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## **A physicochemical study of Medieval and Post-Medieval ceramics from the Aegean**

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# **CHAPTER 1 INTRODUCTION**

## **1. INTRODUCTION**

One of the latest growing fields of archaeology is the scientific approaches of artifacts. Hence, this thesis sets out to analyse 245 samples from 3 different excavated sites in Greece in the most modern way. Every archaeological excavation could be thought of as a one-off scientific experiment and data-gathering exercise. This unique character, however, creates a practical and moral requirement to extract the maximum possible information from the generally mundane collection of bones, stone tools, shards of broken pots, corroded metalwork and biological assemblages that constitute the vast bulk of archaeological finds. Given that pottery has always been one of the main fields of study of archaeological material, seen from many different viewpoints (related to art, economy, daily life, ritual practices etc), the application of material analysis in order to investigate compositions and production technologies of archaeological pottery and glazes has been a growing research field during the last decade stemming from the discipline of archaeometry. Despite the increasing interest in archaeological glazed pottery technologies in recent years some glazed pottery types have received scant attention. This thesis is a technical study which gives information about scientific analyses of a large group of pottery samples and aims at filling this gap, to a little proportion at least.

Generally, several arts such as pottery flourished in Greece, ever since antiquity. Although in Byzantine times pottery changed much, both in form and in decoration, from the famous ancient vases, it still had its own special features and sometimes it made use of the same raw materials. Greece is located on the crossroads of three continents and is thus characterized by diversity and contradictions. Throughout its long history, this southernmost peninsula of Europe, with its numerous islands and islets, has been a starting point of voyages as well as a destination of travellers. It has also been the prey of many conquerors or mere assailants, who were attracted by its strategic position, its control of the sea and its mild climate and consequently influences were diverse.

### **1.1 THE MEDIEVAL TO EARLY MODERN ASSEMBLAGES FROM CHALCIS IN EUBOEA, ATHENS IN ATTICA AND MYTILENE IN LESVOS**

Three important Greek centres of ceramic production, namely Chalcis in Euboea, Athens in Attica and Mytilene in Lesvos gained great recognition during the Medieval and Post-Medieval periods. Until now, research activity in these three areas was mainly based on archaeological studies. It was now high time to pair the archaeological evidence and outcomes of research with archaeometric analyses, in order to define “hidden” aspects of construction technology, pottery decoration and provenance. For this reason, 245 fragments were selected in order to be analysed in the most modern way and specifically with Stereoscopy, Optical Microscopy, Petrographic analysis, non-invasive handheld portable X-Ray Fluorescence Spectroscopy (pXRF), Wavelength-dispersive X-Ray Fluorescence Spectroscopy (WDXRF), Scanning Electron Microscopy (SEM/EDS), X-Ray Diffraction (XRD) and Raman Spectroscopy.

The harbours of Chalcis in Euboea, Athens in Attica and Mytilene in Lesbos connected Greece with the East and West (Figure 1). Chalcis was the physical port of call in the Aegean for nearby Thebes (Koder et al. 1976, 156; Triantafyllopoulos 1990, 170; Georgopoulou 2001, 73). During the Middle Byzantine period a new settlement was founded, farther from the ancient one, in order to better control naval communication. It was a densely populated town, a fortified settlement with houses, streets and churches following a typical Medieval pattern whose earlier structures dated to the 9th-11th centuries (Kontogiannis 2012a). The amount and quality of material evidence attest that it was a rather significant provincial centre particularly in the commercial and cultural life of Byzantine Greece.

The Athenian Agora in Attica, on the other hand, was the heart of public life in ancient Athens and the cradle of democracy. It was the place where the Greek civilization was developed, and consequently various pottery manufacturing techniques and decorative motives with cultural influences from other Greek areas and other countries were created. Although after several raids and administrative changes within the Byzantine State, Athens has lost some of its glory and fame, it continued to be an important centre for mainland Greece.

