The Role of Kin Relations and Residential Mobility

During the Transition from Final Neolithic to Early Bronze Age

in Attica, Greece

by

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A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

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ARIZONA STATE UNIVERSITY

August 2015

ABSTRACT

This dissertation addresses the role of kinship and residential mobility during the transition from Final Neolithic to Early Bronze Age (ca. 3500 – 2500 BC) in Attica, Greece. It examines descent systems, ancestor formation, and the interplay between biological, social, and spatial structure in mortuary practices. It also evaluates the nature and degree of residential mobility and its potential role in the formation and maintenance of social networks. Archaeological hypotheses on the kin-based structure of formal cemeteries, the familial use of collective tombs, marriage practices and mate exchange, and relocation were tested focusing on the Early Helladic cemetery of Tsepi at Marathon. Tsepi constitutes the earliest formally organized cemetery on the Greek mainland and it has also contributed to enduring debates over the nature of the interaction between the eastern Attic coast and the central Aegean islands.

This study integrates osteological, biogeochemical, and archaeological data. Inherited dental and cranial features were used to examine biological relatedness and postmarital residence (biodistance analysis). Biochemical analysis of archaeological and modern samples was conducted to examine the geographic origins of the individuals buried in the cemetery and reconstruct mobility patterns. Osteological and biogeochemical data were interpreted in conjunction with archaeological and ethnographic/ethnohistoric data.

The results generally supported a relationship between spatial organization and biological relatedness based on phenotypic similarity at Tsepi. Postmarital residence analysis showed exogamous practices and tentatively supported higher male than female mobility. This practice, along with dietary inferences, could also be suggestive of maritime activities. Biogeochemical analysis showed a local character for the cemetery sample (96%). The common provenance of the three non-local individuals might reflect a link between Tsepi and a single locale. Burial location was not determined by provenance or solely by biological relatedness. Overall, the results point towards more nuanced reconstructions of mobility in prehistoric Aegean and suggest that burial location depended on a complex set of inter-individual relationships and collective identities. The contextualized bioarchaeological approach applied in this study added to the anthropological investigations of social practices such as kin relations (e.g., biological, marital, social kinship) and residential relocation as diachronic mechanisms of integration, adaptation, or differentiation.

DEDICATION

To My Family

ACKNOWLEDGMENTS

I would like to begin by wholeheartedly thanking my committee: Kelly Knudson for opening the magical world of isotopes, Chris Stojanowski for making me statistically significant, Jerry Rutter for generously and patiently sharing his Aegean wisdom. Sherry Fox has supported me from the very beginning, when by opening the door to the Wiener Lab, she literally opened the door to a whole new existence. There are no words to thank my chair, Jane Buikstra, not only for taking a chance on me, but also for her steady and enduring support. None of this would have happened without her. I would like to also thank Steve Falconer for his help with the dissertation proposal, and I am grateful to my undergraduate mentor Michael Fotiadis and to Nikos Efstratiou for believing in me.

This multifaceted project has been supported by much generous funding: a National Science Foundation Doctoral Dissertation Improvement Grant (BCS-1362025), the J. L. Angel Fellowship in Human Skeletal Studies granted by the Wiener Laboratory of the American School of Classical Studies at Athens (ASCSA), the Ione Mylonas-Shear Advanced Fellowship granted by the ASCSA, a JumpStart Research Grant and a Graduate Research Support Program by the Graduate and Professional Student Association at Arizona State University (ASU), a Research Grant from the School of Human Evolution and Social Change (SHESC), ASU, and a SHESC Doctoral Dissertation Completion Fellowship. The Institute for Aegean Prehistory Publication Team Grant for conservation was crucial to data collection, and I want to thank especially Tom Brogan for his help, as well as Zoe Chalatsi and Stefania Chlouveraki. I also want to thank Michel Roggenbucke and the many volunteer students at the University of Athens as well as Giota Gkioni at the Ephorate of Paleoanthropology and Speleology.

I would like to thank Maria Pantelidou-Gofas for granting permission to study the Tsepi remains. For the repatriation of the Tsepi material, I owe gratitude to Maria Teschler-Nicola and the Vienna Natural History Museum, Anastasia Papathanasiou and the Ephorate of Paleoanthropology and Speleology, Anastasia Rammou and the Directorate for the Management of the National Archive of Monuments, Documentation, and Protection of Cultural Goods, and Christos Koutsothanasis and the Ephorate of Antiquities of Eastern Attica (former 2nd). I sincerely thank the Ephorate of Antiquities of Eastern Attica for a truly wonderful collaboration, especially E. Mpanou, L. Siskou, A. Moraitou, E. Charitaki, M. Sklavos, E. Marneri, and the amazing staff of the Marathon Archaeological Museum with special thanks to G. Kleftakis. I am grateful to the General Directorate of Restoration, Museums and Technical Works and the General Directorate of Antiquities and Cultural Heritage for their help and permission to conduct biogeochemical analyses. I want to thank Maria Stathi for granting permission to study the skeletal remains from Loutsa and the Smithsonian Institution for the permission to study and sample the Cheliotomylos collection. For Cheliotomylos, I owe special thanks to Guy Sanders, Ioulia Tzonou-Herbst, and Dave Hunt. I am grateful for the help of Gwyn Gordon and the W.M. Keck Lab Foundation Laboratory for Environmental Biogeochemistry (ASU) group. Thanks are due to Jim Wright, Jack Davis, and Margie Miles, my Wiener Lab colleagues, and the ASCSA community and staff. Finally, I owe thanks to the Hellenic Hunters Confederation and particularly to all the individual hunters, guards, and local hunting clubs who contributed to the sampling process.

I am deeply grateful to all the people who stood by me in this journey and contributed to this long-lasting task. It is their support that made it all possible.

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CHAPTER 1

INTRODUCTION

The Early Bronze Age (EBA) in the southern Aegean (Greece) (ca. 3100/3000-2050 B.C.) is characterized by major social, political, and economic changes resulting in the formation of small-scale, pre-state complex societies in a number of regions (e.g., Broodbank, 2000; Davis, 2001; Pullen, 1994a,b, 2003a; Renfrew, 1972; Rutter, 2001; Wiencke, 1989). On the Greek mainland, this has been argued to represent the most complex sociopolitical organization until the formation of the Late Bronze Age (Mycenaean) state-level societies (ca. 1650-1100 BC) (Forsén, 2010; Foster and Laffineur, 2003; Häag and Konsola, 1986; Pullen, 2008).

During the early EBA the emergence of formally organized cemeteries with communal tombs on the Greek mainland has been interpreted as an indication of local, competing corporate groups, kin group identity, and lineal transmission of property (e.g., Cultraro, 2007; Pullen, 1985, 1994a). However, the kin-based structure of EBA cemeteries and the family use of graves have never been empirically demonstrated. Recent archaeological excavations of Early Helladic cemeteries in Attica and surrounding regions suggest a complex picture of ritual activities associated with mortuary practices. Furthermore, despite the emphasis placed on the role of the intensified maritime exchanges between the mainland and the Cycladic islands for the development of hierarchical social relations and identity formation, the critically important roles of mate selection and postmarital residence have never been directly addressed.

This study focuses upon the Early Helladic cemetery of Tsepi at Marathon in Attica, due to the following factors (Fig. 1.1). First, this cemetery constitutes the earliest example of formal spatial organization on the Greek mainland, and it is one of the most formally structured cemeteries of any time period in Aegean prehistory. In particular, archaeologists have linked space allocation, uniform grave construction, and communal burial at Tsepi to families and stable kin groups (Pullen, 1994a; Marinatos, 1970a,b; Pantelidou-Gofas, 2005a; Weiberg, 2007). Secondly, the strong Cycladic influences on artifact and grave styles at Tsepi, along with the location of the cemetery at the geographic interface between the eastern Greek mainland and the Cycladic islands, have contributed to long-lasting debates on the nature of EBA coastal mainland-island interaction, including the traditional view that the former was colonized by Cycladic islanders and/or had a privileged relationship with the Cyclades (Marinatos, 1970a).

This research integrates osteological, biogeochemical, and archaeological data. Osteological information is used to examine biological affinity within graves and within grave groups, as well as postmarital residence. Biogeochemical data are used to reconstruct the geographic origins of individuals buried in the cemetery and to investigate residential mobility and migration at Tsepi. Osteological and biogeochemical data are interpreted in conjunction with published archaeological data (i.e., grave construction, grave goods) (Pantelidou-Gofas, 2005a). Ethnographic and ethnohistoric information is used to contextualize the current study within Greece's broader spatial and temporal frameworks.

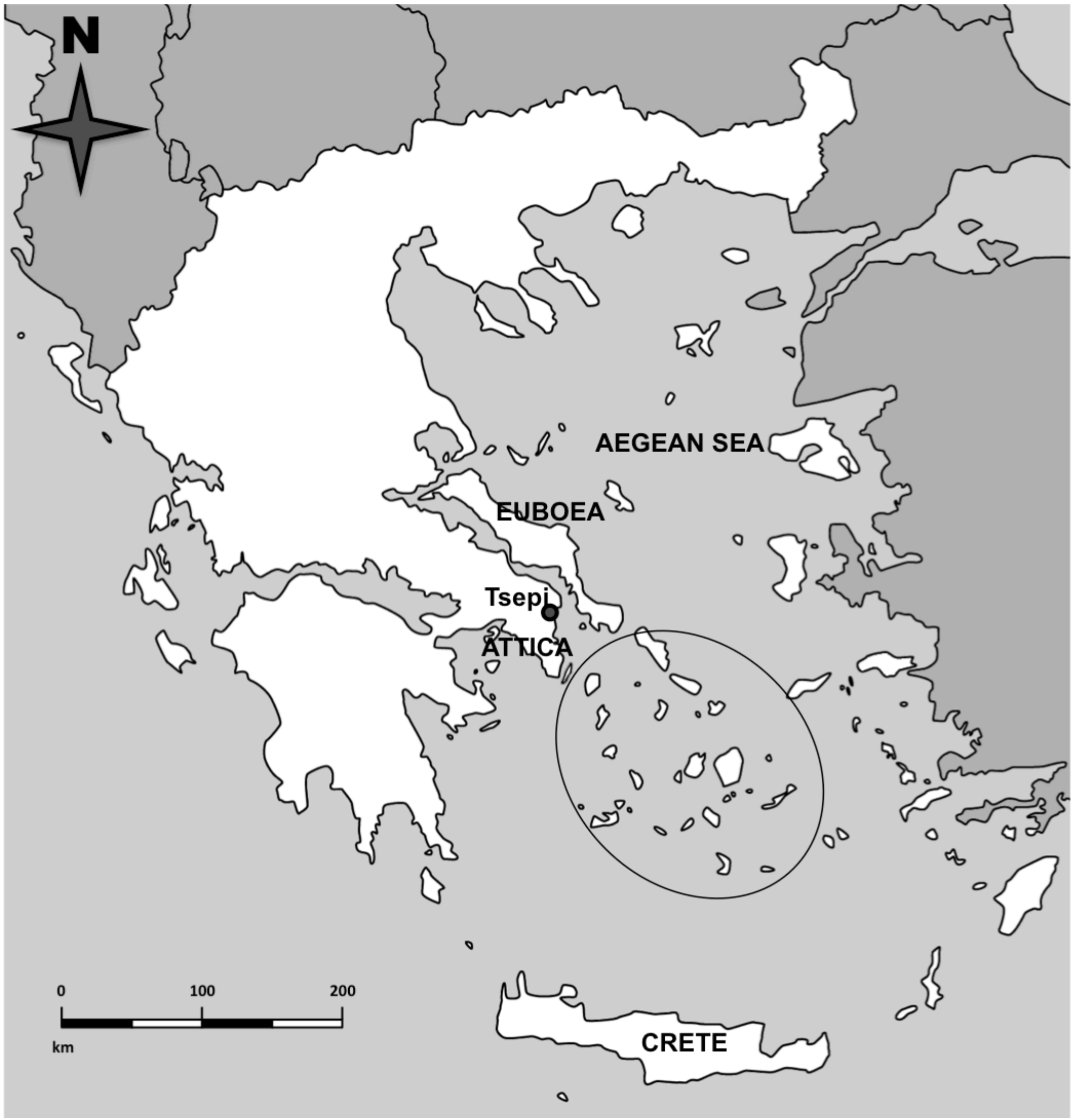

Figure 1.1. Map of Greece and the Aegean Sea showing the location of Tsepi cemetery (the circle marks the Cycladic islands).

Research Objectives and Hypotheses

The research objectives of this dissertation are twofold. First, this study uses biological data to examine biological relatedness within graves and within grave groups, as well as postmarital residence patterns (e.g., exogamous practices). Second, it uses biogeochemical data to evaluate the nature and degree of residential mobility focusing on relationships between coastal Attica and its surrounding regions, and its role in the formation and maintenance of trade/exchange and social networks. This dissertation will address these research questions via a series of testable hypotheses described below.

Cemetery Structure and Biological Relatedness

H_o = Spatial organization of the Tsepi cemetery (use of graves and grave groups) does not depend on biological relatedness.

If the data analysis fails to reject the null hypothesis, then:

a) Grave and cemetery use are determined by temporal factors (e.g., filling one grave first before opening another one) and/or environmental constraints (e.g., lack of space).

b) Spatial organization depends on kinship relationships, but kin affiliation and group membership are based on non-biological relations (e.g., adoption or fictive kinship).

If the data analysis rejects the null hypothesis, then:

H_a1: Use of the same grave is kin-based (i.e., based on lineal descent) and graves represent families and/or kin groups.

Expectations:

- Biological variation within each grave will be lower than across different graves; individuals from the same grave will be biologically more similar to each other than individuals from different graves.
- Because patterns of inter-individual adult relatedness can be affected by marriage practices, within grave biological variation will increase if tombs include marriage partners (i.e., spouses) who are not biologically related (Howell and Kintigh, 1996; Stojanowski, 2005a).
- Juveniles (who are the natal component of a family group) are expected to be closely related to each other and to the adults buried within the same grave (Stojanowski, 2005a).

H_a2: Grave location within the cemetery is kin-based and grave groups represent lineages and/or kin groups.

Expectations:

- Biological variation within a grave group will be lower than across different grave groups and individuals buried within the same group will be biologically more similar to each other than individuals from different grave groups.

Postmarital Residence Practices

H_o = There is no pattern indicative of postmarital residence practices.

If the data analysis fails to reject the null hypothesis, then:

a) Lack of patterning might result from opportunistic behaviors in mate selection and/or cemetery formation, or from the absence of established rules for postmarital residence and/or migration.
b) Lack of significant differences in biological variation and geographic origins between the two sexes might suggest other forms of residence rules, such as bilocal or neolocal residence.
c) The identification of a relativy high biological homogeneity across sexes and across the cemetery will suggest the presence of endogamous practices.

If the data analysis rejects the null hypothesis, then:

H_a1: Postmarital residence is virilocal (i.e., male-based).

Expectations:

- Males will be biologically similar and within-male biological variation will be lower than within-female variation across the cemetery (biodistance data).
- Males will be less mobile than females and will show similar, local biochemical signatures (biogeochemical data).

H_a2: Postmarital residence is uxorilocal (i.e., female-based).

Expectations:

- Females will be biologically similar and within-female biological variation will be lower than within-male variation across the cemetery (biodistance data).
- Females will be less mobile than males and will show similar, local biochemical signatures (biogeochemical data).

Residential Mobility

H_o = The burial sample shows a local geographic origin.

If the data analysis fails to reject the null hypothesis, then:

a) Sociocultural interaction and exchange networks between coastal Attica, Euboea, and the Cyclades are not formed, maintained, and/or facilitated through human residential mobility and/or relocation.

b) The presence of Cycladic influence, artifacts, technologies, and stylistic transfers at Tsepi will need to be interpreted through the import of Cycladic-manufactured objects and imitation of Cycladic practices by local people based on social and/or economic significance.

c) Mobility but not relocation took place.

If the data analysis rejects the null hypothesis, then:

H_a1: Residential mobility follows mate exchange networks.

Expectations:

- The identification of non-local individuals in Tsepi is sex-specific.

H_a2: Cycladic islanders migrated to the coastal mainland and continued a privileged mainland-island interaction.

Expectations:

- The identification of non-local individuals in Tsepi is non sex-specific.
- The identification of non-local individuals in Tsepi is grave-specific suggesting a potential correlation between geographic origins of the buried individuals, their

grave location, and the intra-cemetery distribution of grave goods showing strong Cycladic influence.

H_a3: Residential relocation did take place, but the identification of non-local individuals in Tsepi shows no pattern, spatial or biological.

Expectations:

- The identification of non-local individuals in Tsepi is neither sex-specific nor grave-specific, thus more situational or opportunistic behaviors in residential mobility should be entertained.

Chapter Summaries

Chapter 2 presents the theoretical context for the present study. I begin by considering the background for mortuary analysis and the examination of social and spatial dimensions of the mortuary record. The discussion focuses on the Saxe-Goldstein hypothesis and on ancestor cult. Concepts of cemeteries as landscapes of social memory and permanent, visible statements are also discussed. Furthermore, concepts and definitions of kinship and residence within anthropological inquiry are examined and then contextualized by focusing upon the Aegean context. An extensive review of ethnographic and ethnohistoric data on traditional kinship and residence practices, and mortuary customs in traditional Greece is presented in order to develop interpretative models applicable to the present study. Emphasis is placed on inter-regional variation in residence patterns and kinship systems and on the long-lasting practice of secondary burial. Lastly, this study is placed within its bioarchaeological framework.

Chapter 3 presents the archaeological context for this study focusing on the end of the Neolithic and the beginning of the Early Bronze Age. Topics relevant to this research are outlined, such as inter-regional contacts and mobility. This chapter centers on the Early Helladic mainland and Early Cycladic islands by discussing mortuary practices, including formalization of cemeteries, collective burials, and tomb re-use.

Chapter 4 presents the area and site under study. Past and recent discoveries in Attica and surrounding regions are discussed and the historical and archaeological importance of Marathon is examined. A detailed presentation of the cemetery of Tsepi follows, including the archaeological finds, the burial program, and the ritual aspects. Radiocarbon dating is included as a temporal control in the discussion of the chronology of Tsepi. The chapter ends with an assessment of the overall significance of the Tsepi cemetery.

Chapters 5 and 6 consist of the biodistance and the biogeochemical analyses respectively. The background, materials, and analytical methods are presented, followed by a discussion of the results and the conclusions for each analysis. The final chapter presents the overall discussion and conclusions of the present study by synthesizing the theoretical motivation and the different analyses applied to address the research hypotheses presented in the introduction.

CHAPTER 2

THEORETICAL CONTEXT

Mortuary Analysis

Mortuary analysis has a long history in the archaeological study of sociopolitical organization, as can be viewed through the chronological progression of landmark edited volumes over the last decades (e.g., Brown, 1971; Chapman et al., 1981; Beck, 1995; Rakita et al., 2005). Under the paradigm shift of "New Archaeology" (Binford, 1962), a number of scholars proposed a direct and positive correlation between individual mortuary treatment and personal social position during life (*social persona*, *sensu* Goodenough, 1965), as well as between mortuary variation and social complexity (Binford, 1971; Brown, 1971; Saxe, 1970, 1971; Tainter, 1975, 1978). Critiques of these early approaches, mainly by the so-called post-processual scholars, emphasized the importance of differential meaning and belief systems, intentional manipulation of symbols, *emic* vs. *etic* views, ritual, power, ideology, and active agency of the living (e.g., Carr, 1995; Hodder, 1982, 1986; O'Shea, 1981; Parker-Pearson, 2000; Shanks and Tilley, 1982).

Social and Spatial Dimensions of the Mortuary Sphere

One of the most influential contributions of the processual approach to mortuary analysis has been the focus on spatial dimensions of the mortuary program. Specifically, Saxe's controversial "Hypothesis Eight" had a great impact on mortuary studies, arguing that formal disposal areas used exclusively for the dead resulted from competition among corporate groups for control over restricted resources, legitimized through lineal descent from the dead (i.e., ancestors) (Saxe, 1970:119). Goldstein (1976, 1981) re-examined Saxe's original hypothesis and stressed the remarkable cultural variation in the ritualization of social organization. Based on her analysis of a wider ethnographic sample, she proposed that the maintenance of formally bounded cemeteries is one (but not the only) means for legitimizing the rights of corporate groups to control restricted resources through lineal descent, and that the more formal the cemetery structure, the fewer alternative forms of social organization would apply (Goldstein, 1976, 1981).

Morris (1991) re-opened the debate linking use of and access to formal cemeteries, lineal descent, and property transmission by arguing that cognitive processes and localized belief systems are inherent in the Saxe/Goldstein Hypothesis. He proposed that the active manipulation of the burial location of the dead constitutes an intrinsic aspect of ideological discourse, where ritual not only reflects social reality but also creates sociopolitical structure (Morris, 1987, 1991, 1992). In this discourse there are many messages being conveyed (often contradictory), and the Saxe/Goldstein hypothesis is only one of them. In this, he makes a distinction between the description of an ideological structure and the social reality actively formed by those performing the burial ritual. A crucial aspect of Morris's model (1991:150) is the analytical distinction between "mortuary ritual" (cult of the dead) as a rite of passage separating the dead from the living on the one hand, and "ancestor cult" as a ritual providing continued access to the deceased in the afterworld (following Gluckman, 1937). Even though the two affect one another, ancestor cult is directly linked to inter-generational transmission of property, power, and lineage unity, whereas mortuary rituals can become spheres of inter- and intra-community negotiation, cooperation, and/or competition through elaborate displays (Ahern, 1973; Buikstra and Charles, 1999; Charles and Buikstra, 2002 Morris, 1991; Watson, 1988). Ancestors can be defined as dead predecessors (progenitors *sensu lato*) who are still remembered by their descendants, following genealogical relationships based on culture-specific and socially constructed kinship and descent systems (Fortes, 1965, 1976; Newell, 1976; Whitley, 2002). In that sense, death and mortuary rites alone do not entail ancestorhood; it is the ancestor cult that re-embodies ancestors as communal dead through periodical rites and engages them in social, political, and economic relationships with their descendants (Buikstra and Charles, 1999; Fortes, 1965; Morris, 1991). Placing the dead creates ancestors and generates enduring social memory (Bloch, 1971; Chesson, 2001; Dillehay, 1993; Rakita et al., 2005).

Interestingly, one of Saxe's "intellectual ancestors" rightfully identified by Morris (1993:150) was Fustel de Coulanges. Utilizing ancient Greek and Roman textual sources, in 1864 Fustel (a French scholar probably remembered best as Durkheim's mentor) proposed a deep and inextricable link between the worship of ancestors, the family, and the rights to private property. He emphasized the presence of family tombs very close to the house and/or in the family's landholding that established an enduring bond between families and land, serving thus as a marker (and proof) of ownership. All family members would be interred in the family tomb, not in cemeteries. Ownership of both property and ancestors was transmitted through the male line; women became part of their husband's family and were interred in his family tomb and shared his ancestors. Worship at the (family) tomb corresponded to worship at the household hearth, where the sacred fire was kept. The latter ensured that the ancestors remained alive, and this duality framed domestic religion. The French scholar suggested a "religion of the dead" (Fustel de Coulanges, 2001:14), where the dead ancestors were worshipped as sacred beings in a domestic context. Fustel considered this to be the oldest form of Indo-European religion. These ideas received considerable criticism due to the lack of firm supporting evidence for the presence of family tombs in antiquity. Consequently, his work was rarely acknowledged by subsequent generations of scholars. Regardless of their evidential base, however, Fustel's arguments concerning the central role played by kinship (as a set of social rules) and dead ancestors in ancient society and property have occupied a central place in social anthropological theory (Humphreys, 1980a; Momigliano, 1980).[1]

In Greece, the distinction between the different cult forms requires further elaboration. Here, the cult of ancestors has a long history and has received great attention in the study of antiquity, mostly in relation to the distinction between tomb cults and hero cults.[2] Even though these two concepts are not chronologically pertinent to this study, they are regionally relevant due to the fact that they occur in Attica. Speaking about the worship of the dead, Rohde (1894) suggested that the hero cult of later historical periods originated in the older, native cult of ancestors at the gravesite. However, it was Farnell in 1921 who first raised the issue of the need for a distinction between ancestor cult, hero cult, and the general religious 'tendance' of the dead, though all three were interconnected and often overlapped (Farnell, 1921:2). Farnell used the term 'tendance' to denote the post-burial rites and offerings, usually by family; however, he noted that tendance maintained for a long time (multiple generations) might actually create worship (Farnell, 1921:5; see also discussion in Mylonas, 1951).[3]

Activity at Bronze Age tombs (mostly Mycenaean tholos or chamber tombs) dating from the ninth to the seventh centuries BC (with a noticeable peak in the 8th century) has given rise to a debate over the nature of the cult represented. Normally, worshippers deposited their votive offerings several centuries after the last burial without any new interments, although several cases where later burials did take place are known (Antonaccio, 1995).

In his discussion of the post-Mycenaean finds in the Prosymna chamber tombs, Blegen (1937) identified a widespread cult of the dead in the late Geometric period. Blegen considered the practice to be evidence of memory and population continuity – i.e., those who placed later objects in these tombs believed that their ancestors were buried in them.[4] Drawing on Cook (1953) and Farnell (1921), Coldstream (1976) linked the practice to the spread of the Homeric poems and reclaiming a heroic past. Coldstream focused upon the geographical distribution of these cults and attributed regional variation to differential burial treatment, i.e., the presence or absence of collective graves vs. individual graves in post-Mycanaean times. Areas in the central mainland (e.g., Attica, Boeotia, Corinthia, Argolid), wherein individual burial became the norm, showed evidence of a generalized tomb cult (for anonymous heroes) at the imposing Mycenaean tombs; areas that continued practicing collective burials within chamber or tholos tombs (e.g., Thessaly and Crete) did not practice hero cults. Coldstream further proposed that in

Attica, where, despite the abrupt change in burial practices near or at the end of the Bronze Age, there was continuity of people and, possibly, continuity of veneration of local heroes, hero-cults were particularly varied and popular. Snodgrass (1980, 1982) attributed the phenomenon to significant population increase during the 8th century and the re-settling of agricultural communities: by placing offerings into the old, monumental Mycenaean tombs, the new settlers established their link to the local past and legitimized their claims to the land.

Antonaccio (1993, 1994, 1995, 2006) stressed the funerary component, focusing on the cases where Bronze Age tombs were reused for later burials. She viewed tomb cult and hero cult as two separate phenomena that made different claims on the past. Tomb cults were a type of ancestor cult that created ancestors through the adoption of the long dead, unrelated genealogically and unacknowledged for centuries (1994:400). Drawing on Appadurai's (1981) view of the past as a scarce resource, debatable and mediated, Antonaccio linked the spreading and prevalence of the cults in the 8th century to the intensified competition over the past due to the sociopolitical processes and ideological formations leading to rise of the *polis* (also Morris, 1988).[5]

An analogous activity at Bronze Age tombs, though with a different geographical distribution (interestingly absent in Attica), took place in post-Classical times (4th to 1st centuries BC), yet another period of transition and ideological reformulation. Alcock (1991), acknowledging alternative explanations (such as non-elites' claims to the land or attempts to establish regional unity), attributed the post-Classical tomb cult to elite propaganda for the re-affirmation of power at a time when authority was shifting within and between the polis and other political units.

This emphasis on ancestors certainly received criticism and Whitley's (2002) claim of 'too many ancestors' is definitely worth consideration. Whitley strongly opposed the link between the observed activity during the Geometric period at Bronze Age tombs and ancestral veneration, suggesting instead that the presence of different 'entities' such as heroes, gods, or other mythological creatures from the Greek past may be more pertinent to the nature of the cult. He saw these activities as private (familial) rituals of an elite based on the presence of Orientalizing pottery that marked a revival of Athenian aristocracy, and he further linked them to the emergence of offering trenches in Athenian cemeteries (Whitley, 1994). His argument that ancestors require continuity, however, does not necessarily hold if one considers the various definitions of ancestor (e.g., not linked genealogically). For example, there is an argument that asserts ancestors can be created and used to reinforce otherwise ephemeral links between population groups.[6]

In sum, Whitley offers cogent criticism of the British, post-processual academic trend that seeks to identify ancestors everywhere and anywhere. To his critique, one may add his observation concerning how the present-day lack of kinship networks and identifiable ancestors among contemporary scholars has influenced the academic search for generic ancestors in the past. Nevertheless, this claim of the lack of ancestors in contemporary times does not necessarily hold true for the Greeks. Regardless of population movements, Greek people share a sense of continuity (even if it is not purely genealogical *sensu stricto*, it is ideological and practical given the continuity of landscape and practices).

Regardless of whether or not tomb cult was concerned with ancestors or heroes (some heroes were also legendary ancestors), of great interest here is the recognition that the past may be manipulated by different social groups through the intentional incorporation of the powerful dead and their monuments into the identities and social memories of the present (Bravo, 2009). As noted previously, these forms of worship are normally assigned to a much more recent period in Greek history than the one studied here. Nevertheless, it is significant that this kind of activity is found in Attica (particularly at Menidhi, Thorikos, Aliki, Eleusis, and Athens itself), for it opens the possibility that there previously existed some form of relationship linking the landscape of Attica (and of mainland Greece more generally), the re-use of and reverence for built tombs tied with literal and/or fictive kinship, and the inherited mindset of worshippers.

Ancient Greece and particularly Attica have been the focus of mortuary studies due to the rich archaeological (cemeteries) and textual (including epitaphs) bodies of evidence, especially in relation to the emergence of the *polis*. Morris produced a seminal work on the relationship between death, burial, and sociopolitical organization in classical antiquity, particularly the processes leading to the rise of the Greek city-state (1987, 1992). Building upon the Saxe/Goldstein hypothesis, Morris (1991) went beyond the corporate descent group and saw cemeteries as symbols of the citizen body. By contrasting Athens with Rome, he suggested that the more permeable the citizenship boundaries, the more permeable the cemetery's social boundaries (Morris, 1991). Burial of oneself and of one's ancestors in the formal Athenian cemeteries was proof of descent and thus safeguarded one's rights to citizenship.[7] As the definition of Athenian citizenship loosened from the late 4th century BC onwards, so did the cemeteries' restrictions. For Morris, the fact that non-citizens were buried in Attic cemeteries illustrated the difference separating Athenian ideology and the reality of life in Hellenistic Athens, including the frequently contradictory nature of the two (Morris, 1991).[8]

Cemeteries as Landscapes

Considering classical Athenian cemeteries, Small (1995), through a non-Classicist prism, raised a methodological and conceptual issue in mortuary analysis that will be of great interest for the current study, namely the distinction between cemeteries with permanent grave markers and those without.[9] Cemeteries with permanent markers become settings of monuments aggregated over time and thus spheres of competition and status negotiation. Utilizing ethnoarchaeological work at the historic Nisky Hill Cemetery in Pennsylvania, he argued that grave markers operate in very different ways than grave goods, given that they have much longer lives: once erected, they can be visible and usable for centuries. Within this framework Small addressed a point widely discussed by scholars of Classical Athens: that of sumptuary legislation focused on funerary behaviors that restricted elaborate burial ceremonies and monumental tomb markers.[10] In the case of historical Athens, a common explanation for the restrictions in mortuary ostentation cites more democratic, egalitarian strategies aimed at either removing the financial burdens of elaborate mortuary practices or mitigating the reaction of the non-elites, as part of the new social order that 'restricted' the elites.[11] Cannon (1989, and later 2005) argued for a cyclical pattern of change in mortuary display based on fashion and style, observable as a generalized principle: as the non-elites emulate the elaborate displays of the elites, ostentation becomes redundant; consequently, the elites deliberately shift towards less ostentatious styles to maintain social differentiation. Focusing on grave markers, Small (1995) noted that in built cemeteries these sumptuary restrictions resulted in the immediate distinction between those who had hitherto established ostentatious markers and those who had not. The latter were henceforth denied the opportunity to do so. Accordingly, the legislation fixed the current social order in time by forbidding any emerging social groups to use the cemetery as an arena for negotiation of status after burial. Another point of great interest is the distinction between the context created during an individual burial (e.g., by an assemblage of grave goods) and that of the cemetery as a whole, an entity that continued in use from a time before any particular burial to times well after it (Small, 1995).

Furthermore, Small (1995, 2002) proposed that monumental cemeteries serve as long-term built environments and constitute socially charged landscapes, accumulated over time. Thus, given their long-lasting presence, the cemeteries and/or different monuments within their limits can serve different social strategies and provide the context for status negotiation beyond the elite vs. non-elite distinction. Manipulation of a cemetery's boundaries and markers was not restricted to the family and kin, but also involved other groups. Interestingly, Small (2002) cites the case of Grave Circle A in

Mycenae, which was originally constructed outside the citadel's walls.[12] When the royal citadel was later redesigned, the fortification walls were rebuilt in order to incorporate Grave Circle A. During the course of this construction work, the Grave Circle was remodeled and the grave markers reset. Here Small (2002) draws attention to how the monuments were remodeled and reused by people attempting to emphasize or adjust to different social strategies by manipulating the burial space. Built cemeteries act as landscapes of the dead and interact with the physical landscape, forming visible, material means for the creation and maintenance of collective social memory. As such, they serve not only as both individual and collective points of spatial reference, but also as narratives of the past that can be manipulated in response to social and political pressures (Cannon, 2002; Charles and Buikstra, 2002; Goldstein, 2002).

Kinship and Residence

Kinship is an inherently anthropological concept with a vast associated literature (e.g., Firth, 1951; Fortes, 1949; Holy, 1996; Keesing, 1975; Leach, 1954; Lévi-Straus, 1953; Sahlins, 1968, 2013). The importance of kinship for anthropological research lies in its function as a marker of collective identity. It can act as a mechanism for the formation of social groups and it can have sociopolitical, economic, and territorial correlates. Thus it has the potential to inform sociopolitical organization, intra-/inter-community relations, and identity formation.[13] Kinship studies have a long history in sociocultural anthropology beginning in the late 19th century, as well as more recently in bio-archaeology (a review of the history of kinship studies is beyond the scope of this project; see Johnson and Paul, 2015 for a thorough review). Kinship studies were central to anthropological research for most of the 20th century. The identification of kinship with genealogies, a trend that dominated anthropological research since the late 19th century (Morgan, 1871), led to the re-evaluation of the concept and a "crisis" in the field of kinship studies during the 1970s. The critiques focused upon the preoccupation with the biological foundation of kinship relations (as a "natural" system) and typological classifications that rested upon modern "Western" notions (mainly Schneider, 1968, 1972, 1984). These critiques shifted the focus towards more contextualized approaches to kinship, viewed as a culturally specific social construct. This formulation also argued against cross-cultural applications and monolithic terms. Sahlins (2013:ix) defined kinship as "'mutuality of being': kinfolks are persons who participate intrinsically in each other's existence; they are members of one another". This definition encompasses genealogical relations wherein birth, instead of forming the core of kinship relations, becomes the reflection ("metaphor") of the greater kinship order (Sahlins 2013:ix, 65). Thus, kinship is now conceptualized as a multifaceted and multiscalar phenomenon, highly symbolic and bioculturally sensitive. In this endeavor, ethnographic and ethnohistoric evidence, along with sophisticated bioarchaeological analyses, can be used to formulate expectations and create testable models, and thus to provide invaluable data for a more nuanced reconstruction of the complex conceptions of kinship in the past (Johnson and Paul, 2015).

This dissertation examines kinship systems and their materialization in the mortuary record, in order to identify the social processes that shaped the "international" communities of the Aegean Early Bronze Age. Given that kinship is culturally specific, it will be of great value to examine kinship and residence within their regional context. Considering the different cultural traditions, classic anthropological terms derived from exotic societies do not necessarily apply to Greek systems (see Forbes, 2007). Thus, the Greek ethnographic accounts can provide emic anthropological parallels and thus serve as useful analogies to archaeological studies. Here, I provide a brief overview of the terms commonly used in kinship studies, particularly within archaeology. The descriptive terms associated with kinship studies are used here as a heuristic in order to facilitate discourse and examine broader patterns in biological, affinal, and social kin roles. They serve as a starting point and become the source of critique through bioarchaeological analysis. Next, I present a review of ethnographic and ethnohistoric data on kinship, residence patterns, and mortuary practices in Greece, focusing on accounts of rural communities. The goal of the ethnographic review is manifold: first, to contextualize the current study and evaluate the relationship between kinship and residence and the mortuary domain in the Aegean; second, to formulate expectations and hypotheses to be tested through biogeochemistry and biodistance analyses; third, to draw upon ethnographic analogies, when appropriate, to reconstruct the broader behavioral elements that came into play in the formation of communal identities and mortuary ritual; and finally, to communicate the wealth of ethnographic information on kinship, residential mobility, and secondary burial treatment in the Aegean that can be of use in future studies.

The goal of this work is *not* to classify past kinship systems by attributing them to categories (such as matrilocality versus patrilocality). A review of traditional rural Greece and Classical antiquity can easily reveal the difficulties associated with such typologies – even with the presence of written sources.[14] Undertaking such an endeavor for prehistory becomes even less productive. Aside from acknowledging the limitations of such typological approaches in anthropological research, it is also a fact that kinship studies in Greek prehistory, descriptive or not, are nearly absent (see full discussion in the following chapters). Even basic data required for more sophisticated treatments are missing. Prehistoric kinship studies in the Aegean context are still in their infancy.

Anthropologists have long observed how much Greek societies emphasize kinship, with the nuclear and/or extended family forming the core (e.g., Forbes, 2007; Just, 2009; Lee-Demetrakopoulou, 1955; Loizos and Papataxiarchis, 1991), a pattern documented for the Mediterranean more generally (Davis, 1977; Goddard, 1994). Greek societies stress blood ties and family. The value of honor and shame in structuring values for village communities led earlier scholars to underscore the role of the moral system (e.g., Campbell, 1964, Herzfeld, 1980a). For that reason, Greek and Mediterranean kinship structures appeared too familiar and less appealing to the broader anthropological literature, which during most of 20th century was more interested in the situation of exotic societies (see discussions in Forbes, 2000; Davis, 1977; Just, 2009; Pitt-Rivers, 1965, 1977). Greece and Greek ethnography -caught in between the exotic and the familiar- is commonly absent from broad anthropological theories. Subsumed under the "Western" world, any variation and potential contribution, such as the secondary treatment of the dead, is overlooked. As a result, "[a]nthropology is as marginal to Greece as Greece is to anthropology" (Herzfeld, 1987:2).

Concepts and Definitions

First of all, although the terms 'social structure' and 'social organization' are often used interchangeably, there is an important distinction between the two (Firth, 1951; Radcliffe-Brown, 1952). The former is associated with abstract models or ideals, while the latter concerns social reality. According to Radcliffe-Brown (1952:11), social structure refers to an arrangement of institutionally controlled or defined relationships and thus to a system of social *positions*, whereas social organization refers to an arrangement of activities and thus to a system of social *roles*. Radcliffe-Brown (1952) perceives social structure as an existing concrete reality capable of change and directly observable, while he distinguishes it from what he identifies as the general structural form, which is abstracted from variations or circumstances and remains relatively constant. By contrast, Lévi-Strauss (1953) relates social structure to models built on empirical reality, and distinguishes it from the term 'social relations', which consist of empirical facts ("raw materials"). This view is also echoed in Leach's (1954) emphasis on the conceptual problem of the relation between social structure considered as an abstract model of an ideal society, and the social structure of any actual empirical society. Leach (1954) defines social structure as a set of ideas about the distribution of power between persons and groups of persons. He further argues that phenomena of structural change consist of shifts in the focus of political power within a given system, and that structural change itself refers to changes in the ideal system, i.e., the power structure.

Here, I follow Firth's (1951) conceptual distinction, because it provides an operational framework more suitable for archaeological research (as discussed also in Stojanowski and Schillaci, 2006). Social structure refers to the expected or ideal social relations based on the idealized belief systems and guided practices of a particular society, and in that sense to the enduring (and more static) elements in social relations that are of critical importance to the particular society, thus emphasizing continuity (Firth, 1951). Social organization, on the other hand, refers to the ordering of social relations through individual choice and decision and concrete activity; it is a dynamic process that allows for social adaptation through variation and alternative action, thus encompassing social change (Firth, 1951). As a result, the two concepts, though closely related, have different uses and applications in archaeology. Social structure cannot be observed (bio)archaeologically in that it consists of an abstract model or ideal, contrary to social organization that refers to social reality and empirical facts, and thus can have (bio)archaeological correlates.

Even though the term kinship can be used in a broad sense to refer to the whole conceptual and social field relating to kinship, marriage, and descent, it can also be used to refer to the network of relationships created by genealogical connections and by social ties modeled on genealogical parenthood (Keesing, 1975). The multifaceted nature of the term in combination with the vast associated literature can often cause inconsistent usage. Thus, it is important to provide definitions to avoid possible confusion. In this work, the term kinship is used broadly to incorporate all possible forms of relatedness (e.g., genealogical, affinal, social/fictive, etc.) unless otherwise denoted with a particular adjective (e.g., biological kinship).

Kinship can be biological ('blood'), vertical (i.e., generational, descent) and horizontal (e.g., siblings); it can be affinal (i.e., established through marriage such as spouses and in-laws); it can be cultural/social (e.g., fictive; adoption).[15] Furthermore, kinship as an analogy to social reality can be official (i.e., following the official, immutable, communal ideology) and practical (i.e., following practical, individual, and individualistic strategies) (Bourdieu, 1977:33-38). This latter distinction between normative rules and malleable practices can provide a useful framework for (bio)archaeological studies allowing for more nuanced interpretations of kinship that extend beyond biological (i.e., genetic) relatedness (e.g., Pilloud and Larsen, 2011). Thus, it becomes clear that kinship can act at different scales, can have fluid boundaries and as a form of social identity can intersect with other social roles.

Kinship is defined with reference to an individual or pairs of individuals, thus its definition is always relative; descent, on the contrary, is defined with reference to an ancestor, it is culturally specific, but also absolute within that particular culture.[16] Kinship reckoning is bilateral, including both matrilateral ("mother's side") and patrilateral ("father's side") kin. Descent can be unilineal, either patrilineal (or agnatic) formed through male links, or matrilineal (uterine) formed through female links, or cognatic formed through any combination of male and female links. With reference to the latter form, double descent refers to systems with both matrilineal and patrilineal descent groups, whereby a person belongs simultaneously to two descent groups.

Accordingly, there can be significant conceptual and operational distinctions between the terms *genitors* (the biological parents), *social parents* who are not necessarily identical with *genitors (pater* and *mater*; e.g., adoptive or fictive kinship), and *ancestors* (socially constructed and/or genealogically linked) wherein *progenitors* and *ancestors* do not have to be synonymous. The constructs used to define membership in a social group based on a particular descent sequence (from an ancestor) are called descent rules, and the groups formed are termed descent groups. Descent groups that form discrete corporations with shared rights (usually to some property; e.g., land and other resources), privileges, and liabilities, often sharing a common group name, and that can function as sociopolitical units across generations, are called corporate descent groups (nevertheless, not all corporate groups have to be descent groups and vice-versa) (see Ensor 2013). Moreover, lineage refers to a unilineal descent group whose members trace their descent from a known ancestor and know their genealogical connections to that ancestor; when the members believe that they are descended from a common ancestor but do not know their genealogical connections (e.g., mythical), they form a clan (Keesing, 1975:31). In addition, clans often trace their ancestry and name back to a mythological figure that does not have to be a human being. Furthermore, clans normally have origin myths (Stone, 2010).

Another distinction can arise from the territorial aspect of social groups, between descent groups and local groups. Descent groups can be localized (including in-marrying spouses but excluding out-marrying descent group members) or non-localized (descent groups that do not include in-marrying spouses). Also, another classification concerns domestic groups or residential groups (in another sense, this can incorporate household groups) that consist of individuals who live together including affines and unmarried family members and share resources for their subsistence, building on the family core (Ensor 2013; Stone, 2010). This is why descent needs to be considered in conjunction with residence patterns and postmarital residence rules in particular that specify where a couple should live after marriage.

The main postmarital residence patterns are: (a) virilocal (or patrilocal), whereby residence is male-based; (b) uxorilocal (or matrilocal), whereby residence is female-based, (c) bilocal (or ambilocal), whereby residence is with or near either spouse's parent household, (d) neolocal, whereby residence is separate from either spouse's parent household, (e) natolocal (or duolocal), whereby each spouse lives with or near his/her own parental household, and (f) avunculocal, whereby residence is with or near the groom's mother brother(s) (Stone, 2010). Therefore, it becomes obvious that descent and residence rules need not correspond, and must not be confused.

As far as marriage practices and relationships established through marriage are concerned, there are three basic marriage forms: (a) monogamy, i.e., marriage between two individuals, (b) polygyny, i.e., marriage of a man to two or more women at the same time, and (c) polyandry, i.e., marriage of a woman to two or more men at the same time. Cross-culturally, monogamy is the most common form, while polyandry is the least common (Stone, 2010). Furthermore, in terms of marriage rules, endogamy refers to practices whereby individuals must marry within a certain biological, social, and/or local group, whereas exogamy refers to practices whereby individuals must marry outside a certain biological, social, and/or local group. Exogamy and mate exchange are often practiced by descent groups and form a significant mechanism for the creation and maintenance of alliances facilitated through marriage. Polygyny, found in 70% of modern ethnographic societies (based on Murdock's 1967 sample), has been associated with an imbalanced sex-ratio in favor of women, usually due to warfare (Ember M, 1974a). Thus, marriage practices can be transformed into collective, matrimonial strategies for the survival and perpetuation of social groups (e.g., Bourdieu, 1977:58-71). Reciprocal exogamy (mate exchange) and regulated marriages (such as parental control) appear to have been a common, deep, and 'unique' feature of human societies, including hunter-gatherers, associated with monogamy and affine co-residence (Apostolou, 2007, 2010; Chapais, 2011; Hill et al., 2011; Walker et al., 2011).

