Investigation of archaeological amphorae from the Egadi battles

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Abstract. Archaeological ceramics are considered one of the most important sources of both technological and chronological information. Here, the investigation of some archaeological underwater amphorae from the Egadi's Battle, that decided the end of the First Punic War (241 B.C.), is reported. X-ray Diffraction (XRD), X-ray Fluorescence (XRF), petrography, and Thermoluminescence (TL) were used to determine the composition of the amphorae and to evaluate the compatibly of their age with the above Battle. Considering the historical importance of the act and the well-defined historical collocation these amphorae represent an interesting archaeometric case study.

Keywords: Multianalytical approach, amphorae, thermoluminescence, Canaletto Program, underwater site, Egadi battle.

1. Introduction and motivation

As a photograph immortalizes a moment or a memory, in the same way, the seabed of Levanzo island (Italy) has eternalized for centuries the memory of some events distant in time, such as the shipwreck of a cargo ship of the III-II century BC, which took place near Cala Minnola. This is one of the most evocative coves of the island, where at about 27 – 30 m of depth lie the remains of its cargo, amphorae of the Dressel 1B type, Greek – italics, and anchors, as the one of the historical importance of the Naval battle between the Romans and the Carthaginians. This took place on 10 March 241 BC off the bulk of Capo Grosso, the so-called Egadi's Battle [1,2].

Out of a total of 308 amphorae surveyed and mapped, 278 are Greek - Italic amphorae of the MGS V - VI type and only 33 are Punic of the Maltese ovoid type 142. The Greek - Italic amphorae are ceramic containers used for the transport of wine or oil [3]. They generally have a triangular section hem, cylindrical neck, carinated shoulder, tapered ovoid body, flattened rod-shaped handles, and full tip. They have been found in various sites and wrecks, in the Aeolian Islands (Necropolis of Portinenti and the Secca di Capistello di Lipari wreck), Camarina, Ischia, Adria, to name a few. Uncertainties remain about their origin and their center of production since several are located in distant places, whose dating oscillates between the fourth and second centuries BC.

The petrological analyses [4,5], carried out on some ceramic fragments, have shown that the Greco-Italic amphorae found in sites and wrecks of the western Mediterranean belong, in particular, to the MGS V and V / VI type. They possess a mixture with characteristics, from a point of view both geological and artisanal, rather homogeneous and their area of origin seems to be precisely that of Campania. This might be concluded from similarities in the mixture, which have been found between the MGS V and MGS VI amphorae of the necropolis of Portinenti and the wreck of Secca di Capistello

di Lipari and those of Ischia, the latter object of study by Olcese. Yet, there are amphorae of the MGS V and V / VI type that have different mixtures from those of Campania, as has been documented in Camarina and Adria, confirming the presence of productions also in Sicily and in the Adriatic area.

During the Egadi 2011 campaign, two Greek - Italic amphorae of the MGS V type were found, which returned a stamp and a graffito with Punic letters, elements that allowed the archaeologists to hypothesize the use of these amphorae together with the Punic ones for the transport of food from Carthage to Erice. The petrological analysis carried out on the Greek - Italic amphora with Punic graffiti has allowed tracing its possible production area, Campania or Lazio. This highlights the fact that an amphora made in Roman Italy and placed on a ship Carthaginian highlights the complexity of war economies, where the markets and merchants who operate there generally do not reflect the clear geographical segregation promoted by the politics of the war (and often by historians).

It is hypothesized that in the site where the naval battle of the Egadi Islands took place there are approximately more than a thousand amphorae. However, scarcely five hundred have been located. Once they fell into the sea, the amphorae spread over the entire seabed, which helped to outline both the extent of the area in which the battle was fought and the position of the Carthaginian ships compared to the Roman ones. Furthermore, the amphorae proved to be indispensable finds to get an idea of how the battle took place, to have greater knowledge of both the equipment of the soldiers and the disappearance of the ships and to date the site on the basis of their shapes.