Finally, the island of Lesbos was a regional centre of great importance, both due to its port capacity and to its proximity to West Anatolia (present-day Turkey). In terms of pottery production, this proximity caused it to follow developments which occurred in present-day Turkey, both during Medieval times and after the conquest of large part present-day Turkey shores by Turkish emirates (11<sup>th</sup> century onwards) and the Ottomans (14<sup>th</sup> century onwards). On the other hand, the fact that Lesbos became property of the Gattilusi family, a rich and powerful Genovese clan, led to its receiving influence in its pottery production also from major Italian centres, such as Faenza, Montelupo (Korre-Zografou 1995a).

## 1.2 STATE-OF-THE-ART

During the past decades, the focus of the analysis of Medieval pottery has shifted away from the traditional sphere of dating and style (Morgan 1942; Stevenson 1947; Hayes 1992; Sanders 1995, 2000). What appears to be more crucial are the issues related to provenance and technology production, usually approached through chemical analysis. Interest is converging to networks of production and trade in the eastern Mediterranean (Waagé 1933; Megaw 1968a,b; Megaw and Jones 1983; Megaw et al 2003; White 2009). In this respect glazed pottery yields admittedly interesting data.

Mainstream views tend to support the fact that Byzantine glazing technology was based on the use of lead and specific pigments' recipes and that it remained unaltered from the 7th to the 13th/14th centuries AD (Dark 2001, p. 87; Armstrong et al. 1997, p. 229). However, this view was based on just a limited number of samples coming from a widespread geographical range (Armstrong et al. 1997; Maguire 1997). Nowadays researchers have started to realize the need for deepening their understanding of the glazing technologies of the Medieval world. For instance, Harriet E. White in 2009 studied 'An Investigation of Production Technologies of Byzantine Glazed Pottery from Corinth, Greece in the 11th to 13th centuries'; Carmen Ting in 2021 'The origins and evolution of Cypriot glazed ware productions during the 13th to 17th centuries CE'; Florence Liard et al. in

2019 ‘The production of lead glazed tablewares in late medieval Italy and their exportation to Latin Greece: New considerations on 14th-century contexts from Corinth, Peloponnese’; and Elena Salinas et al. in 2019 ‘Polychrome glazed ceramics in al-Andalus (9th-12th centuries): methods of production and materials’.

The literature has been enriched recently about Chalcis in Euboea, the Athenian Agora in Athens and Mytilene in Lesvos during the Medieval and Early Modern periods. Specifically, concerning Chalcis, Nikos Kontogiannis in 2012 described the chronological sequence of phases of Euripos – Negroponte – Eġriboz as well as the material culture and historical topography of Chalcis from Byzantium to the end of the Ottoman rule. Yona Waksman presented the experimental results about the main ‘Middle Byzantine Production’<sup>1</sup> and pottery manufacture in Thebes and Chalcis in 2014. In 2017 Stefania Skartzis and Giannis Vaxevanis published another very important article about Chalcis in the Middle Byzantine period and the Age of Latinocracy<sup>2</sup> based on the testimony of ceramics (9th-15th c.). Finally, in 2021 Joanita Vroom, Elli Tzavella and Giannis Vaxevanis published their article *Exploring Daily Life in the Byzantine Empire: Pottery from Chalcis (Euboea, Greece), ca. 10th/11th-13th c.*

With regard to Athens, Alison Frantz presented the Middle Byzantine Pottery from the Agora in 1938 and the Ottoman Pottery from the same site in 1942. John McK. Camp published the book ‘The Athenian Agora: A Short Guide to the excavations’ in 2003. Furthermore, John McK. Camp and Craig A. Mauzy published the book ‘The Athenian Agora- New Perspectives on an ancient site’ in 2009. Camilla MacKay published the article ‘Three Late Medieval Kilns from the Athenian Agora’ in 2015 and finally, in 2019 Joanita Vroom published the article ‘Broken Pots from Ottoman Athens: A New View from the Agora Excavations’. At present, Yona Waksman has studied Byzantine and Ottoman pottery from the Athenian Agora in Attica but the results are still unpublished.

