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On the provenance and manufacture of red-slipped fine ware from ancient Cassope (NW Greece): evidence by X-ray analytical methods

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ABSTRACT

Energy-dispersive X-ray fluorescence spectroscopy was used to characterize red-slipped pottery (2nd–1st century BC) from ancient Cassope, north-western Greece. The compositional data were statistically treated by principal component analysis and chemical groups were established, representing locally produced and imported items. Mineralogical investigation by X-ray diffraction indicated firing temperatures in the range from 850 to 1000 °C for most of the sherds, while one group consisted of over-fired items, possibly in excess of 1050 °C. The morphology and elemental composition of the ceramic bodies and surface slips were examined through scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy. The analyses revealed that different pottery groups exhibit surface slips of different nature, in terms of thickness, degree of vitrification and elemental composition. Overall, the diversity in technological characteristics of the examined sherds is indicative of the socio-economic conditions prevailing in Cassopaea during the late Hellenistic period.

1. Introduction

The application of analytical methods to the study of ancient pottery has proved to be a valuable complement to archaeological investigations, aiming to reconstruct the ceramic life cycle, i.e. to extract provenance information and rediscover manufacture technology and use (Tite, 2008). Provenance is normally assessed by elemental analyses followed by appropriate statistical handling in order to identify ceramic groups of similar chemical profiles and to assign each of the detected groups to a certain production centre. Manufacture technology involves several aspects of pottery-making, such as the type of raw materials used, their processing to prepare the clay paste, the surface treatment, decoration and firing to obtain the finished item. Among a long list of instrumental techniques, X-ray analytical methods, including X-ray fluorescence spectroscopy (XRF), X-ray diffraction (XRD) and scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDX), may successfully address the above issues (Buxeda i Garrigós et al., 2001; Maggetti et al., 1981; Maniatis and Tite, 1981; Mirti et al., 1999; Mirti and Davit, 2001; Padilla et al., 2006; Pillay et al., 2000).

The present work reports on the results of a multi-analytical study of pottery recovered from the archaeological site of Cassope in Epirus, north-western Greece. Compositional data of ancient pottery from Epirus are scarcely available (Papachristodoulou et al., 2006). As part of an ongoing research aiming to develop a databank and establish reference groups for ancient pottery in the region, this study focuses on a set of red-slipped fine ware dating from the 2nd to the end of the 1st century BC. The selected sherds were analysed by energy-dispersive XRF spectroscopy with the goal to distinguish between local and imported products. The mineralogy of the ceramic bodies, as well as the microstructure and chemical composition of the red slip layer were examined by XRD and SEM-EDX spectroscopy, respectively, in order to probe manufacturing skills and choices.

2. Archaeological background

2.1. The archaeological site

Cassope was the political centre of Cassopaei, one of the four most famous tribes of ancient Epirus. Geographically, Cassopaea was delimited to its south by the gulf of Ambracia, to the north by

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Acheron river, to the east by Louros river and to the west by the Ionian sea (Fig. 1). The two river shipping routes gave access to the Adriatic coasts, Italy, the Ionian islands and southern Greece, offering substantial opportunities for trade and exchange of goods. Cassope is probably one of the best-attested examples of the emergence of a *polis* (in the sense of city) by a synoecism of *komai* (country settlements). It was founded around the mid-fourth century BC (Hoepfner et al., 1994), on an extended upland, at an elevation of ~550–560 m, overlooking the coastline of the Ambracian gulf and the Ionian sea. The city had a circuit wall of *ca* 3 km length and was grid-planned according to the Hippodamian system, with 20 parallel streets (4.2 m wide) intersecting with two wider streets (6 m wide) to form ~60 building blocks. It is estimated that around 600 private houses were located inside the walls, while part of the population lived in agricultural land to the south (Dakaris, 1971).

The most flourished period of Cassope was during the times of the Epirote League (234–168 BC) and particularly around the end of the 3rd to the beginning of the 2nd century BC, when Cassopaea broke away from the League and became independent, issuing its own silver coinage and trading with Italy through the Ionian ports and the island of Corfu. The city declined following the conquest of Epirus by the Romans in 167 BC, although it was still inhabited until 31 BC, when its residents were forced to abandon it, in order to settle to the newly-established Nikopolis.

The first excavations on the site were carried out between 1951 and 1955 by the Athens Archaeological Society, under the direction of S. Dakaris. A second campaign, conducted by the University of Ioannina in collaboration with the German Archaeological Institute, started in 1977 and lasted until 1983. During the excavations, large amounts of pottery were recovered and their study shed light to different aspects of the political and socio-economic history of Cassope (Gravani, 1994).