In an ethnographic sample of 1,179 societies, the most common descent groups were patrilineal (50%), followed by bilateral (29%), and then matrilineal (14%) groups (Divale and Harris, 1976:255, based on Murdock, 1967). With regards to residence, 71% were patrilocal, 11% were matrilocal, 7% were bilocal, 6% were avunculocal, 5% were neolocal, and 1% was duolocal (Divale and Harris, 1976:255, based on Murdock, 1967). In the same sample, patrilineal descent groups practiced virilocal residence almost exclusively, as was generally the case (Keesing, 1975; Stone, 2010). Interestingly, virilocal residence was the most common practice not only in patrilineal descent groups, but also in ambilineal, double descent, and bilateral groups. However, matrilineal descent groups followed a variety of residence practices, with 39% practicing avunculocal residence, 33% uxorilocal, 19% virilocal, 4% bilocal, 4% neolocal, and 2% duolocal residence.

A common explanation for the evolution of kinship and residence systems has been that the type of postmarital residence depends on the sex that contributes the most to basic subsistence and labor. In terms of subsistence modes (Aberle, 1961, based on Murdock's 1957 sample), the majority of matrilineal descent systems were associated with dominant horticulture (56%, n=84). Thus, matrilineal descent and matrilocality have generally been associated with specific ecological niches and sedentary groups practicing dominant horticulture with a division of labor focusing on women (Aberle, 1961) or with economic activities of very low productivity (Gough, 1961). Patrilineal descent on the other hand, encompassed a wider range of subsistence practices, such as plough agriculture (28%), dominant horticulture (27%), pastoralism (21%), and large domestic animals (13%) (n=248). Interestingly, hunting and gathering/fishing was associated most frequently with bilateral descent systems (30%, n = 204).

A number of ethnographic studies have challenged previous explanations of residence based solely on sexual division of labor, and have suggested a link between residence and warfare (Divale, 1974, 1975; Ember and Ember, 1971; Ember CR, 1974). Ethnographically, patrilocality has been associated with frequent feuding, internal disharmony and warfare, and extensive polygyny (Divale, 1975; Ember CR, 1974; Otterbein 1968); it has also been associated with fishing in hunter-gatherer economies (Ember, 1975). Otterbein (1968) showed that the existence of fraternal groups (indicated by either patrilocal residence or polygyny) is closely associated with feuding and internal war; particularly, fraternal groups influence directly the frequency of feuding and internal war in non-centralized political systems, and only the frequency of feuding in centralized ones.

On the contrary, matrilocality has been linked to internal harmony, absence of internal conflict, group cohesion and external warfare patterns (Divale, 1975; Ember, 1971; Murphy, 1957; Van Velzen and Van Wetering, 1960). Matrilocal residence has been interpreted as an adaptive response to external warfare caused by the migration of a virilocal group into an already inhabited region, and thus has been associated with recent migration (Divale, 1974, 1975). Ember and Ember (1971) argued, however, that under conditions of external warfare, division of labor might determine residence as a familial preference. Moreover, it has been suggested that matrilocality was associated with the maintenance of traditionally oriented houses, under conditions that require men to be away for long periods of time, as well as a means of incorporation of large numbers of captives (Helms, 1970). It has further been argued that matrilocality coupled with bilateral kinship systems is a particularly adaptable form of social organization promoting continuity and cultural stability, especially under conditions of inter-societal contact (Eggan, 1955; Helms, 1970). By the same token, a link between matrilineal forms of descent and matrilocal residence, and recently-introduced long-distance trade (where men are traveling) has been suggested, favoring again a view of matrilineal and matrilocal groups as more stable (Peregrine, 1994).[17]

A material correlation of postmarital residence patterns, mainly patrilocal or matrilocal, has been the size of the house floor area (Brown BM, 1987; Divale, 1977; Ember M, 1973). Generally, houses in matrilocal societies have significantly larger living floor areas than the ones in patrilocal societies according to various ethnographic samples: average house floor areas were calculated to be (a) 30.2 and 21.5 m^2 in patrilocal societies, and 80.6 and 114.82 m^2 in matrilocal societies (Ember M, 1973), (b) 28.6 m^2 and 188.4 m^2 in patrilocal and matrilocal societies respectively (Divale, 1977), and (c) 27.4 m^2 and 78.4 m^2 in patrilocal and matrilocal societies respectively (Brown, 1987). This indicator has found great application in archaeological studies, however not always without problems (e.g., Cameron, 1999; Peregrine, 2001; cf., Schillaci and Stojanwoski, 2002; cf., Peregrine and Ember, 2002). In a recent re-examination of previous ethnographic samples, Porcic (2010) found a statistically significant correlation between average house floor area and postmarital residence patterns in societies practicing agriculture, but not in non-agricultural ones, indicating the importance of the subsistence parameter.

With reference to other forms of residence, some correlations exist between avunculocal residence and previously matrilocal and matrilineal societies subject to high male mortality rates and internal conflicts (Ember, 1974b). Bilocal or multilocal residence (i.e., co-occurrence of any consanguineal residence patterns) has been interpreted as an adaptive response, arising from unilocal residence, to severe depopulation in sedentary societies (agriculturalists) and hunter-gatherers (Ember, 1975, 1978; Ember and Ember, 1972; Service, 1962). Bilocal residence in hunter-gatherers seems to be favored also in conditions of climatic and environmental instability, resource fluctuation, and sex-ratio fluctuation (Ember, 1975, 1978).

More recent studies and reconsiderations of earlier cross-cultural ethnographic samples through multiple regression tests (particularly Murdock's *Ethnographic Atlas*) show a significant correlation between sexual division of labor and postmarital residence when there is a control for the factor of general non-sororal polygyny (Korotayev, 2003a,b). Korotayev (2003a) argued that the correlation between the two variables was always significant in native North American samples where sororal polygyny was associated with matrilocality and high female contribution to subsistence; on the contrary, in ethnographic samples outside North America this relationship is masked by non-sororal polygyny. In addition, there was a significantly higher likelihood for bilocal or multilocal residence to develop when both sexes had roughly equal contributions to subsistence (Korotayev, 2003a). Korotayev (2003a) suggested that both non-sororal polygyny and internal warfare frequency are strong predictors of matrilocality and their combined consideration leads to the highest significance of the correlation between female contribution to subsistence and postmarital residence. Finally, Korotayev's study (2003b) showed that, generally, a very low female contribution to subsistence strongly predicted a non-matrilocal residence and less strongly a patrilocal residence.

Kinship and Residence in the Greek Context

Greek "village" ethnography emerged in the late 1950s and 1960s (Campbell, 1964; Friedl, 1962) with fundamental studies of Greek rural villages that, along with those in Spain, Portugal, southern Italy, and the Balkans, were less developed than the rest of Europe.[18] Since then, Greek ethnography has greatly progressed, producing an invaluable ethnographic dataset for Greek communities. The study of kinship, family, and the household has been a major focus of Greek anthropology and varies greatly in approach depending upon inheritance and property (e.g., dowry), gender roles, naming systems, economic factors, chronological scope, and sources (e.g., ethnography, demographics, archival data).[19]

The terminology used for Greek kinship is uniformly bilateral across the Greek-speaking world, with a few local variations (Andromedas, 1957; Aschenbrenner, 1976; Friedl, 1962; Herzfeld 1983). [20] The terms used are a reduced form of the ancient Greek expressions, with the addition of forms borrowed from other languages (Andromedas, 1957; Miller, 1953; Thompson, 1971). There is no distinction between matrilateral and patrilateral relatives; however, Greek terminology includes a detailed and specific classification of affines not found in English, especially between varieties of a spouse's siblings and the sibling's spouses, as well as the spouse's parents. Despite the general uniformity in kinship terminology, there is considerable inter- and even intra-community variation in the definition, conceptualization, and practice of kinship and post-marital residence within Greece (Forbes, 2007; Herzfeld, 1983). At the same time, there has been significant variation in the way kinship is conceptualized and classified by the social anthropologists. The presence and degree of patriliny (see Herzfeld, 1983) and matrilocality (see Casselberry and Valavanes, 1976), for example, are matters contested by anthropologists studying the Greek culture. In ethnographic accounts, the perception of male domestic dominance has been used as an indication of patriliny instead of patriarchy (Herzfeld, 1983). Thus, in many cases, the identification of agnatic versus cognatic systems has been a matter of interpretation (Just, 2000).

The main term for reckoning kinship in Greek communities is *soi*, often translated as kindred.[21] *Soi* is often used to denote bilateral kindred, but it can also be used for either cognatic or agnatic kindred. Bilateral ideology of *soi* is reported, for example, for the northern Greek Sarakatsani (Campbell, 1963, 1964) and Euboea (du Boulay, 1974). However, there are communities that show a strong patrilineal emphasis and define *soi* as agnatic, e.g., in the northwestern Peloponnese (Aschenbrenner, 1975, 1976; Bialor, 1967, 1973), in the Mani peninsula (e.g., Alexakis, 1980) and in Crete (Herzfeld, 1983, 1985; Saulnier, 1980:114).[22]

Besides kinship bonds formed on the basis of genealogical (biological) and affinal relations, Greek societies consist of bonds of social (fictive) kinship, usually termed spiritual (or ritual) kinship. Spiritual kinship can be as strong as blood (sometimes even stronger) and plays a significant role in social organization and intra- and inter-community organization and ties, especially in rural communities (Aschenbrenner, 1975, 1986; Campbell, 1964; Chock, 1974; Du Boulay, 1974, 1984; Forbes, 2007; Kenna, 1976).[23] Spiritual kinship sanctioned by the Greek Orthodox Church is based on sponsorship at baptism (godparenthood) and marriage (*koumbaria*). The concept of *koumbaros/-a* is analogous, but not equivalent, to that of a best man; it stands for both males and females and has a different function, as it is reciprocal and can extend to whole families (it defines a new form of relationship). Spiritual ties could coexist with biological ties and are long-lasting. Traditionally, there used to be a lineal (intergenerational) succession: the *koumbaros* would baptize the first born child who in turn would have his/her godparent or the godparent's offspring as *koumbaros* and so on.

According to marriage rules in the Greek Orthodox Church, children sharing the same godparent are considered spiritual siblings and, thus, cannot intermarry.[24] By the same token, marriage between the biological children and godchildren of a parent is prohibited, as they are also considered spiritual siblings (sometimes extended to spiritual cousins). In some cases, marriage between *koumbaroi* was also prohibited given the spiritual bond (e.g., Forbes, 2007). In terms of biological relatives, marriages between first and second cousins are prohibited by the Church.[25] Different communities held different attitudes towards marriage between third cousins: third-cousin marriage was preferred in communities of strong endogamy (e.g., Peristiany, 1968 for central Cyprus) or deliberately avoided (e.g., Alexakis, 1996:196-197 for Attica; Just, 2000 for Meganisi; Sant Cassia, 1982 for western Cyprus). However, despite the prohibitions by the Church, marriages between second cousins did occur (e.g., Vernier, 1991 for close marriages on Karpathos).[26] In some cases, couples would elope in order to seal a marriage that featured a close biological relationship (e.g., on Kythnos in Dionissopoulos-Mass, 1975).

Furthermore, traditional Greek societies show significant variation in postmarital residence; there has been no general residence pattern applicable to the whole of Greece (Casselberry and Valavanes, 1976).[27] The variation in residence patterns shows a regional trend, mainly with differences between mainland and insular Greece. Virilocality/patrilocality, uxorilocality/matrilocality, and neolocality have been reported for different locations and groups in Greece. However, the differential or ambiguous definition and the inconsistent use of residence terminology in Greek ethnographic accounts produce non-comparable data and allow for different interpretations. Besides problems with the use of prefixes (such as viri- vs. patri-, and uxo- vs. matri-) and their meaning, there are significant issues regarding the use of suffixes (e.g., -local). Depending on the scale of analysis, the suffix -local is used to mean both the house and the village/community. Thus, depending also on available data, the term can mask underlying variation or fail to account for it.[28] For example, patrilocal is used to describe both an exogamous community where women from other communities marry local men whether or not they form a new household, as well as an endogamous community where the local women leave their parental house and move into the husband's household, common in studies of inheritance of property.

This issue was addressed by Carrasco (1963), who proposed the use of "-domestic" to denote the household (domestic residence) and "-vicinal" to denote the village or community (communal residence). This distinction between different residence referents, their application, and their significance in Greek ethnography were addressed by Casselberry and Valavanes (1976).[29] The suffices "-vicinal" and "-domestic" can be used, for example, to distinguish between cases where both spouses remain in their natal village in the case of village endogamy (i.e., natovicinal, combining Carrasco, 1963 and Barnes, 1960 as discussed in Casselberry and Valavanes, 1976), but they reside in one of the spouses' household (viri- or uxoridomestic). The problems arising from the differential use of the term matri-/patrilocal become particularly apparent when different ethnographers use the same term to describe either intra-community (i.e., domestic) patterns, often associated with the inheritance of the familial house, or inter-community (i.e., exogamous) mobility patterns. Accordingly, this analytical and conceptual distinction offers a more nuanced approach to residence patterns, allowing for a clear distinction between different scales of analysis (endogamous/exogamous patterns versus domestic patterns) as well as different scales of kin affiliation, and can potentially be of great use in bioarchaeological studies of residence (e.g., different levels of exogamy are addressed as a potential confounding factor in archaeological studies between household exogamy and descent group exogamy by Ensor, 2013). Moreover, it will allow for a more conservative use of residence parallels from ethnographic accounts, especially when the nature of information and the level of detail available often equates the use of -local with domestic residence.

In an attempt to provide a general taxonomy using ethnographic data, Couroucli (1985, 1987) suggested four types of traditional Greek kinship based on subsistence and assigned to different geographical regions: a) the pastoral communities of continental Greece, characterized by patrilocal residence, inheritance along the patriline, and often by patrilineally extended households, b) the agricultural communities of continental Greece characterized by strict patrilocal residence, often with an emphasis on the nuclear family, with inheritance of the house and the fields through the patriline, while smaller sections of the land were inherited as dowry, c) the agricultural communities of the islands, particularly those of the Ionian islands, which are similar to those of continental Greece, characterized by patrilineal inheritance but often neolocal residence and strictly nuclear families, and d) the maritime communities of the Aegean Sea, practicing mainly fishing and seafaring, characterized by strong matrilineal tendencies, matrilineal inheritance of the house as dowry, matri- or neolocal residence, and a predominance of nuclear families.

Along the same lines, Loizos and Papataxiarchis (1991:9-10) proposed a threefold classification focusing on postmarital residence, kinship, and gender roles: (a) virilocal communities (where sons reside in the immediate vicinity of the natal household) practicing pastoralism, trade, or family agriculture, with a strong emphasis on agnatic kinship through property inheritance, reckoning of names, and reputation, (b) uxorilocal communities (where houses, inherited as dowries and built near the natal households and neighborhoods, are clusters of matrilateral kin) with a matrilateral bias in kinship relations, and (c) an intermediate type of community where kinship is fully bilateral, postmarital residence tends to be neolocal, and inheritance is fully partible. Papataxiarchis and Petmezas (1998), focusing on inheritance and demo-economic patterns, also distinguished between three large regional groups: (a) the communities of northern Greece with agricultural and pastoral economies that stress patrilaterally extended families, virilocality, and male equal-partible inheritance with trousseau as dowry, (b) the communities of central and southern Greece, including the Ionian islands, with family-based agriculture stressing nuclear and patrilaterally extended family with trousseau and land as dowry, and (c) the maritime communities of the Aegean islands involved in commerce and trading, which stress nuclear or matrilaterally extended households, with houses, land, trousseau, and money as dowry. They suggested that the societal changes of the last two centuries have progressively placed the emphasis on marriage as a socioeconomic event that simplifies and thereby limits the functions of kinship in terms of residence, property, and labor (Papataxiarchis and Petmezas, 1998).

Ethnographic and Ethnohistoric Data

Virilocal (or patrilocal) residence has been the most common traditional practice, especially on the Greek mainland. In his seminal work on the transhumant shepherds of Sarakatsani in the Pindus mountain range of Epirus (northwestern Greece), Campbell (1964) observed bilateral kinship (descent through both matri- and patrilines), but with a patrilineal bias.[30] Residence was patrilocal, forming extended households at least for some years; marriage was not endogamous, but the family was described as a corporate group in terms of property ownership and obligations (Campbell, 1964). In a mountainous village of Koutsovlachs near Konitsa (Epirus), kinship was bilateral and marriage was preferentially endogamous both within kin and within socioeconomic group (Schein, 1971, 1973).[31] Postmarital residence could be described as natovicinal and patridomestic, often forming stem households that include the husband's parents and less often his unmarried sisters. Schein (1973) reported a progressive increase in exogamous practices in the 20th century: marriages exogamous to the village formed 25% in 1900-1922, 50% between 1923-1948, and more than 60% after 1949. Given the patridomestic residence, in exogamous marriages women would move into the husband's village and house, while the female dowry consisted of money. In the mountainous village of Syrrako in Epirus (at the high elevation of 1100 m in the Pindus range), during the 19th and early 20th centuries postmarital residence was patrilocal with women incorporated into the husband's household, while married brothers formed joint patrilineal households under the father's authority (Caftanzoglou, 1998). In central Greece, at the village of Vasilika in Boeotia, residence was virilocal (virivicinal and often viridomestic) with preferred village exogamy (Friedl, 1959, 1962). On Euboea, in the village of Ambeli houses and land were inherited patrilineally and postmarital residence was patridomestic (Du Boulay, 1974).

Postmarital residence has been virilocal in the Peloponnese, e.g., in Argos (Karouzou, 1998), Kalavryta (Kapetanaki-Daskalopoulou, 1993), and Arcadia (personal observation). At the agricultural village of Mavriki (Vovoda) in Achaia (northwestern Peloponnese), residence was virilocal; non-local spouses were from neighboring mountain villages, whereas females marrying outside the village moved into the lowlands and the city (this type of marriage was more prestigious and required higher dowry) (Bialor, 1976). In the early 1960s, at Mavriki about 60% of marriages were exogamous in relation to the village; households usually consisted of nuclear families, but extended households were not uncommon (Bialor, 1976).

At Methana in the northeastern Peloponnese, Forbes (2007) observed a bilateral kinship system that intersected with a patrilineal system.[32] He suggested that the former conceptualized the everyday practice structured by intra-generational bonds, whereas the latter was structured by inter-generational bonds and signified self-belonging and social identity. Residence in Methana was strictly virilocal (often viridomestic). A similar pattern was observed at the village of Richia (Zarakas) in Lakonis (southeastern Peloponnese) (Hart, 1992).[33] Residence was patrilocal both in terms of village and neighborhood, where the agnatic clustering of households formed "patrigroups," something that Hart attributed to the Albanian and pastoral heritage of the local population (1992).[34] In southern Argolid, at the agricultural village of Fourni (close to Kranidi), the majority of the marriages were endogamous (about 66%), with 13% consisting of marriages between cousins (Gavrielides, 1976). Regarding exogamous marriages, 22% were virilocal and 11.5% were uxorilocal; incoming spouses originated from nearby villages and towns or were Arcadian shepherds.[35]

In Messenia (southwestern Peloponnese), at the village of Karpofora, postmarital residence was firmly patrilocal (both virivicinal and viridomestic), often with the parents of the husband residing in the same house (Aschenbrenner, 1975, 1976, 1986). There was a clear preference for exogamy (about 67%), with males remaining in the village and marrying incoming females, while females married into other villages. Mani peninsula in southern Peloponnese is an area of extensive ethnographic work with communities of strong kinship ties and long-lasting patrilineal lineages (*yenies* or clans) (see Alexakis, 1975; Allen, 1973; Andromedas, 1962; Seremetakis, 1990, 1991). In Outer Mani, postmarital residence was traditionally virilocal with reference to the village, though not necessarily viridomestic; marriages took place within a seven-village area to assure that the agricultural land (inherited as dowry) was close enough to the village of residence for daily labor (Allen, 1976). On the contrary, the post-World War II male migration from Mani to Athens was accompanied by uxorilocal residence (as observed often in rural-urban migration).[36]

In central mountainous Crete, Herzfeld (1985) adopted the term patrigroups to characterize the observed agnatic lineages. Even though they did not own property, patrigroups were conceptually, ideologically, and politically corporate, sharing a common group name and often the same neighborhood named after the patrigroup; residence was strongly virilocal with preferential endogamy within patrigroups.[37] In western Crete, at the villages of Nohia and Platanos (in the region of Kissamos in the Chania area) residence was also virilocal; exogamy was the preferred pattern and many women originated from different villages (Lazaridis, 2009). On the contrary, in the town of Rethymnon, residence was uxorilocal following, again, the recent urban tendencies: dowry consisted of a house in the town and women would often marry into the town (Herzfeld, 1991).

The islands of the Ionian Sea in western Greece followed the general rules observed on the mainland. In the small island of Meganisi, postmarital residence was generally patrilocal; houses were inherited through the agnatic line showing a patrilineal bias, though households consisted of nuclear families.[38] Even though most of the males were sailors, there was a preference for village endogamy to ensure village solidarity (Roger, 2000). With the advent of urban migration the patrilocal residence was replaced by uxorilocal residence, where the house was provided as dowry. On Lefkas, sons inherited the family's name, nickname, social status, and house (i.e., paternal) in which they cohabited (Kalafati-Papagalani, 1985).[39] In northern Corfu, at the agricultural, non-coastal village of Episkepsi (mainly producing vines and olives), kinship emphasized agnatic ties and residence was strongly virilocal (Couroucli, 1985). In the late 19th century and until the mid-20th century, the common marriage practice was village endogamy (between 63% and 70%). In the cases of exogamous marriages, however, it was chiefly women who moved between villages, whereas men stayed in their natal village.[40] Between 1880 and 1920, incoming spouses originated in other villages of Corfu, whereas after 1921 spouses from places outside Corfu increased. Between 1961 and 1975, endogamous marriages formed 38%, while exogamous marriages in reference to the village but with spouses originating from the same island formed 46%, whereas marriages with spouses originating from other areas in Greece formed 14% (Couroucli, 1985:69). On 18th century Kythera, the majority of households were nuclear; residence was most commonly neodomestic and patrivicinal, and in the cases of extended households patridomestic (Hionidou, 2011).

An exception to the mainland pattern was the coastal village of Trikeri on Pelion, at the southeastern tip of the peninsula of Magnesia (Thessaly, central Greece). At Trikeri residence was uxorilocal with house (usually the maternal house) and property inherited as dowry, though the married couple formed a new nuclear household (Beopoulou, 1981, 1987). Men moved into different family groups but within the same village. There was a strong practice for village endogamy, especially for women, in order to protect the communal property and keep it within the village's boundaries. Even though Trikeri is located on the mainland, it is described as a maritime community consisting mainly of maritime merchants, sailors, and fishermen (even pirates) due to its coastal character (Beopoulou, 1981, 1987; Petmezas, 1998). Thus, the inheritance and residence patterns observed in Trikeri were in contrast to the practices in the rest of agricultural Pelion, wherein women were traditionally exchanged between families and did not receive immobile property (such as land or a house that had to remain within the agnatic line) until much later in the 20th century when the economy changed (Handman, 1985; Petmezas, 1998).

Here, it is worth noting that on the virilocal mainland, uxorilocal and especially uxoridomestic practices were traditionally associated with very low social prestige and poor financial status (e.g., Allen, 1976; Clark, 1988; du Boulay, 1974; Friedl, 1959; Forbes, 2007; Herzfeld, 1991; Kenna, 1976). A husband moving into the wife's house and family was termed *sogambros* (in-groom). There were exceptions. For example when daughters were only children, the family would get a *sogambros* to maintain the property and assure that the parents, when elderly, would be looked after (e.g., Gavrielides, 1976 for Fourni). Alexakis (1984) notes that in that case, the *sogambros* would sometimes change his last name to that of the father in-law in order to maintain the patriarchical family (*yenia*). These "exceptions", nevertheless, illustrate the malleability of marital rules and their role as buffering mechanisms in order to ensure the perpetuity of the social norms. The scornful attitude towards matridomestic practices changed significantly in the urban settings, where uxorilocal residence became common.[41]

Marriage, inheritance, and naming practices on the Aegean islands differed significantly from those observed on the Ionian islands, Crete, and the mainland. In the Aegean, residence was generally matrilocal (often neodomestic; extended households were not the norm), with the maternal house provided as dowry (for first-born daughter), close residence of the matrilateral kin, and naming systems following both patrilineal and matrilineal trends with an emphasis on primogeniture (Dimitriou-Kotsoni, 1993). Papataxiarchis (1995) provides us with a thorough historical account of male mobility and its relation to matrifocality.[42] Even though the concept of matrifocality is beyond the scope of this study, Papataxiarchis's work (1991, 1995) is of great interest. On the island of Lesvos (northeastern Aegean), kinship was bilateral with a strong matrilineal tendency; households comprised nuclear families and sexes were strongly segregated in activities and everyday life (Papataxiarchis, 1995). Houses were given as dowry to the daughters upon marriage, located preferably close to the bride's natal household (technically neodomestic residence), resulting in neighborhoods often divided between clusters of matrilateral kin (Papataxiarchis, 1995; Stamatoyiannopoulou, 1998). This resulted in a strong pattern of female endogamy and male exogamy. Interestingly enough, spiritual kinship (fictive) also aligned with matrifocal ties (Papataxiarchis 1995). Thus, for the Greek ethnic groups at the 19th century village of Mouria on Lesvos marriages between local women and non-local men were a common phenomenon, while there was no evidence for local men marrying non-local women. The origins of the non-local grooms included other villages on the same island, neighboring islands, and different parts of mainland Greece and Asia Minor. This pattern changed in the late 19th century as a result of differences in socioeconomic status and rising elites, when men were linked with the house and the land while women were exchanged between villages. In the post-war 20th century, males migrated to large cities of the mainland or abroad; female exogamy continued and became associated with higher status (women would marry into locations of higher status, e.g., the city). Papataxiarchis (1995) emphasized that the

Aegean was characterized by extreme mobility throughout history and that men were the mobile sex under various capacities (e.g., sailors) and under different forces as a result of socioeconomic and demographic parameters.

On the island of Samos (eastern Aegean), at the village of Kokkari, postmarital residence was uxorilocal, though not necessarily matridomestic (Galani-Moutafi, 1993). The house was provided as dowry and women left neither their natal village nor their neighborhood. Despite the matrilocal residence and the close proximity of women to their natal kin, the overall bilateral kinship in Kokkari traditionally showed a patrilateral bias stemming from the male dominance in domestic power, agriculture, fishing, and various trade activities. This, however, changed with the advent of tourism, which shifted the emphasis to matrilateral kinship associated with the new roles of women in the local economy and the reinforcement of female-kin relations and mother-daughter ties (Galani-Moutafi, 1993). On the island of Fourni, close to Ikaria, residence was neodomestic and uxorilocal: men moved and got incorporated into the marital house provided as dowry and located in close proximity to matrilateral kin (Dimitriou-Kotsoni, 1993).

Uxorilocal residence has been reported for the islands of the Dodecanese in the southeastern Aegean, close to the coast of Asia Minor. On Rhodes, residence was uxorilocal, with the bride's parents providing the house (neodomestic) and the husband contributing the land; endogamy was the norm (Herzfeld, 1980b, 1983; Savorianakis, n.d.).[43] Residence was traditionally uxorilocal on the island of Karpathos in the southern Dodecanese (Skiada, 1991; Vernier, 1984, 1991). When the pattern of reckoning of first names is considered, females were closely associated with the matrilineal side and males with the patrilineal side. The house passed down from the mother to the first-born daughter as dowry. Marriages were endogamous within the village and generally within the patrilineal lineage (defined by the common surname), which also acted as a political party (Vernier, 1984, 1991). On Kalymnos, a rocky island that has a long tradition of sponge diving, residence was strongly uxorilocal (Bernard, 1976; Casselberry and Valavanes, 1976; Sutton, 1998). The marital house came as dowry and was located with or close to the bride's family. Casselberry and Valavanes (1976) provide us with a detailed account of postmarital residence in Kalymnos.[44] They found a strong matridomestic pattern of 85%, thus highlighting the prevalence of matrilocality in some peasant communities. They also reported that matridomestic residence was the common practice throughout the island, as well as on neighboring islands according to local informants. With reference to the village, the large majority was natovicinal (66.2%) showing also a relative endogamous preference. In the cases of inter-village spouse mobility, 18.3% were matrivicinal over 13.6% patrivicinal. This is why they effectively concluded that regardless of the terminology used, the island showed a strong matrilocal tradition. Interestingly, the observed matrilocality on the island was linked to the fact that the majority of males were either sponge divers or sailors and, thus, absent for several months per year (Casselberry and Valavanes, 1976; Sutton, 1998). A similar pattern existed on the island of Symi where men moved into the house, family, and neighborhood of the bride (Zahariou-Mamaligka, 1986). Symi is a mountainous, rocky, and dry island with a marine-based economy and a long tradition of fishing, sponge-diving, and commercial shipping that resulted in the frequent and long-term absence of men.[45] The strong matrilateral bonds on Symi were exemplified by the extensive use of matronymics (maternal name or nickname) instead of the paternal name or last name for the identification of both male and female offspring (Zahariou-Mamaligka, 1986).[46] On Kos, customarily the oldest daughter inherited the family house and part of the maternal inheritance; the rest of the maternal property was divided among the daughters (Savorianakis n.d.).[47]

Within the Cyclades, on Santorini residence was matrilocal, while villages tended to be endogamous (Hoffman 1976). Houses were transferred as dowry from mother to the eldest daughter upon marriage. The parents had to build houses nearby for themselves and for the younger daughters, thus the village neighborhoods represented matrilineal lines; no extended families occurred within the household (Hoffman, 1976). Residence was also matrilocal on Kythnos (houses were inherited as dowries) and strongly endogamous (Dionissopoulos-Mass, 1975). On the island of Anafi, where the economy was based mainly on sheep and herding, residence was neodomestic: the marital house was provided as dowry by the bride's family, while the land was inherited along the patriline (Kenna, 1976).[48] The majority of marriages were endogamous with regard to the island (the situation concerning the villages is unclear) (Kenna, 1976). Occasionally females could marry a non-local man and move in with him, but there were no local men marrying non-islander women. There were no three-generation households or joint households as was often the case on the Greek mainland. Kenna (1976) further considered that the naming pattern gave equal emphasis to both spouse's families; this in turn stressed the bilaterality of kinship ties, with only the paternal surname showing a patrilineal prominence.

On Mykonos, prior to World War II and before the advent of tourism, the marital house or part of a dwelling was inherited as dowry, which was integral to the female eligibility for marriage (Stott, 1973, 1985).[49] There was a preference for marriage within occupation, so that the male spouse could be incorporated into the bride's family labor, while marriages exogamous to the island were a rare occurrence (Stott, 1973, 1985). Based on census data between 1850 and 1950, female mobility was very low; non-local men (mostly sailors) married local women, while temporal ('circular') migration of local men was a common phenomenon (Hionidou, 2002). On Tinos neodomestic residence was the most common form (joint households did not occur), with a tendency for uxorilocal residence and village endogamy (Dubisch, 1976; 1993).[50] Women marrying into the village were usually considered outsiders, though in-marrying women were more than the in-marrying men (Dubisch, 1993). Dubisch (1976) noted that a house, either purchased or the parental one, was the preferred dowry for a daughter; nonetheless, dowry was not as crucial as in other Greek areas. Ethnohistorically, in Naxos, there was an equal emphasis upon both male and female lines and the first-born daughter, named after the maternal grandmother, inherited the maternal house (Kasdagli, 1991, 1998). Extended households did not occur, so residence was neodomestic but strongly matrilocal and in close proximity to the bride's kin and/or to the bride's locality (Kasdagli, 1991, 1998).[51] Likewise, on 18th century Paros the parental house (i.e., maternal) was inherited by the first-born daughter as dowry, while the other daughters tended to get dwellings as dowry (Zei, 1994).

A different variation occurred on Keos island where residence was bilocal: daughters inherited as dowry the maternal houses in the town (urban settlement), whereas at marriage sons inherited the paternal farmhouses houses in the countryside (Alexakis, 1996-1997).[52] Following this pattern, even though nuclear families were the norm, stem families in Keos, when they occurred, were patrilocal and patrilateral in the countryside and matrilocal and matrilateral in the town. The island of Ios was strongly endogamous; households were nuclear and neighborhoods were not kinship-based, even though kin ties were valued (Currier, 1976). There was a seasonal variation in residence: during the winter, the island population was concentrated in the main town or the harbor, whereas during the rest of the year men or whole families were dispersed in small dwellings around the countryside for agricultural purposes (Currier, 1976).[53]

The presence of matrilocal practices includes communities established by refugees from Asia Minor after 1922. One example was the small island of Ammouliani in Halkidiki, northern Greece (settled in 1926 by refugees from Asia Minor), where there was a strong female role (Salamone and Stanton, 1986). Marriage was endogamous with respect to the village and the marital house was provided as dowry (though dowry was not a prerequisite for marriage). Usually, the younger daughter and her husband would reside in the bride's natal house (i.e., maternal house) with her parents and would inherit the house after their death. These communities were different than the traditional rural communities on the Greek mainland. This is indeed interesting because the area of

Halkidiki was reported as traditionally patrilocal (Handman, 1987a, b; 1995).[54] In Halkidiki, dowry included only mobile items and brides would reside along with their parents-in-law; this pattern changed in the 1980s when patridomestic residence was replaced with neodomestic residence and nuclear family households (Handman, 1987a, b; 1995). Matrilocal and specifically matridomestic residence was practiced in the Asia Minor refugee communities in Piraeus, Athens (Hirschon, 1981). Dowry consisted of the marital house, which however took the form of separate living quarters, often in the basement, within the subdivided parental (i.e., maternal) home. These co-resident households sharing the same house were linked through maternal kin (Hirschon, 1981, 1989).

In southeastern Attica, in the Lavreotiki area (at the villages of Keratea, Kouvaras, and Kalyvia), from the mid-19th to the mid-20th century, matrilocal marriages were about equal to patrilocal marriages, while there were also cases of neolocal residence; thus, there was no clear preference in postmarital residence (Alexakis, 1996). In 1850-1900, 32% of marital houses came as dowry, whereas in 1901-1940 the percentage of dowry houses formed only 18%; in both time-periods the inheritance of land as dowry was around 90%, so there was a matrilocal tendency (Alexakis, 1996). In other villages of the Lavreotiki, 60% of marital houses were inherited as dowry. Regarding the spouses' origins, in the majority of marriages both spouses came from the Lavreotiki (88%), while villages were generally endogamous (75%); however, in cases where one partner was not from Lavreotiki, men showed larger variation in origins, although it is not clear whether or not it was the bride who changed residence upon marriage (Alexakis, 1996:24-25, 206-208). Kinship (*soi*) in Lavreotiki was both bilateral and patrilineal (Alexakis, 1996:172). Alexakis (1996) concluded that the dowry system in the Lavreotiki fell in between that of the mountainous Greek mainland and the Aegean islands: women inherited land but not necessarily a house (unless there was a sogambros). This kind of inheritance system, providing the offspring with rights to the family property regardless of sex, occurred on the eastern mainland (from coastal Thrace and Macedonia in the north all the way to eastern Lakonis in the south). On the contrary, in the mountainous inland areas, dowry included neither land nor house. Land as dowry and the frequent occurrence of sogambros in areas with Arvanites was coincidental; on the contrary, among Arvanites one would expect more patriarchical structures (Alexakis, 1996:57-64).[55]

On the island of Cyprus, residence was traditionally matrilocal; the marital house was either the bride's maternal house or a house built specifically for the married couple and provided as dowry (Hatzitheoharous-Koulouridou, 2004; Sant Cassia, 1982). There was also a preference for village endogamy (Loizos, 1975; Peristiany, 1968, 1976; Sant Cossa, 1982).[56] On the northwestern part of the island (Morphou region), in a large Greek Cypriot village, about 80% of marriages between 1930 and 1969 were endogamous to the village (Loizos, 1975).[57] Prior to 1940, the marital house was customarily provided by the groom and in the case of exogamous marriages residence was virilocal, whereas after 1940 the marital house was customarily provided by the bride and residence became uxorilocal (Loizos, 1975). Loizos (1975) linked the change in marriage and residence practices with male emigration, which caused a proliferation of unmarried women; the addition of the house as dowry resulted from competition over the few available men. In this, he emphasized the malleability of the seemingly fixed residence rules as marriage strategies to accommodate changing social needs (Herzfeld, 2006). However, virilocal residence in early 20th century was not supported by other studies on Cyprus. At the large, agricultural Greek Cypriot village of Peyia on the western coast (Paphos area), the majority of marriages prior to 1930 were endogamous to the village (about 75%) and in the cases of exogamy the spouses originated from neighboring villages (Sant Cassia, 1982). This pattern changed after 1930 when the tendency shifted to exogamous marriages (Sant Cassia, 1982).[58] However, in contrast to the northern part of the island, since at least 1920 residence in Peyia and the Paphos area was uxorilocal, given that the marital house as well as land were inherited as dowry (Sant Cassia, 1982). This pattern was confirmed by Hatzitheoharous-Koulouridou (2004) who studied dowry contracts from 1920 to 1974 in Cyprus and found that in 80% dowry had to include the marital house. In discussing marriage practices, Sant Cassia (1982) stressed the impact of the Greek Orthodox Church marriage prohibitions between first and second cousins, and spiritual siblings on the availability of eligible mates within a community. In addition to the Church's exogamy rules, Loizos (1976) raised the issue of village size and the scale of analysis, emphasizing that small villages tend to function as clusters consisting of neighboring communities wherein, for example, inter-village affinal ties can play a significant role (e.g., Vasilika).

These rich ethnographic data emphasize not only the importance but also the regional variation in the conceptualization and practice of kinship and postmarital residence even within Greece, attesting to the fact that they are complex phenomena that need further examination. The pattern emerging from the ethnographic data is interesting. There seems to be a geographic/regional component to the residence patterns with communities in mainland Greece traditionally practicing virilocal residence (where uxorilocal residence is scornfully viewed) and the Aegean islands, where uxorilocal residence dominates. Another point pertinent to this study is the fact that uxorilocal residence (usually associated with matrilineal biases) is often attributed to high male mobility and/or the maritime nature of those communities where men are absent for long periods of time (e.g., seafaring). On the contrary, virilocality was linked to the long tradition of agropastoral economies, where land formed the core of family property. The few matrilocal exceptions on the mainland occur in coastal communities of a maritime nature (Beopoulou, 1987) or in settlements with a large influx of immigrants (Hirschon, 1981). Furthermore, virilocal residence is often associated with extended patrilocal and patrilineal households. Uxorilocal residence, on the other hand, rarely is associated with extended households. Finally, the mainland-island distinction shows that on the mainland when exogamy is practiced it means the ‘import’ of brides, whereas the islands (especially the larger ones) are characterized by high male mobility where in-marrying men come from not only different villages but different islands. Thus, acknowledging the limitations and the risks associated with ethnographic analogies between the present and the past, Aegean ethnography can be used to construct models for prehistoric human mobility that could also inform the character and activities of the communities under study: e.g., an uxorilocal pattern could be expected in nautical communities similar to the insular ones.

Mortuary Behavior and Secondary Treatment in Greece

Exhumation has been central to Greek burial customs, today and historically, where secondary deposition is the norm. The exhumed remains are either placed in an ossuary or reburied in family tombs. The common practices are directly related to the Greek Orthodox religion, which is a 'national' church tied to the political apparatus.[59] This means that the Greek Orthodox Church is easily the dominant religious organization in Greece. As such, it is inextricably tied to Greek culture, particularly in those sectors of society that can be labeled 'traditional.' It follows that this uniformity in religious faith is mirrored by the general uniformity in the Greek burial program.

The word cemetery is derived from the Greek word *koimeterion* that means a place of sleep (dormitory). The use of the verb "sleep" instead of "die" is also common in the Greek culture reflecting the belief to the afterlife. The death marks only the end of the corporeal existence, but the soul continues to exist. The dead are thus sleeping until the Second Coming when they will be physically resurrected to meet Christ. Greek cemeteries are public. They belong to the local municipalities and exist in association with a church or a chapel. The cemetery area is demarcated by an enclosure (usually a wall), traditionally having only one gate. The gate to the cemetery parallels the gate to the world of the dead as often mentioned in Greek laments. The graves are arranged in parallel rows, oriented west to east according to the orientation of the body with the head to the west in order to see the Christ rising from the east at the Second Coming. Cemeteries consist of supra-ground grave markers (typically marble boxes with a cross and often an enclosure) separated by narrow passages. Each grave always contains a photograph of the deceased and an oil lamp that needs to be lighted continuously.[60] The maintenance of the graves is traditionally a family obligation, particularly for females. Women commit to the upkeep of the grave as well as to that of the household, as the grave is often referred to as the "last residence" (Hirschon, 1983).

In Greece, inhumation is the only permissible form of interment, as cremation is against the Christian Orthodox faith.[61]According to the Christian dogma of "earth to earth" the body must decompose naturally in the burial ground (see also discussion in Danforth, 1982 and Panourgia, 1995). Burial takes place shortly after death. Embalming that interferes with the dissolution of the body rarely occurs, mainly when burial needs to take place long after the death, such as in the case of public figures who are kept in churches for several days for people to pay their respects or if repatriation is required. Normally, the deceased is placed in a wooden coffin and lowered inside the grave pit, at a depth of a few meters. The coffin is placed directly into the soil to ensure the decomposition of all organic materials. Following burial, there is a long series of memorial services at the Church and the grave site, such as at three days, nine days, forty days, six months and then annually, as well as dinners.[62] In addition to the individual memorial services held by the family after burial, there are several communal memorials during the year that commemorate and celebrate all the dead of the community (e.g., "Soul Saturdays").[63]

Exhumation of the deceased takes place three or five years after death and no less than two.[64] This process is accompanied by a ritual now involving only the close family members, though in the villages it can be more extensive. Traditionally, exhumation was analogous to the funeral and involved a large part of the local community. First the priest delivers the appropriate psalms at the grave, which are for the most part the same as those recited in the funeral service. Afterwards the cemetery keepers destroy the memorial grave marker and dig through the grave to uncover the skeletonized remains. The bones are collected and washed with red wine, symbolizing the blood of Christ, and water by close female family members and dried in the sun. Special care is taken so that the skull is removed intact; traditionally, the family members would embrace and kiss the cranium (Danforth, 1982; Eliopoulos, 2006; Politis, 1873). After the exhumation ritual is complete, the bones are placed inside a box with the name, age at death, and date of death along with the photo of the deceased and stored in the ossuary. Ossuaries are small buildings within the cemetery area where the boxes with the skeletonized remains are stored on shelves. Family members are permitted to visit at any time, place flowers, light candles, and recite prayers with the priest inside the ossuary area. The unearthed grave is then open for the burial of another deceased who is not necessarily of the same kin group. Thus, these graves are temporary (rented but not owned), used for the successive exhumation and inhumation of different individuals.

Alternatively, the bones are reburied, often in a family tomb. These are permanent tombs owned by families and used for the sequential burial of family members. When a new relative dies, he or she is interred in the family tomb after the bones of the most recently deceased member are placed into a box or bag and buried inside the tomb on top of or next to the coffin. [65] This can be repeated numerous times, as long as the family members continue to use the same tomb, thus creating a "stratigraphy of death which records the temporal spacing of deaths through the years" (Panourgia, 1995:128). Family tombs are a very common phenomenon in modern Greek cemeteries and can include either the immediate or the extended family. Hence, which family members are given access to the family tomb is an interesting process worth special attention. Panourgia (1995) discusses the case of a family tomb that included members of the extended kindred such as grandparents, parents, offspring, grandchildren, and selected in-laws and in-laws' parents. Thus, burial within the family tomb is based on the approved or disputed "family status" of the deceased resulting in a permanent social statement.

In Greece, it is not normal to purchase a tomb before one's death (it is actually considered bad luck), so family tombs are initiated after someone's death or when the time comes for the exhumation of a family member. Therefore, family tombs are created around a person or a couple; whoever gets chosen to be the first to be interred in a family tomb is usually viewed as the 'head' of the family. For example, in the case of my family, the death of each of my grandfathers resulted in the creation of a family tomb that also included the bones of their mothers, which had up to that time rested in the ossuary. On the other hand, the bones of my grandmothers' parents were either in separate plots or in plots with their male offspring.[66] The pattern of burial matched the pattern of residence in life that was virilocal: both my maternal and paternal grandmothers moved into the house of their husbands and co-resided for decades with their widowed mothers-in-law, and now co-reside with them in the same grave for eternity. This domestic residence pattern was subsequently transferred to the burial location. Thus, post-mortem residence, i.e., the tomb, mirrors post-marital residence and kin affiliation (Fig. 2.1). The relationship between family, residence in life, and residence in death is also illustrated by the use of the word house (*oikos*) for family graves, usually followed by the common last name of the buried individuals (Clark, 1988; Forbes, 2007; Panourgia, 1995). In Methana where exhumation is not practiced, the individual tombs are organized based on kin affiliation and family members (according to last names) are buried next to each other in different sections, forming “a kinship landscape of the dead” (Forbes, 2007:316-318). In Anafi the exhumed bones were reburied in the ossuary of the chapel associated with either the patrilineal side or the family land (customarily inherited through the male line), thus stressing the territorial aspect of burials (Kenna, 1976).