As far as Mytilene in Lesvos is concerned, Caroline Williams and Hector Williams presented the excavations’ results and the finds that were rescued from them in 1986 and 2000. In addition, in another publication in 2009, Hector Williams presented the Medieval and Ottoman Mytilene and he described the building phases of the castle. Finally, in 1998, Mimika Giannopoulou and Stella Demesticha published the book ‘Tskalaria Pottery Kilns in Mantamado in Lesvos’ in which the traditional pottery kilns of the island and the local traditional way that the potters manufactured the ceramics were presented, following a long field work period organized by the Centre for the Study of Modern Pottery.

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<sup>1</sup> Towards the end of the Middle Byzantine period, one may notice the emergence of new glazed pottery types in the local ceramic repertoire of the city. The majority of these wares appear to have been locally made as part of a large-scale production, which were grouped together in the so-called ‘main Middle Byzantine Production (MBP)’. The pottery types manufactured in Chalcis included ‘Slip-Painted Ware’, ‘Green and Brown Painted Ware’, ‘Fine Sgraffito Ware’, ‘Painted Fine Sgraffito Ware’, ‘Incised Sgraffito Ware’, and ‘Champlevé Ware’ (Vroom 2003, 2014; Vaxevanis 2007; Waksman and Wartburg 2006; Waksman et al. 2014).

<sup>2</sup> The Latinocracy (Latinokratia also known as Frankokratia and, for the Venetian domains, Venetokratia or Enetokratia) was the period in Greek history after the Fourth Crusade (1204), when a number of primarily French and Italian states were established by the *Partitio terrarum imperii Romaniae* on the territory of the subjugated Byzantine Empire.

### 1.3 AIM AND SCOPE OF THE THESIS

The present research project aims at investigating the impact of potters on pottery innovation and specifically on the production, distribution and diffusion of technology in the Aegean due to socio-political, cultural and economic phenomena in Mediterranean. This main focus is on the pottery production of Medieval to early Modern pottery from three excavated contents from Chalcis in Euboea, the Athenian Agora in Attica and the Castle of Mytilene in Lesvos Island. Ceramic assemblages from these key sites and specifically 245 fragments were selected applying analytical methods in the most modern way as Stereoscopy, Optical Microscopy, Petrographic analysis, non-invasive handheld portable X-Ray Fluorescence Spectroscopy (pXRF), Wavelength-dispersive X-Ray Fluorescence Spectroscopy (WDXRF), Scanning Electron Microscopy (SEM/EDS), X-Ray Diffraction (XRD) and Raman Spectroscopy.

The abundance of ceramic fragments discovered in and around the kilns at Chalcis in Euboea, the Athenian Agora in Attica, and Mytilene in Lesvos during these periods indicate to their prominence as major ceramic production centers. These regions served as major trading hubs, making it easy to study both domestic and imported ceramic production as well as potential ceramic imitations. Furthermore, glazed pottery from the Medieval to Post-Medieval periods received little attention from archaeologists and other professionals who focused mostly on ceramics from antiquity. For this reason, I conducted a thorough physicochemical analysis on the various ceramic typologies in order to ascertain whether these products were locally made, or were imported, or even were copied after of well-known pottery collections. The ceramic material in the studied areas will represent a reference point for the time span of several centuries as a cultural indicator that will allow us to understand the level of technical and technological knowledge acquired by local and other craftsmen from other regions in these periods. This experimental approach establishes a detailed methodology for the investigation of the range of information acquired through analyzing and characterizing glazed ceramics. This research as pilot application of provenance and technology construction of glaze pottery could serve as a stepping stone for future studies leading to the development and enrichment of an analytical database for glaze assemblages in the future.