For these reasons, the study of the amphorae is important to better deepen the above questions. In this work the study of the composition of some fragments of three amphorae from the Egadi's Battle was performed by means of X-ray Diffraction (XRD), X-ray Fluorescence (XRF), petrography and Thermoluminescence (TL) techniques.

The amphorae of the Egadi battle

Four fragments of Greek - Italic amphorae of the MGS V - VI type (PW12 - 0004, PW12 - 0006 and SI 09 - 0004 (A and B) Figure 1) from the Egadi seabed have been studied in order to determine the composition and age of the ceramic. The fragments PW12 - 0004 and PW12 - 0006 have been identified in the PW - A sector, while S. I. 09 - 0004 (A and B) belong to an amphora, perhaps part of the cargo of a sunken ship not far from the site of the war.

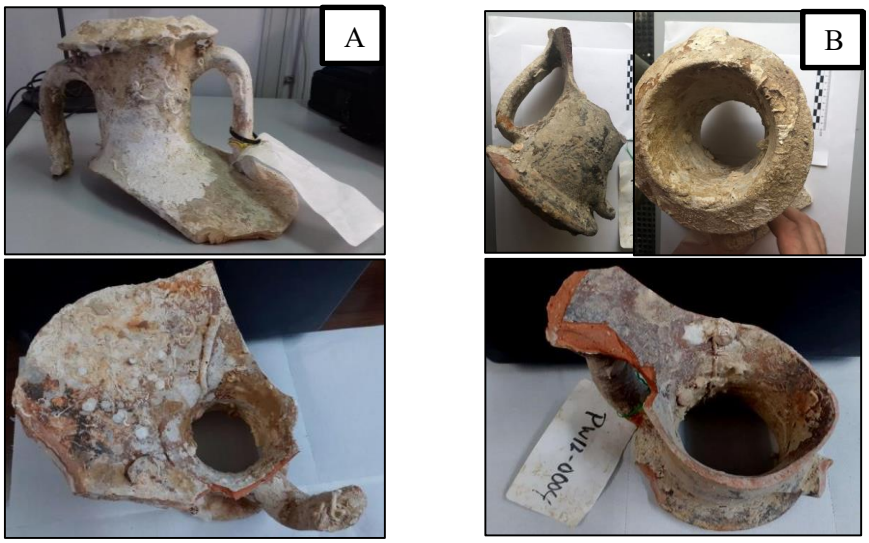

Figure 1. A) Greek - Italic amphorae 1 – INV. SI 09 -0004, Levanzo (Sulfur wreck 2009). h. cm 18.5; d cm 18. Reddish brown clay (Munsell 2.5 Yr 5/8). Part of the hem, neck and loops are preserved. Calcareous concretions entrap shells. B) Greek - Italic amphorae MGS V INV. PW 12-0004 h. cm 17.5; d. cm 17.5. Reddish

brown clay (Munsell 2.5 Yr 5/8). The hem, the neck, one loop and part of the other are preserved. Calcareous concretions entrap shells. Traces of waterproofing are still visible.

The powders collected in several parts of the amphorae thickness (A, B, and C, respectively indicates external, middle, internal part of the total (T) ceramic thickness), after removing the superficial deposition of carbonate encrostations, were analysed by XRF Spectroscopy using a Tracer III – SD Series AXS Bruker spectrometer. The source was a rhodium tube operating at 40 kV and 11 μA. The XRF spectra (Figure 2) showed the main elements (Fe and Ca) and the minor elements (K, Ti, Si, Mn, Ni, Sr, Zr, Rb, Zn, Cr, and Al) all characteristic of clay. Cl and S, also present, are related to the underwater environment where the amphorae where found. The peak profiles are very similar both for the different fragments and between the different parts of the same fragments, indicating that the ceramic paste used for the production of the ceramics is indeed homogeneous.