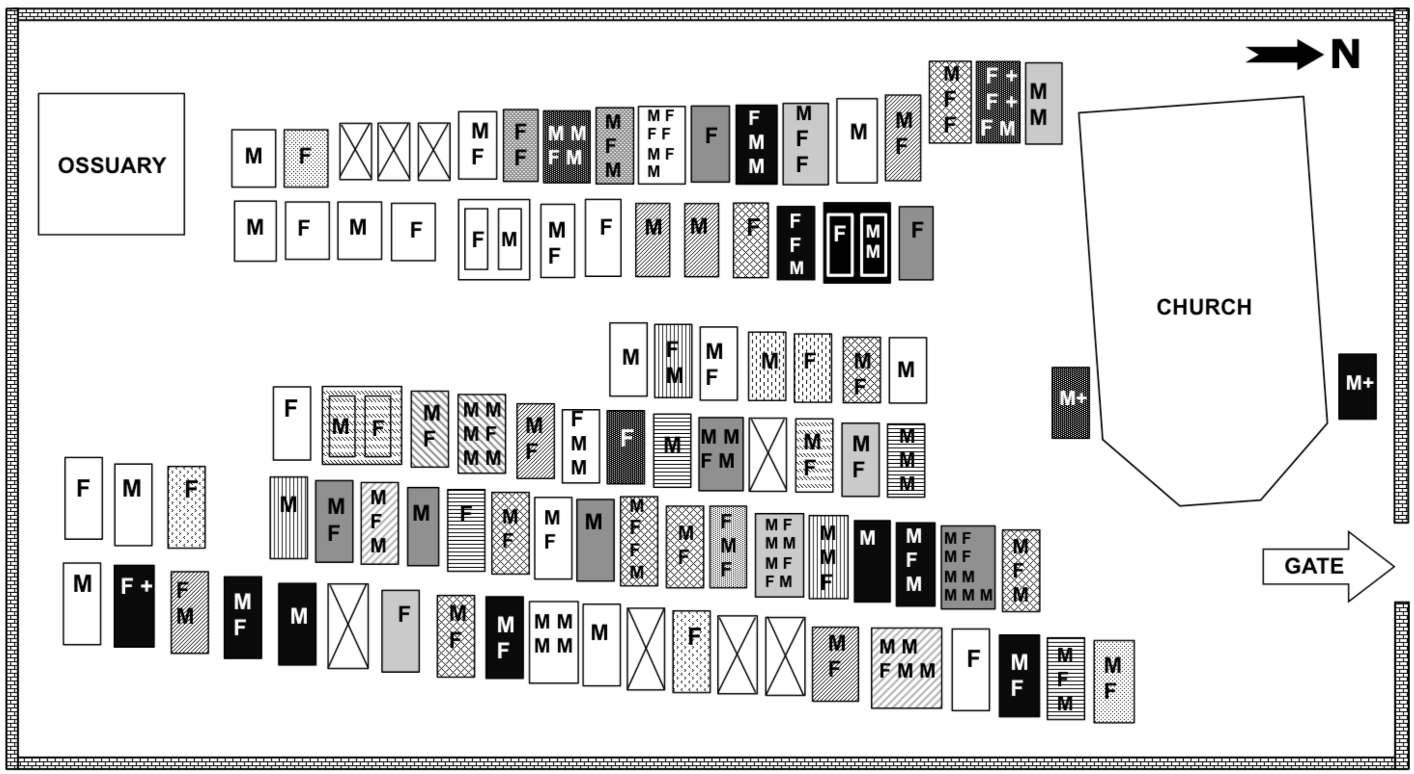

Figure 2.1. Plan of a village cemetery in mountainous Arcadia showing the organization of sexes and kin groups. The organization of the plots follows the patrilocal and patrilineal model common in the area and on mainland Greece. The majority of graves contain multiple individuals (up to nine) and they are all family graves often indicated as "House" or "Family Plot" (M, male; F, female; +, priest or priest's wife). Different color patterns represent different kin groups, based on the last name. Graves of last names that occur only once are left white; x-marked graves are empty. Note that all individuals within a grave share a common last name following the general scheme of parents and male offspring with their wives and/or unmarried daughters who preserve the family name (until 1983 women by law received their husband's last name). Thus, the family plots represent both consanguineal and affinal relationships. Graves of the same kin are often close to each other, but they can occur in multiple locations.

Interestingly, in many villages, until a few decades ago, exhumed bones were placed into an area of the cemetery that formed a communal ossuary usually called the *honeftirion* (loosely translated as melting pot or crucible).[67] The remains were placed inside a cloth sack or a wooden box with the name of the deceased, but these disintegrated quickly, resulting in an area filled with mixed bones of the village dead all resting together (e.g., Hart, 1992).[68] Post-exhumation one's ancestors did not exist individually, but only collectively. The graves were marked by perishable materials (e.g., wooden crosses) or stones. Permanent family graves for the reburial of the bones arose as an indication of status and family history by the wealthier families (Protodikos, 1860) in the 19th century and became progressively more popular in the 20th.[69] Consequently, heaps of human bones were a frequent sight in everyday life until recently, as they were visible and accessible in the cemetery grounds. In fact, medical students used to take bones from ossuaries for study (see also Panourgia, 1995:129). Stories of village children and men playing 'dare' games to prove their bravery, challenging each other to obtain a skull from the ossuary at night were also a common occurrence (personal observation). Around the mid-1900s exhumed remains that did not go into family tombs were placed in individual wooden or metal boxes and stored in built ossuaries: the ossuary was communal, but the remains were stored in individual containers maintaining the identification of the long deceased people.

Exhumation, even though widely and commonly practiced throughout Greece, is neither necessary nor strictly prescribed by the Church.[70] Family members can choose not to exhume a body, as in the case of family tombs. There are areas in Greece where graves are permanent after inhumation, although this is a rare phenomenon. As an example, in post World War II Methana exhumation and secondary treatment of the bones was not practiced; however, a grave could be used for the interment of a second individual, usually a spouse. Spatial organization of graves followed kinship ties: spouses were buried in the same grave, and graves were grouped in family clusters sharing a common last name and thus representing the virilocal pattern of residence (Forbes, 2007).

The lack of space and the need to accommodate the accumulated large numbers of the community's deceased has been a valid explanation for the practice of exhumation (Danforth, 1982; Eliopoulos, 2006). Indeed, exhumation and reburial in family tombs or placement in an ossuary allow for the maintenance of the cemetery ground within its prescribed boundaries throughout time, given that inhumation is the only permitted form of burial. Thus, exhumation does serve a practical necessity. Nevertheless, there is a spiritual and religious component to this long-standing rite.

The complete decomposition of the flesh and the presence of white, clean, pure bones at the time of exhumation are of critical importance. The dissolution of the flesh indicates the dissolution of sins and the entrance of the deceased into paradise; incomplete decomposition and blackened bones signify a sinful person or a sinful ancestor, a troubled and unrested soul, and an incomplete separation of the dead from the world of the living.[71] This is exemplified by common, traditional curses such as "may the earth not receive you" and "may you remain undissolved" (see also Danforth, 1982). The liminal period after burial when the body decomposes (as a form of destruction of the living person) and the soul transitions to paradise ends with the rite of exhumation; this passage represents the "parallel between the moral condition of the soul of the deceased and the physical condition of the body", as well as "between the incomplete separation of the soul from the body and the incomplete separation of the dead from the living" (Danforth, 1982:53, building on van Gennep, 1960; Hertz, 1960, 2004).[72]

Exhumation acts as a paradox. It is the last individual ritual and a dramatic separation rite whereby the deceased is completely and permanently incorporated into the communal world of the dead signified by the ossuary. At the same time, it brings the remains from dark back into light and provides the living with the final and sad opportunity to communicate and reunite with the deceased (hence the kissing of the cranium) (Danforth, 1982). The rite of exhumation thus marks the end of the liminal period for the dead that is reduced in a pure and permanent state, the soul that reaches the final destination in paradise, and the mourners who then rejoin the world of the living (Danforth, 1982).[73]

Regardless of the associated interpretations and arguments about population dis-continuities, the long tradition of mortuary practices including inhumation, secondary treatment, and collective burial in Greece cannot be ignored. If nothing else, this continuity indicates a special relationship with bones, a familiarity with secondary handling, and reverence of relics: the bones of family, the bones of ancestors, the bones of heroes, the bones of warriors, the bones of saints. As articulated by Alcock (1991:447) for ancient Greece: "[t]he Greeks constantly made 'myth out of bones', and through time the remains of the ancestors served in many capacities: as political weapons, as territorial markers, or as legitimating devices". The importance of the heroes' relics with their embedded power is exemplified by a series of narratives in antiquity: the need for Spartans to recover the bones of Orestes from Tegea in order to defeat the Tegeans (Hdt. 1.67.5-68.6; Paus. 3.3.6; also Huxley, 1979), the appropriation of the bones of Arkas from Mainalos by the Mantineians (Paus. 8.9.3-4), the transference of the bones of Theseus from Skyros to Athens by Cimon (Plut., *Theseus* 36; *Cimon* 8.3-6; Paus. 3.3.7), and of course the contested bones of Oedipus between Athens and Thebes (Sophocles, *Oedipus at* Colonus), among others (see also Rohde, 1894 for heroes and the cult of the souls).

In the Christian period the relics of heroes were replaced by the relics of martyrs and saints. Holy relics are used for the inauguration of churches and are accessible to the believers. The bones of monks and priests are also preserved and stored in monastery ossuaries with great reverence, particularly the crania. The "bones bare of flesh" are cited in the Christian Orthodox funeral service as the only outcome of the physical death for all people, regardless of wealth or power, thereby underlining the futility of materialistic possessions. Despite exhumation, the bones of one's family and one's ancestors are deeply valued. The skeletal remains constitute a physical reality, as well as an inherent, familiar concept that goes beyond their materiality. Bones, for example, come up in various everyday expressions. In Greece one swears an oath, not on someone's grave, but on someone's bones (i.e., "on his/her father's bones"). Likewise, the equivalent expression for "turn over in one's grave" in the case of a hubristic act against a deceased individual is "one's bones will creak and squeak". In that sense, it cannot be a coincidence that the Greek national anthem, written by D. Solomos in 1823, praises “liberty arising from the sacred bones of the Greeks”. The famous Greek ethnographer Politis (1873) also emphasized the reverence for the skeletonized remains of the ancestors. This is further illustrated in the account of the people of Parga (in northwestern Greece), when the town was sold to the Turks by the British in 1819: before fleeing, they unearthed and burned the bones of their forefathers so that they would not be defiled by the Turks (De Bosset, 1819; Foscolo, 1850). The burning of the ancestral bones at Parga is also described by a Greek traditional song (*demotikon*) (Aravantinos, 1857:204-205; quoted also by Politis, 1873:1199-1200).

Altogether Greek mortuary rituals are a different variant of the Mediterranean region and should not be subsumed under the umbrella of Western practices. As an example, Panourgia (1995:194, ft. 8) makes an excellent point about how unfamiliar Americans are with collective graves and most importantly with the idea and practice of reburial. Mortuary customs need to be considered within their regional and historic context. An emic, contextualized approach to mortuary practices in Greece and the Aegean world needs to account for the deep-rooted familiarity with physical remains and the practice of secondary treatment. Finally, based on the ethnographic mortuary data, secondary treatment and reburial is not only a ritualistic act but also generates social statements about the nature of the burial group. There is clear evidence that postmortem residence (i.e., burial location) can, in fact, correlate with postmarital residence, and in some cases, domestic residence. For example, as shown earlier, in virilocal mainland communities women are buried with their husbands’ family (that includes unmarried daughters) forming patrilineal and patrilocal burial groups. Thus, there is great potential for the study of prehistoric kinship through the mortuary record in the Aegean.

Bioarchaeological Perspective

Kinship and residence can become a dynamic organizational strategy for the negotiation of individual and collective identities, group membership or differentiation, community alliance, and access to sociopolitical power, as well as a structuring force particularly in non-state societies. Even though archaeological reconstructions of kinship have long received considerable criticism (e.g., Allen and Richardson, 1971), there is a growing interest in the archaeology of kinship (see Ensor, 2013; also Meyer et al., 2012). In effect, the advent of bioarchaeology provided mortuary archaeology with the appropriate analytical tools for the examination of the complex relationships between past sociopolitical, ideological, and biological dimensions (Buikstra, 1977; Buikstra and Beck, 2006) and the reconstruction of social phenomena such as kinship and postmarital residence, particularly through biodistance analysis and biogeochemistry (e.g., Knudson and Stojanowski, 2008). Social relationships cannot be identified through the skeleton – they do not leave a skeletal trace. Biological relationships do. Thus, the analysis of human skeletal remains can be the starting point for the study of social phenomena where inferences about social relationships can be built upon the presence or absence of biological ones.

Arising from a synthesis of Washburn's "New Physical Anthropology" (1951) and Binford's "New Archaeology" (1962), the field of bioarchaeology was introduced by

Buikstra (1977) as a new multidisciplinary perspective on anthropological inquiry and the study of biocultural changes.[74] Buikstra (1977) called for a highly contextualized analysis of human remains incorporating archaeological and social theory, and a scientific orientation aiming at anthropological problem-solving through testable hypotheses and models of human behavior. Almost forty years later, the term is widely used and bioarchaeology has been accepted as an academic field, both in publications and in academic institutions (Buikstra, 2006a,b,c). By bridging the biological and social sciences (as its name denotes), bioarchaeology brought physical anthropology back into the realm of anthropology and human remains back into their archaeological context. Hence, bioarchaeological analysis provides a theoretically solid approach for the reconstruction of past human behavior, sociopolitical organization and processes, individual and population histories, and social identities, as well as for addressing and understanding the microevolutionary processes of gene flow, genetic drift, and natural selection. In addition, a recent development of the field is expressed in the bioarchaeology of identity, which addresses the construction, experience, negotiation, and interplay of social identities (such as ethnicity, gender, age and life course, embodiment, disability, and impairment), and allows for a more nuanced approach to the behavioral reconstruction of past societies and biocultural histories engaging in social theory (e.g., Diaz-Andreu et al., 2005; Gilchrist, 2000; Gowland and Knüsel, 2006; Insoll, 2007; Knudson and Stojanowski, 2008, 2009; Meskell, 2002; Sofaer, 2006; Stojanowski, 2005a).

Despite the fact that the current, wide use of the term implies a unitary conceptualization, definitions and traditions still vary greatly.[75] The debate between processual and post-processual approaches created a major theoretical divide in archaeology. After the 1980s, the rift became greater in European archaeology and the British scholarship in particular, where the polarity between processual and post-processual approaches and between modernism and post-modernism remains to this day unabated. This dissertation, even though it focuses geographically on Greece, theoretically lies more closely tied to a North-American processual-plus approach (Hegmon, 2003). This term was introduced to describe a broad range of approaches that stem from a generally processual perspective but also incorporate diverse theoretical elements (e.g., post-processual trends in different degrees) without necessarily being ascribed to a particular theoretical position or paradigm (Hegmon, 2003). Even though some aspects of early processual archaeology - such as cultural evolutionary typologies and a focus upon ranking and social status - have generally been dismissed or reformulated, other principles of this approach remain valid. Methodological rigor, systematic collection and reporting of data, hypothesis testing, research design, and use of multiple lines of evidence are essential to archaeological inquiry and should form the foundation of any further interpretive framework (e.g., Duke, 1995; Redman, 1991; Wylie, 1993, 2000, 2007). At the same time, as Hegmon (2003) argues, the processual-plus mainstream is also engaged with social theory and integrates concepts of symbols and meaning, ritual, cosmology, notions of place and space, gender, power, agency, and practice (especially Bourdieu's *habitus* [1977] and Giddens [1974]). Whereas previously the focus on past social organization - one agendum of the New Archaeology - was considered to be an end in and of itself, it now encompasses the study of its diverse components and strategies, such as kinship and leadership, and the part they play as arenas for both individual and group integration and differentiation.

In this, I favor a stance described as "mitigated objectivism" embracing the significance of "evidential constraints" in archaeological interpretations (see Brumfiel, 1996; Wylie, 1992a,b, 1993, 2000; cf. Fotiadis, 1994).[76] In relation to mortuary contexts, this approach has been eloquently and effectively described by Charles and Buikstra (2002). The constructive interplay between diverse theoretical traditions is embodied in the analytical framework of bioarchaeology. Thus, building upon data established through bioarchaeological science and acknowledging any methodological limitations, I intend to "push interpretation as far as the 'evidence' will allow" (Charles and Buikstra, 2002:16) to examine alternative archaeological hypotheses and propose additional testable theses not driven (at least intentionally) by theoretical predispositions.

Aegean Bioarchaeology

Even though the analysis of human skeletal remains is still not fully integrated into Aegean archaeology, particularly its interpretations, significant attempts have been made towards a multidimensional and interdisciplinary approach with progressively increasing numbers of human skeletal studies in the last couple of decades.[77] These can be traced to the seminal contributions of J. Lawrence Angel, the founder of contemporary physical anthropology and paleopathology in Greece and the Eastern Mediterranean (for a review of Angel's work and contributions, see Buikstra, 1990; Buikstra and Prevedorou, 2012). During the 1940s, Angel advocated a contextualized, problem-oriented study of archaeological human remains with his social biology (1946a) and created a legacy in skeletal studies in the Aegean.

In Aegean bioarchaeology certain research fields - such as paleopathology- have been addressed more than others.[78] Overall, current bioarchaeological research shows a trend towards demographics, health and disease, behavior and paleodietary reconstruction (e.g., Bartoli, 2001; Fox-Leonard, 1997; Iezzi, 2009; Lagia et al., 2007; Liston, 1993; Papathanasiou, 2001, 2003; Petroutsa and Manolis, 2010; Roberts et al., 2005; Schepartz et al., 2009), as well as forensic work for aging and sexing (e.g., Eliopoulos, 2006; Charissi et al., 2011; Fox et al., 2011; Manolis et al., 2009; Mountrakis et al., 2010). However, studies of kinship and postmarital residence are scarce (see also Buikstra and Lagia, 2009 and Lagia et al., 2014 for overviews of contemporary bioarchaeological research in the Aegean). The stimulating bioarchaeological treatments of kin relations and postmarital residence applied in different contexts through biodistance (e.g., Konigsberg, 2006; Stojanowski and Schillaci, 2006) have not permeated Aegean archaeology. In fact, even though biological and marital kinship studies have been central to Greek ethnography and anthropology (Allen, 1973; Campbell, 1964; Dimen and Friedl, 1976; Herzfeld, 1983; Just, 2000; Seremetakis, 1991), and also in history, particularly in Homeric studies and Classical antiquity (Billigmeier, 1985; Humphreys, 1978; Varto, 2009), they are nearly absent in the bioarchaeology of the region. The sub-discipline of Bronze Age Aegean archaeology often uses kinship (presumably long genealogies) as an umbrella term for the basic socioeconomic unit in theoretical debates (e.g., Branigan, 1998; Voutsaki, 2010) though it rarely addresses or defines it. Thus, despite the major advances in the field, prehistoric kinship in the Aegean remains nearly as elusive as it was forty years ago (Renfrew, 1972).

By integrating osteological, biogeochemical, and archaeological data, this study applies a contextualized bioarchaeological approach to address long-lasting archaeological questions on collective grave use, cemetery structure, descent systems, mate exchange, and social networks through residential relocation in the Aegean Early Bronze Age. Drawing also on ethnographic research, it examines how biocultural phenomena such as familial ties, affinal relationships, and residential changes came into play in the formation of social realities. For example, the prehistoric custom of successive burials that will be discussed in the following chapter presents close similarities with the long tradition of exhumation and reburial in family tombs or communal ossuaries still practiced in Greece. The potential materialization of kinship relations in the mortuary domain, as shown for the rural communities, can provide a useful framework for the investigation of the formation and negotiation of collective identities. It can also be used for a more nuanced approach to the behavioral reconstruction of past societies. On a broader scale, this work aims to add to the anthropological investigation of kinship and residential mobility, as well as the interplay between the two as mechanisms of integration, adaptation, or differentiation at a time-depth of four to five millennia.

CHAPTER 3

ARCHAEOLOGICAL CONTEXT

This doctoral study focuses upon the southern Aegean, particularly Attica and the surrounding regions during the millennium that marks the transition from Final Neolithic to the early phases of Early Bronze Age (ca. 3500 – 2500 BC).[79] Northern Greece shows distinct cultural features and generally follows a different course (see Andreou, 2010; Andreou et al., 1996; Halstead, 1994; for EBA burials in northern Greece see Triantaphyllou, 2001). The island of Crete likewise had a different historical trajectory than the mainland. Crete has been excavated and studied extensively and thus forms a separate analytical unit (for Bronze Age Crete, see the relevant sections in Cline, 2010 and Shelmerdine, 2008).

Temporal and Geographical Scope

The Aegean Bronze Age (ca. 3100/3000 to 1050 BC), has traditionally been classified into three distinct, bounded cultural units tied to specific geographical regions: mainland Greece, home to the Helladic culture (known as Mycenaean during the Late Bronze Age, after the type-site of Mycenae); the islands of the Cyclades, which make up the Cycladic culture; and the island of Crete, corresponding to the Minoan culture.[80] This tripartite divisional scheme became so popular that it still dominates Aegean archaeology, penetrating every aspect of Aegean prehistory including concepts of human and cultural interaction, sociocultural change, and population studies. [81] An analytical overview of the

Bronze Age is beyond the scope of this study (see Cline, 2010; Cullen, 2001; Manning, 1994; Shelmerdine, 2008; for chronological tables, see Manning, 2010:Table 2.2, and Broodbank, 2000:Fig. 1). In this chapter, I will focus on the EH I period and the late Final Neolithic phase leading to it, and I will present the topics relevant to the present research in order to provide a general background. Attica will be discussed in detail in the following chapter (Chapter 4).

The Early Helladic period is the least known and studied period in the Bronze Age Aegean. Geographically, it covers Boeotia, Attica, Euboea, and the Peloponnese, with Argolid, Corinthia, Attica, Boeotia, and Euboea forming the “heartland” of the mainland Bronze Age cultures (Pullen, 1985:47). Chronologically, the EH period ranges from ca. 3100/3000 to 2100/2000 BC and is subdivided into three phases: EH I (3100/3000 – 2650 BC), EH IIA (2650 – 2500 BC), EH IIB (2500 – 2200 BC), and EH III (2250 – 2100/2050 BC) (Manning, 1995:Fig. 2, 2010: Table 2.2).[82] EH II is not only the period with the most striking developments, but also the period most studied (Rutter, 2001). EH III has been studied generally in relation to debates over the nature of the end of the EBA (see Forsén, 1992).

The transitions from EH II to EH III and from EH III to MH are generally marked by discontinuities in material culture (e.g., change in ceramic styles), associated in some cases with destruction layers and abandonment of various sites. These “cultural breaks” initially gave rise to a series of hypotheses about a violent invasion of Indo-European speakers during this time (e.g., Caskey, 1960, 1971, 1986). Recent research has abandoned the invasionist theories and has focused upon a gradual and subtle process of cultural change of a probable endogenous or environmental nature without, however, dismissing the possibility of associated population movements (Forsén, 1992, 2010; Rutter, 2001).[83] In the Cyclades, the absence of EB III pottery suggested a "gap" in material culture between EB II and the succeeding early MBA. This "gap" has been associated with a break in Cycladic and Minoan contacts, the end of artifactual traditions (such as the marble figurines and vessels), and a major shift in settlement patterns from dispersed in the EB I and II to nucleated in the early MBA (Rutter, 1983, 1984, 2013; see also Davis, 2013; Broodbank, 2013; Pullen, 2013; Wiener, 2013). Interestingly, Attica continues its close ties to the Cyclades and shows a similar "hiatus" in EH III. However, contrary to the southern mainland, the central mainland (e.g., Boeotia) underwent a more gradual transition. Moreover, neither Crete nor the islands of the eastern Aegean have revealed a comparable break in continuity between the EBA and MBA (Brogan, 2013; Kouka, 2013).

EH I is the least well known period and for decades was considered to be poorly represented, with EH I tombs practically missing (Alram-Stern, 2004:156-157, 279; Cavanagh and Mee, 1998:15; Coleman, 2011; Rutter, 2001). The general lack of studies (and interest) for EH cemeteries and skeletal assemblages is reflected in Rutter's review (2001:116-117), who attributes the gap to the scarcity of material, particularly in the case of EH I.[84] Recent discoveries and excavations, however, draw attention to the Early Helladic time and mark the need for a reevaluation of the "elusive" EH I period.

The End of the Neolithic Period and the Beginning of the Early Bronze Age

The Neolithic period in Greece and the Aegean region begins in the early seventh millennium BC (roughly at 7000/6800 BC), with the Pre-Pottery phase on the mainland (Thessaly, Argolid) and Crete.[85] Starting in the early seventh millennium BC, small, dispersed farming settlements emerged on good arable land near water, normally in coastal and riverine settings. Occupation was denser in Thessaly, central, and northeastern Greece, while it remained sparse in the Peloponnese and southern Greece and the islands until the Late Neolithic. During the course of the Neolithic, small-scale complexity in social organization and craft production took place, as well as long-range interaction as indicated by the movement of exotic materials (e.g., flint, *Spondylus gaederopus* shell ornaments, and metals within and beyond the Aegean (Perlès, 1992). The earlier Neolithic phases (approximately the Early and Middle Neolithic; ca. 7000-5500 BC) show a strong communal character with households sharing common, open spaces (for food preparation and consumption?) that mark collective activities (see Tomkins, 2010). In the later Neolithic phases (approximately the Late and Final Neolithic; ca. 5500-3500 BC) there seems to be more emphasis on the role of the household as a residential, socioeconomic, and productive unit (probably extended households given their size), with more defined household spaces and enclosed external areas. This change further crystallized in the Final Neolithic (ca. 4500 – 3500 BC) and the transition to the Early Bronze Age (ca. 3600/3500 BC onwards) with the clear separation of the household and communal spheres (e.g., an emerging preference for indoor cooking areas).

The lengthy Final Neolithic (ca. 4500 – 3500 BC) saw great changes in settlement organization, technology, and the circulation of metal objects, raw materials, obsidian arrowheads, and jewelry made of *Spondylus*, all of which were distributed widely from Macedonia to Crete and from the Cyclades to the Peloponnese.[86] The emergence of coastal communities and the development and subsequent increase of maritime trade networks presaged the developments of the Early Bronze Age. Recent work also pushes the invention and use of the longboat back to the Final Neolithic (Papadatos and Tomkins, 2013, 2014). Such socioeconomic changes suggest some level of social differentiation and the formation of a common cultural and symbolic code within the Aegean as early as the fourth millennium BC. [87] These developments were accompanied by a degree of economic and sociopolitical infrastructure that flourished in the EBA (Kouka, 2008; Papadatos and Tomkins, 2013; Tomkins, 2010).

The EBA in the Aegean was characterized by a series of social, political, and economic changes including, among others, hierarchical settlement patterns, monumental architecture (including fortifications), status symbols, sealing systems, exploitation of metal sources, increased production and circulation of metal objects, intensified and extensive trade and exchange networks, and differential mortuary behavior. All of this together led to the formation of small-scale, pre-state complex societies (e.g., Broodbank, 2000; Cosmopoulos, 1991a, 1995; Davis, 2001; Forsén, 2010; Hägg and Konsola, 1986; Manning, 1994; Pullen, 1985, 1986, 1994a,b, 2003a, 2008; Renfrew, 1972; Rutter, 1993, 2001; van Andel and Runnels, 1988; Weiberg, 2007; Weinberg, 1977; Wiencke, 1989). These changes were especially evident in the EB II (ca. 2650 - 2200 BC), a period of significant cultural and social innovation. Settlements increased in number and expanded regionally, a process which was likely accompanied by a population increase in the first half of the third millennium BC (Bennet, 2007; Rutter, 2001; Sampson, 1980). Even though trade and exchange networks, particularly of the maritime variety, have received a great deal of attention (as will be discussed later), agricultural shifts and the introduction of new farming technologies (e.g., plow and traction) must have also played a major role in the consolidation of sociopolitical power and the establishment of elites (Pullen, 1992). Overall, these EH societies exhibit the most elaborate social and political organization seen on the Greek mainland before the beginning of the Mycenaean period several centuries later (e.g., Hägg and Konsola, 1986; Pullen, 1985, 2008).[88] However, the island of Crete and the Greek mainland appear to have followed different social trajectories in the development of state societies, with the former showing a smooth transition of increasing complexity culminating in state formation in the early second millennium BC, and the latter showing a truncated course at the end of the EBA (e.g., Manning, 1994; Parkinson and Galaty, 2007; Pullen, 1985, 2008; Rutter, 2001).

The transition from the Final Neolithic to the Early Bronze Age, and particularly the late half of the Final Neolithic, are poorly documented archaeologically. As a result, our knowledge of the nature of this transitional phase, viewed either as a smooth process or as a discontinuity, is still very limited (Alram-Stern, 2004:507-512; Coleman, 2000:143; Pullen, 2003b). Recent scholarship shows that even though the long period of the Final Neolithic exhibited developments that progressed into the EBA, it was also marked by cultural change and the introduction of new elements (Alram-Stern, 2004:507-

512, 2007; Coleman, 2000; Maran, 1998:7-153).[89] Generally, there are no sites that show clear stratigraphic or chronological (based on radiocarbon dates) continuity between FN and EBA (Coleman, 1992, 2000:123-130, 2011:13-20).[90] Based on these gaps in chronology and site occupation, Coleman (2010, 2011) has argued for a significant depopulation of the Greek mainland during most of the fourth millennium BC and particularly at the end of the Neolithic and before the beginning of the EBA (ca. 4000 – 3700/3600 BC) and, thus, for a discontinuity between the FN – EBA periods. Thus, the EH culture is viewed in contrast with the EM and EC ones, which continued their FN predecessors (Coleman, 2000:132). Coleman's argument for the gap between the two periods was supported by the lack of secure dates in the first half of the fourth millennium BC in the recent project on radiocarbon dating in the FN – EBA southern Balkans (Maniatis et al., 2014; Tsirtsoni, 2015).

Coleman (2000, 2011) used the differences in material culture between the Final Neolithic and the earlier phases of the Early Bronze Age, and the sparse population of the mainland during that time to hypothesize that proto-Greeks (first Indo-Europeans) came to the mainland from the north at the beginning of the EBA. [91] On this interpretation, the Proto-Greeks came from the Carpathian Basin through Serbia and the Axios and Strymon river valleys to northern Greece and moved further south at the turn of the EBA (Coleman, 2000). For this hypothesis, he finds support in the presence of Bratislava/Petromagoula-Doliana lids found in Attica (see Chapter 4 for their presence at Tsepi). Coleman (2011:20) further suggested the presence of a "Proto-Bronze Age" phase in central and southern Greece dated to approximately 3600/3500 – 3100 BC, including the Bratislava/Petromagoula-Doliana ceramics (which, however, were locally made). Attica seems to play an important role in that time period due to the presence of "Proto-Bronze Age" sites, such as the cemetery of Tsepi that continues to the EH sequences, as well as due to the development of metallurgy (Coleman, 2011; Tsirtsoni, 2015). The recent radiocarbon dates from animal bones recovered from the subterranean chambers at the settlement of Merenda in Attica with a phase also dated to the transitional FN – EH might be suggestive of a "transitional" sequence. However, due to problems with the precision of the calibration curve during that time period ("plateaus") and the stratigraphic sequence of the analyzed samples, the radiocarbon results do not allow for a definite conclusion (Tsirtsoni, 2015). The fusion of older (FN) and newer ("Proto-Bronze" – EH I) elements in combination with the radiocarbon dates might instead indicate a slow transformation process with localized break events instead of a generalized collapse (Tsirtsoni, 2015; cf. Coleman, 2000, 2011). The need for further radiocarbon dating and detailed analysis of possible transitional sites is indeed pressing.

Inter-Regional Contacts and the Role of Metallurgy

The presence of obsidian from the island of Melos in the late Upper Paleolithic layers of the Franchthi Cave in the eastern Peloponnese implies the extraction of Melian obsidian as early as the eleventh millennium BC, thereby constituting the earliest evidence for human activity in the Cyclades and mainland-island contacts (Demoule and Perlès, 1993; Perlès, 1992; Renfrew and Aspinall, 1990). The lack of settlements on Melos itself prior to the fifth millennium BC (Cherry, 1981) suggests direct procurement of obsidian by mainland communities as part of long-distance fishing expeditions (Bintliff, 1977; Torrence, 1986). Notably, the wide geographic distribution of Melian obsidian in the succeeding periods, and especially during the Neolithic and the EBA, covers the majority of the Aegean (including the Greek and Anatolian mainlands). Obsidian, however, is not the only material diagnostic for early mainland-island interaction. Kaolin, a white clay from Melos, was used in pottery production during the sixth millennium BC on mainland Greece at the Neolithic settlement of Nea Makri (Pantelidou-Gofas, 1995:140-143). Moreover, andesite was imported from the Saronic Gulf island of Aegina for the production of millstones in the Argolid and Attica during the Late Neolithic and Early Bronze Age (Runnels, 1985). In addition, emery (a dense mineral useful as an abrasive) from Naxos was used in the production of axes as well as marble vessels and figurines in the Cyclades (Evans and Renfrew, 1968). However, inter-regional long-range interaction was intensified in the EBA I and especially EBA II, when a flourishing "international spirit" spread across the Aegean (Broodbank, 2000, 2008; Catapoti, 2011; Renfrew, 1972:451-455).

A major aspect of the intra- and inter-regional interaction was the exploitation of metal ores, the development of metallurgical technologies of production, and the circulation of metals. Although metalwork and metal objects are found prior to the EBA, they became common in the late fourth - early third millennium BC.[92] The importance of metallurgy for Aegean societies and its role in the development and intensification of trade, exchange, seafaring, and social complexity in the third millennium BC has received a great deal of attention (e.g., Branigan, 1974; Renfrew, 1967, 1972; Wilson, 1987; see Day and Doonan, 2007 for history). More recent work on early metallurgy and metal use in the EBA Aegean explores the meaning of the practice and its role in identity construction (e.g., Nakou, 1995).

Copper and particularly its arsenical variety were extensively used for utilitarian objects in the EBA. Copper ores rich in arsenic are frequent in the southern Aegean, and thus arsenical copper was the natural product of smelting (Gale et al., 1985).[93] However, considering the properties of arsenical copper, it has been shown that in some cases deliberate alloying also occurred by adding an arsenic-rich mineral in the smelting process (Charles, 1967; Doonan et al., 2007; Evely, 2010; Renfrew, 1967). Deliberate alloying techniques of tin bronze are later phenomena which emerged during the later phases of the EBA (Gale and Stos-Gale, 2002; Evely, 2010).

The island of Kythnos was a major source of copper and thus a premier site for copper mining and extraction in the EBA Aegean. A number of EBA copper-smelting sites have been identified around the island to date, including the well-studied site of Skouries (literally translated as ‘Slag’) in the northwestern part of the island. In addition, several copper mining areas situated relatively close to the smelting sites have been identified (Bassiakos and Philaniotou, 2007; Gale and Stos-Gale, 1984; Gale et al., 1985; Hadjianastasiou and MacGillivray, 1988; Stos-Gale, 1989, 1993, 1998). Possible EBA copper mining and smelting sites have also been identified on Seriphos island (Gale et al., 1985; Georgakopoulou, 2005; Stos-Gale, 1993) and on Keos island (Gale and Stos-Gale, 2008; Georgakopoulou, 2007). Furthermore, there are some copper ore deposits in the Lavrion region (particularly at Kamareza and Sounion). Lead isotope analysis on copper slags from the EH II site of Raphina, the largest EBA copper-smelting site so far identified in mainland Greece and excavated by Theocharis in the early 1950s (Theocharis, 1951, 1952, 1953, 1954, 1955), has demonstrated that they came from Lavrion (Gale et al., 1985; Gale and Stos-Gale, 2008). On Crete, EM copper smelting sites have been identified on the eastern part of the island at Chrysokamino (Betancourt, 2006, 2007; Catapotis and Bassiakos, 2007) and Petras-Kephala (Papadatos, 2007).[94]

The location of the copper smelting sites on isolated, exposed promontories, typically remote from identified contemporary settlements, has been interpreted as precautionary: the smelters did not want to contaminate their settlements with toxic fumes and took advantage of the prevailing winds for air supply. Another possibility is that they were sited with defensive considerations in mind, given that these smelting areas are near to the sea but inaccessible, with good visibility of both the sea and hinterland (Bassiakos and Philaniotou, 2007; Stos-Gale 1993; Gale and Stos-Gale, 2008). Furthermore, the spatial separation between EBA metal production sites from settlements (and consequently between producers and consumers) has been viewed as a mechanism to regulate the circulation of metal by monopolizing long-distance maritime activity through large trading settlements (Broodbank, 1993, 2000), or as a strategy to monopolize the technical knowledge necessary for metal extraction (Nakou, 1995). However, the recent evidence for metallurgical activities within EBA settlements and the increasing variability in their spatial arrangement might instead suggest close interaction, encouraged collaboration, and negotiation of individual and collective identities (Catapotis, 2007; see also Georgakopoulou, 2007 for EC settlements).

With regard to lead and silver exploitation, two main sources are reported for the EBA: Lavrion in southeastern coastal Attica and the Cycladic island of Siphnos. Argentiferous ores occur in other Cycladic islands, although the amount of silver is generally small. The contribution of the Lavrion argentiferous ores to early Aegean lead and silver metallurgy has been underscored. The main evidence for EBA exploitation at Lavrion derives from the results of lead isotope analyses of metal artifacts from the Aegean – in particular the Cyclades – which show an origin from the Lavrion deposits (Gale and Stos-Gale, 1981a, 1982; 2002; Gale et al., 1984; Stos-Gale, 1989). Direct evidence for lead and silver mining in the Lavrion area before the LBA, however, is scarce. The earliest indication of mining comes from small mine galleries situated around the slopes of the broader Laurion area, which date to the transitional period from the FN to EH I (Kakavogianni et al., 2008). Proof of mining of the argentiferous lead ores at Lavrion comes from Mine no. 3 in the Theater Sector at Thorikos and dates to EH II based on associated pottery (Spitaels, 1984; see also the recent examination of the Lavrion metal sources in Kayafa, M., 2015).

Nevertheless, silver and lead metallurgical activities and processing are attested in a number of EH sites in southeastern Attica (at Mesogeia), mainly through litharge fragments (see recent presentation by Ntouni et al., 2015). Litharge is the by-product of the extraction of silver from argentiferous lead ores through cupellation: after the smelting of ores such as galena or cerussite and during the separation of silver by cupellation, the argentiferous lead is heated under oxidizing conditions to form lead oxide (i.e., litharge [PbO]), while the molten silver does not react. Various quantities of litharge have been recovered from EH sites at Koropi, Merenda Markopoulou, Zapani and Velatouri (at Keratea), Gialou at Spata, and Leondari (or Provatsa at Makronisos), suggesting likely small-scale metallurgical activities (Kakavogianni, 1993; Kakavogianni et al., 2008; Ntouni et al., 2015; Spitaels, 1982). The recent excavations at the EH I - EH II settlement of Lambrika at Koropi recovered a metallurgical workshop covering an area of 70 m^2. The large quantity of litharge found at Lambrika (more than 120 fragments) and its context (structures related to metallurgical activities such as pits and cavities) indicate the presence of an organized metallurgical workshop with hints of standardization of production (Kakavogianni et al., 2008).[95] At Merenda, the litharge remains from a context securely dated to the mid fourth millennium BC represent the earliest evidence for lead-silver metallurgy in the Aegean (Ntouni et al., 2015; Tsirtsoni, 2015).[96]

On Siphnos rich lead-silver ores were exploited in the EBA, although there is no evidence for exploitation of the modest gold deposits before the first millennium BC (Gale and Stos-Gale, 1981a; Wagner et al., 1980). Lead and silver production and working at the mine and cupellation site of Ayios Sostis in northwestern Siphnos dates securely to the EC I (first half of the third millennium BC) (Wagner et al., 1980). Furthermore, archaeometallurgical provenance studies of lead, silver, and copper through lead isotope analyses have a long tradition in the Bronze Age Aegean, showing that Cycladic and Lavriotic metals were circulating widely (Gale and Stos-Gale, 1981a,b, 1984, 2002, 2008; Gale et al., 1984, 1985; McGeehan-Liritzis, 1989; Stos-Gale, 1989, 1993, 1998, 2000, 2006; Stos-Gale and McDonald, 1991; Stos-Gale et al., 1996; Wagner et al., 1980). The presence of different metallurgical stages from mining to artifact production at different locations suggests the circulation not only of finished artifacts but also of ores and smelted ingots. The coastal distribution of the sites with evidence of metallurgical processing has been associated with seafaring, and thus, possibly, with EBA maritime activity and identity (Broodbank, 2008; Catapotis, 2007). However, the impressive series of inland FN – EH Attic sites exhibiting early metallurgy (e.g., Lambrika, Koropi, Merenda) suggest the need for a re-interpretation of the rising of the new technologies and might indicate a major role of the Attic people in metallurgical production.

Maritime Mobility and Mainland-Island Interaction

In the formative third millennium BC, great emphasis has been placed upon the role of maritime exchange and trade networks linking the mainland, Euboea, and the Cyclades. This increased communication was key for the development of hierarchical social relations within and between individual communities, and the resulting "international spirit" allowed for the formation of new maritime identities (e.g., Alram-Stern, 2004:480-482; Agouridis, 1997; Broodbank, 1989, 1993, 2000:166-170; Burns, 2010; Knapp, 1993; Patton, 1996; Renfrew, 1972; Tankosic, 2011).[97] However, the archaeological identification of social interaction, mobility, and inter-group relations in the prehistoric Aegean has been almost exclusively artifact-based. Mainland-island contact has been traditionally approached through the distribution of material culture.[98] In particular, the differential distribution of Cycladic material on the mainland has been assigned social significance: such material is generally thought to have marked prestige and/or wealth (Alram-Stern, 2004:485-486; Cosmopoulos, 1991a, 1995; Doumas, 1977; Pullen, 1985).

However, as Papadatos (2007) correctly discusses focusing upon the relationship between Crete and the Cyclades, the Aegean "cultures" (based on items of material culture such as artifactual types) should not be treated as areas of uniformity on a map. In any case, uniformity in material culture does not necessarily imply uniformity of practices, ideas, beliefs, and social rules. Likewise, the assigned cultural areas should not be identified with bounded ethnic identities (see also discussion in Day et al., 1998:139-144). Even within the Cyclades, which are usually treated as the home of a single, unified culture, there is variation between smaller groups of islands (Broodbank, 2000:175-210, 320-349). Nonetheless, the presence of Cycladic artifacts and styles on the mainland, particularly in Attica and Euboea (as well as along the north coast of Crete), is traditionally linked to the presence of Cycladic colonists. In particular, the cemeteries of Aghios Kosmas and Tsepi in Attica, Manika in Euboea, and Hagia Photia, Gournes, and Archanes on Crete, all of which exhibit Cycladic influence in their material culture, have been interpreted as Cycladic colonies (Betancourt, 2008; Doumas, 1976, 1979; Mylonas, 1959; Marinatos, 1970c; Sampson, 1985, 1988; Weinberg, 1977; see also Alram-Stern, 2004:493-496).[99]

More nuanced, recent interpretations suggest the movement of groups of islanders to the neighboring coasts over more than one generation (Kouka, 2008:275). Metal sources and metallurgical activities (e.g., metalworkers, trade of metals) must have played a significant role.[100] Hence, the presence of *Cycladica* (i.e., materials and styles) in Attica, Euboea, and Crete can be approached through four explanatory mechanisms: a) importation of Cycladic artifacts by locals, b) imitation of Cycladic artifacts and practices by locals, c) importation of Cycladic artifacts and preservation of practices by Cycladic colonists, and d) local production of Cycladic artifacts and preservation of practices by Cycladic colonists (Broodbank, 2000:302-303 for Aghia Photia; see also Kouka, 2008:276). Colonization and migration signify a very specific notion of mobility, namely, a one-time, unidirectional event. Human mobility, however, is multifaceted. It can be multidirectional, seasonal, or even constant; it can involve groups of people (e.g., navigators, traders, craftsmen, mates) or single individuals. Given the permeable boundaries of the Aegean Sea, human mobility in this area needs to be examined as a fluid concept.

Recent studies emphasize the fusion of different stylistic traditions and promote more nuanced interpretations that involve the constant negotiation of community identity, group differentiation, situational factors, and conscious choices in adopting and assimilating diverse cultural elements (e.g., Broodbank, 2000; Nazou, 2010; Papadatos, 2007).[101] Furthermore, for decades the Cycladic islanders have been portrayed as the main (if not the sole) agents of the trade/exchange and maritime activities in the southern Aegean, with regions like coastal Attica featuring as passive recipients of people ("colonists"), artifacts, mortuary practices (e.g., grave construction), raw materials, and ideas. We should allow for more than one direction of mobility and for the possibility that the Attic people, for example, were active agents in the exploitation of the Aegean Sea. Interestingly, Wilson (1987, 1999, 2013) found most pottery to be locally produced at

Ayia Irini on Keos, but, instead of matching either Cycladic or Helladic styles, it matched eastern Attic styles, thus suggesting that earlier the Kephala and later the Ayia Irini settlers may have actually come from Attica. Thus, there is a need to shift the focus from a Cyclades-centered archaeology to the study of the "dynamic Aegean rim" – including Attica – to understand inter-regional interaction and material distribution in the EBA (Papadatos, 2007:441).

On a similar basis, the integrative nature of coasts has been stressed in the most recent scholarship (Papadatos and Tomkins, 2013; Tartaron, 2013). Coasts and coastal sites are receiving greater attention as a particular category of landscape, i.e., "coastscapes" (Pullen and Tartaron, 2007; Tartaron, 2013). Coastal zones have thus been re-conceptualized, from peripheral spaces of the mainland viewed in a constant liminal state between the inland and island centers, to nodes of connectivity and exchange, integrative spaces, and thus central settings for social (trans)formation (Tartaron, 2013:8). The influences of inland networks should not always be subsumed under the dominance of their maritime counterparts (Nazou, 2010; also Coleman, 2011 for networks involving northern Greece). Accordingly, coastal regions such as Attica, which were treated as gray zones between the mainland and islands, are now being interpreted as important centers that amalgamated both inland and island (maritime) processes and consciously shaped regional identities.