The thesis attempts to investigate the Medieval glazed pottery techniques and their development through time at the three aforementioned sites. This can be achieved through multiple sampling of 245 glazed pottery sherds from three well known production centres while applying an integrated analytical methodology that takes into account compositional data of both ceramic bodies and their glazes. In order to identify the source of the clayey materials used for ceramic productions as well as the pottery technology in these areas and outline their compositional variability, an integrated approach is used, in which geology (i.e. mineralogy, petrography), archaeometry, archaeology and ethnography are involved. The examination of the diversity of these pottery finds is pivotal, because this can illustrate ceramic links between the eastern and western parts of the Aegean as well as ceramics links with other pottery workshops in the West (such as Maiolica from Italy) and in the East (such as Çanakkale, Iznik and Kütahya). The goal is to recognize the artistic elements and the technical and functional values of this past world leading to the acquisition of more precise information regarding the provenance of pottery types, which have been found in the Aegean. As such, the purpose of this PhD thesis is to study technological practices, the network of production centres and transitional social and political changes (such as the historical shift from the Byzantine to the Ottoman Empire and the Frankish/Venetian/Catalan interim in some areas). In addition, it

is very important to know about production sites, organization and distribution patterns, or the way these features may have changed through influences of other civilizations, such as the Frankish, Venetian and Ottoman cultures. Hence, the idea to connect all these items into a referencing archaeometric framework of the Medieval period would be a very innovative point of archaeological research in the broader region of the Aegean.

The choice of these three regions was not random: naturally, the existence of Byzantine, Frankish/Venetian and Ottoman sherds was a crucial factor. Even more important was the fact that the respective archaeological authorities were positively inclined towards archaeological science (archaeometry) and willing to cede samples for this research. Last, but not least, was the geographic location: Mytilene lies on the eastern shore of Lesbos, in proximity to major centres, such as Constantinople (Istanbul) and Iznik (for the Late Byzantine and Early Ottoman period) and later Kütahya, Çanakkale in present-day Turkey. Despite the fact, however, that it lays to the east, for a considerable part of its history it was closely connected to the West as well, particularly to Italy. Athens, on the other hand, was a traditional centre of pottery production, relying, apparently, more on its local traditions; yet, its history was turbulent, it underwent destructions and raids and it also remained under alien occupation (Franks, Catalans, Venetians) for larger periods of time, before its final subjugation to the Ottoman Empire in 1458. Chalcis, finally, was a major port controlling the Gulf of Evripos and part of the naval trade between East and West. Politically, it followed more or less the fate of Athens rather than that of Lesbos, yet it also had a long pottery production history which may have affected its yielding in the Medieval and Early Modern periods as well.

#### **1.4 RESEARCH GOALS AND QUESTIONS**

The thesis sets out to expand our knowledge on Medieval to Post-Medieval and Islamic glazing technologies and to explore questions of technological transfer by presenting new analytical data of Medieval glazes from pottery manufactured within and imported into the Aegean during the Medieval to Modern periods through the study of 245 samples from 3 different excavated sites in Greece in the most modern way.

- (1) Groups of glazes, slips, fabrics based on the chemical composition of 245 samples in order to investigate possible differences that can indicate production practices.
- (2) Pigments' recipes based on the chemical composition of the samples in order to investigate possible differences between the pottery types or production practices.
- (3) Petrographic groups based on mineralogical composition of ceramic bodies in order to investigate their manufacture technology (raw materials, inclusions, forming, firing).
- (4) Mineralogical correlation between petrographic groups and geological maps as well as archaeological assumptions in order to define the geological provenance of the samples, which can be an indicator for the workshop provenance.
- (5) Petrographic and chemical relations with groups of Medieval and Post-Medieval pottery in order to discern possible differences in production technology and origins of the primary material (geological provenance of pigments and soils), which can help clarify the workshops.