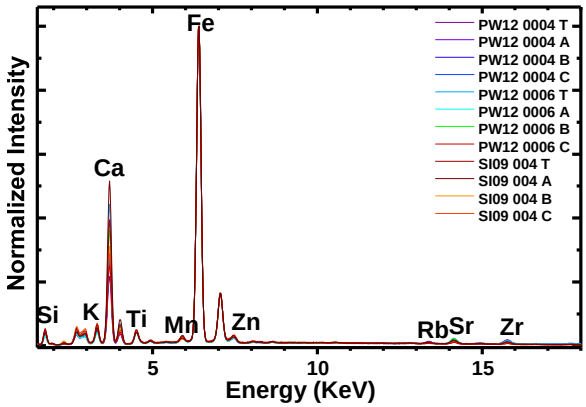

Figure 2. - XRF spectra of the analysed powder (A, B, and C, respectively indicates external, middle, internal part of the total (T) ceramic thickness). Note the similarity of the spectra.

The XRD patterns have been acquired on the same samples by using a Philips PW 1050/39 Bragg–Brentano diffractometer (Cu Ka, λ= 1.54056 Å, 40kV, 30 mA). The XRD patterns of the powders, obtained from samples T (Figure 3) can be mainly described with the reference patterns of quartz (Q), potassium feldspar (K) and calcite (C), whose quantities, evaluated by Rietveld analysis are indicative of the difference in their crystalline composition. In fact, the presence of calcite on all samples SI 09-0004 (0.9%) indicates that the firing temperature was under 850 °C. The amount of quartz on feldspar is similar for all the samples (around Q ≈ 41% K ≈ 59%).

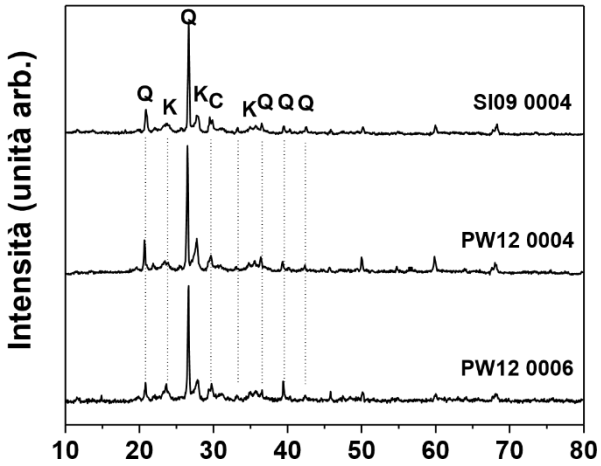

Figure 3. - XRD patterns of powdered samples. Peaks are indexed as below Q = quartz, C = calcite and K = feldspar.

Petrographic analysis was performed on ceramic sherds thin-sections to be observed under a polarizing Leica transmission microscope.