Furthermore, coastal sites that integrated inland and island characteristics are often viewed as gateway communities, especially as an explanatory framework for the strong Cycladic influence on the northern coast of Crete at Hagia Photia (Betancourt, 2008), Poros Katsambas (Wilson et al., 2008), and Kephala-Petras (Papadatos and Tomkins, 2013, 2014). Branigan (1991) likewise used Hirth's (1978) term of a gateway community to characterize EM Mochlos on the northern coast of East Crete.[102] He summarized the following characteristics: a gateway community occurs on the periphery of world systems, at a passage point for a cultural or natural region, and on the line of communication between areas with good mineral or agricultural resources, or high craft production; it supports a limited elite hierarchy that manipulates the system by control of exchange and prestige goods; it is characterized by a high number of imported products that are scarce elsewhere, and by an increase in craft specialization and production at the site, which draws on a wider zone for its subsistence (Branigan, 1991:103). Such coastal communities benefited from their strategic locations (such as the *emporia* discussed by van Andel and Runnels, 1988), mediated and filtered the access to non-local artifacts, raw materials, technologies, practices, and people, and controlled their distribution to the wider (mainly inland) region, without however neglecting local traditions. Competition between these coastal trading sites at different time periods was also a factor that produced differentiation at the regional level. Thus, trade and exchange were the outcome of diverse social mechanisms and dynamic intra- and inter-community relations. The recent work by Papadatos and Tomkins (2013, 2014) on Kephala Petras in the Siteia Bay on Crete has revealed a network involving the northern coast of East Crete, the Attica-Kephala region to the northwest, and the south-central Cyclades. We should note that this network was already functioning in the Final Neolithic.[103]

Another point of view holds that cultural and technological exchange between the mainland and the islands may have had a more localized significance in establishing and symbolizing inter-group alliances. A number of scholars have stressed the role of mate exchange and kinship in the formation and maintenance of mainland-island and inter-island interaction, stylistic transfers, and artifact distributions (Broodbank, 1992, 2000:86-91, 153-157, 163-164, 173-174; Davis, 1987, 2001; Manning, 1994; Patton, 1996). From this perspective, the observed stylistic homogeneity and item distribution can be attributed to social exchange and intermarriage as a mechanism of inter-community buffering. However, it is suggested that during the EBA, and at least by EBA II, household production had been replaced by craft specialist production, and that trade became a restricted domain forming the basis of sociopolitical power (Davis, 2001; Manning, 1994; Renfrew, 1972). Mate exchange and marriage practices as a means for social cohesion and community viability have been entertained in archaeological studies based on similarities or dissimilarities in material culture, local versus non-local artifact production, artifact distribution and circulation, and community viability (e.g., Broodbank, 1992, 2000; Davis, 1987, 2001; Manning, 1994; Patton, 1996). Non-local spindle whorls, which due to their domestic function are associated with women, are often considered to be evidence for incoming female spouses (e.g., Gorogianni et al. forthcoming; Papadatos and Tomkins 2013). Driessen (2012) suggested a matrilineal and matrilocal residence pattern in Prepalatial Crete using archaeological data on house size, seals, and the prevalence of female imagery, in combination with anthropological studies on the general characteristics of matriliny.[104] Despite the stimulating archaeological treatments of mate exchange (see Cullen 1985a,b for the Middle Neolithic), however, postmarital residence in the EBA has never been biologically addressed.

Concepts of Mobility in the Prehistoric Aegean

When dealing with the Aegean area, one has to consider the complex and unusual Aegean island system. Even though some comparisons can be drawn between the Mediterranean, southwest Oceania, and the Caribbean islands, the Aegean does not have exact geographical parallels with any other island system in the world (Braudel, 1972; Broodbank, 2000:6-35; Evans, 1977). Even within the Mediterranean, the configuration of the Aegean archipelago is distinctive. The Aegean islands are not only numerous, but also generally very small. In addition, being enclosed on three sides by mainland coasts and on the fourth by the large island of Crete, with limited access to the open sea only to the south, the Aegean forms an almost inland sea. The relatively short inter-island or mainland-island distances and inter-visibility have resulted in the use of islands as stepping-stones on maritime routes linking coastal areas around the Aegean and the wider Mediterranean area, often rendering communication and mobility by sea preferable to that of traveling over land. In particular, the Cycladic islands form a justifiable regional group as an island cluster in the southern Aegean, defined by wider expanses of water than those separating one Cycladic island from the next. Here, however, note the importance of the Attic and Euboean peninsulas, which provide a gradual transition from mainland to island and serve physically and etymologically as “almost islands” (Broodbank, 2000:41).[105]

Doumas (2004) provides an interesting etymological perspective on the nature of the Aegean insular landscape. Unlike the Latin term *insula*, the Greek word for island, *νήσος*, seems to derive from the ancient Greek lexical root meaning 'swimming' and 'floating' (*νέω* and *νήχω* or *νήχομαι*), sharing the same stem with words like boat (*ναύς*) and duck (*νήσσα*).[106] In that sense, even the etymology of the Greek word for island, contrary to the notions of isolation and insularity of the Latin term, encompasses concepts of mobility and flux that mark the history of the Aegean islands.[107] Overall, island life and processes in the early Aegean, and among the Cyclades in particular, need to be considered as dynamic rather than as static (Broodbank, 2000:9-35, 362-367).

In sum, concepts of prehistoric mobility in the Aegean, based heavily on material culture, have traditionally been viewed through the lenses of migration or colonization. Rather than thinking about movement between static and impermeable zones, however, Aegean mobility needs to be conceptualized as a dynamic, multidirectional process involving both individuals and groups. One of the goals of this study is to shift the focus from the movement of artifacts to the movement of their makers and/or users, i.e., the people themselves. Accordingly, I would like to emphasize that even though artifacts (e.g., pots, figurines) and their ranges are easy to classify, the people who made them are not. Thus, while artifacts and styles have been widely used to identify spheres of interaction, influence, and most importantly boundaries, human mobility can be much more fluid.

Keeping in mind the scale of the Aegean world and the maritime activities involved in trade, one can expect people to move more than once and in different directions (even cyclical) within their lifetimes. As Burns (2010:291) notes, trade (i.e., the transfer of goods) "is necessarily accompanied by the movement of people, which enables additional interaction such as the sharing of technology or the communication of ideas and beliefs." To this I would add the sharing of genes that, one should keep in mind, actually need not be accompanied by permanent relocation. Scenarios such as the following are thus plausible: a group of mariners that spends half a year at its "home base" and half a year traveling and/or fishing (sometimes with short-term residence in other places), as was the case for example with modern marine communities of the Aegean islands until recently. In this framework, postmarital residence is just one option for examining one-way (without this meaning that migrants would never return) patterned residential relocation. Significant work has been done on the various aspects of maritime voyages in prehistoric times: how many days, how many people, what type of boats, what kind of routes, currents, distances, island networks (e.g., Agouridis, 1997; Broodbank, 2000). However, the actual voyage is only one part of the equation. Coleman (1999:128-129), in discussing contact and trade between Cyclades and the North Euboean Gulf, emphasized the movement and migration of individuals in the EBA without necessary group and/or community planning, giving the example of traders "who would sometimes have stayed behind in ports they visited and made homes and marriages there," thus providing perhaps a more realistic picture of EBA mobility. What happened after these mariners reached their destinations? And what happened to their families while they were away? Given that they could not catch the next ferry, where did they stay? Given the lack of hotels, would they not need to be affiliated with some residential community on the other coast to spend their time while away from "home," if there was one to begin with? In this vein, it would be more reasonable for the coastal communities to serve as a connecting point, even as a starting point, and not a divider. As a result, the Aegean Sea can be seen as a unifying experience, without losing sight of the actual scale of the Aegean world.

Mortuary Practices

A major source for Bronze Age burial practices is the seminal work of Cavanagh and Mee (1998). With regard to the EH, their analysis focused upon the cemeteries of Aghios Kosmas and Manika. Tsepi was mentioned briefly but was dated to EH II. Thus, the two scholars asserted that it was not until EH II that organized cemeteries became common. Given the lack of data, Cavanagh and Mee (1998:20) concluded that in the EH I period "the dead were not formally buried and have consequently eluded us" and that "[w]e might speculate that descent and inheritance were not contentious issues in this period." Since then, however, there have been significant archaeological discoveries that alter our view of EH I (e.g., further excavation at Tsepi in Marathon, recent discoveries of EH cemeteries at Asteria, Loutsa, and Kifissos in Attica and Nea Styra on Euboea, as well as in the Peloponnese); thus, the EH funerary landscape drawn by Cavanagh and Mee (1998) has to be revisited.

Social complexity in the EBA Aegean has been approached mainly through mortuary analysis and the excavation and study of cemeteries. Generally, the differential distribution of grave goods in EC cemeteries and the distinction between "poor" (with no or only low-quality pottery) and “rich” graves (e.g., metal objects, frying pans, etc.) are considered indications of personal wealth and of emerging social hierarchies (Alram-Stern, 2004:305-308; Doumas, 1977:58-63; Renfrew, 1972; Sampson, 1988); the variation in the quality and number of finds, however, does not always correspond to the size and/or quality of the grave. Doumas (1977:56) further illustrated that multiple graves tend to be poorer than single graves in the EC cemeteries.[108] The interpretation of individual wealth and status in the EH mainland cemeteries was complicated, however, by the common practice of including multiple burials within each grave (Cosmopoulos, 1991a:32-35, 1995; Pullen, 1985:140-146). Here the problem arose from the difficulty in assigning particular items to specific individuals, as well as from the possibility that grave goods of earlier burials were removed in later interments (Pullen, 1985:143-144,369-370).[109] Given the large number of interred individuals and the small number of accompanying offerings, EH tombs were generally considered to be poor. Weiberg (2007:202-205) concludes that EH cemeteries show no evidence of status differentiation and social inequalities in wealth based on grave goods found in cemeteries. Thus, the “problematic” study of status in EH tombs that results from the low number of grave goods and the lack of certain links to specific individuals has led to the assumption of simpler or simplified mortuary rituals. However, as I shall discuss analytically in the following chapter, the recent discoveries of large deposit areas with increased quantities of pottery in EH cemeteries (Tsepi and Asteria) definitely alter the picture of the EH burial program. The presence of hundreds of broken vessels within the cemetery indicates the practice of complex and possibly multi-staged mortuary rituals.

Moreover, in his multifaceted approach to EH social organization, Pullen (1985:369-371) identified a possible lack of differentiation in individual ranking based on mortuary data. He suggested that the only indication for differential burial treatment was age distinction, i.e., the fact that infants were buried within settlements. This same conclusion has been reached by a number of other studies on particular sites (e.g., in Asine) (Cosmopoulos, 1995; Pullen, 1990). There is no indication for differential burial treatment based on sex and/or gender. However, given the dearth of human skeletal studies for the EH period, any hypothesis of this sort should remain tentative. The exclusion of infants from the EH formal burial grounds does not hold true, as will be discussed in the following chapters in connection with the Tsepi material. All ages and all sexes seem to have been interred in these graves. Thus, the examination of biological and social groupings in the EH cemeteries will further elucidate the differential distribution of grave goods and their association with the burial groups.

The multiple, sequential burials have generally been interpreted as family graves (nuclear or extended) and are often viewed as expressions of kin group identity associated with lineal transmission of property and ancestorhood (Alram-Stern, 2004:303-304; Cultraro, 2007; Cavanagh and Mee, 1998:10, 111, 116-117; Mee, 2010; Mylonas, 1959; Pullen, 1985, 1994a,b; Weiberg, 2007).[110] Graves containing multiple interments are commonly interpreted as family burial areas, a view that goes back to Tsountas (1898) for the Cyclades and was later applied to Kephala on Keos (Angel, 1977; Coleman, 1977) and Aghios Kosmas in Attica (Angel, 1959; Mylonas, 1959). Sampson (1985, 1987) concluded that based on the current evidence the identification of family use was not corroborated, though it cannot be excluded, and he attributed the multiple use of graves to population density and economic management of available land. The presumption of family graves is often based on the presence of adults (females and males) and children together in the same graves (Alram-Stern, 2004:286). However, the intra-grave biological relationships of individuals have not been examined. Thus, as Cavanagh and Mee (1998:131) also noted, "no firm conclusions can be drawn for EH collective tombs." Pullen (1985:371) believed that communal tombs of the formally organized cemeteries (e.g., Tsepi, Manika, Aghios Kosmas) represent groups larger than nuclear families. Likewise, the emergence of formally arranged cemeteries has been linked to the presence of corporate groups and/or lineages competing for the control and legitimization of crucial economic resources (e.g., land ownership) and sociopolitical power (Cultraro, 2007; Fowler, 2004:95-97; Pullen, 1985, 1994a,b; Talalay, 1991).[111] However, these remain untested hypotheses given that the biological structure of the late FN – EH cemeteries and the interplay between biological and social groupings have not been empirically demonstrated.

Cemetery Usage and Organization

Cemeteries emerged in the Late and Final Neolithic and became more organized and common by the EBA II (Cavanagh and Mee, 1998:10-11,15-16).[112] During the Neolithic, burials in caves were a common phenomenon, usually consisting of ossuaries with secondary deposits such as at the Late and Final Neolithic Cave of Alepotrypa (Papathanasiou, 2001, 2005, 2009; Papathanasiou et al., 2000).[113] In addition, mortuary areas with pit graves containing single inhumations also occurred, often in association with pits containing broken pottery such as in the recently excavated FN site of Proskynas in Lokris, dated to the late fifth millennium BC (Psimogiannou, 2012).[114] However, during the LN/FN there was a shift in the direction of organized cemeteries with collective graves containing multiple inhumations (Cavanagh and Mee, 1998:10).[115] The LN/FN site excavated at Tharrounia on Euboea included a cemetery that contained eight irregular pit graves built with stone and/or schist slabs, except for the burials found inside the adjacent cave (Skoteini Cave) (Sampson, 1992:86-91; 1993:223-240). Human remains were found in six of these pits, while the other two had been looted. The graves contained disarticulated remains, interpreted as secondary deposits because no complete, *in situ* skeletons were recovered. Each pit contained the fragmentary remains of multiple individuals, ranging from two to five. [116]

The Final Neolithic cemetery with adjacent settlement at the promontory of Kephala on northwestern Keos is the earliest organized cemetery with collective burials (Coleman, 1977).[117] Kephala constitutes the earliest occurrence of built tombs and shows early features (such as platforms and figurines) that later appear in the EBA cemeteries of the Cyclades and Attica, thus demonstrating continuity in burial rites from the Final Neolithic to the EBA (Alram-Stern, 2004:510-512). At least 40 graves were excavated at Kephala, but the layout of the cemetery reveals no clear organization. The graves were often built next to each other, generally following the natural topography, but there was no uniform orientation in grave construction or in the positioning of the skeletons (Coleman, 1977:44).[118]

In the EBA, formal cemeteries became the norm. With regards to the Cyclades, the excavation of EC cemeteries has a long history (e.g., Bent and Garson, 1884; Stephanos, 1905; Tsountas, 1898, 1899). The EC culture is in fact mainly known through cemeteries uncovered on a number of islands (e.g., Syros, Naxos, Amorgos, Antiparos, Paros, and Melos) (see the Horizon, 2008 volume for recent finds). EC cemeteries are always located in close proximity to settlements (Doumas, 1977, 1987). The cemeteries do not show uniformity in grave orientation, with graves either randomly oriented or following the natural topography (Doumas, 1977:34-35; Tsountas, 1899).[119] Clustering of graves into groups, often with a dense distribution, was a common phenomenon (Doumas, 1977:31-35; Hekman, 2003; Philaniotou, 2008; Tsountas, 1898, 1899).[120] The exceptionally large EC cemetery of Chalandriani on Syros dated to the EC II was divided into a western and an eastern part and contained 649 excavated graves (see Hekman, 2003 for an overview, history, and a thorough presentation of the site). [121] Recent excavation of EC cemeteries include Ano Kouphonisi (Zapheiropoulou, 1984, 2008), Tsikniades on Naxos (Philaniotou, 2008), and Rivari on Melos (Televantou, 2008), which show greater variation and will further nuance our interpretation of EC burial practices.

Contrary to the situation in the Cyclades, until recently few EH cemeteries had been identified and excavated, with the result that the majority of information about the EBA mainland derived from settlements.[122] The recent discoveries of EH cemeteries in Attica, Euboea, and the Peloponnese significantly alter the EH, and EH I in particular, funerary landscape (Attica will be discussed in detail in the following chapter). Three EH I cemeteries were identified in the Peloponnese, at ancient Elis (Rambach, 2007), Kalamaki (Vassilogamvrou, 1996-1997, 2008), and Apollo Maleatas (Theodorou-Mavrommatidi, 2004). The earliest of the three is the cemetery at Kalyvia in ancient Elis (northwestern Greece) that dates to the early EH I and possibly to the end of the Final Neolithic (Rambach, 2007). The cemetery consisted of rock-cut chamber tombs, very similar to the Mycenaean chamber tombs, generally arranged in two rows and following a similar orientation (Rambach, 2007).

Generally speaking, EBA cemeteries vary considerably in their layout and degree of organization, and thus the emergence of formally planned cemeteries with marked graves raises questions regarding their social correlates. Cavanagh and Mee (1998:20) attributed the presence of more conspicuous burials and cemeteries in the EH (which they dated to EH II), to the increase in the number and size of settlements and the resulting competition over agricultural resources, which in turn generated the need for territorial markers to symbolize property rights. Weiberg (2007) suggested that the formalization of extramural cemeteries was associated with emerging economic growth and the dispersal of EH settlements. The growing number of settlements called for the definition and demarcation of each community through a common burial ground reserved for its members. In this way, smaller groups could use the formalized burial ground to claim a new location, and the cemetery became the marker of the group's seniority based on ties to the landscape (Weiberg, 2007:200). The standardization of cemeteries placed an emphasis on the settlement as a whole, promoting the community as a group above the level of the individual or the smaller subgroups (such as perhaps the family) represented by each tomb. Thus, the formalized cemeteries and the use of graves for multiple individuals emerged as a new arena for the negotiation and manipulation of power between smaller groups (both at an intra- and inter-community level). The new practices reinforced the connection with the landscape through visible markers (visual language) and maintained an ideology of seniority through the long-lived graves and the accompanying appreciation of the past (Weiberg, 2007). Accordingly, the change in burial customs arose as a response to changing social realities.

Regarding Attica and Euboea in particular, Weiberg (2007, 2013b) attributes the rise of discrete, formalized cemeteries to the emerging economic growth of the period, which was the result of their close contact with the Cycladic islands. This image is in contrast with that of the EH Corinthia and Argolid, which were characterized by settlements with monumental features and long-lived, multiple phases (e.g., “megaron” structures) that Weiberg (2007) attributes to economic stability. We thus uncover a regional pattern (east vs. south). The contrast between the construction of ephemeral houses (adobe) and permanent tombs (stone-built) indicates an emphasis on the durability of the landscape of the dead. In a certain sense, the tombs and the dead were buried for the future (Weiberg, 2007:307).[123] Furthermore, Weiberg (2007) proposed that during EH II, the monumentality and formalization of settlements took over the previous role performed by the cemeteries, with the reverence for and negotiation of the past shifting from the long-term reuse of graves to the reuse of settlements.

Overall, discrete cemeteries were the norm on the central and southern mainland, with the graves commonly containing multiple, successive burials (e.g., Tsepi, Aghios Kosmas, Manika). A few exceptions are briefly mentioned here. The EH well deposit from Cheliotomylos in Corinthia (ancient Corinth) that was also included in the biogeochemical analysis (see Chapter 6) presents us with a different picture.[124] The shaft of a water well (ca. 16.5 m deep) was excavated by the American School of Classical Studies at Athens in 1930 (Shear, 1930) and was briefly published about two decades later (Waage, 1949). The recovered deposit consisted of human and animal skeletal remains, ceramic vessels, terracotta spindle whorls, a seal impression and a terracotta anchor, obsidian blades, two copper pins, and two bone pins (Waage, 1949). Based on stylistic observations, the assemblage was dated originally to the EB III (Waage, 1949) and later to the EB II (Pullen, 1985). A large number of vessels were recovered (more than 100), mainly sauceboats, saucers, and bowls (Pullen, 1985). The ceramic vessels in their majority were either recovered intact or were reassembled, indicating that they were deposited in the well intact (and not as a waste fill) (Waage, 1949) and/or in a fairly short amount of time (Pullen, 1985).

According to Pullen (1985), the ceramic assemblage of Cheliotomylos is similar to domestic contexts. Weiberg (2007, 2013a) interpreted the accumulated pottery as the result of mortuary feasting practices deposited with the skeletal remains as a single event. This unusual deposit has raised questions regarding the nature of the disposal and whether or not it represents multiple primary burials (as practiced in the EBA) and a secondary usage of the well shaft (see Pullen, 1985:113-115; also Forsén, 1992:72-73) or a mass burial (see Rutter, 2001:123, ftn.119). Weiberg (2005:216-221, 2013a) considers the skeletal assemblage to be the secondary deposition of skeletonized remains –as part of a two-stage ritual. However, Waage (1946:422) clearly stated that “bodies and not skeletons must have been thrown into the well." With the exception of one skeleton mentioned separately, great care was taken in the excavation of the skulls. The preservation and excavation of the very narrow (1 m diameter) and deep space made the recovery of complete skeletons and long bones nearly impossible (Waage, 1946:422). The prioritization of skulls for both storage and study was a common practice. Waage (1946) also reported that in many cases the mandibles were found in articulation with the crania. The skeletal remains have been published only briefly. According to Hrdlička (Waage, 1949:422), approximately 30 individuals were represented including five males, five probable males, nine females, four children of ages between six and twelve years old, and five adolescents. Brief observations on the material were also published by Angel (1942, 1959, 1977), who reported twelve males, nine females, and nine children but no infants. An EH I-II ossuary was recovered in Corinthia, in a cave at Perachora in Lake Vouliagmeni (Koumouzelis, 1989-1991; Stravopodi, 2009). The deposit contained 52 individuals, young subadults in their majority, and broken sherds that could not be reassembled. The cave is close to a known Early Helladic settlement, in the vicinity of which an EH II grave grave has been excavated (Hatzipouliou-Kalliri, 1983). The tomb contained the commingled remains of 10 individuals and fifty broken vases and was also interpreted as an ossuary (Hatzipouliou-Kalliri, 1983). Finally, along with LN and FN layers the Cave of Ayia Triadha at Karystos (Euboea) also produced an atypical EH/EC II funerary skeletal assemblage (Mavridis and Tankosić, 2009). The contextualized study of the Ayia Triadha human remains will elucidate the nature of the deposit and might reveal a mortuary use of caves in the EH/EC previously undetected.[125]

Intramural Burials

Intramural pithos burials of adults occur at Strefi in Elis, and they were also identified in the EH III tumuli at Olympia (Elis) during the excavations for the New Archaeological Museum (Koumouzelis, 1980) and at Pelicata on the island of Ithaca in the Ionian Sea (Heurtley, 1934-1935). The adult burials in pithoi were secondary deposits. Pithos burials (probably of children) occur at the Altis in Olympia and at Berbati in Argolid (see Forsén, 1992:89-93). A possible EH II pithos burial of child was also found at Kirrha in Phocis (Forsén, 1992:154-155). Intramural infant/child burials in jars occur at EH II Platygiali, close to Astakos in western, central Greece (Alram-Stern, 2004; Haniotes and Voutiropoulos, 1996). Interestingly, one of the two EH graves discovered inside the MH tumuli cemetery of Vranas in Marathon contained a pithos burial (Oikonomakou, 2001-2004).

Intramural burials also took place in the EH, mostly but not exclusively for children; however, they are less frequent and tend to occur in the later phases of EH (see Alram-Stern, 2004:296-297; Cavanagh and Mee, 1998:15-16; Forsén, 1992: 232-240; Pullen, 1985, 1994).[126] In the Peloponnese, intramural burials were found in Laconia (southern Peloponnese) at Kouphovouno (EH II burials of two adults and one child; Forsén, 1992:105) and Ayios Stephanos (EH II burials of adults and children; Forsén, 1992:106-107), in the Argolid (northeastern Peloponnese) at Lerna (EH III burials of infants; Forsén, 1992:37), Asine (late EH II burials of children; Forsén, 1992:63), Tiryns (five EH II or III burials; Forsén, 1992:49), and Berbati (two EH III burials, one adult and one child in a pithos; Forsén, 1992:55), in the Corinthia (northern Peloponnese) at

Tsoungiza (one EH II cist tomb containing a child; Forsén, 1992:71), and in Elis (northwestern Peloponnese) at Strephi (at least one EH II adult pithos burial; Forsén, 1992:86). In Central Greece, intramural burials were found near Raphina (northeastern coastal Attica) at Askitario (two EHI II child burials; Forsén, 1992:120), in Phocis at Kirrha (one EH II pithos burial of the child; Forsén, 1992:154-155), and in Boeotia at Thebes (one EH II adult burial under a house floor, one EH II or EH III cist tomb with two skeletons, and one EH burial of an adult close to a wall; Forsén, 1992:134) and Eutresis (one EH II child burial; Forsén, 1992:138).

Tomb Architecture

In terms of the main grave types, built tombs first occur at the FN cemetery of Kephala on Keos and the LN/FN cemetery of Tharrounia on Euboea (Alram-Stern, 2004:282; Coleman, 1977:45-48; Sampson, 1992:86-91; 1993:223-240).[127] Built tombs of a complex form continue in Attica at EH I Tsepi (Pantelidou-Gofas, 2005a) and EH II Aghios Kosmas (Mylonas, 1959), and were recently discovered at EH/EC II Nea Styra on Euboea (Kosma, 2010, 2012, 2013, 2015a,b,c). Cist graves are generally considered a Cycladic form due to their widespread occurrence in the Cyclades since the beginning of EC I (Alram-Stern, 2004:282-286; Broobdank, 2000:152-153; Doumas, 1977:37-46). Rock-cut chamber tombs (consisting of a chamber, a "doorway," and a passage) were common on the mainland, reported in Corinthia, Boeotia (Lithares, Paralimni), and Euboea (Manika) (for overview and references, see Alram-Stern, 2004:289-289; Cavanagh and Mee, 1998:17; see Cultraro, 2000 for origin and development). They also occur in the EH I western Peloponnese at ancient Elis (Rambach, 2007) and Kalamaki (Vassilogamvrou, 1996-1997, 2008). More recently EH I/II cemeteries with rock-cut chamber tombs were discovered in Attica, at Asteria (Kaza-Papageorgiou, 2006, 2009; Petrakos, 2012a) and Kifissos (Aigaleo) (Asimakou and Pashali, 2015). In the Cyclades, rock-cut chamber tombs are limited, found mainly on Melos and Ano Kouphonissi (Alram-Stern, 2004: 286-289; Doumas, 1977:49; Televantou, 2008; Zapheiropoulou, 1983, 2008). Burial mounds and ritual tumuli were sporadic phenomena in the later EH period (Aravantinos and Psaraki, 2011a,b; Müller Celka, 2011; see also Cavanagh and Mee, 1998:17).

EH tombs are not always considered monumental (cf. Sampson for the Manika tombs). Rutter (2001:111) presents the burial tumuli of the EH III (which continue into MH) as the first monumental tombs on the mainland, considering that in the previous phases monumentality was restricted to large-scale buildings and settlements. Admittedly, EH tombs perhaps do not appear monumental when compared to the EM tombs. However, I believe that the presence of extensive cemeteries with clear signs of planning and comprised of composite stone-built graves with entrance shafts and above-ground built structures (e.g., enclosures, platforms), such as is the case at Tsepi, should be considered monumental, especially when compared to simpler graves within the mainland sphere (see also Sampson, 1987 on the monumentality of the Manika tombs).[128]

Treatment of the Dead

The practice of collective burial and grave reuse has been adopted and subsequently abandoned at different times in Greek history and prehistory, alternating with the single burial.[129] Collective burials can be traced back to the Neolithic and become frequent in the Early Bronze Age cemeteries on Crete and the mainland before disappearing. Later on, they reappear with different burial structures at the very end of the Middle Bronze Age (i.e., the Shaft Grave Period) and subsequently continue with the Mycenaean chamber and tholos tombs.[130] In the Cyclades, the graves included mainly single inhumations, while the presence of multiple burials within graves seems to be a phenomenon of the EC II period (with the exception of the island of Syros, where clusters of single graves persisted) (Alram-Stern, 2004; Broodbank, 2000:152; see also Doumas, 1977:49, 50-51, 55-58).[131]

Generally, the deceased was placed in a highly contracted position lying on his or her side, the so-called “sleeping position” and was usually placed on the right side facing the entrance (Tsountas 1898:147, 1899; cf., Zapheiropoulou 2008).[132] The head was often placed on a small slab that served as a headrest; the presence of small slabs and stones close to the arm and leg joints on top of the skeletons was probably aimed at keeping them in place (Tsountas 1898:147-148, 1899:84). This contracted position of the body was the norm regardless of the size of the grave, suggesting that it was prescribed by something other than mere practicality (Alram-Stern, 2004:299-301; Cavanagh and Mee, 1998:18-19; Doumas, 1977:49).[133] In collective graves, the bones of the previous deceased were collected at one side of the grave pit, with greater care shown in the case of the skulls. Primary and secondary burials were placed in niches in the chambers of the rock-cut EH I tombs at ancient Elis (Rambach, 2007).[134] At Kalamaki, a skeleton had been placed on a bench carved in the side of the tomb chamber (Vassilogamvrou, 2008). The recent discoveries of EH chamber tombs including multiple individuals in western Greece and in Attica (see Chapter 4) contradict the earlier view that the repeated use of chamber tombs was rare (Cavanagh and Mee 1998:19).

Single inhumations were not common on the EH mainland. The three EH I pit graves at Apollo Maleatas contained single inhumations (Theodorou-Mavrommatidi, 2004). A few pit graves with single inhumations, mostly of juveniles, with no grave finds were recovered in ancient Elis (Rambach, 2007). These were found in association with the entrances of the EH I rock-cut chamber tombs that contained multiple individuals (Rambach, 2007). Thus, again, there seems to be a close relation between the type of burial and the architectural feature.

A regional difference in burial practices between eastern and western Greece can be perceived, particularly in the cases of Elis (northwestern Peloponnese) and the Ionian islands (Alram-Stern, 2004; Pullen, 1994). Cremations (incomplete) occurred in the EH tumuli at the R cemetery at Steno on Lefkas island in the Ionian Sea, with pithos burials recovered close to the tumuli (Dörpfeld, 1927; Kilian-Dirlmeier, 2005). At Ancient Elis an EH II tomb was recovered whose construction combined features of cist and rock-cut tombs. The tomb contained no bones, but there was evidence of fire and two complete jars filled with soil and ashes, interpreted as evidence of cremation with the subsequent use of urns (Koumouzelis, 1980:60). Cremations are rare in central and southern Greece, being more common in Macedonia and northern Greece (e.g., Xeropigado Koiladas in Kozani, Agios Mamas in Chalcidiki, Poliochni on Lemnos) (see Alram-Stern, 2004:302). Some burned bones are reported in Lithares, Berbati, and Manika, but these do not necessarily represent cremations (Cavanagh and Mee, 1998:18).[135]

Ritual

Generally, a two-stage mortuary ritual has been proposed: first the inhumation takes place, and at a later time the tomb is opened again in order to rearrange the bones of the latest burial and clean the part of the tomb chamber to receive the next deceased (Alram-Stern, 2004:299-301; Cavanagh and Mee, 1998; Pantelidou-Gofas, 2005a; Weiberg, 2007). However, the formation processes of the EH grave contexts, the different stages of deposition, and the pre- and post-interment settings are not always clear. Issues like whether or not the rearrangement of the bones took place when the tomb was opened to receive another body or as a separate event, and whether or not bones from earlier burials were removed during the re-opening of graves are still open to debate (e.g., Pantelidou-Gofas, 2005a; Weinberg, 2007). At Manika, Sampson identified 15 pits among graves that served as ossuaries for the bones from earlier burials. At Aghios Kosmas, Mylonas (1959) found graves that, even though the main floor area had been cleaned and the bones had been pushed aside, did not contain an articulated skeleton. This observation, combined with the discovery of an extended skeleton buried in a trench between two graves, has been used as evidence for the co-existence of two different burial practices (Mylonas, 1959:118). One consisted of the primary inhumation inside the tomb chamber, lowered through the roof, and the other was a two-stage ritual where the deceased was first buried in some form of a trench and after (partial?) decomposition, the bones were placed in the grave. This hypothesis, however, has not found much support (for Tsepi see the discussion in the following chapter). The co-presence of single inhumations in pit graves and multiple inhumations (including *in situ* skeletons) in rock-cut chamber tombs at ancient Elis might shed some light to the EH I burial practices (Rambach, 2007).

In Manika, cut-marks, openings, and breakages on the human bones were identified as intentional modifications resulting from cuts on tendons made in order to place the body in its contracted position after rigor mortis had set in (Fountoulakis, 1985, 1987). However, given the general complexity and variation of taphonomic alterations (e.g., worms, burrowing animals, excavation practices) of archaeological human remains – and particularly for the commingled contexts of the Early Bronze Age created by the constant handling of remains – the distinction between taphonomic and intentional modifications can be blurred, especially for scholars not familiar with the archaeological context (see Fountoulakis, 1987: Pl. IIIb,c,d,e; Pl. IV,a,b,c; Sampson, 1985:234, Fig.73a, 74, 75). Thus, the artificially induced marks on the Manika bones should be considered tentative until specifically reexamined by a taphonomic specialist. Furthermore, a common assumption is that, in order to allow for the positioning and folding of the body, burial had to take place very quickly after death (i.e., within the first few hours) before *rigor mortis* set in (e.g., Pantelidou, 2005a:331; see discussion in Weiberg, 2007). This is a misconception. *Rigor mortis* begins a few hours after death (spreading from the head and neck downwards to the rest of the body) and is completed between 10 and 48 hours after death, after which it ceases (Roach, 2003).[136] As a result, one need not assume a very short period between time of death and burial, a situation that would not be realistic if one considers the difficult task presented by the need to open an elaborate grave (such as at Tsepi).[137]

Cavanagh and Mee (1998:116) highlight the emphasis that collective tombs place on the ideas of family, membership in the community, and perpetuity, and they attribute the adoption of this type of tomb (e.g., in the EBA and in the LBA) to particular social processes that demanded different expression in burial rituals. There is a tight link between secondary treatment and burial in collective tombs that suggests an interplay between the burial program and the ceremonies involved (Cavanagh and Mee, 1998:1 16). Collective burial forces the individual to directly confront and handle the remains of previous burials and, thus, engenders secondary burial rituals: "the emotional response to direct contact with human remains must be allayed, beliefs concerning the afterlife adapted to the experience, and a ceremonial elaborated which involved the whole community" (Cavanagh and Mee, 1998:116). Accordingly, the form of burial and tomb architecture shaped the ritual. The formation of tomb entrances with blocking materials marks a focus on the liminal rites that took place during secondary burial.[138] In terms of general patterns in ritual and practice, the analogy between the collective graves of the EBA and those of the LBA is indeed a very intriguing one, suggesting that we should also look for analogies in the sociohistorical processes of the two periods.[139]

Even though secondary treatment of the dead in the Mycenaean era and their placement in collective tombs have received much attention and analysis in the literature, reuse of graves and secondary treatment of the Early Helladic dead have not.[140] By the same token, the hermeneutic device provided by the distinction between the different forms of rituals (i.e., cult of the dead vs. ancestor cult; discussed in the previous chapter), though applied by Morris for the Classical Greek world, has not been explored in the case of the Early Helladic mainland (for ancestor veneration in EM Crete, see Murphy, 1998).[141] Nevertheless, Gallou and Georgiadis' (2006) description of Mycenaean mortuary rituals and secondary treatment and their argument for ancestor worship could also be applied to the Early Helladic mainland mortuary rituals. Indeed, if one were to substitute the terms Mycenaean or Late Helladic with Early Helladic one could recite the passage verbatim and it would hold true for the cemetery of Tsepi. Furthermore, I should note that the "holy triad" of Mycenaean funerary architecture, the *dromos* (entrance shaft), the *stomion* (entrance), and the chamber (Gallou, 2005:64-67) is exemplified at Tsepi. Cavanagh (1987:167) acknowledged the long history of the thresholds and entrances in funerary rites and their presence in the EH at Aghios Kosmas, Tsepi, and Manika – despite their non-functional character. However, based on the recent evidence that the dead were in fact entered through the entrance shaft and not by opening the covering slabs (as previously thought), the tripartite construction of the Tsepi graves and funerary rituals acquire a new meaning.

One of the reasons why EH mortuary rituals have not received much attention is the generally dismissive attitude towards the successive inhumations, which are seen as either disrespectful of the deceased or uninteresting – despite the fact that similar practices in the Mycenaean mainland are usually (but not always) treated as evidence for secondary burial rituals.[142] The secondary rearrangement ("pushing aside," "sweeping away," "pilling up") of the bones of earlier burials has often been viewed as an indication of a lack of respect towards the dead (e.g., Cosmopoulos, 1991a:35), even though, as noted by Cavanagh and Mee (1998:19), "secondary burial need not imply disrespect." Specifically, Mylonas (1959:119-120) concluded that the practice of pushing bones aside showed that "no great consideration or respect was due to the bones of ancestors."[143] This view is echoed in his conclusion that there is no evidence for a "cult of the dead" (ancestor cult) in the Early Helladic period (Mylonas, 1951:66-68), defined as repeated rites at the grave over long periods of time.[144] However, Mylonas (1951) concluded that there was no evidence for a cult of dead throughout Helladic times on the mainland, preferring instead to set its beginning in Geometric times. In light of new finds and the large temporal gap separating us from Mylonas, however, the presence of ancestor cult in the Early Helladic needs to be re-examined. In the following chapter I will further discuss the area under study and I will argue that Tsepi (and possibly other EH cemeteries) sheds new light on EH burial practices and reveals evidence for cult activity that allows us to trace the presence of ancestor worship back to the EH mainland.

CHAPTER 4

STUDY AREA AND STUDY SITE

As has been stated, the current study focuses upon the area of Marathon in Attica and its association with surrounding regions (Fig. 1.1). Attica formed the "heartland" of the mainland EH culture, along with Boeotia, Corinthia, and the Argolid (see Pullen, 1985:47). Coastal Attica constitutes part of a micro-region within the Aegean, including Euboea and Keos, that in EB I (ca. 3100 – 2650 BC) and particularly in EB II (ca. 2650 – 2200 BC) developed strong stylistic affinities with the Cyclades. This process led to the formation of a "Hellado-Cycladic" or "Cyclado-Helladic" *koine*, analogous to the Neolithic Attic-Kephala culture (e.g., Broodbank, 2000; Davis, 2001; Forsén, 2010; Kouka, 2008; Manning, 1994; Wilson, 1987, 1999).[145] EH Attica is marked by flourishing coastal and inland sites, associated mostly with metal ore exploitation and an intensive mainland-island maritime network.[146] Thus, Attica exemplifies how the boundaries between different regional cultures can become blurred, exhibiting not only a fusion of traditions but also the development of localized features. It thus plays an important role in the debate over the nature of contact between the mainland and islands and the dual character of the coast (as also on Keos, see Wilson, 1987, 1999, 2013).[147]

Attica

Early Bronze Age Attica, in terms of a funerary landscape consisting of cemeteries, until recently included only Aghios Kosmas (southwestern coast) and Tsepi (eastern coast). Individual EH graves have been reported in Athens (Kerameikos and the Acropolis), Alyki at Glyfada/Voula, Markopoulo, Sounio, Raphtopoulo at Porto Raphti, and Raphina (among others; Theocharis 1955; for an overview and references for EBA Attica, see Alram-Stern 2004:537-558; Pullen 1985:127-132, 230-240).[148] Excavations in the last two decades have brought to light many new prehistoric and EH sites which have significantly altered the picture of EH Attica (see the recent conference on Athens and Attica in Prehistory in Athens, May 27-31, 2015; see also Dogka-Tsoli and Oikonomou, 2013; Katsarou-Tzeveleki, 2009; Nazou, 2014).

Of great importance and relevance to this study is the discovery of an extensive EH (EH I and EH II) cemetery at Asteria in Glyfada (Kaza-Papageorgiou, 2001-2004, 2006, 2009; Petrakos, 2012, 2013). Asteria is located on the coast of the Pounta Peninsula, only 5 km south of the EH cemetery and settlement of Aghios Kosmas. The cemetery consists of clusters of graves cut into the local bedrock and is marked by a wall on the western side. Several graves have been exposed, but only six have been excavated to date. Most of the graves are marked on the surface by an enclosure formed by either a single or double series of rocks, leaving the side of the entrance open as at Tsepi (Kaza-Papageorgiou, 2009). The graves have a short passage (*dromos*) and a narrow entrance that was blocked with vertical slabs. The chambers, usually circular in shape (about 1 m deep and 1 m diameter), were covered by slabs of local bedrock. The excavated graves contained multiple inhumations, often with the latest interment recovered *in situ* at the entrance of the tomb, with the deceased lying in a highly contracted position on his or her side. Grave 14 contained at least twenty individuals, including at minimum three young juveniles (two young children and an infant).[149] The last interment was a young adult, placed transversely in a highly contracted position on the right side, facing the entrance (and the sea). The palms were extended in front of the face, resting on the elevated bedrock. The pelvis was damaged by the placement (or fall?) of a large stone. The remainder of the tomb chamber was filled with the skeletal remains of previous burials (in some cases the articulation of elements was preserved), often forming groups. The pile of bones contained crania, long bones, and pelvis fragments, as well as vertebrae and small bones. Three miniature vessels, obsidian tools, and shells were recovered from Grave 14 (Kaza-Papageorgiou, 2012; Petrakos, 2012a). One of the vessels (a miniature pyxis of EC style) was found next to the palms, near the shoulder of the *in situ* burial. The other two vessels were found among the human remains, at the northwestern side of the grave one of them in association with the mandible of a child about 5 years old.

There were, however, cases where the area at the entrance of the grave was found clean but lacking an *in situ* inhumation, with the bones of earlier burials pushed to either side (Grave 7; Kaza-Papaegeorgiou, 2006), as is occasionally the case at Tsepi. A very interesting feature of the cemetery is its large, shallow pit (diameter of about 10 m) that probably served as the depositional area for offerings and other ceremonial items during mortuary rituals (Kaza-Papegeorgiou, 2006; Petrakos, 2013). The pit contained hundreds of vessels (mostly broken), as well as obsidian, figurines, marine shells, and lithic tools, but no bones.[150] Close to the cemetery there is a large prehistoric (EH) stone pile with sherds and lithic tools, formed by the refuse of a metallurgical and lithic workshop (Petrakos, 2013). No settlement has been identified, but the adjacent area and hill above have not been excavated. The greater area of Asteria also had Mycenaean habitation, including a settlement and large cemetery at Alyke, east of the Pounta peninsula.[151] Further inland, at Alimos, the extensive EH settlement on the hill of Kontopigado contained buildings with adjacent, linear walls and evidence for obsidian working and distribution (Kaza-Papageorgiou, 2009; Kaza-Papageorgiou et al., 2011).[152] Other EH settlements in western Attica include the EH I settlement at Palaia Kokkinia at Piraeus (Theocharis, 1951, 1955:ftn.8) and the recently excavated EH settlement at Moshato (Chrysoulaki, 2015). Prehistoric remains dated to the LN – FN and the EH periods were also recently recovered at the Laimos peninsula in Vouliagmeni and confirmed the FN – EH use of the area (Giamalidi et al., 2015).[153] Sites dated to the FN and EH I -II periods were recently recovered in northern Attica, including EH II ritual deposit pits at Kifisia (Georgousopoulou, 2015; Palaiologos and Stefanopoulou, 2015).[154]

Numerous EH sites, mainly settlements, occur in the area of the Mesogeia along the east-central Attic coast (Rafina, Loutsa, Askitario, Vraona, Chamolia, Pounta Porto Rafti), with some others sited on hills (Zagani, Spata, Mesosporitissa, Pyrgos Vraonas, Christos, Merenta, Lamptrai), and still others in the plain (Pallini, Koropi, Choumeza Spaton, Kipoi, Markopoulo) (Apostolopoulou-Kakavogianni, 2001:35; Kakavogianni, 2009; Kakavogianni and Douni, 2009).[155] The area has evidence for much metallurgical activity, chiefly at Lambrika, Koropi, and Raphina. Koropi, in particular, located inland at the center of the Attic peninsula, had a strong EH presence with an extensive EH I-II settlement (Andrikou, 2013). At Lambrika there was a large metallurgical workshop for the cupellation of silver from lead, where hundreds of fragments were recovered

(Kakavogianni, 2005; Kakavogianni et al., 2009, 2008; see also Chapter 3). At Kentro Ygeias in Koropi, large subterranean rock-cut chambers were found, probably evidence for communal storage (Kakavogianni, 1986, 2015). Another large settlement with phases dated to the Final Neolithic, EH I, and EH II periods with two isolated buildings (one dates to early EH I and the other to the end of EH II) have been excavated at Merenda, to the east of Markopoulo that also included litharge remains (Kakavogianni, 2009; Kakavogianni et al., 2009; Ntouni et al., 2015).[156] The settlement included clusters of underground chambers cut in the soft bedrock, which contained pottery as well as slag and litharge and were used as habitation sites (Kakavogianni, 2015). The chambers at Merenda date to the Final Neolithic, in the last half of the fourth millennium BC (Kakavogianni, 2015; Tsirtsoni, 2015). The rock-cut chambers at Mesogeia have only a few parallels in the Aegean (e.g., in FN Cyprus) (Kakavogianni, 2015; Kakavogianni et al., 2009) and, thus, they might represent an Attic feature of the FN – EH period.

Further north, at Loutsa on the eastern coast of Attica, a tumulus-like construction enclosed within a circular wall and featuring paved passages, covered a deep shaft (2.15 m deep) that included hundreds of broken vessels (mostly jars and shallow bowls) dating to EH I (Efstratiou et al., 2009). Likewise at Loutsa (Artemida), recent rescue excavations recovered two early EH graves (excavation by archaeologist Maria Stathi, Archaeological Ephorate of Eastern Attica, Hellenic Ministry of Culture; Asimakou and Pashali, 2015). Grave construction combined built and rock-cut types. The tomb chambers were oval, lined with stones and covered with soil. They had a narrow entrance on the eastern side that was apparently non-functional in view of the lack of permanent roofing of the tomb chamber. The entrance of Grave 1 consisted of two vertical stones and a threshold. Grave 2 included two early EH vessels and one marble, violin-shaped figurine, as well as a fragment of an animal bone palette (Stathi, 2015). Both graves lacked *in situ* skeletons. The disarticulated remains formed a pile in the area across the entrance and were highly fragmentary. Both skeletal assemblages consisted of cranial and long bones. Small bones (e.g., phalanges) and other anatomical elements (e.g., vertebrae, pelvis) were missing. This suggests that the graves were either ossuaries used only for secondary depositons or that during periodic episodes of reuse and/or cleaning only crania and long bones were kept and all other bones were removed. However, due to the quality of the soil, the lack of a permanent roofing of the tomb chamber with one or more stone slabs, and the commingling of the remains, bone preservation is poor. Based on preliminary osteological analysis, a minimum number of four individuals (including a young child about 6 − 7 years old, an older child/young adolescent between 10 − 15 years old, and two adults) is estimated for Grave 1, and a minimum number of three individuals (including an older child about 12 years old and a young adult) for Grave 2.[157]

Recent rescue excavations at Kifissos, in northern Attica, recovered three EH graves in total (Asimakou and Pashali, 2015). Two of the rock-cut graves were found next to each other. Graves 1 and 2 had a passage (*dromos*) leading to the burial chamber; a stone was blocking the entrance. Grave 1 included a primary burial in the tomb chamber, along with remains from secondary burials; the crania of the secondary deposits were placed along one side. Grave 1 included an EH I vessel, while Grave 2 included EH sherds and one EH II collared jar. A third EH grave that included an early (EC I), schematic (spade-shaped) marble figurine was excavated about 2 km away, in a different plot at Kifissos (Asimakou, 2015).