The main and sub group of questions will be the following:

**Main questions:**

- \* Is it possible to verify the local manufacture of specific pottery categories and to identify imported non-local pottery categories based upon chemical and petrographic characteristics of the fabrics of 245 samples from three sites?
- \* Which are the differences among the three sites concerning pottery manufacturing technology particularly in view of glazes, taking into account imported pottery wares and potential technology transfer?
- \* Which information can be extracted in terms of recipes for specific glaze pigments, unveiling practices for mixtures of pigments in order to achieve particular colour shades?

**Sub-questions:**

- \* Which are the technological developments, for example in terms of raw material selection, from the Medieval to the Early Modern periods in each region?
- \* How was the ceramic body prepared before painting took place in the pottery workshops under study?
- \* Which are the technical developments in terms of decoration evolving through these Byzantine workshops?
- \* Up to which extent valuable and probably imported pigments were used for decoration recipes of the studied samples?
- \* How was the local pottery-making influenced by techniques of imported ceramic manufacture and motifs from East and West?
- \* Regarding the Ethnographic research, to what extent the potters of the 20th century follow the same practises for the construction of pottery?
- \* Do the potters of the 20th century use the same raw materials as those from the Medieval to Post-Medieval times?

Furthermore, the technological characterization and definition of possible production areas/centres would lead further into a contextualization of the ceramics in terms of trading routes and distribution. One of the central questions is undoubtedly the influence of Byzantine and Ottoman technological standards in the Aegean.

## **1.5 SCIENTIFIC ANALYSES**

The amount and quality of material evidence show that the aforementioned three centres were of a certain standing both in the pottery production and in the cultural life of Medieval Greece. The selection of these specific sites is that all three are considered to have been important production centres of pottery, located on the west (Chalcis in Euboea, Athens in Attica) and east (Mytilene in Lesbos) coasts of the Aegean. Therefore, an analytical methodology for 245 samples from 3 different excavated sites in Greece was selected to optimize the range and depth of information

that could be obtained from the glazed ceramics with the use the most modern scientific analysis and specifically Stereoscopy, Optical Microscopy, Petrographic analysis, non-invasive handheld portable X-Ray Fluorescence Spectroscopy (pXRF), Wavelength-dispersive X-Ray Fluorescence Spectroscopy (WDXRF), Scanning Electron Microscopy (SEM/EDS), X-Ray Diffraction (XRD) and Raman Spectroscopy (Figure 2). Using a combination of chemical analysis (XRF, SEM/EDS, XRD) and ceramic petrography fabric groups were investigated in order to establish which fabrics were produced at these three sites and which were imported, and make observations concerning ceramic technological practices. Finally, the glazes and the pigments were chemically characterized using pXRF, SEM/EDS, XRD and Raman Spectroscopy.

The collections of sherds and pottery from these three areas attest to some impact from pottery workshops in the West (such as Maiolica from Italy), as well as from pottery workshops in the East (such as Iznik and Kütahya in Western Turkey (Frantz 1938; 1942; Vroom 2003; 2005; 2014: 80-87, pp. 90-93; 2019; Waksman and Wartburg 2006; Waksman et al. 2014; Williams 2009; Skartsi and Vaxevanis 2017). The Frankish and Ottoman occupation periods may have changed the course of cultural development, but not entirely. Hence, in spite of all the technological advancements, the Byzantine substratum of local pottery in these three centres remains evident. It is important, however, to decide the level up to which the Byzantine substratum of local pottery was maintained. The examination of the distribution of decoration and technical knowledge of the pottery finds is pivotal, because this can illustrate cultural links between the eastern (Byzantium, the Aegean, Christian and Islamic Syria) and western parts of the Mediterranean (e.g., Italy, southern Spain). These three important commercial hubs were very important due to their geographic location and historical trajectory, they were also prominent actors in Aegean maritime commerce, prone to influences from the large centres of Europe and Western Turkey (Asia Minor) respectively, both on the political and social and on the cultural level. Furthermore, they related to the major maritime trade routes across the Mediterranean.

