

## V45 Iron Age Vessels from the Archaeological Museum of Adria (North-Eastern Italy): A Textural, Chemical, and Mineralogical Study

Filomena Gallo<sup>1</sup>, Alberta Silvestri<sup>1</sup>, Gianmario Molin<sup>1</sup>, Alessandra Marcante<sup>2</sup> and Paolo Guerriero<sup>3</sup>

<sup>1</sup> University of Padova Department of Geosciences, Via Gradenigo 6, 35131 Padova, Italy

<sup>2</sup> University of Siena, Department of Archaeology and History of Arts, Via Roma, 56, 53100 Siena, Italy

<sup>3</sup> ICIS-CNR, Corso Stati Uniti 4, 35127 Padova, Italy

*filomena.gallo@unipd.it*

During Iron Age radical changes occurred in glass production, in particular in the use of fluxing agents. It is well known that in the Late Bronze Age glass was produced using plant ashes as the batch fluxing component (Angelini et al., 2002), while the Final Bronze Age was characterized by the appearance in Europe of the so-called “mixed alkali glasses” (Angelini et al., 2004). From the 7<sup>th</sup> century BC onwards, glass composition changed radically, and the so-called “natron based” glass became widespread in eastern and western regions.

This research is focused on a small group of Iron Age vessels, dating from the 6<sup>th</sup> to the 2<sup>nd</sup> century BC and coming from the Archaeological Museum of Adria (Rovigo). These glass items include essentially three types of vessels (*oinokai*, *aryballoi* and *amphoriskoi*), produced with the technique of the core-forming. They belong to the so-called ‘Mediterranean Groups’, characterized by an intense transparent blue body decorated with yellow, white and turquoise trails. Notwithstanding the bulk chemistry and the opacifying agents of numerous Iron Age vessels were extensively characterized in recent works (Arletti et al., 2010, 2011), a textural study on the transparent glass body was never performed. In this respect, a complete chemical textural and mineralogical characterization was conducted on the Adria vessels.

All analyzed samples are soda-lime-silica glasses, produced with a siliceous-calcareous sand and natron as flux. Their bulk composition is consistent with that of the coeval vessels of Bologna and Spina (Arletti et al., 2010, 2011) and is also similar to the typical Roman glass. Trace elements analysis revealed that the main chromophore of these glasses is cobalt, associated with copper and iron. Numerous residual phases were observed in all the blue bodies. They likely represent residues of Co-bearing raw materials and are constituted mainly by drops of copper sulphides, sometimes with metallic segregations (Pb, Sb), and by metallic inclusions containing Fe-Co-Ni.

All the white decorations show the presence of euhedral calcium antimonates crystals, dispersed in the glass matrix. The same phases were identified in the turquoise samples, although with an anhedral morphology, suggesting a different production technology. Finally, the analytical data for the yellow glasses show the presence of euhedral and anhedral lead antimonate crystals, with notably iron contents ( $\text{Fe}_2\text{O}_3 = 3.62\text{-}10.16$  wt%), suggesting that this element comes from Sb and/or Pb raw materials or, alternatively, that it was added during crystal synthesis in order to modify the colour (Dik et al., 2005).

ANGELINI, I., ARTIOLI, G., BELLINTANI, P., CARDARELLI, A., DIELLA, V., POLLA, A. AND RESIDORI, G., 2002. Project: “Glass materials in the protohistory North Italy”: a first summary. In:

- D'AMICO, C. (Ed.) *Atti II Congresso Nazionale di Archeometria*. Patron Editore, Bologna, 581-595.
- ANGELINI, I., ARTIOLI, G., BELLINTANI, P., DIELLA, V., GEMMI, M., POLLA, A. AND ROSSI, A., 2004. Chemical analyses of Bronze Age glasses from Frattesina di Rovigo, northern Italy. *Journal of Archaeological Science* **31**, 1175-1184.
- ARLETTI, R., MAIORANO, C., FERRARI, D., VEZZALINI, G. AND QUARTIERI, S., 2010. The first archaeometric data on polychrome Iron Age glass from sites located in northern Italy. *Journal of Archaeological Sciences* **37**, 703-712.
- ARLETTI, R., LIVI, L., FERRARI, D. AND VEZZALINI, G., 2011. The Mediterranean Group II: analysis of vessels from Etruscan contexts in northern Italy. *Journal of Archaeological Sciences* **38**, 2094-2100.
- DIK, J., HERMENS, E., PESCHAR, R. AND SCHENK, H., 2005. Early production recipes for lead antimonate yellow in Italian art. *Archaeometry* **47**, 593-607.