EH pottery has been recovered on three mountain peaks in Attica that served as major peak sanctuaries in the first millennium BC. The evidence from Mt. Hymettus and Mt. Parnes, both sanctuaries of Zeus in historical times, suggests that they were used as places of worship in EH I (Kakavogianni et al., 2009; Ruppenstein, 2011). At Mt. Tourkovouni on the northernmost peak, the evidence suggest the presence of a temporary settlement during the Final Neolithic and EH I period (Ruppenstein, 2011).

Finally, the EH II cemetery at Nea Styra on the western coast of southern Euboea exhibits close ties to the Attic coast. The Nea Styra cemetery, discovered during a rescue excavation, contained three tombs lined with schist slabs, each featuring a stepped passage (*dromos*) also lined with schist slabs (Kosma, 2010, 2012, 2013, 2015a,b,c). The graves contained rich EC finds, such as Cycladic figurines and marble bowls. Tomb 1 contained fifty crania, the largest number identified to date for an EH/EC grave, but no *in situ* burial. Among the commingled remains, all anatomical elements were identified. The presence of small bones and articulated anatomical elements (e.g., partial thorax with vertebrae and ribs in articulation) suggests, at least in part, primary deposits.[158] The skeletal assemblage included adult individuals (males and females), as well as infants, young and older children, and adolescents. Faunal remains (pigs, cattle, and sheep/goat) and marine shells were also identified. Nea Styra commands a strategic location on the maritime route along the Euboean Gulf and lies directly across the gulf from Marathon. Further excavation and study of the EH tombs at Nea Styra will shed new light not only on the relationships between Euboea and the Cyclades, but also on the close contact between eastern Attica and western Euboea (Kalligas, 1983; Kosma, 2010).

Marathon: a Diachronic Perspective

Marathon, on the eastern coast of Attica, played a major role in Attic and Greek history (see Eliot and Osborne, 2005). It is best known for the victory of the Athenians over the Persians during the battle in 490 BC, an event that subsequently became an enduring symbol of democracy. Marathon owes its international fame to the legend about a messenger who ran from Marathon to Athens (ca. 43 km) to announce this victory, only to die immediately after his arrival (Petrakos, 1995:30-32). Marathon also featured in the legends of the Athenian hero Theseus, who consolidated Attica and captured the Marathonian Bull, a creature that had done great damage to the plain of Marathon (Apollod., *Bibl*. *Myth*. 1.5; Plut., *Theseus* 14.1; Strabo, 9.1.22; Paus., 1.27.9). The earliest reference to Marathon is found in the *Odyssey* (7.80), where Homer tells us that Athena returned to Athens from the island of Scheria by way of Marathon. This brief discussion is of great interest as Athena's role as the patron goddess of Athens and Attica is considered. Scheria, an imaginary island that was home to the Phaiakians, is generally thought to have been modeled after Corfu (Kerkyra) in the Ionian Sea. Accordingly, in the earliest extant Greek literature, Marathon is the entry point of Attica for one traveling by sea, and Homer thereby emphasizes Marathon's role as a node on the Aegean maritime network. Relevant is the fact that Tsepi has clear evidence for trade contact with the Cycladic and other islands. While admittedly written at a later date, the poet nevertheless highlights a feature of Marathon's landscape that formed part of the area's character from at least the Final Neolithic.

According to Pausanias, the people of Marathon revered those who died at the famous battle as heroes. There were also local cults of the hero Marathon, who gave his name to the deme, and of Herakles (Paus., 1.15.3, 1.32.4). Marathon was the son of Epopeus (the king of Sicyon), the son of Aloeus, the son of Helius (i.e., the Sun). In order to avoid his father's illegal and immoral actions in the Corinthia, Marathon migrated to the coast of Attica (Paus*.,* 2.1.1). When Epopeus died, Marathon went back to Peloponnese, divided the kingdom among his sons (Sicyon and Corinthus), and then returned to Attica. According to Plutarch, whose source was Dikaiarchos, a hero Marathus was originally from Arcadia and participated in the expedition of the Dioscuri to Attica; according to an oracle, Marathus offered himself as a sacrifice before the battle and thus gave his name to the *deme* of Marathon (*Theseus* 32.4).

The toponym derives from the word for the aromatic plant fennel (*marathos*), which grows naturally in the area (Petrakos, 1995). The plant *marathos* appears in Linear B, on 3 tablets from the House of the Sphinxes at Mycenae with lists of oil and aromatic herbs and spices: *ma-ra-tu-wo/marat*^{h}*won/* (Beekes, 2010; MY Ge 602, 605, 606). The word *marathos* (as well as Marathon) is pre-Greek, adopted by the IE speakers when they arrived in Greece (Beekes, 2010; Chantraine, 1999).

Human occupation at Marathon began in the Neolithic (sixth millennium BC) and continues to the present day. There is thus a marked historical continuity and diachronic significance to the area. The plain is delimited to the northeast and southeast by two marshes, the Great Marsh of Schinias and the Little Marsh of Brexiza, respectively. Before drainage of these marshes in the twentieth century, the area had a major problem with mosquitoes, well known since antiquity (the mosquitos of the region are even mentioned in Aristophanes' comedy *Lysistrata*). However, the marshes did not exist in tbe early prehistoric times and the end of the Neolithic and the Early Helladic I period that form the core of this study, when the sea level was higher and the settlements were actually on the coast (for the extensive work on the paleoenvironmental evolution of the coastal plain of Marathon, see Kapetanios, 2015; Margoni and Kapetanios, 2015; Pavlopoulos et al., 2003, 2006). Overall, the plain is characterized by an abundance of water (streams, springs, and marshes), fecund soils, and rich vegetation, making it ideal for cultivation from prehistory until today. The fertility of the plain and its proximity to the sea make Marathon a unique landscape in Attica.

The earliest evidence for human occupation in Marathon is found in the Cave of Pan at Oenoe, at the northwest of the plain, which was occupied from the LN (5300 - 4300 BC) to the end of the Late Helladic period (ca. 1700 - 1050 BC) (Mpanou and Oikonomakou, 2008) (Fig. 4.1). Interestingly, the decoration of the Neolithic pottery from the Cave of Pan is stylistically closer to that of the central Greek mainland than to that of neighboring Nea Makri (Petroheilos, 2010). The only burial recovered in the cave dates to the FN period (4300 - 3200 BC); the body was placed in a shallow pit, with a ceramic vase containing a necklace with numerous beads. After their victory over the Persians, the Athenians founded a shrine to the Arcadian god Pan; the cult of Pan in the cave continued until the 1st century BC (Mpanou and Oikonomakou, 2008). In the valley of the river Charadros, about 2 km from the modern village of Marathon, was the location of the Classical *deme* of Oenoe (Themelis, 1974).

An extensive and long-lasting settlement has been discovered at Plasi, extending over an area of about six hectares on the southwest coast of the Bay of Marathon (Marinatos, 1970a,b,c,d; Mpanou and Oikonomakou, 2008; Themelis, 1974; Travlos, 1988) (Fig. 4.1).[159] The earliest use of the site goes back to the Final Neolithic, but an extensive, organized, and fortified settlement existed in the Early Helladic period with imported Cycladic or locally produced Cycladicizing pottery. The Middle Helladic layers consisted of large buildings, including industrial remains (a potter's kiln), cist graves, and pottery of fine quality. Occupation of the site continued into the Late Helladic, Geometric (including graves), Archaic, and Classical times, with finds also documenting the Hellenistic, Roman and Byzantine eras.[160] The location of Plasi is probably – but not securely – to be identified with the Classical *deme* of Marathon that lay between Probalinthos and Trikory(n)thos (Marinatos, 1970a,b,c,d; Themelis, 1974; cf. Travlos, 1988).

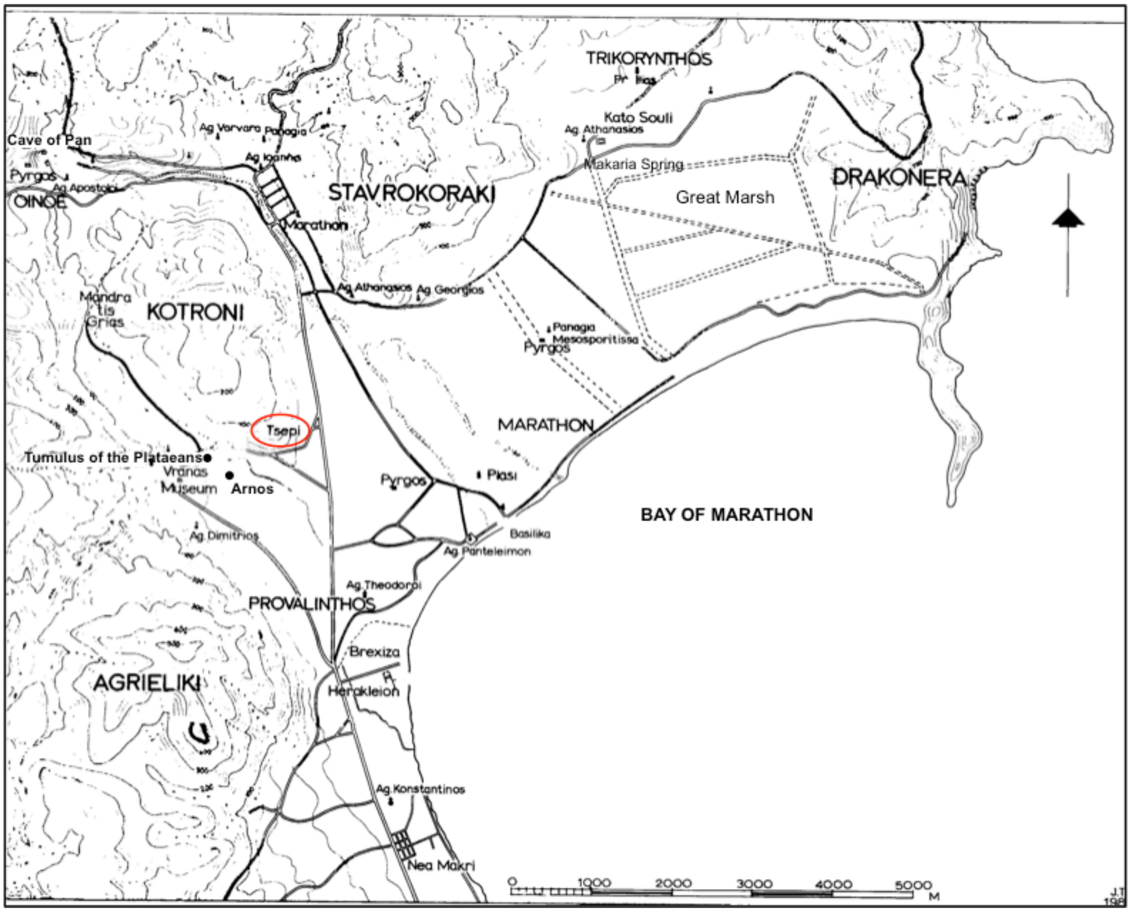

Figure 4.1. Map of Marathon (modified after Travos, 1988:223, Fig. 271).

Another EH settlement with an acropolis was discovered at Kato Souli, in the foothills of Mt. Stavrokoraki, to the northwest of the Bay of Marathon next to the ancient fountain of Makaria (and the modern water pump) (Mastrokostas 1970, 1974; Themelis 1974) (Fig. 4.1). This general location (including the Olympic Rowing Venue) is identified with Trikory(n)thos (McCredie, 1966; Mpanou, 2010; Themelis, 1974). A Neolithic – EH settlement was discovered and excavated at Boriza (Mpanou 2010; Mpanou and Oikonomakou, 2008; Oikonomakou, 2001-2004) (Fig. 4.1). An ellipsoid building dated to the Neolithic or EH I was discovered in the same area (Mazarakis-Ainian, 1995). It is possible that these remains are associated with the cemetery of Tsepi (Mpanou, 2010). A small EH II settlement (2900-2000 BC) was also discovered in the northern part of the Great Marsh, where the Olympic Rowing Venue was constructed; the settlement was abandoned at the end of the Early Bronze Age due to flooding (Kapetanios, 2015; Mpanou and Oikonomakou, 2008; Oikonomakou, 2001-2004).

An extensive and elaborate Neolithic settlement has been excavated at Nea Makri, on the coast immediately to the south of Marathon (Mpanou, 2010; Theocharis, 1954; Pantelidou-Gofas, 1995, 1997) (Fig. 4.1).[161] The site also has EH finds (EH II and EH III). One EH communal tomb was uncovered, including approximately 15 individuals, frying-pans, and fragments of a pyxis. This could have been prehistoric Probalinthos (Themelis, 1974). The *deme* of Probalinthos is located in the eastern foothills of Mt. Agrieliki (Xylokeriza) at Nea Makri, while the Classical cemetery of the *deme* was located at the small marsh of Brexiza, where in the Roman period a large sanctuary dedicated to the Egyptian gods was established (Themelis, 1974).

Close to the cemetery of Tsepi, less than 2 km to the northwest, lies the MH cemetery of Vranas (1800-1400 BC) (Fig. 4.1).[162] The cemetery consists of seven identified tumuli, four of which were excavated by Marinatos (1970a,b,c,d;, 1971, 1972). Tumulus I enclosed eight graves, one of which dates to Early Christian times, while another contained the upper skeleton and body of a small horse. According to Themelis (1974), this does not represent a MH horse burial; the horse skeleton was placed in the grave after it was robbed and/or emptied of human remains, and then was covered by stones and animal bones in Late Byzantine times. Tumulus II included only one grave and Tumulus III had four graves. Tumulus IV covered a stone structure used as an ossuary for the bones of secondary burials from Mycenaean graves based on the associated finds (14th and early 13th centuries BC). During the construction of the new roof for the Vranas tumuli in 2004, two earlier burials were discovered in the northwestern part of the cemetery. One was a burial inside a vessel, and the other was a small, simple cist grave that included a decorated vessel dated to the Early Bronze Age (Oikonomakou, 2001-2004). The cist graves had walls lined with schist slabs and not river cobbles, as is the case at Tsepi (Mpanou and Oikonomakou, 2008; Pantelidou-Gofas, 2005a).

At Arnos, at about 500 m to the southwest of the cemetery of Vranas, there is a large Mycenaean tholos tomb that was discovered and excavated in 1933-1935 by Sotiriadis (Marinatos, 1970a; Sotiriadis, 1933, 1934) (Fig. 4.1). The burial chamber (diameter of 7 m) contained two pit graves with typical Mycenean pottery and one plain gold cup. The excavation of the 25 m-long *dromos* (entrance corridor) of the tholos tomb in 1958 revealed the antithetically positioned burials of two horses, placed on their left and right sides. The two horses were a burial offering to the dead, reflecting heroic burial practices described by Homer (Petrakos, 1995). The tholos tomb at Arnos dates to 1450 – 1380 BC (LH IIIA1) and constitutes one of the very few tholos tombs found in Attica.

Close to the prehistoric tumuli in Vranas, to the east, a large Classical tumulus, the so-called Tumulus of the Plataeans, was partially excavated by Marinatos in the 1970s (Fig. 4.1). The tumulus was more than 3 m high and with a diameter of 30 – 35 m.

The section of the tumulus excavated to date contained eleven burials, two of which were cremations. The dead were reported to be all male adults, with the exception of a child of about 10 years of age (Marinatos 1970c,d; Petrakos, 1995). The artifacts, including grave stelai, date to 500 – 490 BC. Marinatos identified the tumulus with the burial monument for the Plataeans from Boeotia that died during the Marathon Battle (as mentioned by Pausanias), and considered the buried child to be a possible young military messenger. However, Marinatos' hypothesis regarding the Tumulus of the Plataeans has recently been contested and the tumulus' identification is under reconsideration (Petrakos, 1995; Petroheilos, 2010). Whatever the case with this particular tomb, I should note the diachronic use of the area of Marathon and in particular the valley of Vrana, including the cemetery of Tsepi for burials, given the presence of major funerary remains in such close proximity (Fig. 4.1).

An interesting point, not often mentioned, is the complex Early Helladic settlement organization in Marathon that may have served as a forerunner to the famous Classical *Tetrapolis* (Themelis, 1974, 1986, 2011). The *Tetrapolis* of Marathon (i.e., "Four-Cities"), part of the Attic *Dodekapolis* (i.e., "Twelve-Cities" prior to the legendary unification [*synoikismos*] of the Attic districts by Theseus), was the cult association of the *demoi* of Marathon, Oenoe, Probalinthos, and Tricory(n)thos (Strabo, 398-399) (Fig. 4.1). Marathon was the "capital" and thus its name survived for the characterization of the whole region. The Pelasgian name *Hyttenia* (Υττηνία) was acknowledged as an earlier form of *Tetrapolis* (Androtion, FGrH 324 F 68; Aelius Herodianus, *De prosodia catholica* 3,1 p 297).[163] *Hyttenia* shows pre-Greek -*tt*- (Fick, 1905:129), and some have suggested that '*Huth*' or '*Hut*' is the number four in the Tyrrheno-Pelasgian (pre-Greek) language (Woudhuizen, 1992:31).

Themelis (1974, 1986, 2011) interprets the ancient references to Hyttenia as a precursor to the *Tetrapolis* organization, citing the clear evidence for urban patterning in the Early Helladic era. Marathon (Plasi?) served as the center of the plain with three satellite settlements (some fortified); all four acted as a unified administrative and sociopolitical entity that persisted in the later *Tetrapolis*. Themelis (2011) considers *Hyttenia* as an example of a prehistoric hierarchical political system associated with population increase, metallurgy, trade, and maritime connections, all of which resulted in social differentiation. Themelis (1974) draws attention to the fact that at least two of the four names, Probalinthos and Tricory(n)thos, are pre-Greek, which is suggestive of the presence of organized settlements at least since the Early Helladic times.

The fact that the ancient sources recognized *Hyttenia* as the earlier name of the Tetrapolis indicates that locals and literary elites had some knowledge of a tradition associated with the deep antiquity of the region. This point is also implied by Herodotus' account of the early history of Athens and Attica. The historian tells us that the residents of Attica in the fifth century BC claimed to be autochthonous, that is, born from the soil of their home region (Hdt. 1.56-8). Moreover, Herodotus reported that the inhabitants of Attica were Pelasgoi who eventually coalesced with the intruding Greeks (Hdt. 1.57.3).[164] Herodotus also believed that the Greeks had taken the names of their gods from the Pelasgians (2.52.1-3). All of this, of course, is orally transmitted material, but one cannot deny that the Classical Greeks recognized the early – what would now be called prehistoric – heritage of Attica and its inhabitants. This must, in part, be attributed to the material culture, which from time to time would have been discovered and wondered at as new construction and engineering projects were undertaken. If the cultural and linguistic synthesis in Attica as reported by Herodotus is considered, it is particularly intriguing that two of the toponyms of the Tetrapolis likely exhibit later Greek modification or reinterpretation of pre-Greek place names. That is, note how *Probalinthos*, which has the typical pre-Greek suffix *-nth-* (-νθ-), has been quasi-hellenized with reference to the Greek verb *proballō* (προβάλλω) 'to throw forward, guard against,' which has an impeccable IE etymology. Similarly, in the case of Trikory(n)thos we find the IE prefix *Tri-* (Τρι-), 'three,' used with the pre-Greek suffix –*nthos* (-*νθος*).[165]

One can at least hypothesize, albeit a bit speculatively, that some variations of Probalinthos and Trikory(n)thos were names of settlements in the vicinity of Marathon during the earlier EH. Place names tend to remain static, even after population movements, immigration and emigration. Interestingly, the sacrificial calendar of the Tetrapolis, preserved in an inscription of the earlier 4th century BC (*SEG* 50.168), is replete with dedications for heroes, both male and female, named and unnamed. There is even a hero named Hyttenios, obviously derived from the prehistoric toponym. Given the fact that hero and/or ancestor cult had earlier developed around prehistoric tombs, one wonders if these anonymous and otherwise little known heroes of the Marathon area were once associated with the cluster of Bronze Age burial contexts located in the vicinity of Tsepi-Vranas-Arnos.

The Cemetery of Tsepi

The EH cemetery of Tsepi is located at the western end of the Marathon plain in eastern coastal Attica, about 2.5 km from the sea (Figs. 1.1, 4.1).[166] The cemetery was built at the foot of the rocky hill Kotroni, in the old riverbed of the Skorpio Potami stream that had been filled with sediments and thus provided soft ground for digging graves (Fig. 4.1).[167] This also explains the extensive use of river cobbles in the cemetery's architecture (Fig. 4.2). Currently, about 70 graves have been identified, but the full extent of the cemetery remains unknown. To date, no associated settlement has been found. Given the lack of a settlement nearby, it has been suggested that, despite the 2.5 km distance, the EH settlement at Plasi was associated with the cemetery of Tsepi (Petroheilos, 2010; Themelis, 1974). However, Marinatos rejected any relation between the EH Plasi settlement and the Tsepi cemetery (1970c:348), and, more recently, Pantelidou-Gofas has agreed (2005a). Weiberg (2007) proposed that the absence of a settlement at Tsepi could suggest that the cemetery was used by dispersed farmsteads located in the wider, surrounding area. However, the absence of a settlement is most probably due to the absence of systematic archaeological investigation in the area adjacent to Tsepi. Travlos (1988) linked the cemetery to the remains of a settlement found in a trial trench in 1979, about 400 m south of the cemetery (Papangeli, 1979). Mpanou (2010), however, suggested an association between Tsepi and the recently recovered Neolithic and/or EH I remains at nearby Boriza, only 300 m to the southeast.

Tsepi was discovered by chance in November of 1969 when the owner of a local house was digging a well in his back yard at the location of what was later identified as

Grave 1 (in the southwest corner of the plan, Fig. 4.3) (Pantelidou-Gofas 2005a:15,23).[168] The cemetery was originally excavated by Spyridon Marinatos between 1970 and 1973 (Marinatos, 1970a,b,c,d, 1971, 1972). In 1997, the Archaeological Society at Athens commissioned Maria Pantelidou-Gofas to study and publish the finds of Marinatos' excavation (Pantelidou-Gofas 2005a) and to continue with the excavation of the cemetery (Pantelidou-Gofas 1999, 2000, 2002, 2003, 2004, 2005a,b, 2006, 2007, 2008a,b, 2010a,b; Petrakos 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012b, 2013). In 2003-2004 a rescue excavation took place inside the cemetery area for the construction of the new roof (Kapetanios 2010; Mpanou and Oikonomakou 2008; Vasilopoulou 2010). Marinatos excavated 28 graves (T1 to T27), in some cases only partially, and uncovered the ancient surface of the cemetery at a depth of about 1.2 m (Fig. 4.3).[169] Pantelidou-Gofas has excavated approximately 20 graves to date,[170] and two graves were excavated during the construction of the roof (T71, T72).[171]

The cemetery is characterized by an orderly space allocation of graves and exceptional uniformity in grave construction and orientation (Figs. 4.2, 4.3). The graves are generally arranged in rows following a northwest-southeast orientation, with the entrance to the southeast.[172] They are demarcated by individual enclosures with an opening to the southeast, and separated from one another by narrow passages (Figs. 4.2, 4.3). Weiberg (2007) drew attention to the fact that the opening of the graves at Tsepi is directed towards the coast (to the southeast), suggesting perhaps a relationship between the dead and water. At Aghios Kosmas, Mylonas (1959) observed a tendency for the graves' openings to face the settlement. This would hold true for Tsepi, too, if the associated settlement was in fact located to the southeast of the cemetery (see aforementioned comment by Travlos, 1988 on Papangeli, 1979).

Figure 4.2. The southeastern part of the Tsepi cemetery showing the graves excavated by Marinatos in 1970-1973 that form the core of this study.

Grave construction is complex and generally uniform across the cemetery.[173] Each grave consists of a set of features: the tomb chamber (*lákkos*), the entrance (*stómion*), an access shaft (*próthyron*), a raised platform (*lithóstroto ypérgeio epípedo*), and an enclosure (*períbolos*) (see Pantelidou-Gofas, 2005a:287-297 for detailed descriptions). The tomb chamber is usually rectangular (sometimes circular) about 0.80 – 0.90 m deep and about 1 m long, lined with dry stone walling. The walls of the tomb chambers of earlier graves were lined with vertical schist slabs (e.g., T3, T19).[174]

Figure 4.3. General plan of the cemetery of Tsepi showing the numbering of the presently uncovered graves (after Pantelidou-Gofas, 2005a; courtesy of the Archaeological Society at Athens).

On the eastern side of the tomb chamber, there is a rectangular entrance (measuring about 0.4 m x 0.5 m) with a threshold (identifying the opening as a formal doorway); this entrance is closed on the outside with a schist slab placed vertically across the opening.[175] The floor of the chamber was covered with pebbles and sand; in some cases, the builders simply re-used the layer of river cobbles formed by the earlier riverbed (Pantelidou-Gofas, 2005a:290). The tomb chamber was roofed with large schist or limestone slabs, which were themselves subsequently covered by soil to form a raised platform, rectangular in plan (even above the circular pits) and capped with two or three layers of river cobbles.

To the east of the grave, a narrow passage of varying length leads to the entrance of the tomb chamber, thus forming a short access shaft (*próthyron*).[176] The walls of the access shaft are often lined with cobbles and its bottom is horizontal, inclined, or less often stepped.[177] The access shaft was filled with clean soil and covered by a pile of cobbles above ground level. The eastern sides of the walls of the access shaft were often faced with vertical schist slabs that rose above the ancient surface level to serve as a marker of the shaft entrance, an early form of what would in LBA and historical times be termed *stelai*, a feature unique to Tsepi (e.g., T7, T9, T12) (Pantelidou-Gofas, 2005a).[178] In some cases the protruding top of these slabs was broken in antiquity, thus making the slabs invisible on the surface (e.g., T44, T45, T52, T54). Pantelidou-Gofas has interpreted such breakage as an intentional indication of the cessation of the use of the tomb (2008, 2009; also Petrakos, 2008).[179] She further observed that these *stelai* are absent in the graves in the southeastern area of the cemetery (T19, T20, T22, T24, T25, T26, T27), as well as in the majority of the graves in the northern area (Pantelidou-Gofas 2005a:293). In these cases, however, vertical limestone slabs or smaller stones often served the same purpose (T20, T21, T57).[180] Finally, each grave is demarcated on the ground surface contemporary with the tomb's usage by a rectangular enclosure formed by a series of river cobbles, with an opening to the east that allowed access to the grave. There are two noteworthy exceptions to such individual enclosures: two graves, one next to the other, share the same enclosure (T10 and T11), while in another case the enclosures of two different graves share a common side (T42 and T53).[181] In one case, the enclosures of two adjacent graves (T3 and T4) share a common side: the northern side of the enclosure of T3 was removed and replaced by the southern side of the enclosure of the later T4 (Pantelidou-Gofas, 2005a:32). T45 did not have an enclosure (Pantelidou-Gofas, 2008a). Pantelidou-Gofas (2005a) rightfully attributes the construction of the graves to specialized workmen, similar to Sampson's (1987:19) remark about "experienced master-builders" for the construction of the Manika tombs.

An enigmatic feature found at Tsepi is a long series of stones running northeast-southwest for about 12.70 m in the north-central portion of the cemetery (Pantelidou-Gofas, 2005a:262). It runs over the western side of T57, between the western side of T58 and the eastern side of T56, and over the western side of T55, petering out close to the stone pile structure numbered 51 (see plan in Fig. 4.2). Its function is unclear. It does not seem to serve as an enclosure for the cemetery given that graves occur on both sides, unless the cemetery expanded at a different time. A large enclosure wall delimited the western side of the Asteria cemetery, though parts of it might have been constructed after the EH era (Kaza-Papageorgiou, 2006, 2009; Petrakos, 2012a).

The standardization in grave construction at Tsepi is of great significance, and sometimes extends even to the remodeling of earlier graves. [182] In the cases of T3, T19, T49, and T53, an entrance and an access shaft were added to the original cist graves lined with large schist slabs to integrate them both visually and functionally into the rest of the cemetery.[183] This shows that standardization in grave construction and formality of layout were established early on and had to be followed.[184] Furthermore, this documented adaptation of the original, simpler cist grave to a more complex form gave rise to the new grave type in Tsepi (Pantelidou-Gofas, 2005a). Pantelidou-Gofas (1998) suggested that the new grave type might have been established towards the end of EC I, as evidenced by the finds from T19; however, the precise date of this new type cannot be determined. The earlier cist graves seem to follow the standard Cycladic designs, but the early date of Tsepi might raise questions regarding the origins of this form, which has previously been considered a Cycladic feature imported to the mainland.[185]

Pantelidou-Gofas (2005a:297-299, 336-343) emphasized the material used for the slabs covering the tomb chambers, either schist or limestone. The locally available and readily accessible available material limestone can be easily quarried close by at the Kotroni hill, whereas schist is only found further away at Mt. Agrieliki. Schist is common in the Cyclades and used widely in Cycladic cist graves. Besides the fact that schist is a softer and more easily worked rock than limestone and thus easier to work, the use of schist probably resulted from the desire to imitate the cist graves according to the excavator (Pantelidou-Gofas, 2005a:337-338). However, if according to the recent finds the early graves at Tsepi predate the EC ones, then the hypothesis for the emulation of EC prototypes is no longer valid.

The raised platform above the tomb chamber constitutes another major feature at Tsepi; whether or not it served a ritualistic, symbolic, or other function is unclear. At Kephala, seven of the forty excavated graves (it is unclear if some platforms were destroyed due to erosion) had carefully built, stone platforms above, five of which were rectangular and two circular or semi-circular (Coleman, 1977:45-47, Pl. 10).[186] Their tops (up to 40 cm higher than the roofing slabs of the tombs on which they rested) did not necessarily protrude above ground level, which made Coleman (1977) doubt their use as grave markers. One smaller platform stood alone, not covering a grave. Coleman suggested that the platforms might have been part of the burial ritual (e.g., for libations and offerings), however he acknowledged that there is no compelling evidence for their specific function. Platforms occur in EC cemeteries, for example at Lakkoudes and Ayioi Anargyroi on Naxos, though not as a uniform feature within cemeteries and not necessarily on top of graves (Alram-Stern, 2004:283, 304-305; Doumas, 1977: 35-36).[187] At the EC cemetery of Ayioi Anargyroi in Naxos, a long (40 m), narrow (3 – 4 m wide), raised, and terraced platform was found running along the southern side of the graves leading to the adjacent hill, with steps leading to its top (Doumas 1977).[188] At the side of the platform, a deposit area was discovered, where open, incised vessels, described as "hat-liked" vases by Doumas (1977, 2008) and as basins by Pantelidou-Gofas (2008a), were found, some of them broken *in situ*. These have been interpreted as vases used in mortuary rituals (e.g., incense burners; Doumas, 1977:103) that were afterwards discarded in a specific area. At Akrotiri on Naxos, individual platforms were constructed over each grave (Doumas, 1977:36, 82-83). Doumas (1977, 1987) linked the presence of platforms to the performance of mortuary rituals.

In the case of Tsepi, the elaborate supra-chamber structure (roofing slabs, platform) was permanent (cf. Aghios Kosmas and the later discussion under "Burial Program"). Excavation has shown that the roofing of the tomb chamber was not removed and that burials took place through the access shaft (Pantelidou-Gofas, 2005a). More importantly, the uniform, conspicuous above-ground features and the marking of individual graves at Tsepi in various ways by means of enclosures, raised platforms, piles of cobbles above the access shafts, and small *stelai* at the entrance resulted in a well-ordered cemetery plan within which specific tombs could easily be recognized.

Furthermore, the type of grave present in Tsepi, particularly the presence of doorways with thresholds and, sometimes, lintels, may reproduce contemporary house architecture (Alram-Stern, 2004; Mylonas, 1959:66 for Aghios Kosmas, drawing on Tsountas, 1899 for the corbelled tombs on Syros; Pullen, 1985, 1994; see Soles, 1992 for EM Crete).[189] This resemblance to house construction could mean that the tombs were meant to be houses for the dead.[190] The parallel between domestic and funerary architecture is more striking if the layout of EH settlements is considered, and especially Konsola's (1984, 1986, 1997) discussion of early urbanization in EH culture. The elements of organization of EH settlements, such as an orderly layout, the generally uniform orientation of the buildings, the networks of (often paved) streets, the arrangement of buildings into blocks (though sometimes irregular), and the maintenance of plots, indicate compliance with rules of construction and a considerable degree of planning.[191] These features have clear analogies in the intra-cemetery organization of EH cemeteries, particularly at Tsepi. Indeed, Tsepi is the most formally organized of all EBA cemeteries and one of the most formally organized cemeteries of the prehistoric Aegean in general (cf. cemetery plans at Aghios Kosmas in Mylonas, 1959: drawing 48; Kephala in Coleman, 1977: Pl. 8-9; Manika in Sampson, 1983:71).[192] Thus, the construction of the Tsepi cemetery shows a considerable degree of planning that was accompanied by a set of rules for constructing individual graves. Furthermore, it is quite possible that the features of Tsepi are indicative of a close link between settlement and cemetery organization.

Burial Program

The graves at Tsepi contain multiple burials and were used for successive primary inhumations over a long period of time, as evidenced by the cases of *in situ* skeletons. At Tsepi, the maximum number reported for a grave is 27 individuals in T12, based on a count of excavated crania (Pantelidou-Gofas, 2005a). The deceased was placed transversely in the space immediately inside the doorway, usually lying on his or her right side facing the entrance and in a highly contracted position.[193] The head and/or hands were sometimes placed on a stone that served as a kind of pillow (e.g., T5, T18). Placement on the right side was the norm in the EC I - II Cyclades (Doumas, 1977:55; Tsountas, 1898:148). In the corbelled tombs of EC II Syros, however, the deceased was placed on the left side more often than on the right (Tsountas, 1899:83). Broodbank (2000:199) mentions this as a difference between the northern and the southern Cyclades; however, placement on the left side was very rare in other Cycladic islands except for Syros (Doumas, 1977:55). In the Kouphonisi cemeteries the deceased were facing the interior of the tomb chamber (Zapheiropoulou, 2008).

The body was introduced into the grave through the doorway after the removal of the filling from the access shaft. This is distinct from the practice at Aghios Kosmas and Kephala, where the dead body was lowered into the chamber through the roof (Mylonas, 1959:65-66; Coleman, 1977:48), and to Marinatos' (1970d) original interpretation (Pantelidou-Gofas, 2005a). The bones from the earlier burials were collected at the western end of the grave pit, with the skulls often placed in an orderly fashion along the southern or western side. Often the bones of the previous burials were collected in groups, particularly the long bones (e.g., T33, T36), indicating not only that someone would have had to enter the tomb chamber for this arrangement, but also that he or she showed considerable respect for the earlier remains, which were not simply pushed aside (Pantelidou-Gofas, 2005a:329). In some cases limbs were still articulated, a fact indicating that they had not yet fully decomposed prior to the next interment (T18, T20) (Pantelidou-Gofas 2005a:328).

The absence of an *in situ* skeleton despite the preparation of the entrance area (i.e., cleaning) in some graves raises questions regarding the burial ritual. In the case of T19, the area immediately inside of the entrance was cleared of bones but did not contain a final interment (Pantelidou-Gofas, 2005a). Likewise, in T33 the entrance area was cleared of previous burials but did not contain an *in situ* occupant (see the later discussion of burial in the access shaft of T33) (Pantelidou-Gofas, 1999).[194] This led Pantelidou-Gofas to suggest that the clearing of bones from the eastern side of the pit did not necessarily take place at the time of the new inhumation, but rather at some point after the decomposition of the flesh of the latest burial, thus forming a separate event independent of a new interment in the grave (Pantelidou-Gofas, 1999, 2005a).[195]

A separate funerary ritual that consisted of the cleaning and/or preparation of the tomb chamber and of access to it was also proposed by Cavanagh and Mee (1998) for this particular type of tomb. Considering the Mycenaean chamber tombs, Cavanagh (1978) proposed a second burial rite that "must have involved the living far more than the dead" (1978:177). This probably involved the removal of previously deposited skeletal remains from the tomb, their display to the relatives, and their return to the tomb chamber or to a pit in the passage (*dromos*), often mixed with the bones of even earlier ancestors. In the case of the EH tombs at Tsepi, a person would have had to enter the grave by crawling through the functional doorway to rearrange the bones and attend to the recently and/or anciently deceased (see Pantelidou-Gofas, 1998: Pl. 14b; 2005a:216 fig. 228). This would require someone to enter a small, dark burial chamber filled with – not always fully – skeletonized and decomposed human remains. This practice necessitates very close contact with human remains, thus suggesting an intimate relationship with the dead and the performance of a different set of rituals focused upon the secondary treatment of the remains – in the case of strong beliefs about pollution, the burial rites would have avoided such close and frequent contact with skeletal remains, regardless of who was in charge of the burial and grave maintenance.

In some instances, the *in situ* skeletons were discovered at the bottom of the tomb chamber with skeletal remains placed on top, which might suggest that later use of such tombs was for secondary burials only (e.g., T53).[196] Pantelidou-Gofas (2008) attributed the presence of commingled cranial and long bones on top of the *in situ* interment in T53 to the transfer of skeletal remains from a different grave during remodeling. As an alternative explanation, she rightly notes that the secondary placement of crania on the *in situ* skeleton in T43 could have taken place at the time of the interment (Pantelidou-Gofas, 2009). Thus, the placement of a few crania on the *in situ* interments should not necessarily be considered as a separate event.

The case of T43, however, presents us with significant deviations. The usage of the tomb chamber was divided into two phases by a layer of clean soil. The upper layer contained crania and bones on top of two *in situ* skeletons (one on top of the other, but the lower one was missing the cranium), with an estimated number of 12 individuals (Pantelidou-Gofas, 2009). The lower (and earlier) phase included four *in situ* skeletons, one next to the other, laid down transversely on the river cobbles and covered by a large number of pebbles as well as sherds (including a sherd dated to the Final Neolithic). The positioning of these earlier skeletons suggests that they were introduced into the tomb chamber through the roof (Pantelidou-Gofas, 2009).[197] The excavator sees this as evidence for the presence of two chronologically distinc burial rituals in the cemetery, one earlier and one later. In some cases the bones of the earlier burials were covered with pebbles (e.g., T49; Petrakos, 2011).

In two graves (T14, T33) primary burials took place in the access shaft (*prothyron*). The access shaft of T14 contained an *in situ* skeleton, as well as five crania and also other bones (Pantelidou-Gofas, 2005a:106). The access shaft of T33 contained an arrangement of long bones and two broken crania, with an *in situ* skeleton below (Pantelidou-Gofas, 2005a:192). Pantelidou-Gofas (2005a) notes that in both graves the covering slabs were broken, thus the placement of burials in the access shaft was probably dictated by the inability to use the tomb chamber without accessing it from the top. Moreover, the access shaft of T49 included the secondary deposition of a cranium and long bones (Petrakos, 2011). Long bones were deposited on top of the filling of the access shaft of T68 and were covered with a schist slab (Pantelidou-Gofas, 2005b). In the access shaft of T71 a secondary deposit of postcranial remains was recovered arranged densely in a perfect circle, suggesting either a shallow pit or the original placement of the bones inside a container made out of perishable material, such as a cloth sack (Kapetanios, 2010:22-23). In a single case, a secondary burial was found under a layer of cobbles in the area between T71 and T72. This deposit contained three crania placed next to each other facing east, with the long bones in an oval-shaped arrangement (Kapetanios, 2010:22-23).

In some cases, smaller, shallow tomb chambers for children occur within the enclosure of the main grave (e.g., T5a, T27) (Pantelidou-Gofas, 2005a:334-335). Exceptions are T15, which was used exclusively for the burial of a young child

(Pantelidou-Gofas, 2005a:110-111), and T45, which contained an *in situ* burial of a child on the floor of the chamber and the secondary burials of another child and a juvenile individual (Pantelidou-Gofas, 2006). A pit was used as a child's grave constructed at the entrance of T62 during the last use of the grave (Petrakos 2013). It should be noted, however, that burial of children also takes place within graves.

Small pits with finds have been recovered in association with graves at different locations within the cemetery. Along the northern side of T19, a small elliptical pit marked by cobbles and open on the eastern side (similar to the grave entrance) has been called T19a (Pantelidou-Gofas, 2005a:127-141, figs. 129, 140). The pit contained six broken vessels but no bones. Around the middle of the pit, there was a vertical, cylindrical opening (0.045 m diameter, 0.30 m depth) coated with a thick layer of clay which resembled the rim of a vessel (Pantelidou-Gofas, 2005a:137). The vessels consisted of basins and cups. Basins have otherwise only been recovered in the deposit pit (39), being unattested in graves except for a single sherd from T43. Thus, the pit was probably used during mortuary rituals, while the opening likely served for libations (Pantelidou-Gofas, 2005a:139). A small pit was also recovered on the northeastern side of T45. This pit contained no finds, but it had four or five very narrow holes and included pebbles (Pantelidou-Gofas, 2006:3). Furthermore, finds on the original EH surface of the cemetery comprise four vessels (a small amphora, a miniature necked jar, a pyxis-shaped vessel, and a cup) and a triton shell (*Charonia tritonis*) distributed among pebbles, found between the enclosures of T12 and T13 (Pantelidou-Gofas 2005a:103-104).[198]

To the west of T69 was a pit containing fragmentary remains (Kapetanios, 2010:22). Between this pit and the enclosure of T69, a small amphora was found covered with a drinking cup (placed upside-down); the small amphora was placed inside a pit and contained a bronze bead and a small fragment of burned bone (Kapetanios, 2010:24).[199] Kapetanios (2010) interpreted this find as either the secondary burial of a cremation or an urn for the remains of a cremation (Kapetanios, 2010:24). However, as the description and depiction stands, there is not enough evidence for the identification of a cremation.[200] It seems more plausible to interpret this find as evidence of feasting and/or libations, especially given the drinking cup.

Grave Finds

The grave finds consisted of a variety of ceramic vessels (small amphorae, pyxides, necked jars, jugs and juglets, various miniature shapes, drinking cups, platters, frying pans, and lids), pigment palettes, obsidian, a variety of personal ornaments and small metal finds, and figurines (Pantelidou-Gofas, 2005a:300-323) (Fig. 4.4; Appendix A).[201] The recent discovery of the frying pan in T49 with a handle that ends in two projections resembling human feet shows that the vessel was free-standing, thus shedding new light on the function of frying pans (Pantelidou-Gofas, 2011; Petrakos, 2011). The two marble figurines (T10, T19) are very schematic, indicating their early date.[202] Obsidian blades and/or flakes/debris, as expected, were commonly found inside the tomb chambers (T5, T7, T9, T10, T11, T12, T19, T20, T22, T23, T25, T26, T31, T43, T45, T68) (n = 34 at least; Pantelidou-Gofas, 2005a,b, 2006, 2009). Obsidian was also recovered during the study of the human remains from T12, T20, T25, and T26 (n = 10). Pantelidou-Gofas (2005a:331) interprets the frequent presence of obsidian inside the tomb chambers, often commingled with bones, as implements used in the preparation of the deceased for burial or in the burial ritual itself (Pantelidou-Gofas, 2005a:331).[203]

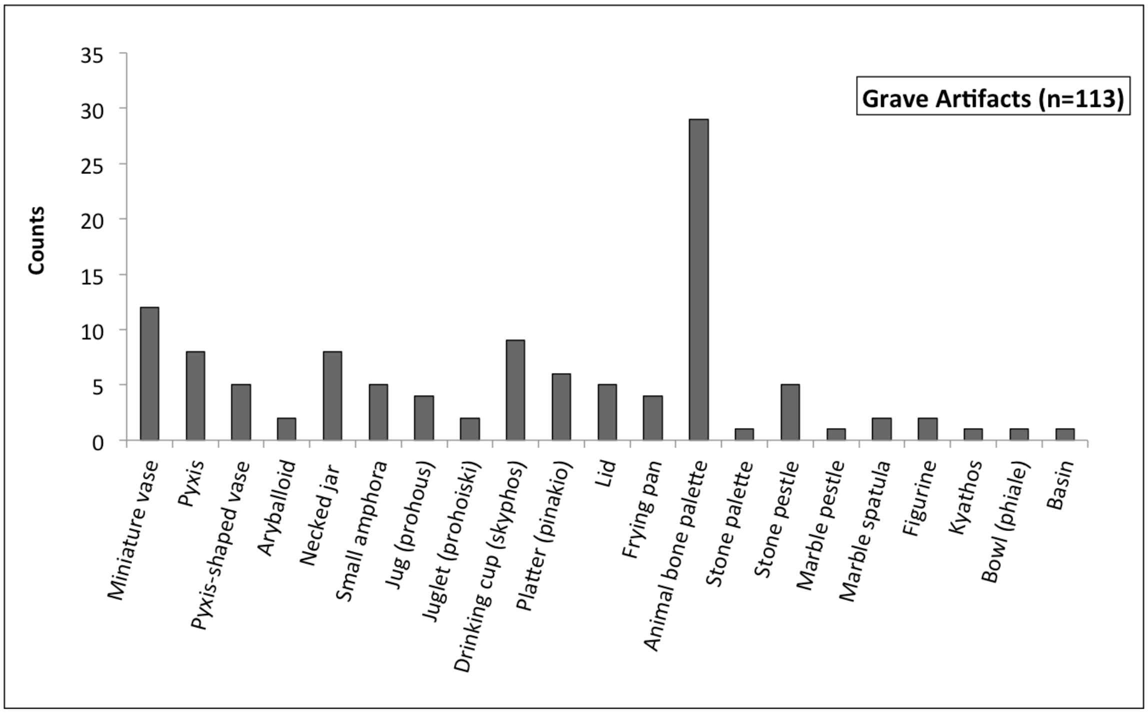

Figure 4.4. Number and types of artifacts discovered from the Tsepi graves (Data from Pantelidou-Gofas, 2005a, 2006, 2007, 2008b, 2009, 2010, 2011). The number of bone palettes includes the ones recovered during the analysis of the human remains).