## 1.6 STRUCTURE OF THE THESIS

The background chapters of this thesis are structured in a way which best draws together the paramount information on which this research relies, and moves from a general to a site-specific level.

**Chapter 1** briefly presents an introduction of the three understudy areas and specifically Chalcis in Euboea, Athens in Attica and Mytilene in Lesvos; the present situation; aim and scope of the thesis; research goals and questions and the scientific analyses.

**Chapter 2** provides a historical overview of the three important locations of pottery production in detail and specifically Chalcis in Euboea, Athens in Attica and Mytilene in Lesvos from the Medieval to the Early Modern periods, and presents the physical evidence for glazed pottery manufacture during these periods. Also, types of kilns in the Medieval and Post-Medieval Times are presented. The amount and quality of material evidence show that these three centres were of a certain standing both in the pottery production and in the cultural life of Medieval Greece. Furthermore, they were important commercial hubs, related to the major maritime trade routes across the Mediterranean.

**Chapter 3** presents a statistic analysis of the archaeological data. In this chapter, I relied on statistical methods in order to collect the archaeological data, take decisions based on these data and make predictions in order to employ the correct analyses and effectively present the results in the following chapters. For this reason, in the following lines I will present the archaeological results extracted by the collection, organization, analysis and interpretation of archaeological data.

**Chapter 4** lets us know about the Ethnography of each region and brings together previous research on raw material resources for pottery manufacture in the locality. In this chapter, ethnography allowed me to gain a deep understanding of these artifacts culture, social dynamics and cultural differences of the potters from the three studied areas. Finally, I will compare the ethnographic data with the archaeometric data in order to enrich my knowledge about the provenance and the technology construction of the raw materials in the three studied areas.

**Chapter 5** deals with the chronology and the typology of the studied pottery. My desire to investigate the typology of the 245 ceramics produced locally in Chalcis in Euboea, in the Athenian Agora in Attica, in Mytilene in Lesvos came out of the need for more scientific study of ceramics from excavations in these sites. I studied the typology of the ceramics deeply in order to carry out a comprehensive physicochemical study in the next chapters, with the intention of determining whether such production was sufficiently identified in order to be defined "local or imported production" and at the same time to ascertain the existence of local characteristics, exclusive to certain territories.

**Chapter 6** defines the ceramic glazes, the pigments and the clay vitrification. I tried to explore and express the potters' visions, aesthetic perception and even intuition and subsequently I tried to determine the pigments and all the hues that were created by them by physicochemical analysis. For this reason, in this chapter, I describe the chemistry but also the chemical reaction of the glazes, the decoration techniques of pottery, firing, fluxes and clay.

Specifically, **Chapter 7** presents the X-Ray Fluorescence analysis. Firstly, pXRF was very important to examine up to which extent the archaeological typology and fabric classification could be linked to grouping according to chemical composition. For this reason, it was applied at all the 245 samples from the three studied archaeological regions. Secondly, pXRF analysis was applied in some selected glazes in order to create a glaze grouping for lead and alkali glazes also. At the same time a considerable number of pigments was analyzed. Furthermore, 76 ceramic body samples were selected and measured using X-Ray Fluorescence Spectroscopy (WDXRF). Apart from major and minor element concentrations, WDXRF sufficient sensitivity for determining the concentrations of a considerable series of trace elements with high energy resolution in order to investigate the provenance of the studied samples.

**Chapter 8** presents an introductory overview on the prevailing geological formations that make up the three areas where the studied ceramic material comes from, namely Attica, central Euboea (Lilas river plain) and eastern Lesvos is given in the following paragraphs. The chapter aims at providing a minimum adequate petrologic and geomorphologic background of the three geographic provinces, considered potentially useful for associations between indigenous clays (or relevant facies) deriving after natural processes from the background formations, and ceramic

production in the above areas by exploiting the locally available clay-forming siliceous and argillaceous raw materials. Finally, at all of the 245 samples were studied under the microscope and also at thin sections of 30 ceramic samples were applied petrographic analysis. The combination of Optical Microscopy (OM) and ceramic petrography made it possible to define fabric groups, establish which fabrics were produced at these regions and which were imported, and make observations concerning ceramic technological practices.