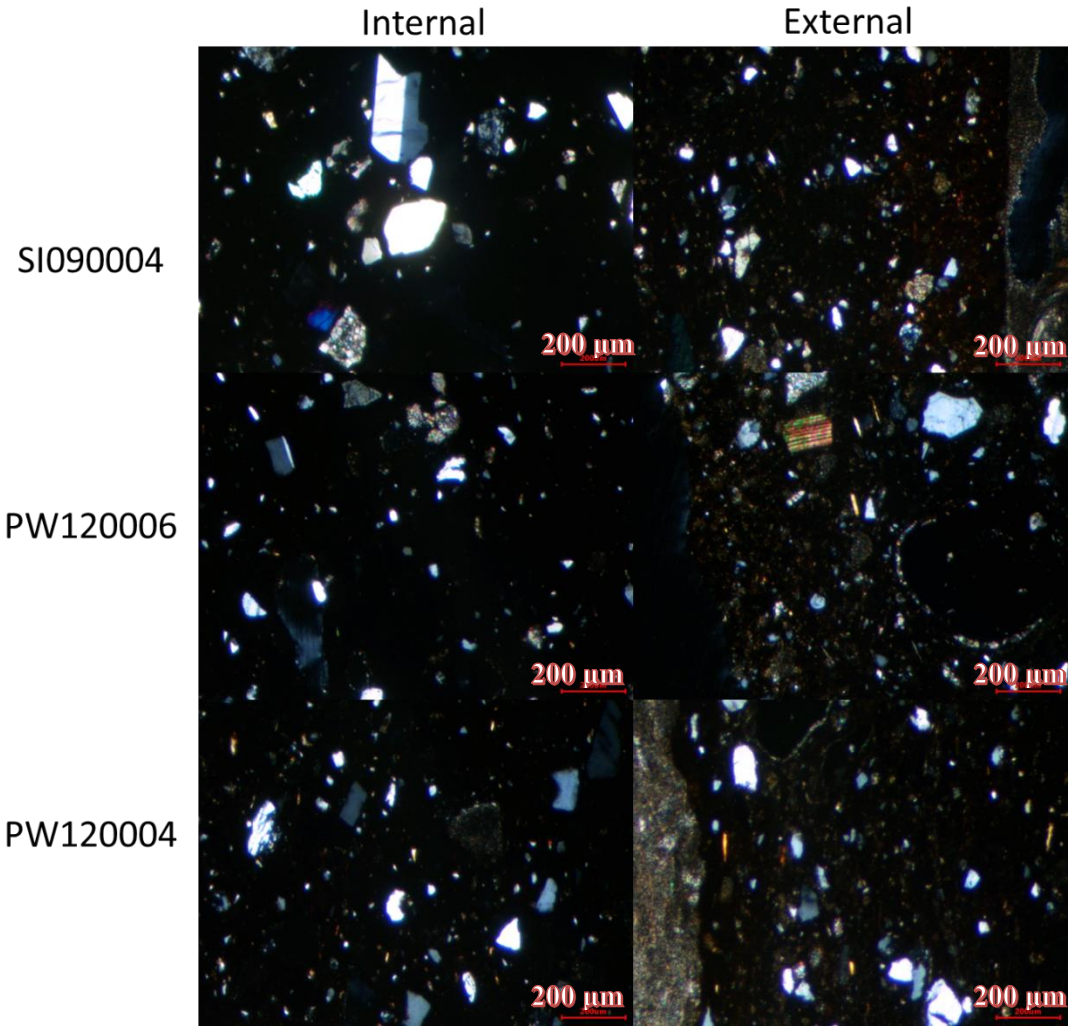

Figure 4. - Thin section microphotographs of internal and external area of the ceramics

(crossed nicols; scale bar = 0.2 mm)

The finest granulometric fraction is composed of fine grained quartz and even rarer tiny mica flakesc together with some volcanic minerals are also present such us sanidine, clinopyroxene and rare biotite. All sections of the external layer show an optically active matrix which is impregnated by a variable quantities of secondary calcite due to partially decomposed bioclastic components during the firing process and subsequently recrystallized in the form of microcrystalline calcite. This indication corroborates the occurrence of not high firing temperature or complete cooking of the external layer respect to the inner. The mineralogical composition is similar to the ones observed by Capelli et al. [5] for amphorae discovered in the same site and assigned to the Tyrrhenian coast between Tuscany and the Gulf of Naples, even if the compositional and textural/technical differences suggest a diverse productions and workshops location.

In order to assess the compatibility of the samples with the presumed age, thermoluminescence investigations have been performed on the quartz extracted by the fine grain method. The experiments were conducted by using the Lexsyg Research Fully Automated TL / OSL Reader instrument from Freiberg Instruments GmbH, using either X-ray tube or a mercury UV lamp operating at 254 nm as the excitation sources, and a 9235QB-type photomultiplier from ET Enterprises as the detector. The investigations have been continued by irradiating with calibrated artificial doses to obtain a calibration curve and extrapolate the archaeological dose. The ratio with the esteemed annual dose provides a compatible dating with the year of the battle.

2. Considerations

The results, part of the Canaletto Program "Multianalytical approach for the dating and authentication of archaeological ceramics" are here presented. The main goal of the project is the development of a multianalitycal protocol for the characterization of underwater archaeological ceramics, allowing to distinguish original and false objects starting from the knowledge of various objects of the same archaeological site. This study not only fits the project objectives but also provides results defining compositional and phases features characterizing the ceramics coming from the Egadi battle site to help archaeologist to better define the site context and the ship cargo provenance. Moreover, thermoluminescence analysis effort clearly defined the place in time of the battle.

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