Animal bone palettes were a common find in the Tsepi graves. These are worked long bones (probably femora) of large animals shaped as a "palette", often preserving small perforations in each of the four corners. These bone artifacts are generally interpreted as palettes for grinding pigments –however, their function is open to debate (see the recent hypothesis for the use of the “palettes” as early, schematic figurines by Koufovasilis, 2015).[204] Pantelidou-Gofas (2005a) reported 21 palettes from 14 graves: T2, T3 (two palettes), T4, T5, T6, T7, T10, T12 (two palettes), T16, T17, T19 (three palettes), T25, T49, T57 (four palettes). During this study, additional bone palettes from the aforementioned graves were identified among the human skeletal remains: a palette fragment from T6, a palette fragment from T10, and fragments of three palettes from T25 (Fig. 4.5).[205] Moreover, one nearly complete bone palette and fragments of two more were identified among the skeletal remains from T22. In total, 29 bone palettes have been identified, making bone palettes the third more common find from the Tsepi graves after ceramics and personal ornaments, excluding obsidian. In total, 15 graves included animal bone palettes; 13 of those graves are located at the southern half of the cemetery, excavated by Marinatos.

At Tsepi all pigment palettes except one were made of bone (Fig. 4.4), contrary to the EC I palettes made of marble or stone. The single stone palette at Tsepi comes from T24. Stone or marble palettes have been found in the cemetery and settlement of Aghios Kosmas (Mylonas, 1959), the settlement of Zygouries (Blegen, 1928:125, Fig. 184), the settlement of Lithares (Tzavella-Evjen, 1984:188-189), and on Crete (see Karantzali, 1996: 46, 80, 152).[206] One bone palette, on the other hand, was found in Manika (Sampson, 1988:71) and in the recently excavated EH I cemetery in ancient Elis (Rambach, 2007, Fig. 35).[207] A segment of an animal bone palette, identical to the ones from Tsepi, was identified among the human remains from Grave 2 at Loutsa in Attica (unpublished material). The sole bone palette found in the Cyclades comes from the EC I cemetery of Lakkoudes on Naxos (Doumas, 1977: Pl. 26e; Rambach, 2000a: Pl. 94.21). Pantelidou-Gofas (2005a:320-321) dates the bone palettes of Tsepi earlier than the Cycladic ones, an observation corroborated by their discovery in graves with early finds.

Figure 4.5. Fragment of animal bone palette, broken on top and on the side, identified among the human skeletal remains from T25 (left: internal, convex surface; right: external, concave surface).

The lids with incised decoration are also worthy of special mention (Forsén, 2010).[208] Pantelidou-Gofas (2005a:314-316) noted that the features of the lids are not insular. These shallow vessels (thought originally to be lids of pyxides) are of a type called Bratislava lids, known from the Baden culture in the Karpathian Basin (ca. 3500 – 3000) and occurring in Albania, Bulgaria, Serbia, Hungary, Slovakia, and the Czech Republic (Maran, 1997, 1998a:344-346, 1998b). Coleman (2011:27) uses the term “Petromagoula-Doliana” for these types of incised shallow lids and bowls in order to differentiate them from their European counterparts and avoid making their Eastern

European origin a foregone conclusion. The new name derives from their frequency in the Petromagoula-Doliana group of northern Greece, where they were manufactured locally.[209] The similarities between the two types (Bratislava and Petromagoula-Doliana) suggest close contact between central Greece and the Balkans, which would have occurred through the major river valleys.[210] Coleman (2011) sees these decorated vessels not as functional lids but rather as ritual items, closely related to the later frying pans (both lids and frying pans are found at Tsepi).[211] Coleman views the "Tsepi incised pans" (2011:28) as later forms of the Petromagoula-Doliana bowls. The "Petromagoula-Doliana group" (extending from central Greece on the east to Epirus on the west) dates to the mid-fourth millennium BC and the earlier part of its second half.[212]

Coleman (2011), building on his earlier argument (2000), claims that the Petromagoula-Doliana group represents a migration into Greece from the north (i.e., Balkans) of people who introduced the Indo-European Greek language, forming part of the "Proto-Bronze Age" cultural groups of the mid-fourth millennium BC in the Balkans. The presence of the incised lids in Tsepi could thus suggest that the EH people of Attica were partly descended from these "Proto-Bronze Age" immigrants who followed a route leading south along the western coast of the Euboean Gulf (Coleman, 2011:29). Regardless of the argument for a north-south population migration in the early EBA, Coleman's (2011:29) concluding remark that "some features taken to be of Cycladic character at Tsepi and other central Greek EB I sites actually originated in central Greece and Attica, particularly the regions around the S. Euboean gulf, and passed from there to the Cyclades" challenges the previously established Cycladic-centered approach to EH culture. Coleman had earlier proposed (1992) the possibility of parallel development for the mortuary customs of the mainland and those of the Cyclades, whereas the Cycladic finds (possibly locally made) at sites such as Aghios Kosmas and Tsepi were usually attributed to Cycladic colonists.

The number and composition of personal ornaments (jewelry) in the Tsepi graves constitute another distinctive feature (Fig. 4.6) A large number of beads (34 in total) have been recovered, the majority made of different stones (n = 25; T5, T10, T12, T20, T33, T58), in addition to two bronze specimens (T17), one golden one (T12), five made of bone (T22, T68), and one made of *Spondylus* shell (T36). T58 contained a necklace with 17 stone beads (one phallus-shaped, one bird-shaped, and one stone seal with a perforation) and one perforated animal tooth (Petrakos, 2012).[213] Both golden objects come from the same grave (T12): a segment of a decorated golden band and a golden bead in the form of a wheat seed. Additional pendants consisted of a cowrie shell (T10) and two land snails (*Cyclope neritea*) with perforations (T33; Pantelidou-Gofas 2005a:201).[214] The grain-shaped bead in combination with the phallus-shaped bead and the cowrie shell (Fig. 4.7) might suggest an emphasis on fertility and agriculture.[215] This could likewise support Pullen's (1992) argument for the role of agriculture in the establishment of elites in the EH era.[216] Silver items consisted of six bands from T12 and one silver ring from T19. During the conservation of the human remains from T1 – T27, two more silver bands (fragments) were recovered: one from T12 (raising the total number of silver bands from T12 to seven) and one from T14 (previously thought to contain no artifacts) (Fig. 4.8). Thus, contrary to the general assumption that there was a lack of intra-cemetery differentiation, T12 appears to have a more prominent position (see Fig. 4.9).

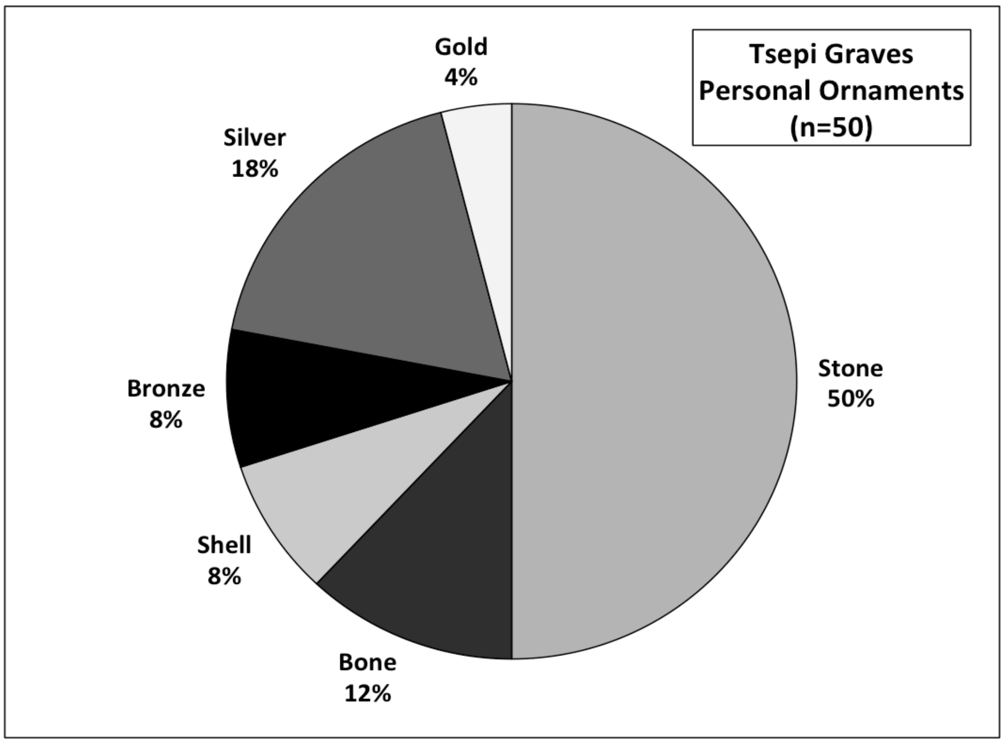

Figure 4.6. Variation of material in personal ornaments recovered in Tsepi graves (Data based on Pantelidou-Gofas, 2005a; *Ergon*, 2006-2013; *PAE*, 2006-2011; and material recovered during the study of the human remains).

Figure 4.7. Pendant of *Luria lurida* (cowrie) shell found with the human skeletal remains from T10 in Tsepi cemetery. The artificial round perforation is visible on the upper right side (left view); the rest is taphonomic damage.

Figure 4.8. Cranium 23 from T12 during microexcavation and conservation showing the silver band with dotted decoration *in situ* (close-up in the upper right corner). The silver band was revealed above the right temporal suggesting that the deceased was wearing the silver band around the head.

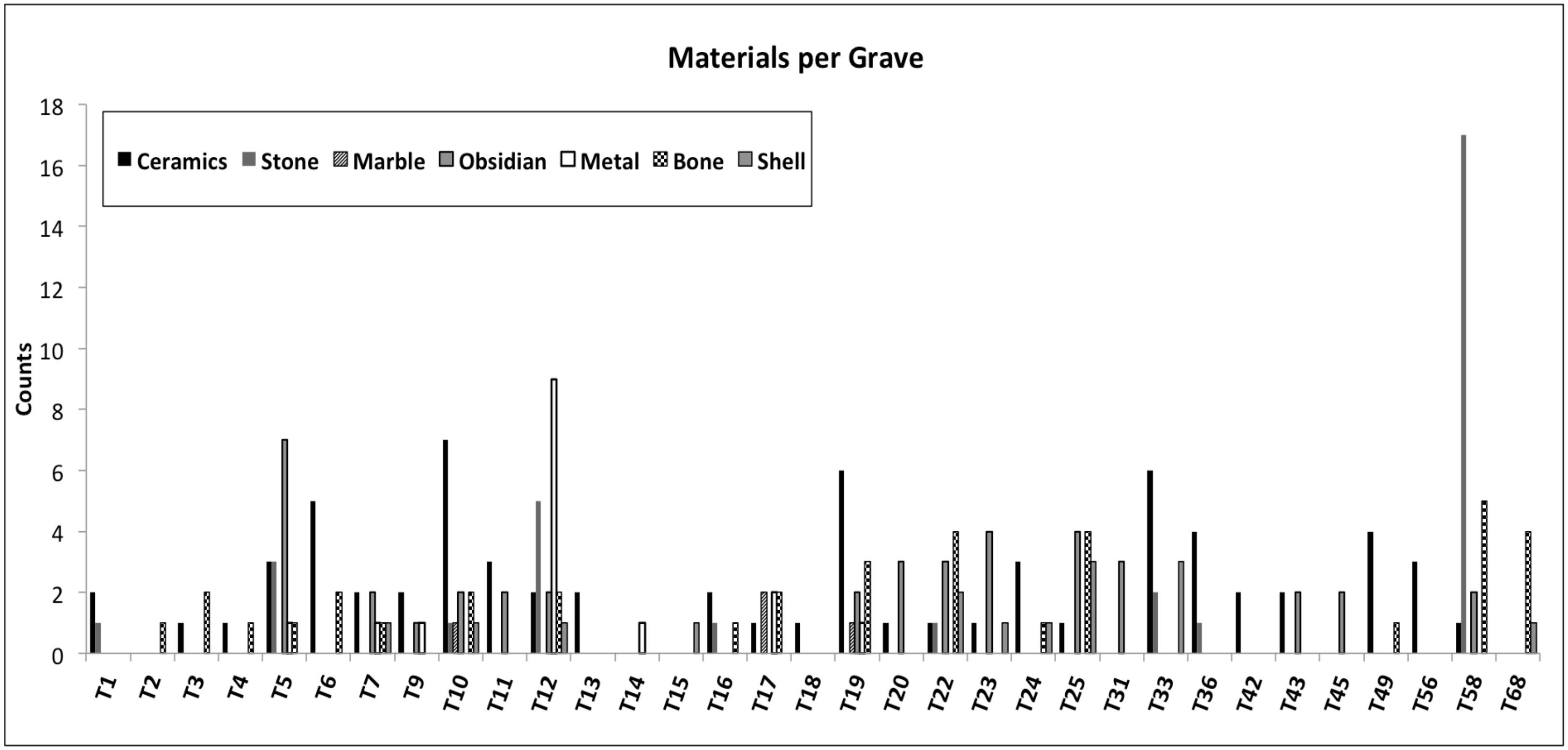

Figure 4.9. Distribution of materials in the Tsepi graves (Data based on Pantelidou-Gofas, 2005a; *Ergon*, 2006-2013; *PAE*, 2006-2011; and material recovered during the study of the human remains). The rubric "stone" here includes stone materials other than marble, which are considered as a distinct category. This graph does not include the faunal remains (not worked) recovered from the Tsepi graves).

Interestingly, a litharge fragment was recovered in Grave 7 (Pantelidou-Gofas, 2005a:323).[217] This litharge derives from cupellation for the extraction of silver, probably from Lavrion ores (Oikonomou and Chioti, 2005). This is the only case to date of litharge recovered from a funerary context. It could suggest the close relationship of one of the individuals (the last interment?) buried in T7 with metallurgy. In any case, the litharge and small metal finds from Tsepi (silver, gold, bronze) raise questions regarding local metallurgical activities. What this find means for the role of metal sources in the lives of the people at Tsepi and in Attica more generally remains to be seen.

Moving away from the conventional emphasis on pottery in analyses of EH grave finds, Weiberg (2007:279-286) made an important contribution by shifting the focus to the different kinds of materials represented and their variable distribution. In her examination of the mortuary record of the EH mainland, Weiberg focused her analysis upon Tsepi (based on the graves included in Pantelidou-Gofas, 2005a), Manika (Sampson, 1985, 1988; Sapouna-Sakellarakis, 1987), Aghios Kosmas (Mylonas, 1959), Perachora-Vouliagmeni (Hatzipopouliou-Kalliri, 1983), Kalamaki (Broneer, 1958), Zygouries (Blegen, 1928; Pullen, 1985), Corinth (Heermance and Lord, 1897), and Cheliotomylos (Waage, 1949). Admittedly, the very small number of available graves in the Corinthia (n = 9) might not be representative of the whole region, especially compared to Attica and Euboea (n = 114). There is also a chronological component: the Corinthian graves seem to be generally later than the Attic-Euboean ones. Nevertheless, an interesting, possibly regional, pattern emerges (Weiberg, 2007:278-286). Pottery makes up the vast majority, if not the whole assemblage, in the Corinthian sites, while it constitutes less than half in the Attic and Euboean sites, where the variation in materials is striking. Weiberg attributes this high level of variation in the Attic (Aghios Kosmas, Tsepi) and Euboean (Manika) cemeteries to their geographical locations on trade routes. In addition, differences exist between the pottery associated with mortuary contexts in the Argolid and the Corinthia and that of Attica and Euboea (Weiberg, 2013). In the former case, domestic pottery and open shapes are common (e.g., sauceboats), whereas they are rare in the latter where small and closed shapes are characteristic (e.g., pyxis). However, Weiberg's (2007) analysis did not include the deposit pit in Tsepi. With reference to Attica and Euboea, the prevalence of obsidian blades and chips at Aghios Kosmas is striking, with pottery following as the next numerous class of artifact (Weiberg, 2007:280, 282). In Manika, obsidian forms something less than 50% of the total materials (a percentage a bit higher than that of pottery) (Weiberg, 2007:280). In Tsepi, the composition is very different with pottery forming much less than 50%, but with the other half including a wide variety of materials (Fig. 4.10).[218]

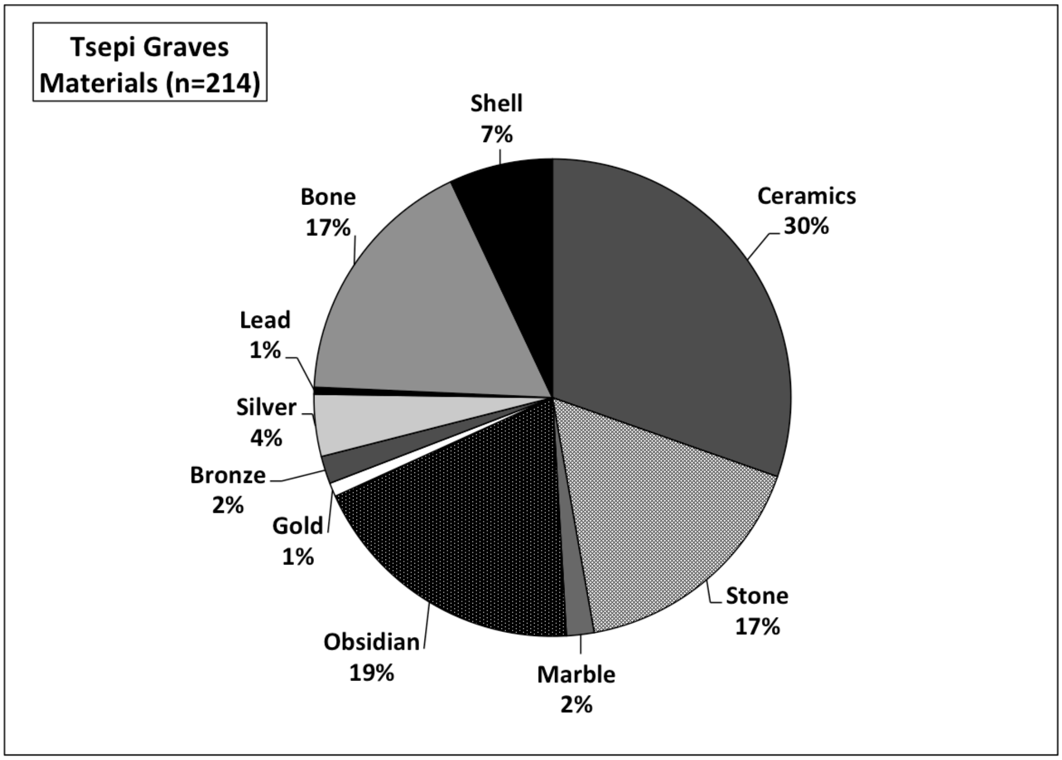

Figure 4.10. Composition of materials recovered in the Tsepi graves (Data based on Pantelidou-Gofas 2005a; *Ergon* 2006-2013; *PAE* 2006-2011; and material recovered during the study of the human remains). The rubric "stone" here includes stone materials other than marble, which are considered as a distinct category. This graph does not include the faunal remains recovered in the graves.

This emphasis on the variation of materials found in Tsepi is of great importance (Weiberg, 2007:278-286). Tsepi not only has the largest range of materials (pottery, stone, obsidian, bone, silver, shell, marble, bronze, gold, and lead), but also includes all known metals (note here that each metal has its own source). Gold was found neither at Aghios Kosmas nor in Manika; interestingly, gold was found at Zygouries (two gold ornaments, each in a different grave). Furthermore, Tsepi shows the largest number of small finds (Fig. 4.11).[219] It also has the largest number of beads, as well as the largest number of metal bands (silver and gold), which actually come from the same grave.[220]

Despite the presence of metal objects and litharge, the Tsepi graves did not contain any "weapons" such as daggers, which are commonly found in the EBA Cyclades and Crete. All the metal finds from Tsepi are jewelry (beads, metal bands, a ring, and part of a wire, with the exception of the litharge), while there are no tools (at Aghios Kosmas, bronze tweezers were recovered). The high frequency of small finds might relate to body ornamentation (see also Catapoti, 2011 for embodiment; Weiberg, 2007). Daggers were recovered in the Manika graves (Sampson, 1985; Sapouna-Sakellaraki, 1987) but not at Aghios Kosmas.[221] Spindle whorls associated with the domestic sphere were found neither at Tsepi nor Aghios Kosmas; they were plentiful at Manika and in the well at Cheliotomylos. Pins were also absent in the former group. Palettes are very common at Tsepi, as well as at Aghios Kosmas, but they hardly represented in Manika and absent from Zygouries. On the contrary, bone tubes are absent in Tsepi and Aghios Kosmas (as well as Zygouries and Cheliotomylos) but present in Manika.[222] Accordingly, there is clearly a differentiation between the different sites, and possibly regions, with Tsepi obviously playing a special role in EH I.

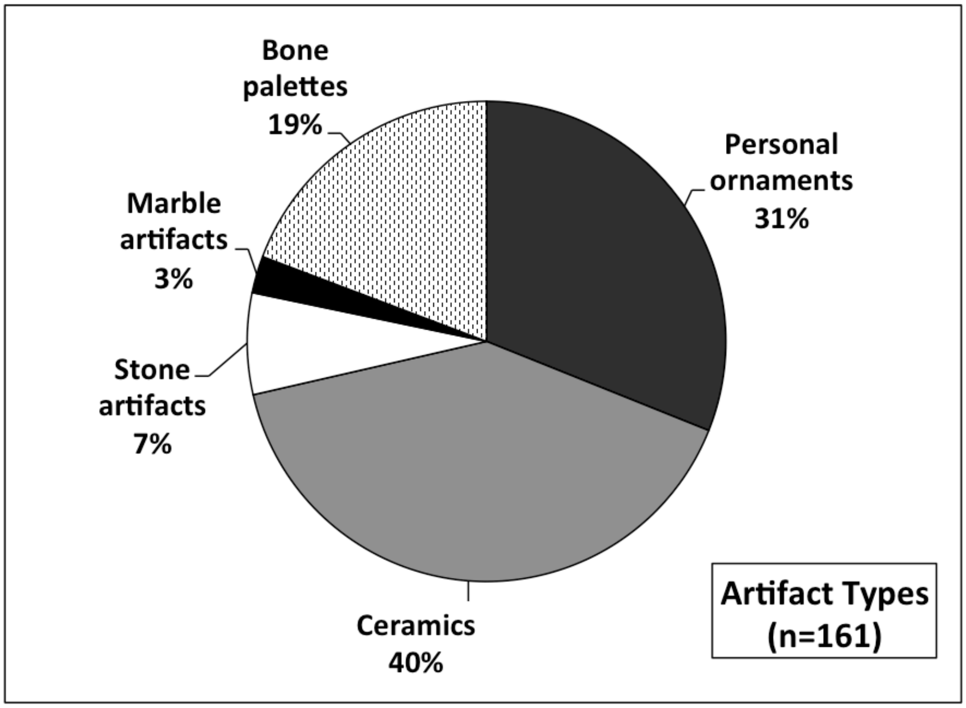

Figure 4.11. Percentages based on type of artifact in the Tsepi graves. Note the high percentage of personal ornaments (small finds). (Data based on Pantelidou-Gofas, 2005a; *Ergon*, 2006-2013; *PAE*, 2006-2011; and material recovered during the study of the human remains). Here marble objects are considered separately from other stone objects (annotated as "stone"). This graph does not include obsidian and shell that is not worked (i.e., only artifacts).

Finally, faunal remains (n = 24) were recovered in 11 graves at Tsepi (Table 4.1).[223] These consist mainly of teeth (Table 4.1). A few bones were recovered, one radius and five scapulae –all pig–, in addition to the fragment of a sheep/goat mandible. The species represented are pig (*Sus scrofa*; n = 11), cattle (*Bos taurus*; n = 6), and sheep/goat (*Caprinae*; n = 4), with a clear prominence of pig specimens.[224] The distribution of the faunal specimens is of some interest (Fig. 4.12). Graves T5 and T6 show the largest concentrations of faunal remains (n = 6 and n = 5, respectively), both containing all three species. In T6 three teeth (one of each species) were found next to the *in situ* skeleton of the last interment, raising some questions as to whether they may have been deposited as an offering (Pantelidou-Gofas, 2005a:61; identified during the study of the human remains). Any interpretation of the role of the faunal remains in the burial contexts should remain tentative until their study by a specialist. However, their presence adds significantly to the possibility of ritual feasting practices in a mortuary context at Tsepi. In this argument, the small, burned unidentified bone recovered in T9 should also be taken into consideration. The possibility of funerary feasting and libation at Tsepi is supported by the presence and frequency of certain vessel types from the graves, e.g., cups, the second largest category of ceramic vessels after miniature vases (Fig. 4.3). Pantelidou-Gofas (2005a:318) generally interprets the grave finds as offerings serving the needs of the dead. Thus, the cups in her view are likely to have held beverages and/or food for the dead. Kapetanios (2010:28) proposes that, with the exception of personal ornaments, the grave finds at Tsepi could represent the remains of funerary rituals performed during reuse of the graves rather than offerings to the deceased *per se*. Weiberg (2007:350-356, 2013a) interprets the ceramic assemblages of the EH mortuary contexts as evidence for eating and drinking practices. The large numbers of ceramic vessels discovered in the deposit pits (see the following section) at Tsepi, particularly the open shapes (though platters were also recovered in some graves, Fig. 4.3), point to the practice of extensive funerary rituals, most probably including feasting.

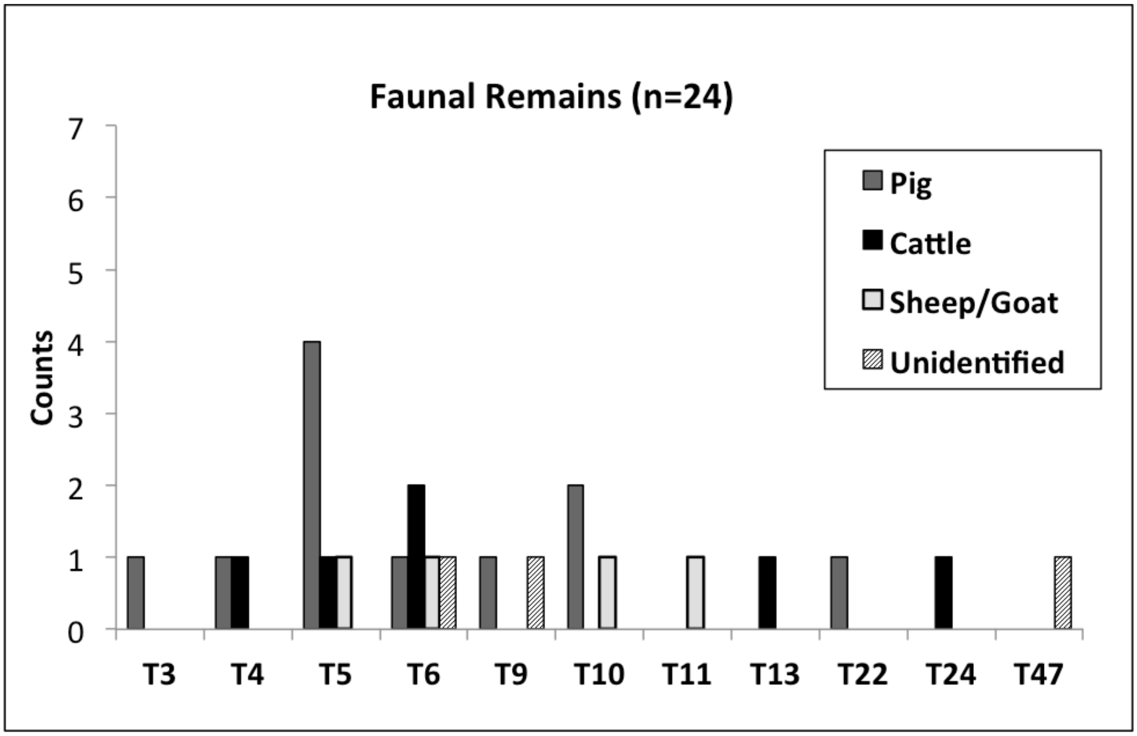

Figure 4.12. Distribution of faunal remains in the Tsepi graves. (Data based on Pantelidou-Gofas 2005a; *Ergon* 2006-2013; *PAE* 2006-2011; and material recovered during the study of the human remains).

Table 4.1. Faunal remains recovered in the Tsepi graves. (Data based on Pantelidou-Gofas, 2005a; *Ergon* 2006-2013; *PAE* 2006-2011; and material recovered during the study of the human remains). Artifacts made of faunal bone and/or teeth are not included here.

Tomb #	Specimen	Animal
T3	Scapula	Pig
T4	Incisor	Cattle
	Molar	Pig
T5	Two right scapulae	Pig
	Incisor	Cattle
	Incisor	Pig
	Radius	Pig
	Mandible with deciduous premolar	Sheep/Goat
T6	Incisor	Cattle
	Incisor	Pig
	Molar	Cattle
	Molar	
	Tooth	Sheep/Goat
		Large animal
T9	Incisor	Pig
	Burned bone	Unidentified
T10	Deciduous premolar	Sheep/Goat
	Left and right scapulae (paired?)	Pig
T11	Molar	Sheep/Goat
T13	Incisor	Cattle
T22	Incisor	Pig
T24	Incisor	Cattle
T47	Tooth	Large animal

Ritual Deposit Pits

A very interesting feature at Tsepi is the deposit within a pit on the western side of the cemetery, located between graves T30, T34, T40 and excavated from 1999-2000 (# 39 in the plan Fig. 4.2) (Pantelidou-Gofas, 2008b). The pit was only superficially excavated by Marinatos between 1970-1973, who considered its excavation nearly complete, while the wares found posed questions about whether or not it was household refuse or burial waste (Pantelidou-Gofas, 2008b; for its subsequent excavation, see Pantelidou-Gofas, 1999, 2000; Petrakos, 1999, 2000).

The pit is large (2.6 x 3.0 m, 1.2 m deep) and partially lined with drystone walls (Pantelidou-Gofas, 2005a:223, 2008b:281), and was found densely packed with broken pottery. All the vessels, with a few exceptions, were broken *in situ* by pebbles, cobbles, and stones with the sherds and often the stones preserved in place. The fragments of the broken vessels were completely recoverable in their vast majority. As documented by the absence of soil coating on the vessels, the pit was not filled with soil, thus the pots remained uncovered and visible. More than 1,000 vessels were represented. The types consist of open and closed shapes, including basins (lekanes), fruit stands, jars, small amphorae, cups, and pyxis-shaped vessels (with crusted decoration). Recently, sherds of "cheese pots" were also identified from the deposit pit, including a vessel resembling a boat (Pantelidou-Gofas, 2013). Many of the vessels showed evidence of burning (i.e., they were subjected to fire in their last use). Probably to be associated with the deposit in the pit is an area of blackened soil and ashes to the west that may have served as a pyre for the funerary rituals (Pantelidou-Gofas, 2010a; Petrakos, 2007). A puzzling feature, however, is that many vessels were already fragmentary when burnt, with the result that sherds from the same vessels may appear very different (Pantelidou-Gofas, 2013). Among the finds, there were also large *pithoi* (0.40 – 0.50 m high), products of a local workshop that, in contrast, showed no signs of burning. This lack of burning and their large size suggest that they were not part of the ritual offerings to the dead, but were rather used for the transportation of large quantities of liquids (e.g., wine) or perhaps grain (Pantelidou-Gofas, 2004; Petrakos, 2004). No human bones were found in the pit, with the exception of a group of fragmentary bones in a separate shallow pit at the topmost layer, at a depth of about 0.20 m (Pantelidou-Gofas, 2002:40, 2003:33-34). Other finds included a few animal bones, an obsidian blade, a metal band, a bead, and three marble figurines (Pantelidou-Gofas, 2005a:223, 2008b).

Two main differences were observed between the vessels recovered from the graves and those from the deposit pit. The vessels found inside the graves were mostly recovered intact and in good condition, whereas the vessels from the deposit pit were all broken. Moreover, the types of vessels included in the graves were different than those recovered in the deposit pit. The vessels from the deposit pit were household wares and thus did not constitute typical burial offerings. With the exception of one sherd in T43, basins were not found inside tomb chambers. Nevertheless, the majority of finds from the deposit pit were of good quality despite their household nature. Based on the pottery, the pit was in use in the early phase of EH/EC I – not continuously throughout EH I, as is the case with the rest of the cemetery (Pantelidou-Gofas, 2008a). Recent petrographic analysis of the ceramics recovered from the Deposit Pit 39 (n = 120) suggested a common local provenance for the ceramic group (Pomonis and Pantelidou-Gofas, 2015).

The recent discovery of a second deposit pit, generally speaking contemporary with Deposit Pit 39, is similarly of great importance. In the area between the graves T14, T16, T62 and the stone pile 66, large quantities of pottery formed a wide pile up to 0.70 m thick that was later covered with stones and pebbles (Petrakos, 2012). The lower layers contained broken vessels of types similar to those found in deposit pit 39 as well as a few new types, while the upper layers contained mainly broken bowls. However, these did not show evidence of fire.

The famous Greek ethnographer Politis (1894) provides us with a detailed account of the Greek funeral custom of breaking vessels (e.g., plates, jugs) (see also Panourgia, 1995 for more recent references and the continuation of the ritual even today). "Vessels either especially dedicated to the deceased or else having been used in the funeral rites are broken at the grave" (Politis, 1894:29). This includes, for example, vessels used by the priest during the funerary liturgy, vessels used by the participants for purification rituals (e.g., washing of hands), and vessels used for food offered to the participants at the grave (Politis, 1894:33-35 with references in p35, ftn. 1). The custom was observed extensively in Greece (e.g., Peloponnesus, northern Greece, the islands) and Cyprus. Breakage of clay vessels also took place in front of the deceased's house and other houses along the route to the cemetery during the procession of the dead body, particularly in Arcadia (Politis 1894).[225] Politis (1984) stressed the survival of the custom from deep antiquity (for discussions on the continuity of the rite in Greece and analogies with archaeological funerary contexts in different times, especially Mycenaean Greece and Classical Antiquity, see Fossey, 1985; Grinsell, 1961, 1973). Politis (1894) also pointed to similar customs in different parts of the world. Tylor (1871:436) discussed the funeral object sacrifice in different cultures and cited examples of breaking vessels and utensils given to the dead in the Americas (in various Native American tribes), in Australia, and Madagascar among other places.

Furthermore, the custom of funerary meals and periodic memorial services was nearly ubiquitous in Greece, observed also in antiquity (e.g., *περίδειπνα*, *μνημόσυνα*) (Politis, 1873).[226] Food was intimately connected with funerary ceremonies, offerred at the grave and at the church after the funeral and the memorial services, as well as periodically on set holy days when rituals take place for the commemoration of the dead collectively, in continental and insular Greece. The items consumed incldued boiled wheat (*kóllyva; κόλλυβα*),[227] bread, pies, rice, seeds, dried fruits, honey, wine, and olive oil (Politis, 1984; Protodikos, 1860; Ricaut, 1696:299; Saint-Sauveur, 1800, vol. 2:55-56; Sonnini, 1801, vol. 2:153). Except for the *kóllyva,* bread and cheese or olives and wine were also offered after the procession, usually after the interment (Politis, 1873; Protodikos, 1860:14). Protodikos (1860:14) reported bread, cheese, olives, and wine to be offered at the grave after the interment. Protodikos (1860:17) tells us that the peasants also performed a meat feast on the major holy day closest to the completion of the first year after burial, when they brought meat, bread, and wine to the church.[228]

Overall, it is plausible that the deposit pits were used for the "ritual destruction" of vessels as part of the funerary rituals or their aftermath (see also Renfrew, 1984:35, 1991:91-101). The presence of two deposit pits suggests that the *in situ* breakage of vessels in specific areas of the cemetery was a systematic rite.[229] This is further corroborated by the deposit pit found at the cemetery of Asteria.[230] Interestingly, even though the pottery found in the Tsepi graves is generally complete, there still are several broken potsherds (some of them of open vessels, e.g., basin, *phiale*). These could represent the remains of vessels broken at the grave during funerary rituals. The presence of animal bones in the deposit pit and inside the graves, in combination with the broken open vessels and the large number of drinking cups, are probably associated with ritualistic feasting (see earlier discussion regarding the faunal remains from the graves).

Chronology

Contrary to the previously expressed opinions that considered the Tsepi burials as EH/EC II phenomena, the cemetery dates mainly to the EH I period (ca. 3100 – 2500).[231] Based on the finds, the earliest use of Tsepi cemetery dates to the beginning of the EBA or the end of the Final Neolithic (Pantelidou-Gofas, 2005a:324-325). The earliest find from a grave context is the decorated small amphora (crusted ware) from T25, characteristic of the Final Neolithic in central and southern Greece in the Attica-Kephala culture but less common in the Cyclades (Pantelidou-Gofas 2005a:324). The deposit pit 39 dates to the Final neolithic, before 3200 BC (Petrakos, 2007). Based on the lids, Coleman (2011) dates the early phase of Tsepi to 3500 BC along with the Petromagoula-Doliana group. The cemetery continues to be used throughout EC I, while some graves remain in use until the early phase of EC II. However, characteristic types of the mature

EH/EC II are missing. The majority of the finds correspond to the Kampos Group (Manning, 1995; Zapheiropoulou, 2008), thus dating the cemetery to EH/EC I (Alram-Stern, 2004:156-163, 175-179, 279; Forsén, 2010; Rambach, 2000:255-264). Accordingly, the early date of Tsepi significantly alters the image of Final Neolithic and EH I Attica and requires a re-evaluation of the cemetery's antecedents and the origins of its more distinctive features.

In order to examine the temporal scope of grave and cemetery use, radiocarbon dating analysis was performed to obtain absolute dates for a sample of burials from Tsepi. In total, 12 human bone samples (femora and tibiae) from different graves and different grave layers were analyzed for radiocarbon (^{14}C) at the National Science Foundation Arizona AMS Laboratory at the University of Arizona. The aim of absolute dating was a) to establish absolute dates for the usage of the Tsepi cemetery, b) to address the potential contemporaneity of different graves, and c) to examine the duration of use of selected graves and grave groups.

Brief Introduction to the Method

Radiocarbon dating is a method that allows for the absolute and direct dating of organic materials (such as charcoal and bone) up to 50,000 years old. Since its inception in 1949, the method has been widely applied in archaeology, where the ability to obtain independent, calendar dates of archaeological samples revolutionized the field. The principle of radiocarbon dating is based on the known, constant decay of the radioactive isotope ^{14}C. All organisms, while alive, remain in approximate equilibrium with the concentration of ^{14}C in the atmosphere. When the exchange with the atmospheric ^{14}C ceases (i.e., when an organism dies), the ^{14}C present at the time of death continues to decay at a constant rate. Thus, the measurement of the residual ^{14}C in a sample can be used to infer the age for that sample, which is the approximate estimate of the length of time between the present (set at 1950) and the time of death (i.e., when the intake of ^{14}C stopped).

The conventional methodology was based on decay counting (i.e., the beta particles emitted during the decay of ^{14}C atoms). One of the major drawbacks during the first few decades of the use of the radiocarbon dating technique was that it required several grams of pure carbon, and thus very large samples (e.g., hundreds of grams of bone), often unavailable. A major development in the field was the introduction of Accelerator Mass Spectrometry (AMS) in 1977, where the use of accelerators enabled the ^{14}C atoms to be distinguished from ^{12}C atoms by their different atomic mass and thus the direct measurement of the amount of ^{14}C in a sample as the ratio of ^{14}C to that of the the stable carbon isotope ^{12}C (for AMS, see Duplessy and Arnold, 1989; Hedges, 1981; Stafford et al., 1991). This direct counting of ^{14}C decreased significantly measurement times and, most importantly, the required original sample size to only a few grams (for bone). In addition, the direct counting of the amount of ^{14}C makes AMS 1,000 to 10,000 more sensitive than the conventional decay counting technique.

In radiocarbon dating, accuracy refers to how close the measured (estimated) date is to the 'true' date of the sample, including systematic erors (± ranges) (i.e., obtaining a 'correct' age), while precision refers to the degree of uncertainty expressed as an error value (i.e., a small error means high precision). Obviously, a precise measurement does not have to be necessarily accurate. Depending on the size of the carbon sample and the facility, AMS can give precision of about ± 0.4% in ^{14}C content or ± 35 years in radiocarbon age (uncalibrated) and can go down to ± 0.2% or better than ± 20 years in radiocarbon age (information available at http://www.physics.arizona.edu/ams/facility/capacity.htm).

The accuracy depends on a variety of factors. A major one is the calibration of the measured radiocarbon dates, expressed in terms of ^{14}C years BP (i.e., before present, where present is set to AD 1950 due to the standard used), to get the true age in calendar dates (calibrated radiocarbon dates are usually noted as cal.).[232] The need for calibration results from the fact that, contrary to the original assumption that atmospheric ^{14}C had been constant, there have been fluctuations in the atmospheric ^{14}C over time. Thus, the observed radiocarbon dates have to be calibrated based on published calibration curves in order to be converted to calendar dates. The time-period of interest here (5,000 BP) falls in a period for which there are available robust data (mostly based on tree rings) and published calibration curves that can produce accurately calibrated dates with high certainty (Ramsey et al., 2006). The calibrated dates are an estimate, an expression of statistical fit between the radiocarbon dates and the calendar dates and are given with a probability range (based on the standard deviation). Therefore, a higher probability comes with a lower precision (i.e., larger error range). Calibrated dates are commonly reported for 95% (2σ) and 68% (1σ) confidence levels.

Radiocarbon Results

Given that the analysis is performed on extracts of collagen, preservation is of critical imortance. Fresh bone consists of about 20% collagen. However, the protein content in dry bone decreases and degrades over time. The rate of degradation depends highly on the physical and geochemical environment (i.e., burial). Unfortunately, collagen extraction failed for 11 out of the 12 bone samples analyzed from Tsepi due to poor preservation. Only one bone sample from T12 produced a radiocarbon date (Fig. 4.11). The bone sample belongs to the upper layers of grave T12 and presumably represents one of the latest phases of grave use. The results of the radiocarbon analysis give a calibrated date between 3629 – 3029 calBC (95% confidence interval) and most likely between 3531 – 3086 calBC (90.1%) (Fig. 4.13). The date, even though broad, supports the early use of the Tsepi cemetery in the second half of the fourth millennium BC.

However, the quality of the bone collagen extract is problematic suggesting significant collagen degradation, as was also indicated by the lack of collagen in the rest of the skeletal samples (see van Klinken, 1999 for quality indicators). Collagen yield was significantly low (0.16%), below the margin for low collagen bone (van Klinken, 1999). The low collagen yield may indicate an unreliable measurement. Further quality controls thus become important. Carbon yield was also low (23%) as expected in poorly preserved bone with low collagen (van Klinken, 1999). The $\delta^{13}C$ measurement (-19.9‰) is within the expected range and does not flag an unreliable measurement (van Klinken, 1999). Unfortunately, there was not enough collagen for a $\delta^{15}N$ measurement. Thus, overall, the radiocarbon date should be used with caution until additional radiocarbon dates become available for the Tsepi remains. To date, this is the only absolute date available for the cemetery of Tsepi and for Early Helladic cemeteries in Attica in general.

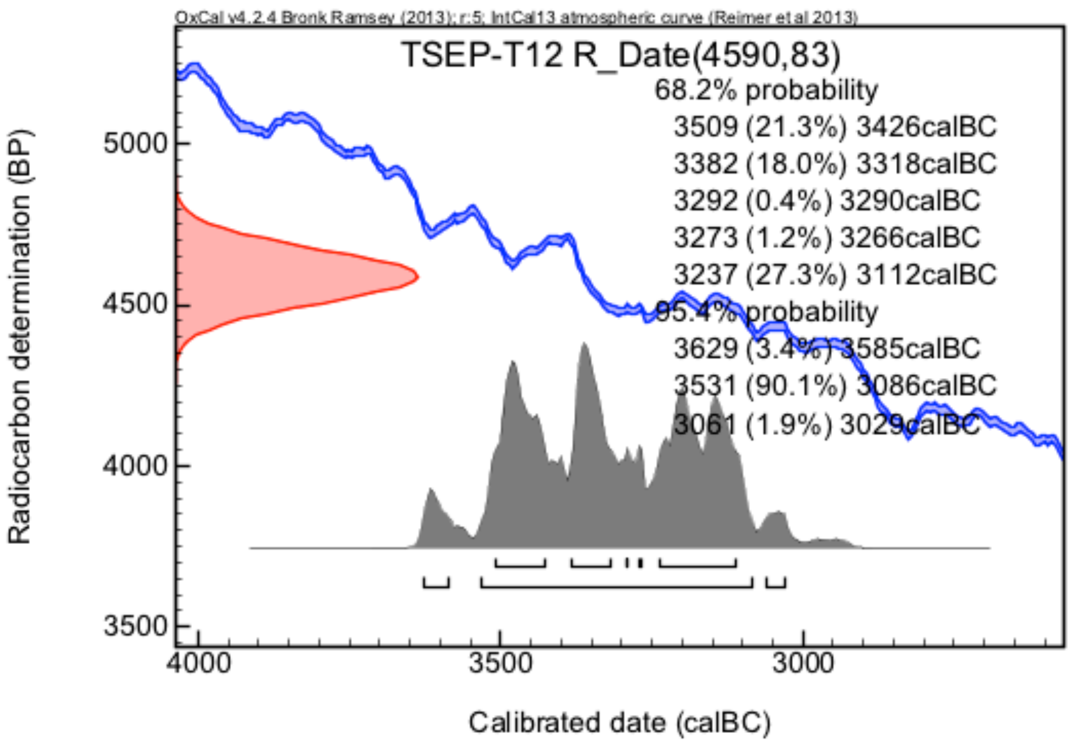

Figure 4.13. Radiocarbon date for a human bone sample from Tomb 12 from Tsepi cemetery.