**Chapter 9** presents the X-Ray Diffraction (XRD) analysis. X-ray Diffraction provided qualitative analysis of the chemical compounds through the study of the ceramics crystalline structure as well as the firing temperature of the ceramic materials. XRD was used for the characterization of the mineral content of ceramic materials and to investigate inclusions, as well as the matrix. 90 bulk samples of the 245 samples were analysed and the obtained results were compared to the ones revealed through the petrographic study (OM) and the microtextural analysis (SEM).

**Chapter 10** the Scanning Electron Microscopy. SEM-EDS was used to investigate the microstructures of 119 fresh fractured samples and 66 polished sections of those fragments in more detail. With this method, the stratigraphic structure of the layers, the distribution of inclusions and colourants and the elemental composition of the ceramics were investigated. Thus, SEM combined with EDS provided supplemental information for identifying the raw material sources and the techniques used for the surface coatings of ceramics such as slip, paints and glazes. The SEM study of the microstructure of archaeological ceramic provided reliable data for assessing the firing conditions, in terms of firing temperature and the atmosphere, which were applied in the ceramic kiln. The obtained results were then compared to those provided by Optical Microscopy (OM) and the mineralogical analysis (XRPD) in order to describe in detail, the technological aspect of the ancient ceramic manufacture. In addition, glazes were chemically characterized using non-invasive handheld portable X-Ray Fluorescence Spectroscopy (pXRF) in combination with Scanning Electron Microscopy (SEM-EDS) analysis of the glazes enabled more detailed investigations of their manufacture.

**Chapter 11** the Raman Spectroscopy analysis. Micro-Raman spectroscopy was here applied for the study of ceramic pigments showing different features and technological background. Especially, the Raman scattering measurements were performed at the surface of painted ceramics in order to analyze existing pigments. Infrared spectroscopy yielded complementary information in combination with X-Ray Fluorescence Spectroscopy (pXRF) and Scanning Electron Microscopy (SEM-EDS).

The **Chapter 12** presents a discussion of the results of the main groups of pottery identified from the petrographic and chemical analysis, according to these chronological ranges and **Chapter 13** gives the conclusions of the study and presents considerations for future research.



