, Si and Fe in the bole and Ca and S in the ground layer - and pointed to the presence of a pure gold with 22 carats. The minor and trace elements were studied through ICP-MS and provided valuable information regarding the study of the gilding technique and the typification of the gold-leaf: Cr, Hg, Pb, Pd, Pt and Sn were identified. Although in the case of Pt and Sn the results were unclear – these elements only had a concentration approximately 3 times the detection limit – the performed SR-XRF confirmed the presence of Sn. These elements are a contribution from the different layers in the gilding: Cr, Pd, Pt and Sn from the gold-leaf and Pb and Hg from the bole and ground. Pb and Hg can indicate the use of lead white or vermilion as additives to the ground and bole layers – as mentioned in several treatises from the 13<sup>th</sup> to the 18<sup>th</sup> centuries. The  $\mu$ -XRD analyses are currently under study.

The definition of an accurate and practical methodology for the analysis of the gold-leaf and gilding technique is a work in progress. However, it was possible to extract useful information related to physical, chemical and technological features, from the several exams performed. These are important contributions for fingerprinting the gold use in Porto's cathedral main altarpiece and will allow future comparison with other works from the same period.

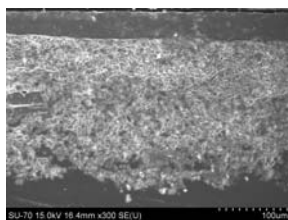


Figure 1: SEM image of the cross section (300 x).

	Element					
Concentration	Cr	Hg	Pb	Pd	Pt	Sn
$\mu\text{g.Kg}^{-1}$	4,10	31,76	80,27	3,94	0,14	3,00
DL	0,5	1	5	0,5	0,05	1
$\mu\text{g.Kg}^{-1}/\text{DL}$	8,2	31,76	16,05	7,88	2,8	3,00

**Table1:** ICP-MS results: trace elements in the sample and detection limits (DL) expressed in  $\mu\text{g.Kg}^{-1}$  (ppb). In red, probable false positives.

#### Acknowledgements:

Portuguese Foundation for Science and Technology (FCT) for PhD grant SFRH/BD/38593/2007.  
 GeoBioTec Research Centre – Aveiro – Portugal.  
 RNME – Pole University of Aveiro (FCT Project REDE / 1509 / RME / 2005).  
 The financial of EU to perform XRF experiments at the ESRF is acknowledged.

#### References

- 1 Ferreira-Alves N. M. 1989. *A Arte da Talha no Porto na Época Barroca. Artistas e clientela. Materiais e técnica*. Volumes I e II. Arquivo Histórico, Câmara Municipal do Porto.
- 2 Bidarra, A., Rocha, F., Coroado, J. 2009. *Gold leaf analysis of three baroque altarpieces from Porto*. In: *ArchéoSciences*. Vol. 2 (33): 417-421.
- 3 Bidarra, A., Coroado, J., Rocha, F. 2011. *Retábulos Barrocos: definição de uma metodologia para o estudo da folha de ouro*. AuCORRE - Conservação e técnicas de análise para o estudo e salvaguarda do património metálico. <http://aucorre.org/project/pdf/301530.pdf>