Significance

The significance of the Tsepi cemetery is multifold. Firstly, Tsepi is the earliest formal cemetery in Attica and one of the very few EH I cemeteries known in mainland Greece, with activity there beginning in the Final Neolithic. Thus, Tsepi can provide great insight into the transition from the Final Neolithic to the Early Bronze Age, a formative period (including the "Proto-Bronze Age") about which so little is known. Tsepi constitutes the earliest example of intra-cemetery spatial organization on the mainland and one of the most formally structured cemeteries of any time period in Aegean prehistory. Placing Tsepi in its regional context underlines the existing variation in organization at the inter-cemetery level (and of the associated communities) and, thus, highlights Tsepi's formality. In particular, space allocation, uniform grave construction, and multiple grave use at Tsepi have been linked to long-lived families and kin groups and to compliance with community regulations (Marinatos, 1970c,d; Pantelidou-Gofas, 2005a; Pullen, 1985, 1994b; Weiberg, 2007). Hence, Tsepi provides an ideal setting for the study of the role of formally structured cemeteries and multiple grave use in analyzing sociopolitical organization during the Aegean FN – EBA.

Secondly, the deposit pits, the breaking of vessels, the possibility of feasting, and the practices of both primary and secondary burial indicate the presence of elaborate funerary rituals and a very early ancestor cult. During the second funeral, the deceased individual was transformed into an ancestor through the gathering of the bones at the side of the grave pit, accompanied with feasting, breaking of vessels, and libations. The tripartite symbolism of the grave construction reflects the rite of passage from living to dying to the state of being dead. The reuse of graves provided living relatives with the opportunity to interact with their ancestors and to intentionally affirm and negotiate their relations, thereby actively shaping collective memory.

Thirdly, the strong Cycladic influences detectable in artifact types and grave construction, along with the geographical location of the cemetery, have contributed to long-lasting debates over the nature of the EBA coastal mainland-island interaction, including the traditional view of the colonization of the former by Cycladic islanders (Marinatos, 1970c). However, even though most of the recovered pottery can be formally categorized as EC, it is all locally made. Overall, despite the heavy Cycladic stylistic influences and traditions, the artifacts and mortuary practices at Tsepi appear to deviate from the typical insular characteristics, showing new autonomous patterns that use both Helladic and Cycladic forms. This amalgamation of diverse features suggests the presence of a regional culture (Pantelidou-Gofas, 2005a). Furthermore, the Bratislava/Petromagoula-Doliana lids at Tsepi now show connections with Thessaly and Epirus, expanding the Tsepi network significantly to the north (Coleman, 2011; Forsén, 2010). The presence of a variety of metal objects and particularly the recovery of a litharge fragment from a grave context might also reveal links with metallurgical production sites. The emergence of Tsepi as a major node in maritime and land networks raises questions regarding the origins, mobility, and identity of its people, all of which can be directly addressed through the skeletal remains. Accordingly, Tsepi offers us an invaluable look at the technological, social, and human interactions in southern Aegean FN – EBA societies.

Finally, given the recent discoveries of a number of EH cemeteries it appears that many of the funerary features observed at Tsepi, such as tomb architecture (e.g., tripartite tombs, tomb enclosures) and mortuary rituals (e.g., tomb re-use, collective tombs, ritual deposit pits) were more widespread than previously thought. The cemetery of Asteria at Glyfada, in particular, shares close similarities with Tsepi, as does as the cemetery of Nea Styra on Euboea, directly across from Marathon (see previous discussion). Thus, we might be dealing with funerary behavior that arose at the end of the Final Neolithic (Tsepi for the most elaborate form) in the wider Attic region and continued in the EH I/II. The early date of Tsepi further challenges the Cycladic origins of the new funerary elements and might in fact support an Attic development. Moreover, during this time Attica shows a distinctive trend for early metallurgy (e.g., Merenda). To this, one may also add the use of subterranean chambers, which to date are a feature peculiar to Mesogeia. Thus, the transition from the Final Neolithic to the Early Bronze Age seems to be accompanied by the emergence of a gradual, and yet distinctive, Attic identity, in which Tsepi might have played a key role.

CHAPTER 5

BIODISTANCE ANALYSIS

Background

Analysis of biological distances (biodistance) uses observable phenotypic variation such as inherited dental and cranial features (size and morphology) as a proxy for genotypic variation, to infer and reconstruct biological relatedness within a microevolutionary framework (Buikstra et al., 1990; Cheverud, 1988; Stojanowski and Schillaci, 2006). Biodistance analysis applied in bioarchaeological contexts is mainly concerned with the processes of gene flow and genetic drift. Based on the scale of analysis, biodistance can estimate genetic relatedness (or distance) both at an inter-population (at a continental, regional, or local scale) and at an intra-population or intra-site (inter-individual) level, the former addressing population origins, temporal or geographic continuity or discontinuity, and synchronic variation and the latter addressing diachronic changes or kinship, among others (Buikstra et al., 1990). [233] Population history focuses on the genotypic and phenotypic similarity between populations resulting from gene flow (e.g., migration) and/or common ancestry (historical relations) (Relethford, 1996). Population structure, on the other hand, focuses on genotypic and phenotypic variation within a population (or among different contemporaneous sub-populations) resulting from the relationship between genetic drift and gene flow (e.g., differential effective population size), thus reflecting the population's mating structure (Relethford, 1996; Relethford and Lees, 1982). The basic assumption is that populations who exchange mates or share a more recent common ancestral population are phenotypically more similar than populations that do not. In addition, it is assumed that the environmental effects are minimal, shared or similar, or randomly distributed within and between the populations/samples compared, and thus that the observed phenotype reflects the genotype rather than the environment. In population structure studies a distinction is made between model-free and model-bound approaches. Model-free methods examine overall genetic variation and can use population genetic theory and models of population structure, but without estimating specific population genetic parameters; they interpret the observed patterns based on estimated correlations and analogies to population structure models but without accounting for the microevolutionary cause (Relethford and Lees, 1982). On the contrary, model-bound methods estimate population genetic parameters by directly incorporating models of population structure (Relethford and Blangero, 1990; Relethford and Lees, 1982).

Even though inter-population and/or inter-site analyses have a long tradition in biodistance studies, intra-site approaches of biological variation are a fairly recent development. By using the whole cemetery as a reference sample, intra-cemetery analysis has the further advantage of avoiding the problems of inter-cemetery comparisons, such as non-contemporaneity, differential temporal variation, catchment areas, and burial practices (Sjøvold, 1976-1977; Stojanowski and Schillaci, 2006). Intra-cemetery biodistance studies consist of (a) kinship and cemetery structure analysis, (b) postmarital residence analysis, (c) sample aggregate phenotypic variability, (d) temporal microchronology, and (e) age-structured phenotypic variation (see Stojanowski and

Schillaci, 2006 for an analytical review; also Stojanowski, 2001). The first two types of analysis are relevant to this study. Reconstructions of social phenomena such as kinship systems and postmarital residence practices through biodistance analysis have successfully been applied to a variety of contexts, regions, and periods (e.g., Alt and Vach, 1998; Alt et al., 1997; Buikstra, 1980; Cook and Aurby, 2014; Corruccini and Shimada, 2002; Howell and Kintigh, 1996; Konigsberg and Buikstra, 1995; Lane and Sublett, 1972; Schillaci and Stojanowski, 2002; Shimada et al., 2004; Stojanowski, 2003, 2005b; Stojanowski and Schillaci, 2006; Tomczak and Powell, 2003; see also Johnson and Paul, 2015). In kinship analysis, the basic premise is that family members are phenotypically more similar to each other than to contemporary unrelated individuals, due to the shared presence of genes that most likely are identical by descent (i.e., inherited from a recent common ancestor), rather than identical by state (i.e., resulting from chance) (Alt and Vach, 1998; Sjøvold, 1976-1977; Stojanowski and Schillaci, 2006). Furthermore, the main theoretical assumptions for sex-specific migration and postmarital residence analysis are that (a) at an intra-cemetery level the sex with the greater variability is the more mobile sex composed of biologically unrelated individuals of in-coming migration, and that the sex with the lower variability is the non-mobile or resident sex composed of biologically related individuals; and (b) at an inter-cemetery level the sex with the greater inter-group variability is the non-mobile or resident sex, and that the sex with the lower inter-group variability is the mobile or migrating sex (gene flow homogenizes the mobile sex across sites and diversifies the non-mobile sex across sites) (Konigsberg, 1988; Konigsberg and Buikstra, 1995; Lane and Sublett, 1972; Spence, 1974a,b; Stojanowski and Schillaci, 2006).

With regard to the data used, cranial metrics (Carson, 2006a; Cheverud, 1988; Droessler, 1981; Sj*øvold, 1984),* cranial nonmetrics (Berry and Berry, 1967; Buikstra, 1980; Carson, 2006b; Cheverud and Buikstra, 1981; Hauser and DeStefano, 1989 Sj*øvold, 1984)*, dental metrics (Goose, 1963; Hillson et al., 2005; Kieser, 1990; Stojanowski, 2001, 2005b, c), and dental morphology (Scott and Turner, 1997; Turner et al., 1991) are suitable for estimating biological relatedness. To account for problems in dental crown measurements introduced by wear, and thus to maximize data collection, mesiodistal and buccolingual dimensions can also be measured at the tooth cervix (cervico-enamel junction) (Fitzgerald and Hillson, 2008; Hillson et al., 2005; Stojanowski, 2007). The presence of rare anomalous dental morphological variants has been shown to be a useful indication of familial relationships at the intra-cemetery level (Alt, 1997; Alt and Vach, 1998; Alt et al., 1997). Depending also on the type of data collected and analytical methodology, inter- and intra-observer error (DeStefano et al., 1984; Gualdi-Russo et al., 1999; Knapp, 1992; Molto, 1979; Utermohle and Zegura, 1982) and pre-analysis data treatments and tests, such as age-dependency, sex and size correlation, inter-trait correlation, collapsing sides, and trait dichotomization (e.g., Korey, 1980; McGrath et al., 1984; Perizonius, 1979; Powell, 1995; Stojanowski, 2001) need to be considered. However, because skull preservation in prehistoric Greek samples is often problematic (fragmentary crania or crania deformed due to taphonomic processes, such as soil weight and commingling), cranial metrics are considered to be inappropriate for this context given the measurement error introduced by the restoration of the crania.

Biodistance Analysis in the Aegean Context

Craniometry has a long history in Aegean scholarship, closely tied to prehistoric Aegean archaeology. The first studies date to the late 19th and early 20th centuries and consist of craniometric reports and cephalic indices of skulls mainly from the island of Crete, in search of the origins of the Minoans as the creators of the first Aegean civilization (Dawkins, 1900-1901; Mackenzie, 1905-1906; Sergi, 1901, 1967 [reprint of first English edition, London 1901]; Xanthoudides, 1924). Aegean biodistance studies persisted in using craniometry to reconstruct biological relatedness throughout the 20th century (Charles, 1958, 1962, 1965; Manolis, 1991, 2001; McGeorge, 1983; Musgrave and Evans, 1981). The University of Athens has a long legacy in skeletal biology and biometric studies at the Anthropological Museum of the Medical School (note the craniometric work of its director from 1915 to 1950, J. Koumaris (1928, 1930, 1931, 1932, 1933, 1934a,b, 1935, 1939, 1942, 1948), as well as at the Department of Biology that also houses a modern skeletal collection (Eliopoulos, 2006; Eliopoulos et al., 2007; Manolis, 1991).

A dominant figure in Aegean biodistance studies has been J. Lawrence Angel. Heavily influenced by Hooton, Angel's initial research interests emphasized craniometry and the study of biological affinities of Mediterranean people. In his dissertation and early work, in the early 1940s, Angel applied Hooton's methodology to interpret the complex interrelationship between racial mixture and cultural vigor in Greece (e.g., Angel, 1942, 1944, 1945, 1946b). He used photographs of standardized views of skulls from a large Greek skeletal series, ranging from the Neolithic to Medieval times, to construct six morphological cranial types: Basic White, Classic Mediterranean, generalized Alpine, Nordic-Iranian, Mixed Alpine, and Dinaric-Mediterranean, each denoting a distinct place of origin. Angel constructed the average types separately for male and female skulls, in an attempt to trace different historical patterns between sexes. Showing his broad anthropological perspective, Angel analyzed skeletal samples from the wider Eastern Mediterranean region in an attempt to reconstruct biological relationships. Looking for diachronic trends and microevolutionary processes, he concluded that even though ancient Greeks as a whole showed marked phenotypic heterogeneity, overall racial continuity in Greece was striking. Even though he visibly moved away from biodistance as an exclusive focus of his research after joining the Smithsonian in the early 1960s, Angel did continue to report typological data throughout his career; however, he repeatedly acknowledged the artificial nature of types in his work and emphasized their use as reference points and convenient symbols.

Angel's approach in biodistance analysis falls within the typological paradigm that dominated physical anthropology in the early 1900s; still, his work predominated biodistance studies in the Aegean and the Eastern Mediterranean until the 1980s (e.g., Angel, 1971, 1973a,b,c, 1982, 1986). Nevertheless, his contributions need to be considered within their own historical context; within that, they were truly pioneering. Angel used biodistance data to address archaeological and anthropological questions, always following a contextualized problem-oriented approach. Thereafter, recent biodistance studies have moved away from typology, using univariate and less often multivariate statistics (without however incorporating microevolutionary theory), addressing still analogous archaeological questions regarding population histories and origins in particular (e.g., Manolis, 1991; McGeorge, 1983; Musgrave and Evans, 1981; Nafplioti, 2007; Parras, 2004; Xirotiris, 1980).[234] However, even though Angel's work decidedly influenced Aegean bioarchaeology and created stimulated research directions stemming from his research topics (such as health and disease, particularly anemias, and paleodemography), overall the number of biodistance studies in the Aegean has decreased during the last decades of 20th century, a trend also noted in North America (Buikstra and Lagia, 2009; Buikstra et al., 1990).

The PhD dissertations on biodistance in the Aegean focus on cranial metrics, occasionally including cranial discrete traits (McGeorge, 1983; Nafplioti 2007; Powell, 1989), and less often, dental metrics and morphology (Nafplioti, 2007; Parras, 2004). Overall, they focus on questions about population origins, inter-population affinities, continuities and discontinuities associated with migrationist theories as explanations for cultural change (e.g., Manolis, 1991; Nafplioti, 2007; however, see McGeorge, 1983 for an early attempt at marriage and kinship reconstruction). In search of population continuities, research has focused on inter-site and inter-population analyses, often aggregating published data from different observers without accounting for inter-observer error and for cemetery sample biases. Kinship and postmarital residency studies are nearly absent in the Aegean, except for studies alluding to familial grave use based on the observed occurrence of some basic discrete traits.[235] Hence, there is a promising future for intra-cemetery analysis addressing questions of cemetery structure, grave use, postmarital residency, and social organization in Aegean bioarchaeology.

Materials

This study focuses upon the Early Helladic cemetery of Tsepi and includes the human skeletal remains from the "old excavation" by Marinatos in 1970-1973. Marinatos' excavation consisted of graves T1 to T27 (T8 and T21 remained unexcavated, while T18 was partially excavated) that were reported to contain a total of 239 skeletons (including juveniles), based on the count of skulls during excavation (Pantelidou-Gofas, 2005).[236] Of these graves, the tomb chambers of T8 and T21 remained unexcavated, the tomb chamber of T18 was only partially excavated, while no bones were located for T1, T2, and T23. Graves T11, T18, T20, T24, T25, and T26 still preserve skeletal material *in situ* (Fig. 5.1). For the purpose of this study, following all necessary permits, the osteological material from Marinatos' excavation was transferred to the Wiener Laboratory of the American Classical Studies at Athens (ASCSA) where conservation and data collection took place.

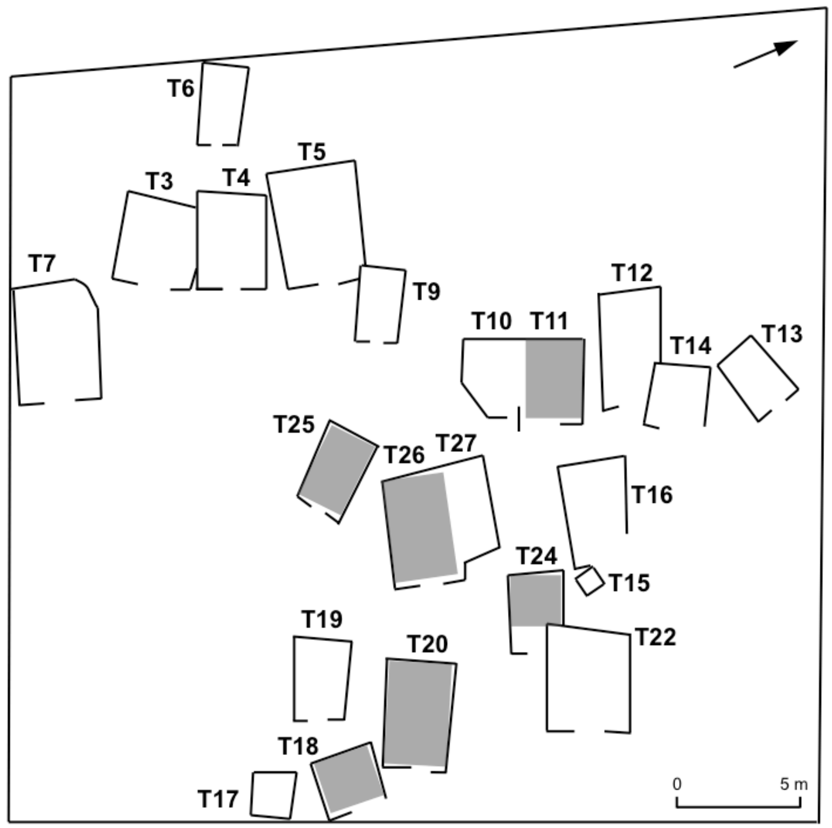

Figure 5.1. Schematic plan of the Tsepi graves (enclosures) excavated by Marinatos (in 1970-1973) included in this study (based after the published cemetery layout in Pantelidou-Gofas 2005). The studied graves are located at the southern part of the Tsepi cemetery. Only graves with associated skeletal material are depicted. Graves with partially excavated chambers that still preserve skeletal material *in situ* are shaded.

The study of materials excavated decades ago that remain non-inventoried poses numerous challenges, including labeling and provenance issues and preservation limitations. A major component of this project has been cleaning and conservation to allow for data collection.[237] A portion of the skeletal material had been cleaned superficially and consolidated by Breitinger at the time of the excavation, while a small number of skulls have been fully conserved. The crania were often affected by taphonomic processes and Breitinger took great care to preserve the cranial shapes as were found during excavation. This method, though more time-consuming than the disassembling of the cranium during cleaning, is considered appropriate given that it preserves important archaeological information that will otherwise be lost: it can inform us about the way the cranium was handled after the primary inhumation, e.g., whether or not it was placed on one or the other side, and thus can allow us to make significant inferences about the formation of the depositional context. The conservation conducted during this project focused upon skulls and dentitions. Breitinger's conservation treatment consisted of PVA and cellulose. In many cases, the original consolidation created a very hard coating making the bone underneath very brittle. In these cases, the conservation treatment consisted first of the removal of the original consolidation by the application of acetone, then drying cleaning assisted by ethanol and water, and then consolidation with Paraloid B72 resin (Ethyl Methacrylate copolymer). Given the significant number of soil blocks, micro-excavation also took place in the Wiener Laboratory during the conservation and study of the remains (Fig. 5.2). Miscellaneous postcranial and small soil blocks were cleaned with the aid of water and/or ethanol.

Figure 5.2. Skull of the second skeleton found *in situ* in T7 during micro-excavation and conservation at the Wiener Laboratory. The skeleton was placed on the right side and preserves the hands folded in front of the face.

The burial context included primary interments, secondary deposits and commingling, with the skeletal material being often poorly preserved. The complex taphonomic history includes fragmentation due to commingling, but also extensive modifications by insect activity (Fig. 5.3). Borings and grooves were identified in a large number of cranial and postcranial elements from T4, T5, T9, T13, T17, T19, T26. The affected areas match closely reported cases from Middle Bronze Age contexts from the Levant, attributed to dermestid beetles (Huchet et al., 2013; Ortner, 2003:45). Angel (1975:304; Pl. 438) reported similar post-mortem borings by insects on a cranial fragment from Middle Bronze Age Eleusis. The specific activity of the dermestid beetles at Tsepi is probably associated with the lack of soil inside the open and covered tomb chambers, as well as periodic (and possibly seasonal) re-opening of the tombs (see Huchet et al., 2013 for a detailed discussion on traces from dermestid pupal chambers on archaeological human bone). The variation observed in some skeletal elements at Tsepi (holes of different sizes and irregular etching) might also involve the post-mortem (and possibly post-excavation) activity of wasps (for bone modifications attributed to wasps and wild bees, see Pittoni, 2009).[238] The identification of extensive, entomological modifications on the Tsepi material is of great importance for the study of human skeletal remains in Greece and the Eastern Mediterranean. This is particularly relevant to archaeological contexts involving secondary treatment of skeletal remains, where post-mortem bone modifications by humans are commonly discussed (e.g., Early Bronze Age Manika in Euboea; Fountoulakis, 1988). The presence and effect of the entomological activity should not be misidentified as either pathological or intentionally modified by humans (see Strouhal 1991:220 for a reported case from Nubia and a discussion of pseudopathology and differential diagnosis of metatastatic lesions).

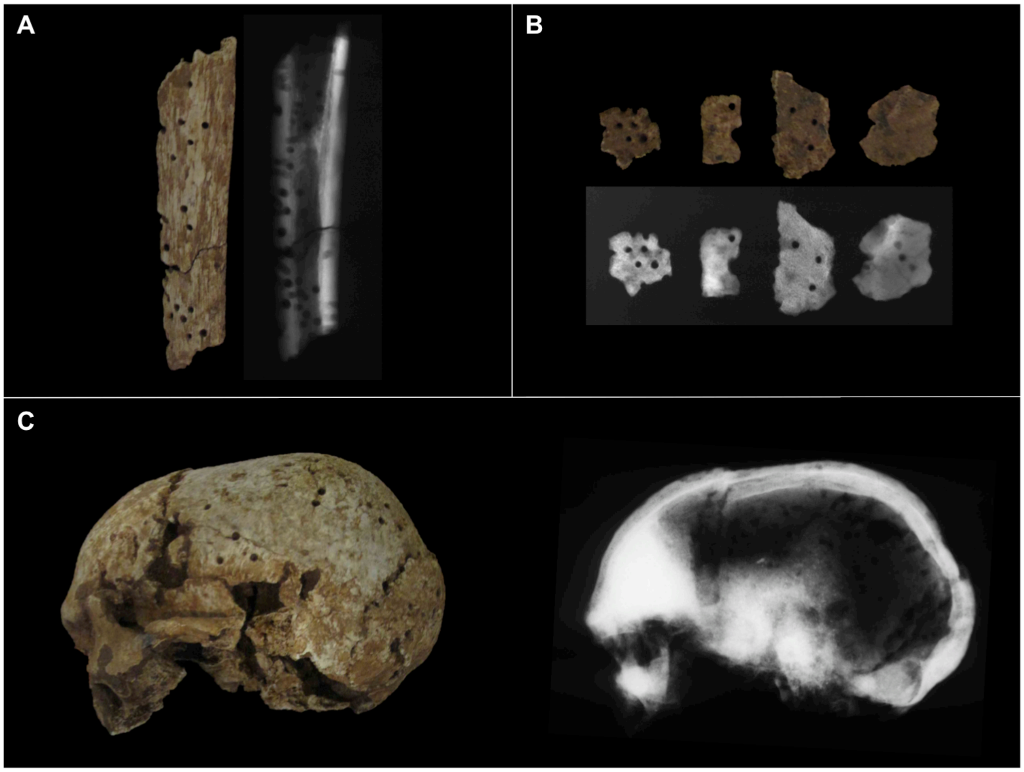

Figure 5.3. Photos and radiographies of specimens with modifications (borings and channels) probably by dermestid beetles (*Dermestidae*). (A) Tibia from T17, (B) cranial fragments from T26, and (C) male cranium from T19.

Data Collection

To examine the degree of within grave and within grave group biological relatedness and sex differences resulting from postmarital residence, data on dental dimensions and cranial non-metric traits were collected in accordance with established precedents (e.g., Buikstra and Konigsberg, 1995; Stojanowski, 2005a,b; Stojanowski and Schillaci, 2006). Maximum mesiodistal and buccolingual dimensions of the crown were measured using a Mitutoyo Absolute IP67 Digital Caliper to the nearest 0.10 mm. Crown measurements followed standard protocols (Buikstra and Ubelaker 1994); mesiodistal crown measurements were taken at the maximum width of the tooth crown, and not between contact facets. To account for problems introduced by dental attrition, mesiodistal and buccolingual measurements were also taken at the cervix of the same teeth using a Paleo-Tech Hillson-Fitzerald Dental Caliper (Fitzgerald and Hillson 2008; Hillson et al. 2005; Stojanowski, 2007). Mesiodistal cervical measurements were slightly adjusted to allow for comparable measurements between loose and *in situ* teeth by measuring the maximum mesiodistal diameter at the cemento-enamel junction of the buccal cusps on posterior teeth. Data were collected in all permanent teeth with a complete crown to maximize sample size, with the exception of third molars that show the highest variation. Left side measurements were preferentially recorded with antimere substitution for missing data. To ensure consistency, the same calipers were used throughout the study. The presence of selected dental morphological variants was also recorded following Alt (1997) and Turner and colleagues (1991). Rare anomalous dental variants have been particularly useful for biological kinship reconstruction, given that the identification of familial relationships is based on the increased occurrence of rare, genetically determined traits (Alt and Vach, 1998; Alt et al., 1997; Rosing, 1986). Finally, cranial nonmetric traits were recorded that provided the largest sample size of sexed individuals (based on cranial morphology). Due to the incomplete preservation, facial traits were excluded. A long list of morphological traits was recorded following Buikstra and Ubelaker (1994) and Hauser and De Stefano (1989). Data collection of morphological cranial and rare dental traits took place on the left side with antimere substitution. In case of asymmetry, the highest score was used. Traits were scored as absent (0), present (1), or unobservable (9).

Skeletal sex and age estimates were based on standardized criteria (Buikstra and Ubelaker 1994). Given the nature of the skeletal assemblage and the degree of commingling and incompleteness, sex determination was based on cranial and mandibular morphological criteria, while age estimation was based on dental development. Pelvic remains with observable features were scarce and with rare exceptions did not correspond to matching crania, thus they were not included in the study.

Pre-Analysis Data Treatments

Odontometrics

To control for intra-observer error and consistency throughout the data collection, measurements of selected teeth originally recorded at the beginning of the study were repeated at the end. Pairwise t-tests were performed between observations. To control for age dependency and tooth size affected by dental attrition, crown measurements were recorded for wear stages between 0 – 3 for anterior teeth and 0 – 4 for posterior teeth (wear scores followed Smith, 1984). Implementation of multivariate analyses requires complete data matrices. The preservation and degree of commingling and incompleteness of the skeletal assemblage resulted in a large number of missing data and thus posed a significant limitation on the present study. Regarding dental analyses, even though the presence of caries was nearly absent, the assemblage showed significant antemortem tooth loss, particularly of the posterior dentition. Thus, mandibular dentitions were selected because they provided the largest sample size.

A conservative cutoff of 20% for inclusions was implemented in accordance with standard procedures (Stojanowski, 2005a; Paul and Stojanowski, 2013): individuals and variables with more than 20% missing data were excluded from further analysis. This resulted in the working dataset of 23 individuals and 12 variables (C_1MD, C_1BL, P_1MD, P_1BL, P_1MDC, P_1BLC, P_2MD, P_2BL, P_2MDC, P_2BLC, M_2MD, M_2BL).[239] The remaining missing values were imputed using the expectation-maximization (EM) algorithm in Systat v. 10. To remove potential sex effects, a Q-mode correction by individual was performed whereby each measurement was divided by the geometric mean of all variables. In order to account for inter-trait correlation and redundant variation, the 12 original variables were reduced to three uncorrelated variables using Principal Component Analysis in Systat v. 10. Principal components (PC) were extracted from both the imputed raw data matrix and the Q-corrected data matrix. From the raw dataset 8 principal components were extracted that accounted for 97% of the total variation, while from the Q-corrected dataset 10 principal components were extracted that accounted for 99% of the total variation. The first three principal component scores for each dataset were included in further analyses (Table 5.1). The component loadings for all 12 variables of the raw dataset are positive indicating that PC 1 represents tooth size variation (Table 5.2). This was not the case for the component loadings for the 12 variables of the Q-corrected dataset, however, indicating that PC 1 represents tooth shape variation (Table 5.2). Likewise, the rest of the principal components for both scores seem to represent both dental size and shape variation (Table 5.2).

Table 5.1. Principal components scores for 12 mandibular odontometric variables for the raw dataset (PC 1, PC 2, PC 3) and for the Q-corrected dataset (Q-PC 1, Q-PC 2, Q-PC 3) for Tsepi cemetery. Numbers in parenthesis show the percent of total variance explained by each component.

Individual[a]	Tomb location	PC 1 (47%)	PC 2 (15%)	PC 3 (12%)	PC 1-Q (33%)	PC 2-Q (18%)	PC 3-Q (15%)
T3-M	West	0.618	-0.663	-0.773	0.300	0.186	1.188
T4-F	West	1.043	-0.531	0.158	-0.522	0.771	0.306
T4-F	West	-1.946	-1.012	0.509	2.254	-0.100	-1.293
T4-M	West	0.859	-0.889	0.063	0.481	-0.866	-0.556
T5-F	West	0.528	-0.875	-0.976	0.340	0.020	0.901
T6-M	West	1.814	1.179	0.234	-1.504	-1.656	-0.931
T6-M	West	-1.114	0.133	0.908	0.434	0.241	-1.216
T10-F	Middle	1.118	0.686	-0.605	-1.182	-0.145	0.742
T10-M	Middle	0.128	1.832	1.958	-2.034	1.352	-1.387
T10-M	Middle	-0.462	0.212	-0.743	0.305	-0.705	0.269
T12	Middle	1.005	1.350	-0.429	-1.518	-0.679	0.123
T12	Middle	-1.496	-0.559	-0.552	1.241	0.170	0.707
T12-F	Middle	-0.802	1.102	-0.305	-0.346	-0.350	0.376
T14-F	Middle	0.335	0.033	1.060	-0.584	1.267	-0.634
T17	East	0.909	-1.287	1.814	0.079	1.916	-0.486
T17	East	0.545	-0.542	-1.839	0.256	-0.838	1.860
T18-F	East	-0.619	-0.764	0.204	0.628	2.051	1.321
T19	East	-0.333	0.055	1.820	0.133	-0.230	-1.995
T19-F	East	-0.236	0.846	-0.236	-0.239	-0.697	0.366
T19-F	East	0.910	-2.118	-0.035	1.244	-0.173	-0.174
T20-F	East	-1.504	-0.282	-0.412	1.147	-0.823	-1.007
T24	East	-0.877	0.866	-0.238	-0.444	0.902	0.758
T24-M	East	-0.424	1.227	-1.585	-0.469	-1.615	0.761

[a] T: Tomb number. When sex is known, it is indicated as M, for male or probable male, and as F, for female or probable female.

Table 5.2. Loadings by variable for the first three principal components for the raw dataset (PC 1, PC 2, PC 3) and for the Q-corrected dataset (PC 1-Q, PC 2-Q, PC 3-Q) for Tsepi cemetery. Numbers in parenthesis show the eigenvalues for each component loading.

Variable[a]	PC 1 (5.633)	PC 2 (1.776)	PC 3 (1.382)	PC 1-Q (3.977)	PC 2-Q (2.209)	PC 3-Q (1.786)
VAR 1 (C_1MD)	0.474	-0.198	-0.585	0.369	0.050	0.710
VAR 2 (C_1BL)	0.836	0.084	-0.218	0.046	-0.654	0.088
VAR 3 (P_1MD)	0.489	-0.599	0.192	0.617	0.544	0.038
VAR 4 (P_1BL)	0.838	0.282	0.019	-0.686	0.105	0.026
VAR 5 (P_1MDC)	0.688	-0.266	-0.507	0.360	-0.503	0.555
VAR 6 (P_1BLC)	0.737	0.419	-0.039	-0.636	-0.411	-0.107
VAR 7 (P_2MD)	0.437	-0.334	0.731	0.422	0.533	-0.546
VAR 8 (P_2BL)	0.846	0.206	0.227	-0.755	0.537	0.098
VAR 9 (P_2MDC)	0.403	-0.715	-0.173	0.745	0.082	0.041
VAR 10 (P_2BLC)	0.830	0.330	0.190	-0.822	0.213	-0.014
VAR 11 (M_2MD)	0.558	-0.463	0.212	0.655	-0.250	-0.595
VAR 12 (M_2BL)	0.825	0.241	0.010	-0.210	-0.602	-0.602

[a] Abbreviations: C_1MD, lower canine mesiodistal; C_1BL, lower canine buccolingual; P_1MD, lower first premolar mesiodistal; P_1BL, lower first premolar buccolingual; P_1MDC, lower first premolar mesiodistal cervical; P_1BLC, lower first premolar buccolingual cervical; P_2MD, lower second premolar mesiodistal; P_2BL, lower second premolar buccolingual; P_2MDC, lower second premolar mesiodistal cervical; P_2BLC, lower second premolar buccolingual cervical; M_2MD, lower second molar mesiodistal; M_2BL, lower second molar buccolingual.

To maximize the number of individuals and the number of graves included in the analysis, the mandibular tooth with the largest sample size (lower first premolar, n = 47) for all four dental measurements (crown mesiodistal and buccolingual, and cervical mesiodistal and buccolingual) was selected for univariate analysis. This dataset includes isolated teeth for which sex is not known. However, canines are the most sexually dimorphic human teeth (Garn et al., 1964, 1967a,b; Moss and Moss-Salentjin, 1977), thus sex dependency is not expected to be significant for the premolars. Two principal components were extracted from the four measurements (Tables 5.3, 5.4). Only the first principal component with an eigenvalue above 1 was included in further analysis, representing 65% of the variation (Tables 5.3, 5.4). The component loadings for the four variables (i.e., measurements) of the lower first premolars indicate that PC 1 represents tooth size variation. The second principal component was only used for visual representations.

Table 5.3. Principal component scores for the mandibular first premolars. Numbers in parenthesis show percent of total variance explained.

Individual tooth (Tomb #)	Tomb location	PC 1 (65%)	PC 2 (17%)
T4	West	0.461	7.320
T4	West	0.530	7.650
T4	West	-1.963	6.050
T4	West	-1.015	7.250
T4	West	0.873	7.640
T5	West	0.465	7.510
T5	West	0.894	7.880
T5	West	-0.010	7.600
T6	West	0.818	7.780
T6	West	-0.754	7.080
T6	West	0.321	7.160
T6	West	1.560	7.910
T6	West	1.163	8.000
T6	West	-1.169	7.160
T6	West	-1.673	6.420
T7	West	-0.784	6.920
T7	West	-1.355	6.690
T7	West	-1.187	6.720
T10	Middle	1.241	8.250
T10	Middle	0.067	7.880
T10	Middle	-0.499	7.050
T10	Middle	1.664	8.320
T10	Middle	1.990	8.620
T10	Middle	1.301	8.320
T11	Middle	0.262	7.370
T12	Middle	0.876	7.690
T12	Middle	-0.833	6.810
T12	Middle	-0.870	6.910
T12	Middle	-1.361	6.940
T13	Middle	-0.780	7.200
T13	Middle	1.482	8.200
T14	Middle	0.468	7.560
T17	East	0.495	7.440
T17	East	0.594	7.240
T19	East	-0.629	6.860
T19	East	-0.669	6.790
T19	East	0.680	7.310
T20	East	-1.167	6.840
T20	East	0.688	7.840
T20	East	0.977	7.890
T20	East	-0.924	7.120
T20	East	0.293	7.570
T22	East	0.403	7.350
T24	East	-0.647	6.910
T24	East	-1.138	6.710
T24	East	-0.290	7.220
T25	East	-0.850	7.560

Table 5.4. Loadings by variable for the principal components for the mandibular first premolars. Numbers in parenthesis show the eigenvalues for the component loading.

Variable[a]	PC 1 (2.587)	PC 2 (0.7)
VAR 1 (P_1MD)	0.752	0.090
VAR 2 (P_1BL)	0.906	0.315
VAR 3 (P_1MDC)	0.666	-0.742
VAR 4 (P_1BLC)	0.870	0.162

[a] Abbreviations: P_1MD, lower first premolar mesiodistal; P_1BL, lower first premolar buccolingual; P_1MDC, lower first premolar mesiodistal cervical; P_1BLC, lower first premolar buccolingual cervical.

Cranial Non-Metric Traits

Only crania that could be sexed were included in the analysis. Male and probable male individuals and female and probable female individuals were pooled to maximize the available sample size. For bilateral traits, in the case of asymmetry, the maximum score was recorded. Variables that exhibited very low (< 0.05%) or no variability were excluded from further analysis. Likewise, individuals and variables with more than 20% missing values were excluded. This resulted in 67 individuals including 28 males or probable males and 39 females or probable females, and 12 variables. A trimmed dataset was also created that contained no missing values with a total of 39 individuals and consisted of 20 female and 19 male individuals.

The effect of sex on cranial trait expression was examined through the Pearson chi-square in a two-way table with the Yates' correction in SYSTAT v. 10. None of the included variables was significantly correlated with sex (Table 5.5). Inter-trait correlation was examined through the Pearson chi-square in a two-way table with the Yates' correction using SYSTAT v. 10 (Appendix B). Suprameatal depression was significantly correlated with suprameatal spine and was removed from further analysis (Appendix B). Sutura mendosa and retromastoid process showed a significant p-value for Pearson χ^2 but a non-significant value for Yates corrected χ^2 (Appendix B). To further examine the relationship between this pair, a Jaccard binary similarity coefficient was calculated in SYSTAT v. 10. The Jaccard coefficient was determined at 0.2 and was not considered significant (correlation between -1 and 1), thus it was not removed.

Table 5.5. Sex dependency based on chi-squares through two-way tables.

Trait	Pearson χ^2	Probability	Yates corrected χ^2	Probability
Metopic suture	0.003	0.958	0	1
Supra-orbital notch	0.002	0.965	0	1
Parietal foramen	0	1	0	1
Lambdoidal ossicles	0.266	0.606	0.056	0.812
Parietal notch bone	0.007	0.931	0	1
Auditory exostosis	0.114	0.735	0	1
Suprameatal spine	1.036	0.309	0.577	0.448
Suprameatal depression	0.244	0.621	0.057	0.811
Mastoid foramen	3.03	0.082	1.939	0.164
Sutura mendosa	0.729	0.393	0.066	0.798
Retromastoid process	0.475	0.491	0.027	0.87
Occipital foramen	0.021	0.886	0	1

Analytical Methods

Mandibular Odontometrics

Univariate Analysis of Variance (ANOVA) was performed for each of the first three principal components of each dataset for graves that had more than 3 individuals. Graves were also grouped by location in three groups (East, Middle, and West) and Analysis of Variance was performed for each of the first three principal components of each dataset for the three different grave groups. To determine which pairs were different in the case of a significant F-statistic, Tukey's Honestly Significant Difference (HSD) was applied that is more conservative and it was compared to Fisher's Least Significant Difference (LSD) that is more liberal. Furthermore, bivariate plots of the principal component scores were used to assess the pattern of relationships between individuals and grave groups (Stojanowski, 2005a). The first three factor scores for both the raw data and the Q-transformed data were used to estimate inter-individual Euclidean distances. Hierarchical cluster analysis was performed on the Euclidean distances to generate a cluster tree by average linkage using Clustan version 7.05 (Wishart, 2004). The best cut by upper tail rule was used to identify the cluster partitions that show significant departure from the distribution of fusion values (Wishart, 2004). In addition, matrices of Gower's similarity coefficients were generated in XLSTAT to estimate another measure of inter-individual distances. The resulting matrices of Euclidean distances and of Gower similarity coefficients for the first three principal components of both datasets (raw data and Q-corrected data) were ordinated using multidimensional scaling in XLSTAT, set at

100 trials and iterations in order to maximize the available information. Two-dimensional plots were used in order to make visual comparisons easier.

Univariate Analysis of Mandibular First Premolars

First, bivariate plots of the principal component scores were used to visually examine the pattern of relationships between individuals and grave groups (Stojanowski, 2005a). Bootstrap resampling was used to provide p-values for variance differences based on standard deviations within and across grave groups for the first principal component (PC1) following Stojanowski (2005). Bootstrapping is a resampling method that randomly selects repeated samples of predetermined size from a dataset with replacement, in that each time a sample is drawn, it is returned to the sampling pool (Manly, 1997). In each iteration, the skeletal group of a grave or a grave cluster (in-group) is compared against the cemetery (out-group). If a skeletal group represents a family group (i.e., biologically related individuals), than drawing samples from within skeletal group should produce smaller variability estimates than drawing identically sized samples from the whole cemetery.

Standard deviations of PC1 were generated for each grave with a sample size greater than 5, and they were compared to distributions of 999 identically-sized simulated sample standard deviations from the out-group (cemetery). The 1000 standard deviations (999 bootstrapped plus one observed) were ranked in ascending order; the rank of the observed standard deviation represents the p-value. The null hypothesis states that variability estimates within skeletal group and across skeletal groups are similar. A significant p-value (α examined both at 0.05 and 0.1) will indicate that variability estimates within skeletal group and across skeletal groups are statistically different, suggesting that skeletal groups consist of biologically related individuals (i.e., family members). Moreover, 95% confidence intervals were generated for the standard deviations for each skeletal group included in the former analysis. The confidence limits were obtained by generating the bootstrap distribution of 1000 standard deviations for each skeletal group (999 bootstrapped plus one observed) by ranking them in ascending order. The 25th and 975th values were used as the 95% confidence limits for the true population. Finally, in addition to p-values, the observed standard deviation of PC1 for each skeletal group was compared to the average of the resampled standard deviations. The same analysis was repeated to compare variation between three grave groups based on grave location (West, Middle, East).

Spatial Analysis

To further examine the spatial patterning, morphological cranial and dental non-metric traits that showed low overall frequencies were selected (scored as presence/absence). The traits included in this analysis are: metopic suture, rotation of mandibular first premolar, rotation of mandibular second premolar, rotation of maxillary first premolar, compressed maxillary second molar, interruption groove of maxillary central incisor, interruption groove of maxillary lateral incisor. In this analysis, isolated frontal bones and isolated teeth were included for the scoring of the metopic suture and the interruption grooves respectively. Observations were made on the left side with antimere substitution and maximum expression in case of asymmetry (as described in Data Collection). The sample parameter was calculated for each trait (number of traits present/number of observations for the whole sample). Individual graves were then examined to test whether or not the concentration of traits by grave was different from an expected random distribution of traits (Howell and Kintigh, 1996). Binomial probabilities were estimated using the sample frequencies in order to assess whether a given grave showed a non-random concentration of traits (Howell and Kintigh, 1996). The distribution of traits among graves was then examined visually, by plotting the traits on the cemetery's plan.

I performed spatial statistics in order to analyze the spatial patterning (clustering vs. dispersion) of the selected morphological traits. Specifically, second order-statistics are based on the distribution of pairs of points and describe the spatial correlation between those pairs (Ripley, 1976, 1977, 1981; Rosenberg and Anderson, 2011). I used Ripley's K function (Ripley 1976, 1977) in the statistical software PASSaGE 2.0 (Rosenberg and Anderson, 2011). The method was widely applied to ecology (e.g., Dale, 1999; Wiegand and Moloney, 2004) and more recently was used on archaeological (e.g., Bevan and Conolly, 2006; Crema et al. 2010, Orton 2005) and osteological data (e.g., Duncan and Schwarz, 2014; Stojanowski, 2013). Ripley's K function (Khat) measures the average number of points found within the radius of a set distance, from each point, divided by the mean density of the pattern (Rosenberg and Anderson, 2011). It is defined as the average number of points found within the radius divided by the mean intensity of the pattern (i.e., the number of points per area) (Rosenberg and Anderson, 2011). Using

Monte Carlo methods (Manly, 1997), it can be used to assess departure from spatial randomness. Here, Ripley's L function (Lhat) is used that compares K to the expected value by calculating the difference between them (Rosenberg and Anderson, 2011): when points are randomly distributed, the expected value of L is zero. Negative values indicate clustering, whereas positive values indicate regular spacing (Dale, 1999; Rosenberg and Anderson, 2011). Monte Carlo methods are used to generate a 95% confidence interval around the results for Lhat (here set at 999 replicates) and test whether or not the observed pattern (clustering or dispersion) is statistically significant than expected by chance (i.e., random pattern).

Given the lack of real burial coordinates, pseudo-coordinates were extracted axes from the published plan of Tsepi cemetery in the image manipulation software GIMP (available at www.gimp.org). The cemetery plan was used as a diagram with an x (south to north) axis and a y axis (east to west). Distances for each grave were estimated from the bottom left corner (south-east) that was used as the point for the axes' interception (0,0). Based on the scale of the applied coordinates, this resulted in an average 50-unit distance between graves (100 units represent 5 m). Given that the graves at Tsepi contain multiple individuals and that this study focuses upon inter-individual relationships, individuals from the same grave were differentiated by adding 1 unit based on the scale of the coordinates used. So, for example, if the coordinates for a grave were (160, 540), the first each "additional" individual from that grave was assigned (161, 541), the second was assigned (162, 542), the third one (162, 543) etc. This assured that the within-grave inter-individual distances would be less than the between grave inter-individual distances.

Euclidean distances were then calculated using PASSaGE. The bivariate extension in second-order analysis was used to examine the spatial relationships between individuals exhibiting specific traits using bivariate (presence-absence) data matrices in PASSaGE. To examine whether or not individuals exhibiting a certain trait are associated or disassociated with other individuals exhibiting the same trait, the option for "A to A contrast" that examines the association or disassociation between points of the same type was used in PASSaGE (Rosenberg and Anderson, 2011). Maximum scale was set at 25% and a step distance of 1.0 was used to be able to detect inter-individual distances between graves (based on the scale used). The software then uses a Monte Carlo resampling to generate a 95% confidence interval around the results (here 999 replicates were applied).