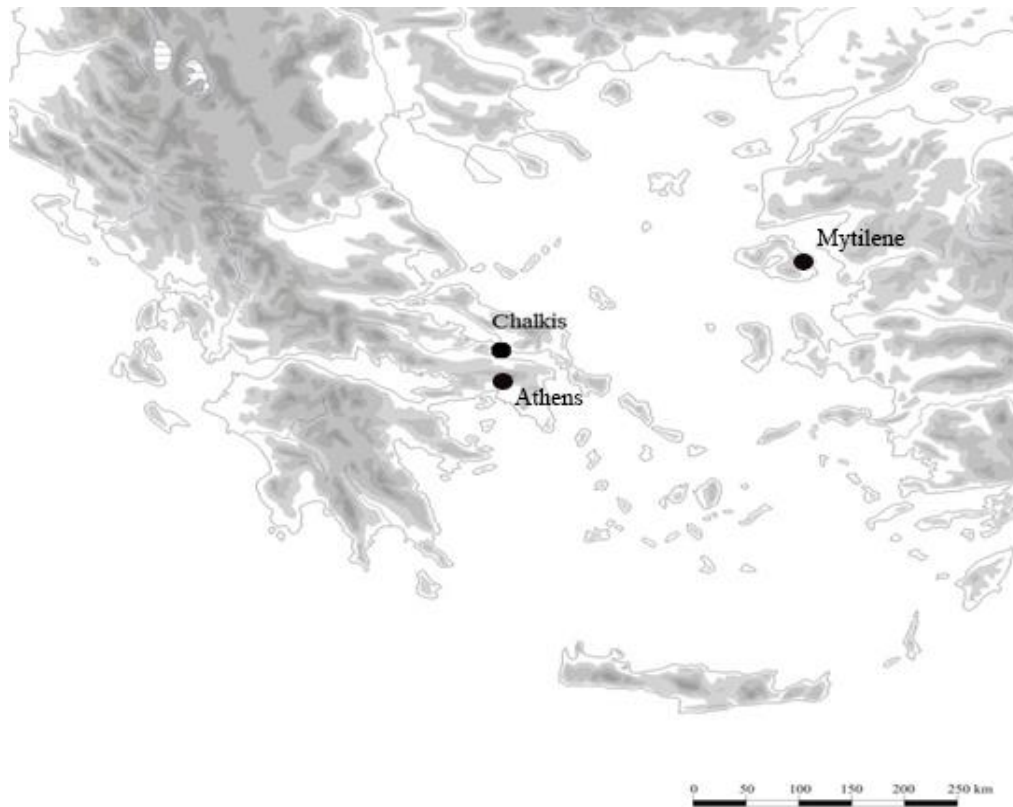


Figure 1 Map showing Chalkis in Euboea, Athens in Attica and Mytilene in Lesvos in Greece.

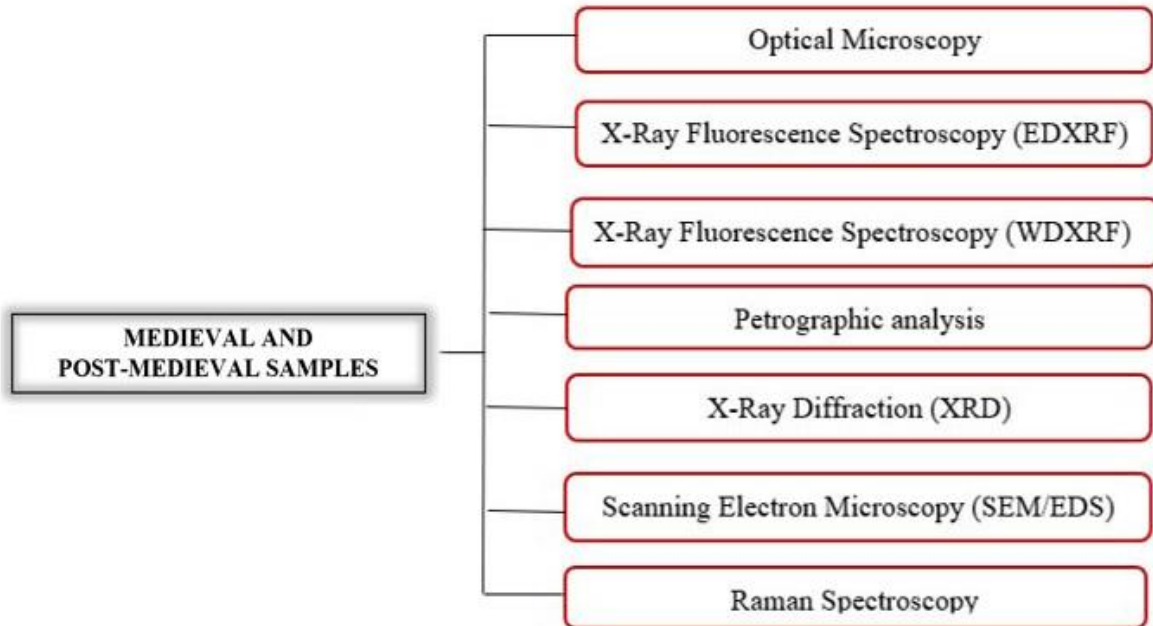


Figure 2 Flow chart that illustrates the order of the research methods as carried out in this thesis.