

Analysis of Molded and Coreformed Glass from 1st Millennium BC Gordion, Anatolia

Karen Privat¹, Wendy Reade² and Janet Duncan Jones³

¹. Electron Microscope Unit, The University of New South Wales, Sydney, NSW, Australia

². Centre for Classical and Near Eastern Studies of Australia, The University of Sydney, NSW, Australia

³. Classics Department, Bucknell University, Lewisburg, PA, USA

We report the analysis of glass vessels recovered from 1st millennium BC contexts at the site of Gordion, the ancient capital of the Anatolian Kingdom of Phrygia (in modern day Turkey). The Phrygians (c.8th-7th century BC) were renowned for their metalworking skills and produced vessels in a distinctive “Phrygian” style. While no archaeological evidence has yet been found to support local glassmaking, the presence of a highly-developed metalworking industry coupled with the discovery of colorless glass vessels molded in a typical Phrygian shape at Gordion have opened the question of a local glassmaking or glassworking industry within the kingdom [1]. Due to the significant concentration of molded glass vessels found at Assyrian Nimrud, and because of the well-established political interactions between Phrygia and Assyria, von Saldern has suggested that some vessels reached Gordion from Nimrud as diplomatic gifts [2]. EPMA of molded colorless glass vessels from Gordion was used to investigate vessel provenance and manufacturing techniques. In addition to the Phrygian material, molded colorless glass vessel fragments recovered from later Hellenistic (4th-3rd c. BC) contexts at Gordion were analyzed to examine changes in glassmaking technology and provenance over time.

Analyses were conducted using a JEOL JXA-8500F Hyperprobe (15kV, 15nA, 30µm beam diameter). Calibration was done using Astimex MINM25-53 mineral standards, Corning A&B reference glasses [3] and Glen Spectra RM01 reference glass. Oxide analysis of 13 elements (Na, Mg, Al, Si, P, K, Ca, Ti, Mn, Fe, Co, Cu, Sb) yielded raw totals of 98-100%; analytical error is estimated at < 2% relative for elements > 1% and < 6% relative for low-concentration elements.

All of the Gordion glasses exhibit a typical soda-lime-silica composition. The earlier, Phrygian molded glasses range widely in composition in stark contrast to the Hellenistic glasses, which yield a much more consistent chemical composition. Most of the Phrygian glasses can be categorized as high magnesia/high potash (HMHK), indicating that plant ash was used as a flux in their manufacture. The Hellenistic glasses contain low levels of magnesia and potash (LMLK), and were therefore probably manufactured using a mineral soda as flux. The low alumina content of the Phrygian glasses from Gordion suggests a relatively pure silica source, such as ground quartz pebbles; whereas the Hellenistic glasses have a higher alumina content, indicative of a less pure silica source, such as an alumina-bearing sand. The chemical composition of the Hellenistic glasses from Gordion is indistinguishable from contemporary glasses from Rhodes and Macedonia [3-5], which allows us to say little about probable provenance of the Gordion material, but further reinforces the trend of highly regulated production methods in this later period. When the earlier Phrygian glasses from Gordion are compared to published analyses of near-contemporary molded colorless glass artefacts from Egypt, Jordan and Mesopotamia [6-9], the Gordion glasses do not exhibit a distinctive chemical signature, but cluster closely with glasses from Nimrud and Nesikhons. Viewed as a whole, the stylistic and chemical evidence are not suggestive of a native Phrygian glassmaking industry, but rather support the model of glass importation as finished products or as raw glass to be reworked locally.

With the decline of the Phrygian Kingdom, Gordion was incorporated into the great Achaemenid Empire and subsequently into the Hellenistic empire of Alexander the Great. Remains of coreformed glass vessels dating from the late Phrygian period through the Hellenistic era have been recovered from Gordion. These vessels represent all three established chronological groups of Mediterranean coreformed glass, and extend the distribution of Group I (6th-5th c. BC) and Group II (mid-4th-late 3rd c. BC) into Anatolia. Based on the distribution pattern of Group I Mediterranean coreformed artefacts, the production center(s) for Group I glasses was probably located in the islands of the Aegean or along the coast of Asia Minor, with Rhodes generally considered as a likely production site [10-12]. Group II vessels, characterized by new forms, decorative schemes and colors, are found throughout the Mediterranean basin, with a high concentration of finds in central Italy and Magna Graecia strongly suggesting manufacturing centers in this region [11-12]. Samples of Group I and II coreformed vessels from Gordion were analysed by EPMA in order to investigate the relationship between groups in terms of technology and provenance, and to see if the groups or their sub-classes exhibited distinctive chemical fingerprints.

The Gordion coreformed glasses all exhibited a soda-lime-silica LMLK composition. Group I vessels exhibited higher silica and iron values on average, compared to their Group II counterparts, but the wide spread of the chemical data does not support the use of elemental analysis as a classification tool. When analyses from Group I coreformed glasses from Gordion are compared with those from Georgian and Italian sites [13-15], only very slight differences in composition can be identified. These differences may suggest different manufacturing locations for this vessel type, and not just a Rhodian origin. Only data from Italian Group II glasses are available for comparison with the Gordion Group II samples [14-15]; all Group II glasses exhibit similar compositions. According to the limited data available, no new, previously unidentified region of production can be proposed. We are hopeful that work currently underway involving additional EPMA and LA-ICP-MS analysis of the Gordion material will allow more subtle chemical distinctions related to manufacture and provenance to be identified [16].

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