2.2. The ceramic collection

A set of 38 red-slipped potsherds spanning the period from the second quarter of the 2nd to the late 1st century BC was selected for analysis in the present work. The sherds included different parts – such as rims, bases and bodies – of fine tableware, namely *pinakia* (plates) and *skyphoi* (bowls). The archaeological criteria of date, style and fabric provided a classification into local red-slipped (LRS) pottery, eastern sigillata A (ESA) and western terra sigillata (WTS). The LRS pots exhibit a brittle fabric, yellow-reddish to pale brown in colour, coated with a red to brown-red surface slip, poorly-adhering and lacking in brightness. Except for the colour of the slip, the ceramic body and the quality of manufacture are characteristic of the local black-slipped pottery. The production of vessels with a red slip from Cassopean potters was initiated from the second quarter of the 2nd century BC and continued during the 1st century BC (Gravani, 2004). The ESA items possess a fine-grained, hard-textured, homogeneous body, with a colour ranging from pale white to reddish. Although, in general, the surface coatings are poorly preserved, they appear to be deep orange, dark red to brownish red, not particularly lustrous. The macroscopic examination of their typology and manufacture technique indicates that these pots have characteristics common to ESA that was widespread in the eastern Mediterranean at the end of 2nd century BC until the last decade of the 1st century BC (Gravani, 2004). The WTS sherds are imported Roman products, dating to the 1st century BC, and are characterised by a fine-grained reddish body, coated by a shiny, highly vitrified and well-preserved red to brown-red slip (Gravani, 1994).

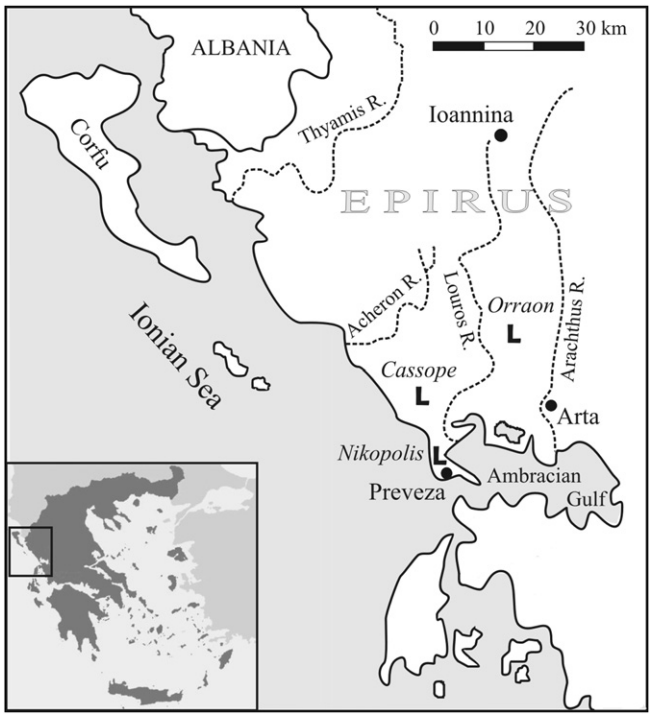

Fig. 1. A map showing the location of Cassope in ancient Epirus.

3. Analytical methods

3.1. Characterization techniques

The major, minor and trace elements composition of the potsherds was determined through a home-built EDXRF spectroscopy assembly, described elsewhere (Papachristodoulou et al., 2006). A small area of each specimen, preferably on broken edges, was scrubbed using diamond polishing pads, until the surface slip or any surface contaminating particles were entirely removed and a clean layer of the ceramic body was exposed. A small piece was subsequently extracted and ground to a fine powder in an agate mortar. Powdered samples were pressed in 12 mm diameter pellets by mixing 300 mg of sample powder with cellulose at a ratio of 10% w/w. Photons emitted from annular radioisotopic ^{109}Cd and ^{241}Am sources were used to excite the characteristic X-rays of potassium (K), calcium (Ca), titanium (Ti), chromium (Cr), manganese (Mn), iron (Fe), zinc (Zn), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), lead (Pb), barium (Ba), lanthanum (La), cerium (Ce) and neodymium (Nd). The WinQxas software package (IAEA – International Atomic Energy Agency, Vienna, Austria) was used for spectral analysis and elemental compositions were assessed with reference to the SOIL-7 certified material provided by IAEA.

X-ray diffraction (XRD) patterns were obtained for representative potsherds using a D8 Advance Brüker diffractometer operating with CuK_α ($\lambda = 1.5406$ Å) radiation and a secondary beam graphite monochromator. Powder samples, obtained as described above, were scanned over an angular 2θ range from 5 to 60°, in steps of 0.02° (2θ) at a rate of 2 s per step.

Fresh-fractured sections of selected sherds were examined through a Jeol JSM 5600 scanning electron microscope and a field-emission scanning electron microscope (SEM, FEI Inspect F) coupled with an EDX spectrometer. Elemental analyses for bodies and slips were obtained by scanning five different areas in each case and using a ZAF correction to account for matrix effects. Measurements were typically run at 20 kV and 10 nA, with overall counting times of 300 s.