RESEARCH



It is not crystal clear: "nuances" in the selection of raw materials for Iron Age translucent glass revealed by chemical analyses of beads from central Italy

Oleh Yatsuk¹ · Leonie Koch² · Lorena Carla Giannossa³ · Annarosa Mangone³ · Giacomo Fiocco^{4,5} · Marco Malagodi^{4,5} · Astrik Gorghinian⁶ · Marco Ferretti⁷ · Patrizia Davit¹ · Alessandro Re⁸ · Alessandro Lo Giudice⁸ · Cristiano Iaia⁹ · Monica Gulmini¹

Received: 31 January 2024 / Accepted: 11 July 2024 © The Author(s) 2024

Abstract

The Iron Age was a period of change, with many innovations in the glass-making technology. The chemical composition of the set of objects considered in the present study demonstrates the diversity of the raw materials used and the depth of knowledge about the manipulation of glass appearance in the eighth-sixth centuries BCE. The study was carried out using fibre optics reflection spectroscopy and portable X-ray fluorescence spectrometry at the museums' premises to examine a large number of glass beads and preliminarily group them on the basis of their composition and spectral characteristics. In addition, a smaller set of selected samples was analysed by laser ablation inductively coupled plasma mass spectrometry to provide a comprehensive chemical characterisation of the material. The compositional data indicated that the samples belonged to the high magnesium and low magnesium glass compositional types. Only one sample was recognised as low magnesium medium potassium glass. Glasses within each group were made from different sands, suggesting different provenances. Some of the samples were suggested to be of local origin, while the others were interpreted as imported glass. Evidence of glass colouring, decolouring and recycling are also discussed.

Keywords Ancient glass · Raw materials · Iron Age · pXRF · LA-ICP-MS

Introduction

One of the first steps in glass making is the selection of the raw materials. In the first half of the first millennium BCE ancient craftspeople could use silica-rich sand or crushed quartz (Moretti and Hreglich 2013; Rehren and Freestone 2015) to make the base of the glass batch, i.e. the mixture

Monica Gulmini monica.gulmini@unito.it

- ¹ Department of Chemistry, University of Turin, Via Giuria, 7 – 10125 Turin, Italy
- ² Institute of Prehistoric Archaeology, University of Cologne, Weyertal 125, 50931 Cologne, Germany
- ³ Department of Chemistry and Laboratorio di Ricerca per la Diagnostica dei Beni Culturali, University of Bari "Aldo Moro", Via Orabona 4, 70126 Bari, Italy
- ⁴ Arvedi Laboratory of Non-Invasive Diagnostics, CISRiC, University of Pavia, Via Bell'Aspa 3, 26100 Cremona, Italy

of raw materials ready to be fused. As it was unattainable for the ancient furnaces to melt pure quartz, certain (usually alkali-rich) materials were used to obtain eutectic systems, which significantly lowered the temperature required to melt the batch (Brill 1963; Henderson 1985; Angelini et al. 2019). These materials are usually referred to as fluxing agents, or simply fluxes.

- ⁵ Department of Musicology and Cultural Heritage, University of Pavia, Corso Garibaldi 178, 26100 Cremona, Italy
- ⁶ National Institute of Nuclear Physics, National Laboratory of Frascati, Via Enrico Fermi 40, 00044 Frascati, Rome, Italy
- ⁷ Italian National Research Council, Institute of Heritage Science, Via Salaria Km 29.300, 00015 Montelibretti, Rome, Italy
- ⁸ Department of Physics, University of Turin and INFN Branch in Turin, Via Giuria, 1 - 10125 Turin, Italy
- ⁹ Department of Historical Studies, University of Turin, Via Sant'Ottavio, 20 – 10124 Turin, Italy