Postmarital Residence Analysis

To examine postmarital residence, I used covariance matrix determinants following Konigsberg's modified model for intrasite male-female variation (1988). The determinant of a variance-covariance matrix can be used as a scalar measure of generalized variance (Green, 1976:122-123). A covariance matrix and a determinant were calculated for the cranial binary traits separately for each sex in R (available at http://cran.cnr.berkeley.edu/) using R-script provided by Konigsberg (available at http://konig.la.utk.edu/Rstuff.htm). The ratio of the two determinants (|C♂| / |C♀|) was used to compare the level of male and female intra-site variation. Greater sex-specific variance is assumed to represent greater sex-specific mobility associated with a patterned postmarital residence system (see Stojanowski and Schillaci, 2006). Within individual sites, a ratio of the two determinants (|C♂| / |C♀|) equal to 1 will represent equal male to female mobility, a determinant ratio greater than 1 will represent higher male mobility, and a determinant ratio less than 1 will represent lower male mobility and higher female mobility (Konigsberg, 1988:478). Some scholars have used the natural logarithm of the ratio of the male to female determinants (Cook and Aurby, 2014; Schillaci and Stojanowski, 2003). In this case, a positive ln(|C♂| / |C♀|) will reflect higher male mobility, a negative ln(|C♂| / |C♀|) will reflect higher female mobility, and a ln(|C♂| / |C♀|) equal to zero will reflect equal mobility between the sexes (Schillaci and Stojanowski, 2003:8, based on Konigsberg, 1988). Using the same R-script, the original data matrix is then resampled through bootstrapping (for 999 iterations) to create a randomization distribution of determinant ratio values and assign significance (Konigsberg, 1988; Petersen, 2000). Two datasets were examined. One with a total of 67 individuals including 28 males or probable males and 39 females or probable females, and 11 variables with less than 20% missing values per individual and per variable, to maximize the sample size (referred to as original dataset hereafter). A trimmed dataset was created from the original dataset that contained no missing values with a total of 38 individuals, including 18 male or probably male individuals and 20 female or probable female individuals (referred to as trimmed dataset hereafter).

Results and Discussion

Mandibular Odontometrics

The results of univariate Analysis of Variance (ANOVA) of the principal component scores for mandibular odontometrics for both raw and Q-corrected data are presented in Tables 5.6 and 5.7. The analysis showed no statistically significant difference between different graves (Table 5.6) and between different grave groups (Table 5.7). Only ANOVA of the second principal component of the raw dataset showed a difference statistically significant at the 0.1 level between different grave groups ($F = 2.607$, $df = 2$, $p = 0.099$) (Table 5.6). Tukey's HSD multiple comparisons test showed no significant difference the different groups. Fisher's LSD test showed a significant difference between the Middle and the West grave group ($p = 0.049$) and a difference significant at the 0.1 level between the East and Middle grave groups ($p = 0.074$). Scattered plots of the principal components do not show a clear pattern between different grave groups (Figs., 5.4, 5.5). However, the plot of the principal components of the raw dataset shows two clusters: the first cluster consists of T3, T4 (two of the three individuals) and T5 from the West group and T17 (two individuals) from the East group, and the second cluster consists of T19 (two individuals) and T24 from the East group and T12 from the Middle group (Fig. 5.4). Note also that most individuals from the Middle group are located in the positive quadrant (Fig. 5.4). In the plot of the Q-corrected data, individuals from the West group (T3, T4, T6) show a tight cluster, while individuals from the adjacent graves T17 and T18 of the East group are also closely together (Fig. 5.5). This indicates lower variation in certain graves (T4, T17, T19), and in grave groups (particularly West and East), but also that phenotypic proximities cross-cut graves and grave groups.

Table 5.6. Analysis of Variance (ANOVA) summary statistics for the principal components for both raw and Q-corrected data for graves that had more than three individuals (T4, T10, T12, T19).

Variable	F-statistic	P-value	R^2
PC1	0.190	0.900	0.067
PC2	1.930	0.203	0.420
PC3	0.523	0.679	0.164
PC1-Q	1.135	0.391	0.299
PC2-Q	0.334	0.801	0.111
PC3-Q	0.716	0.570	0.212

Table 5.7. Analysis of Variance (ANOVA) summary statistics for the principal components for both raw and Q-corrected data for the three different grave groups based on location (West, Middle, East).

Variable	F-statistic	P-value	R^2
PC1	0.382	0.703	0.035
PC2	2.607	0.099*	0.207
PC3	0.026	0.977	0.002
PC1-Q	1.881	0.178	0.158
PC2-Q	0.198	0.822	0.019
PC3-Q	0.276	0.762	0.027

*Significant at the 0.1 level.

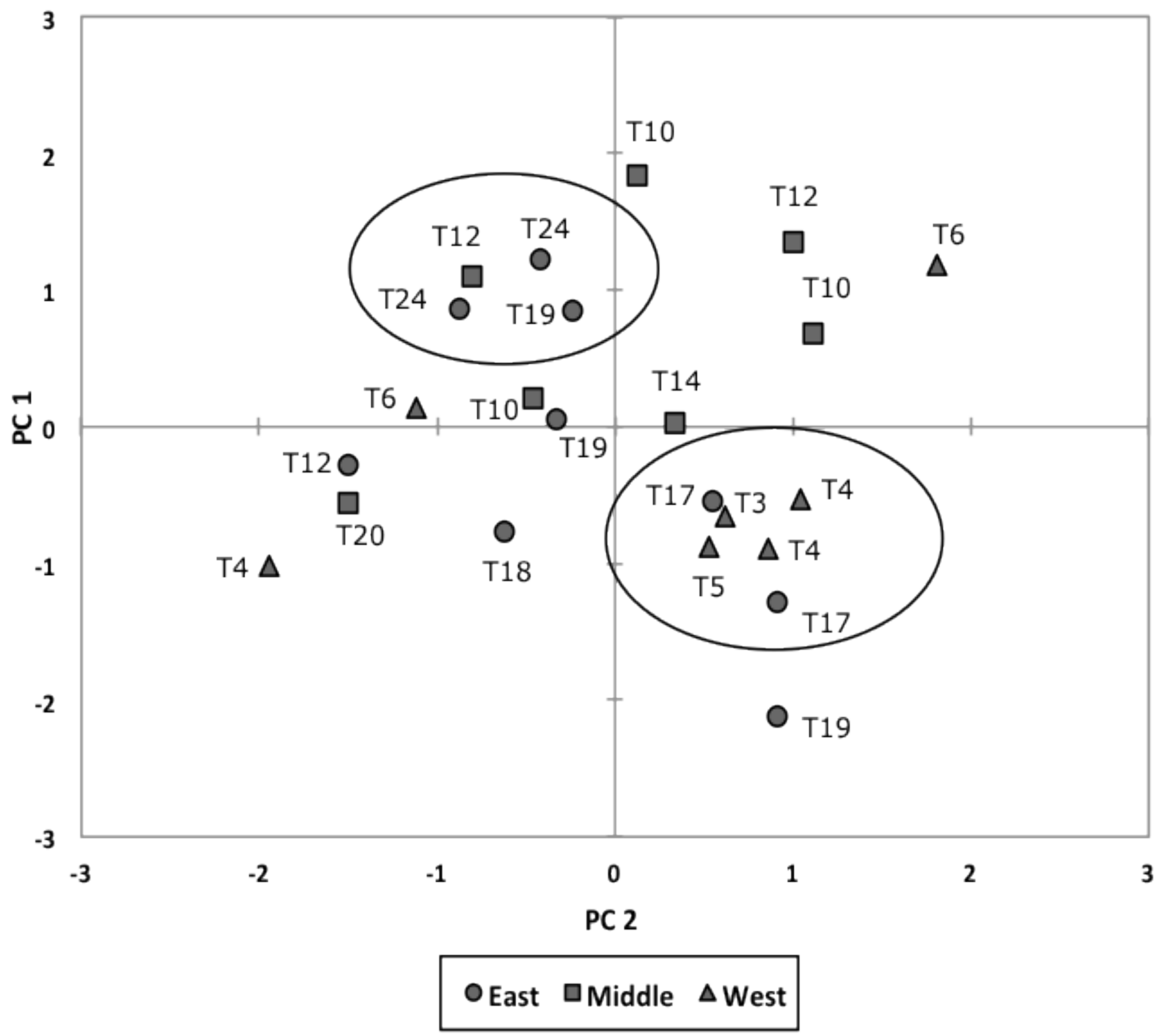

Figure 5.4. Plot of the principal component scores for the raw dataset marked by grave number and grouped by grave group. Visual clustering of individuals is marked by circles.

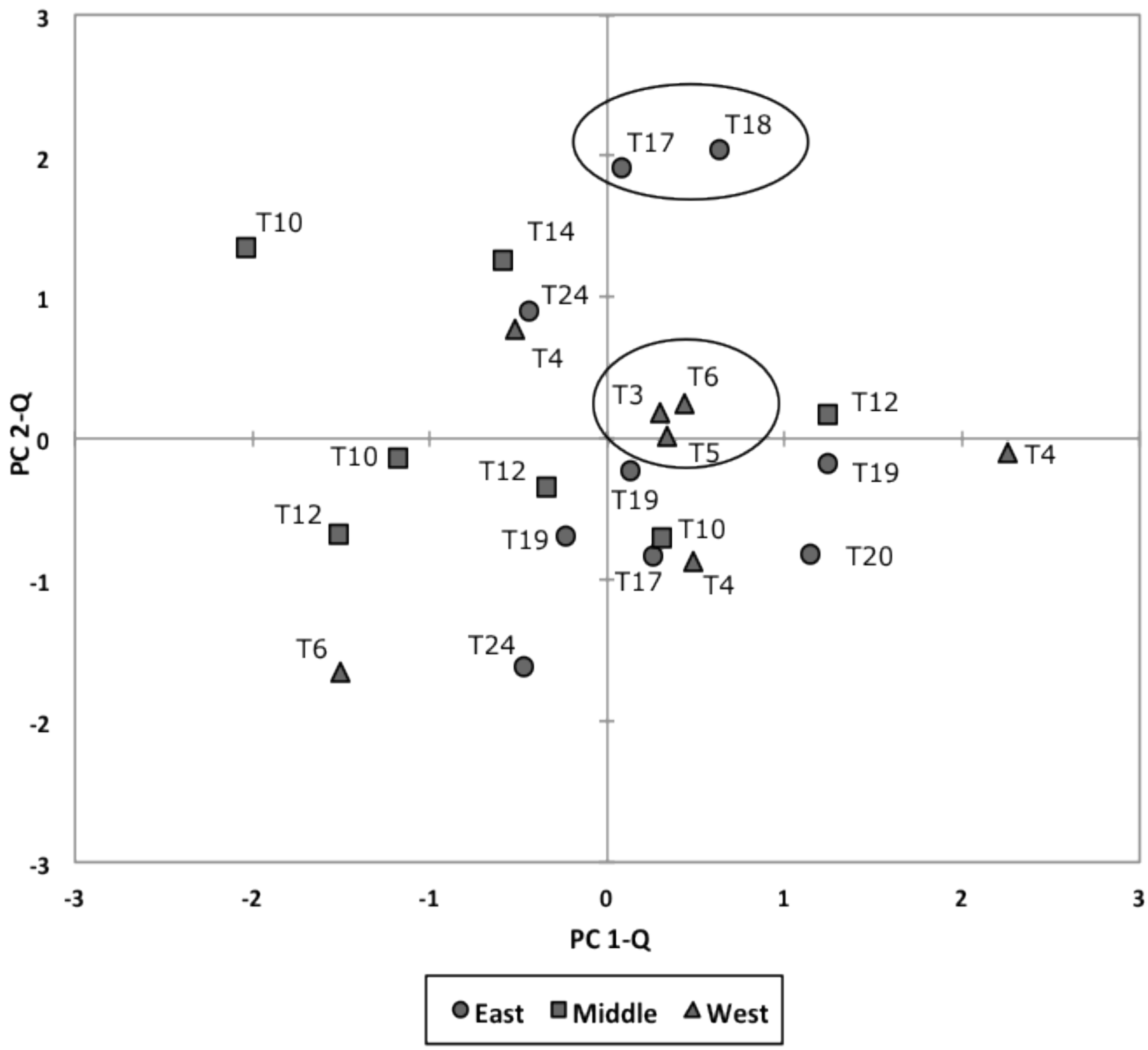

Figure 5.5. Plot of the principal component loadings for the Q-corrected dataset marked by grave number and grouped by grave group. Visual clustering of individuals is marked by circles.

The results of the hierarchical cluster analysis of the inter-individual Euclidean distances of mandibular odontometrics did not follow the organization of different graves closely (Figs. 5.6, 5.7). In both datasets, individuals from Tombs 3, 4, and 5 (the western sector of the cemetery sample) tend to cluster together. In general, the raw data produced tighter clusters, suggesting that the Q-correction removed some of the variation, potentially attributed to sex (Fig. 5.6). Cluster A of the raw data corresponds to the middle and eastern sector of the cemetery, including two individuals from T24 (Fig. 5.6). Cluster B includes individuals again from the middle and eastern sector, with the exception of a single individual from T4 of the western sector (Fig. 5.6). Cluster C shows the clearest pattern wherein individuals from the eastern sector (T3, T4, T5) are closely clustered together, along with two individuals from the eastern sector (T17, T19) (Fig. 5.6). Interestingly the tightest cluster in the group belong to a male-female pair from T4 (Fig. 5.6). Considering the observed variation, this pair might not indicate spouses, but possibly a parent-offspring relationship. Clusters D and E correspond to middle and eastern groups with the exception, in both cases, of individuals from T6 on the westernmost location (Fig. 5.6). Overall, from the individuals of known sex, males seem to be more dispersed across different clusters (Fig. 5.6).

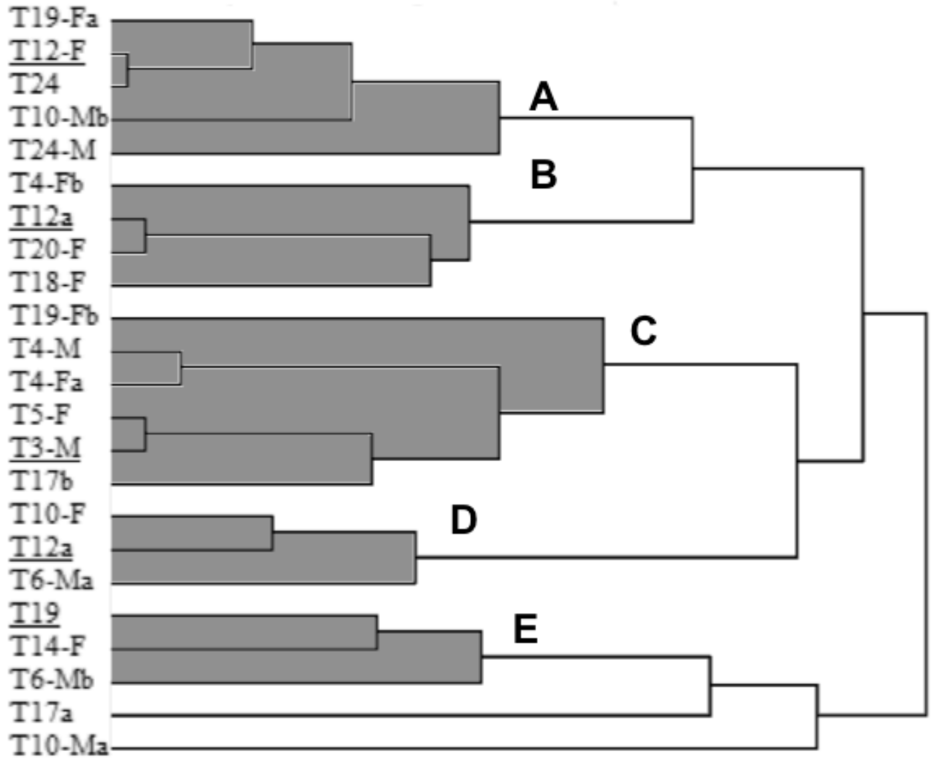

Figure 5.6. Cluster tree of Euclidean distances based on the first three principal component scores of the raw mandibular odontometric values. The shaded areas indicate the cluster partitions based on the best cut function.

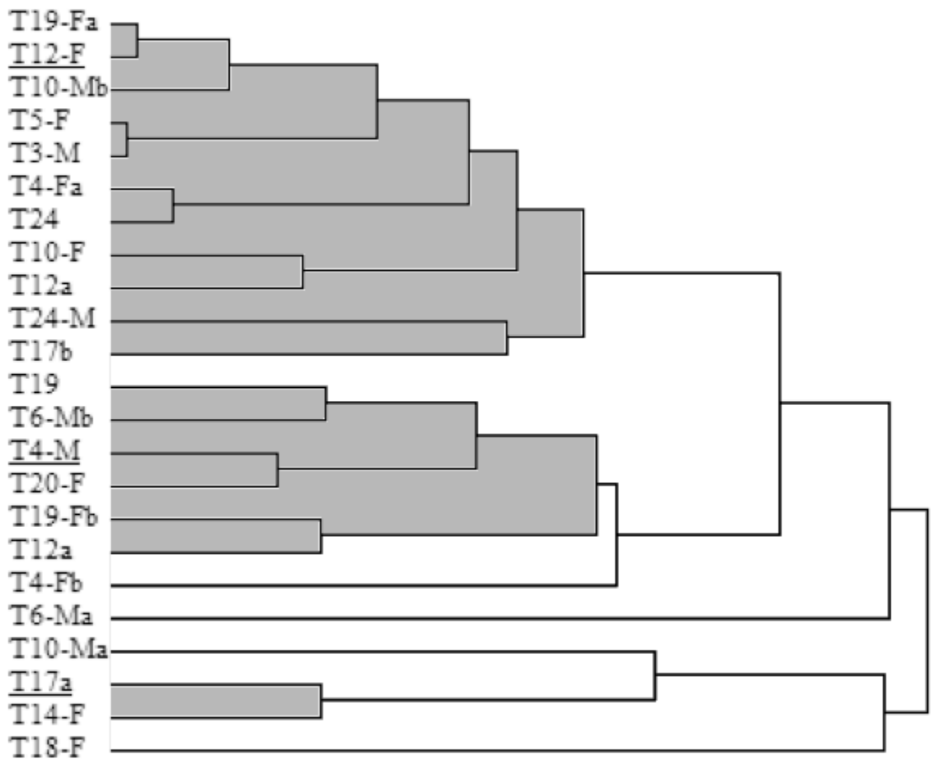

Figure 5.7. Cluster tree of Euclidean distances based on the first three principal component scores of the Q-transformed mandibular odontometrics. The shaded areas indicate the cluster partitions based on the best cut function.

The results of the multidimensional scaling (MDS) show a similar pattern. Considering first the raw dataset, the MDS plots of the Euclidean distances and the Gower similarity coefficients seem to be in accordance suggesting a robust pattern (Figs. 5.8, 5.9). In both cases, individuals from T3, T4, and T5 (western section) are closely clustered together. The second group that persists includes individuals from T10, T12, T19, T24 (middle and eastern sector). In addition, other groups that cluster together include a pair of individuals T12 and T20 (middle and eastern sector), a pair from T14 and T18 (middle and eastern sector; note that they are both females), and finally a pair from T10 and T12 (middle and eastern sector) (Fig. 5.8). With the exception of two out of the three individuals from T4 (male and female), individuals from the same graves tend to be dispersed. Overall, clustering is observed not within-graves, but within-grave groups. Note the three male individuals from T4, T10, T24 that remain at the edge of the graph (Fig. 5.8) for both datasets indicating greater biological distance from the rest and, thus, possible outliers.

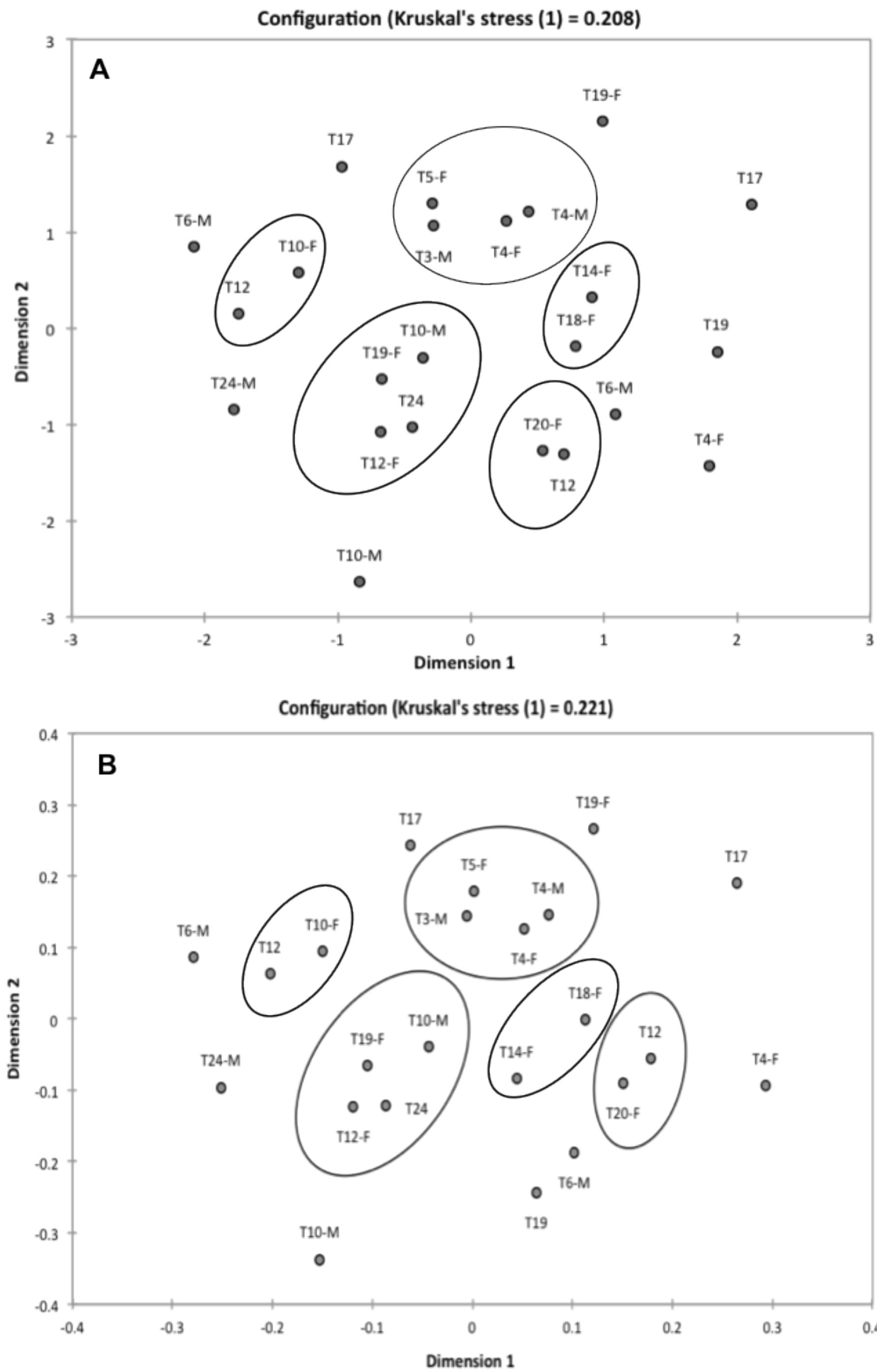

Figure 5.8. 2D multidimensional plots of the first three principal component scores for raw mandibular odontometric data. (A) Plot of Euclidean distance matrix and (B) plot of Gower similarity coefficients matrix. Visual clusters of individuals are marked with circles. Note that both graphs generally show a similar pattern.

The two plots for the Q-corrected dataset (based on Euclidean distances and Gower similarity coefficients), on the other hand, show a similar tendency but with slightly different groups (Fig. 5.9). The two individuals from T3 and T5 (male and female respectively) remain tightly clustered together, along with one of the females from T4 (Fig. 5.9). Likewise, individuals from T10, T12, and T19 are clustered together (Fig. 5.9). Here, different pairs of clustered individuals emerge, with individuals from T14 and T17 (middle and eastern sector), and individuals from T4 and T24 (western and eastern respectively) (Fig. 5.9). As observed in the Euclidean distance matrix, the groupings of individuals cut across graves. The MDS plot of the Gower similarity coefficients shows a relatively tighter pattern overall, where females tend to be closer together towards the center of the plot, and males are generally dispersed towards the edges of the plot (Fig. 5.9).

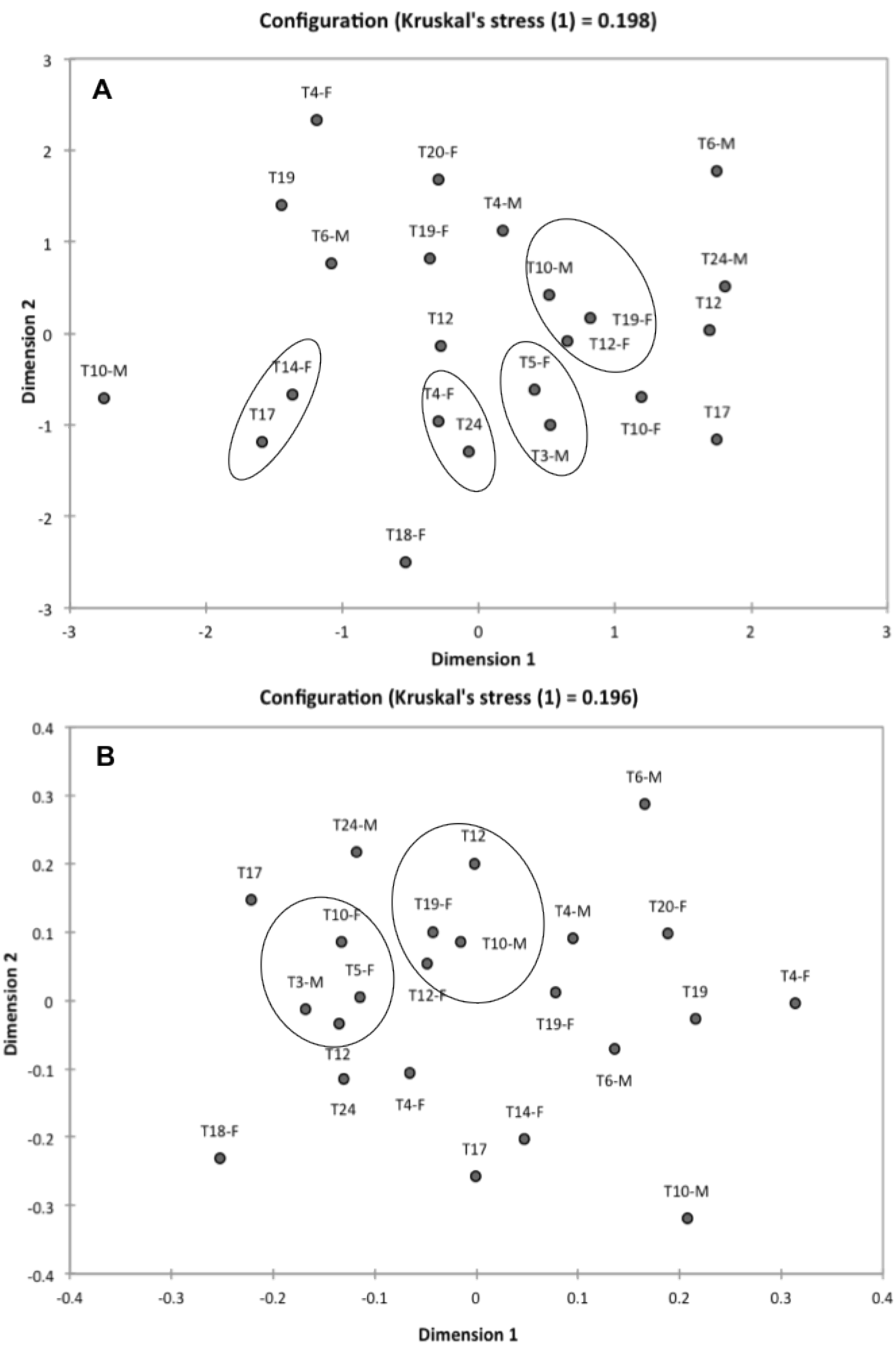

Figure 5.9. 2D multidimensional plots of the first three principal component scores for Q-corrected mandibular odontometric data. (A) Plot of Euclidean distance matrix and (B) plot of Gower similarity coefficients matrix. Visual clusters of individuals are marked with circles.

Univariate Analysis of Mandibular First Premolars

The bivariate plot of the principal component scores shows a clustering pattern that generally follows grave groups, but not exlusively (Fig. 5.10). Individuals buried in the same grave groups tend to cluster together, such as is the case of the individuals from the graves of the middle sector at the top right corner that form a group separate from the other grave groups (Fig. 5.10). The graves from the middle sector also tend to show the lowest within grave variation, particularly T10 and T12 (Fig. 5.10). Most of the individuals buried in graves at the western sector are located at the middle of the graph (T4, T5, T6), with the exception of T7 (Fig. 5.10). Individuals from T7 are generally close together at the left end of the graph, but away from the rest of the western tombs (T4, T5, T6) (Fig. 5.10). This might suggest that T7 that forms the beginning of a new grave row separately from graves T4 and T5 represents a different grouping. Moreover, even though individuals from graves T4, T5, and T6 are consistently clustered together, note that T4 also includes an individual that is an outlier for the whole cemetery (Figs. 5.10). This indicates that T4 consists of a major group that is phenotypically similar to the rest of the western graves and a minor group that is phenotypically diverse from the rest of the cemetery sample. Individuals from the eastern sector form two groups, a loose one at the left part of the graph, and a tight one at the middle of the graph (Fig. 5.10).

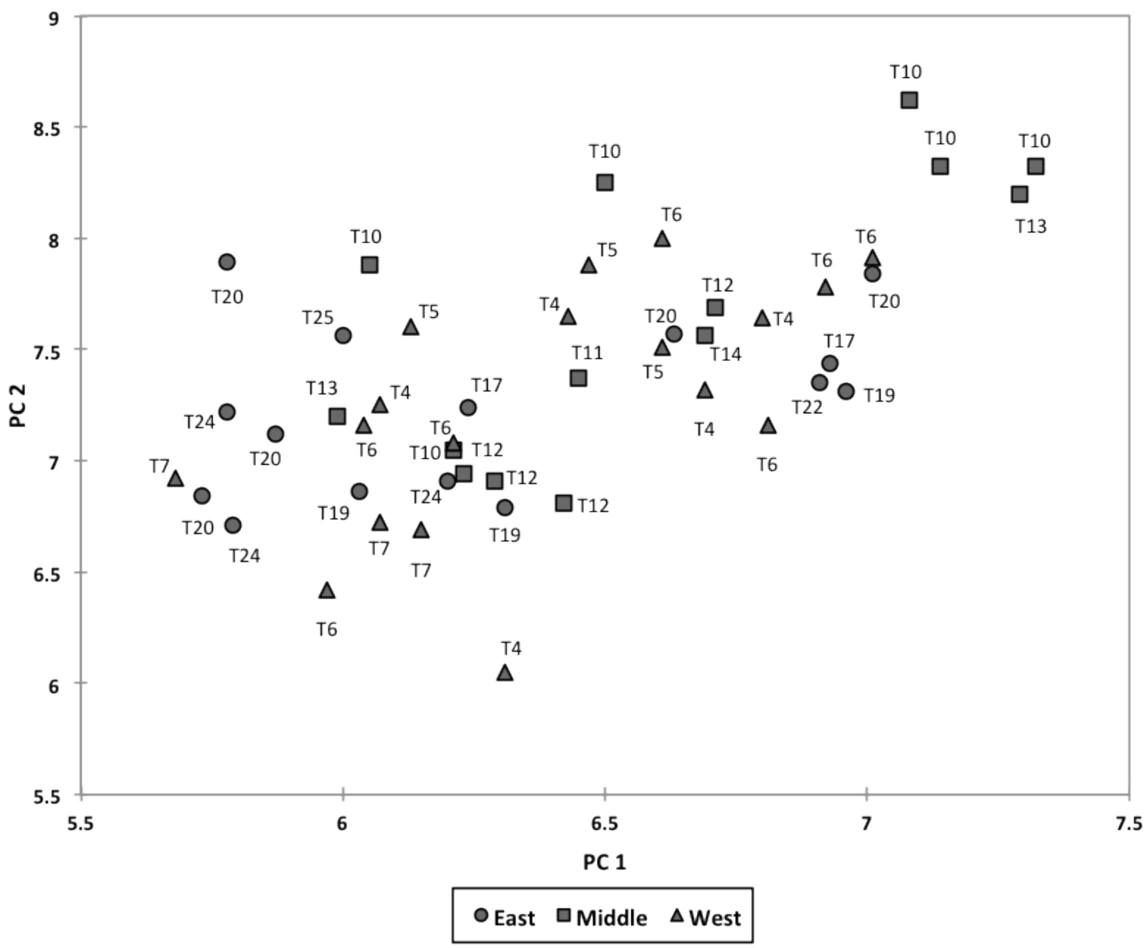

Figure 5.10. Plot of principal component scores for mandibular first premolars.

Descriptive statistics and p-values for the bootstrapping tests are presented in the summary Tables 5.8 and 5.9. The p-values for each grave are high, indicating no statistical difference between in-group (grave) and out-group (cemetery) variability (Table 5.8). When the confidence intervals of the standard deviations are plotted by grave, they show great overlap between graves (Fig. 5.11). Graves T4 and T6 show higher, observed standard deviations than graves T10 and T12 (Table 5.8; Fig. 5.11). In addition, the observed standard deviations for graves T10 and T12 are much higher than the average value of the resampled standard deviations (Fig. 5.11). Turning to the different grave groups (West, Middle, East, based on location), the p-values for the West and Middle grave groups are high, indicating no statistical difference between in-group (grave group) and out-group (cemetery) variation (Table 5.9). The observed standard deviations for the West and Middle grave group are higher than the average of the resampled standard deviations (Fig. 5.12). However, the p-value for the East grave group is significant (p = 0.05) (Table 5.9). The observed standard deviation is also much lower than the average of the resampled standard deviations (Fig. 5.12). This indicates that the phenotypic variation found in the East grave group is significantly lower than expected by chance, suggesting that individuals buried in the East group are closely related biologically.

Table 5.8. Descriptive statistics and p-values for the first principal component of mandibular first premolars per grave.

PC1	n	Mean	sd	p-value
T4	5	-0.22	1.21	0.84
T6	7	0.04	1.24	0.92
T10	6	0.96	0.97	0.50
T20	5	-0.03	0.96	0.51

Table 5.9. Descriptive statistics and p-values for the first principal component of mandibular first premolars per grave group.

PC1	n	Mean	sd	p-value
West	18	-0.16	1.08	0.79
Middle	14	0.36	1.10	0.81
East	15	-0.15	0.76	0.05*

*Significant at the 0.05 level.

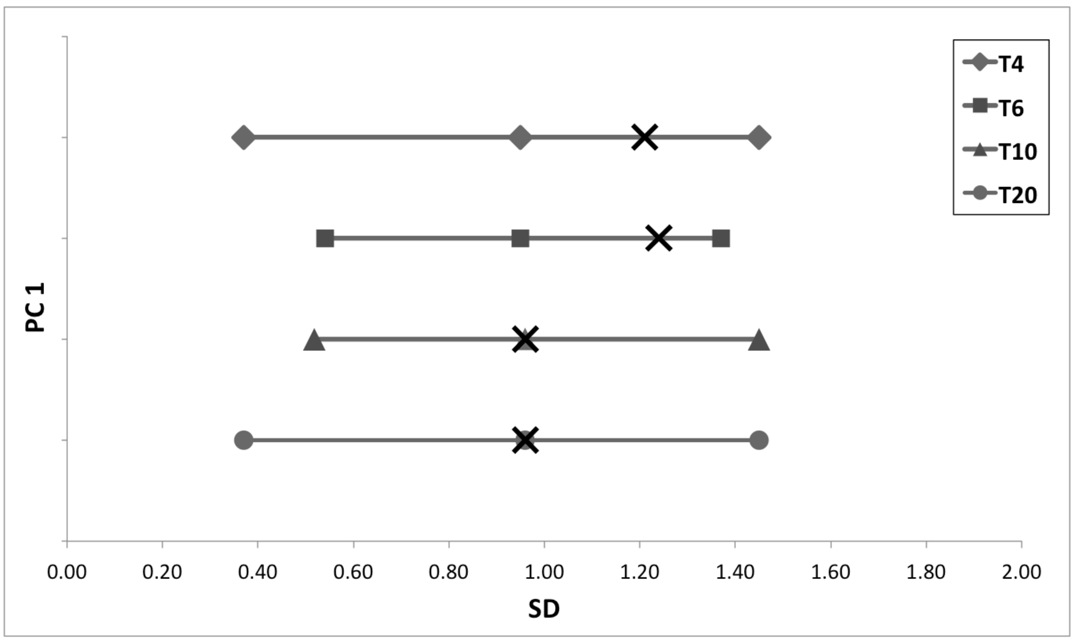

Figure 5.11. Plot of the average of the resampled standard deviations with 95% confidence intervals for the first principal component of mandibular first premolars by grave. X marks the observed standard deviation for each grave.

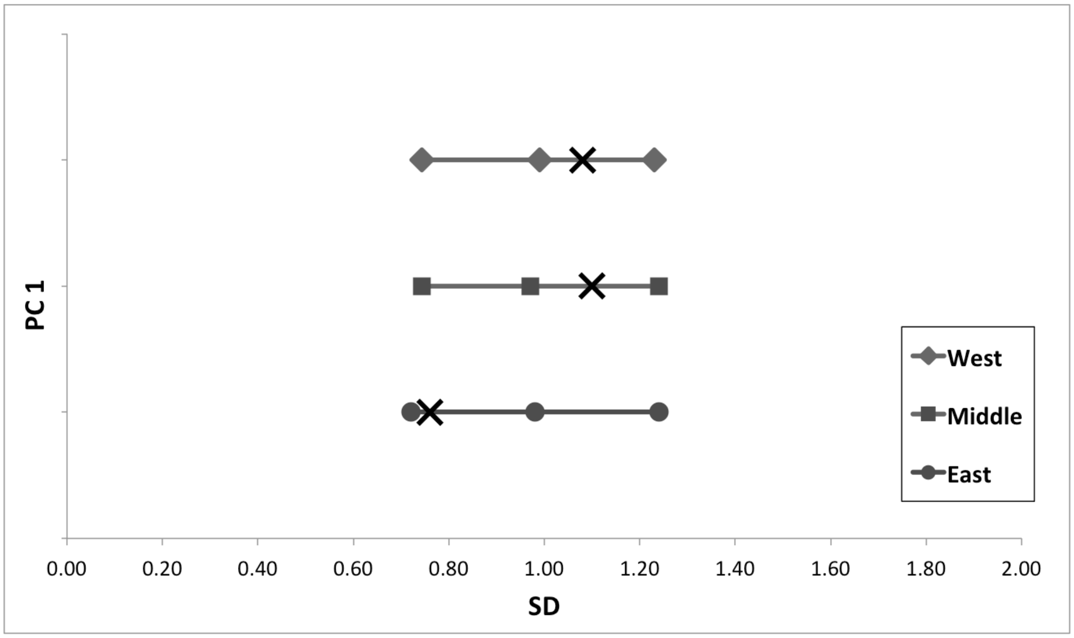

Figure 5.12. Plot of the average of the resampled standard deviations with 95% confidence intervals for the first principal component of mandibular first premolars by grave group. X marks the observed standard deviation for each grave group.

Spatial Analysis

Before the examination of individual morphological traits, a Ripley's K analysis was used to visualize the inter-individual distances at Tsepi based on the assigned coordinates. As expected, individual burial locations are significantly clustered at Tsepi given that the tombs contain multiple individuals (Fig. 5.13). The frequencies and binomial probabilities for the seven morphological traits under study are shown on Table 5.10. As described previously, the overall probability for each trait is the combined frequency of the trait in the cemetery sample. The traits with overall frequencies below 10% are metopic suture (4%), rotation of mandibular first premolar (6%), rotation of maxillary first premolar (4%), and interruption groove of the maxillary central incisor (6%) (Table 5.10). Rotation of mandibular second premolar and compressed maxillary second molar show a slightly higher frequency (11% for both), while interruption groove of the maxillary lateral incisor shows the highest frequency (24%). The tomb specific probability is the likelihood of finding that many individuals in the same grave exhibiting the trait by chance calculated as the binomial probability based on the overall trait frequency and the number of observations per tomb. Thus, for example, given the low overall probability of 0.04 for the presence of metopic suture in the cemetery sample, the co-presence of a metopic suture in three individuals in the graves T4 and T7 has a 0.02 probability (Table 5.10).

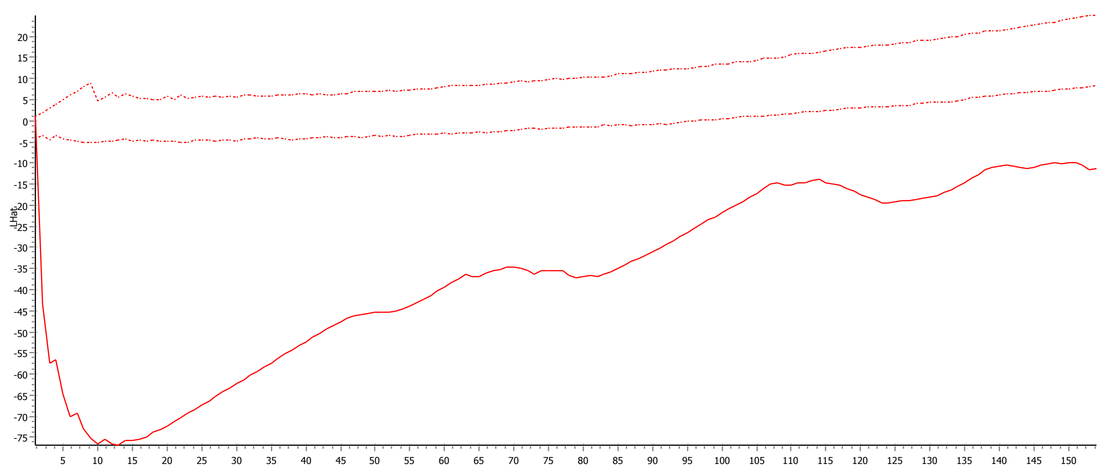

Figure 5.13. Ripley's K analysis of inter-individual distances at Tsepi. The expected value of LHat is zero when points (i.e., individuals) are randomly distributed. The dotted lines indicate the 95% confidence interval. The negative LHAT are statistically significant and thus indicate significant clustering that reflects the clustering of multiple individuals within each grave.

Table 5.10. Distributions of selected morphological cranial and dental traits by tomb (T) at Tsepi. Traits: number of traits present/number of observations, frequency (% in the sample). The first number per grave shows present/number of observations. The number in the parenthesis shows the binomial probability.

Trait[a] / Tomb[b]	MS 9/224 (0.04)	R P_1 4/63 (0.06)	R P_2 6/56 (0.11)	R P^1 2/51 (0.04)	C M^2 12/107 (0.11)	IG I^1 6/104 (0.06)	IG I^2 22/92 (0.24)
T3	0/8	0/1	0/1	0/1	0/1	0	0/1
T4	3/17 (0.02*)	1/7 (0.29)	2/9 (0.19)	0/6	2/10 (0.21)	0/12	1/6 (0.40)
T5	0/12	0/2	0/3	0/1	1/7 (0.38)	0/7	1/2 (0.36)
T6	0/6	0/5	0/3	0/4	1/12 (0.37)	1/12 (0.36)	3/15 (0.23)
T7	0/10	0/2	0/1	0/1	1/2 0.20	0/7	0/1
T9	0/15	0/1	0/2	0/1	0/2	0/7	0/4
T10	0/30	0/7	1/3 (0.26)	0/1	2/5 (0.09[c])	0/9	2/7 (0.31)
T11	0/1	0/1	0/1	0/1	1/8 (0.39)	0/4	1/6 (0.37)
T12	1/17 (0.35)	0/11	1/9 (0.39)	0/1	0/6	1/5 (0.23)	1/3 (0.42)
T13	1/12 (0.31)	0/3	0/1	1/2 (0.08[c])	0/8	1/10 (0.34)	4/10 (0.13)
T14	0/20	0/3	0/3	0/7	0/6	1/5 0.23	1/6 0.37
T15	0/1	0/1	0/1	0/1	0	0	0/1
T16	0/0	0/1	0/3	0/5	0/5	0/2	1/2 0.36
T17	3/16 (0.02*)	0/0	1/1 (0.11)	0/9	1/2 (0.20)	0/2	0/3
T18	0/5	0	0	0/1	0	0/7	0
T19	0/11	2/4 (0.02*)	0/3	0/1	2/8 (0.17)	1/7 (0.29)	4/11 (0.16)
T20	0/10	0/5	1/5 (0.35)	0/9	0/9	1/7 (0.29)	2/4 (0.20)
T22	1/13 (0.32)	0/1	0/2	0/3	0/5	0/7	1/3 (0.42)
T24	0/9	1/5 (0.23)	0/4	0/2	0/3	0/2	0/3
T25	0/8	0/1	0	1/2 (0.08[c])	1/4 (0.31)	0	0/4
T26	0/3	0/2	0/2	0/1	0/2	0/1	0/1

[a] Trait abbreviations: MS, Metopic suture; R P_1, Rotation mandibular first premolar; R P_2, rotation mandibular second premolar; R P^1, Rotation maxillary first premolar; C M^2, Compressed maxillary second molar; IG I^1, Interruption groove maxillary first incisor; IG I^2, Interruption groove maxillary second incisor.
[b] Only tombs with recovered skeletal remains are included here (T27 only contained very fragmentary juvenile crania and deciduous teeth).
[c] Significant at α = 0.10.
* Significant at α = 0.05.

Of 224 observed frontals for the cemetery sample, only nine individuals show persistence of the metopic suture producing an overall probability of 0.04 (the probability is the frequency for the cemetery). Overall, three females, five males, and one individual of undiagnosed sex showed metopic sutures. Of the nine individuals with metopic sutures, three are located in T4 (two females and a male), three are located in T17 (two probable males and an individual of undiagnosed sex), one is located in T12 (male), one is located in T13 (male), and one is located in T22 (female) (Fig. 5.14). Statistically significant binomial probabilities are observed for the co-occurrence of three cases of metopism in graves T4 and T17 ($p = 0.02$ for both) (Table 5.10). The observed negative LHat of the bivariate extension of Ripley's K is below the low confidence envelope value and indicates significant clustering of individuals with metopic suture in small distances (Fig. 5.15).

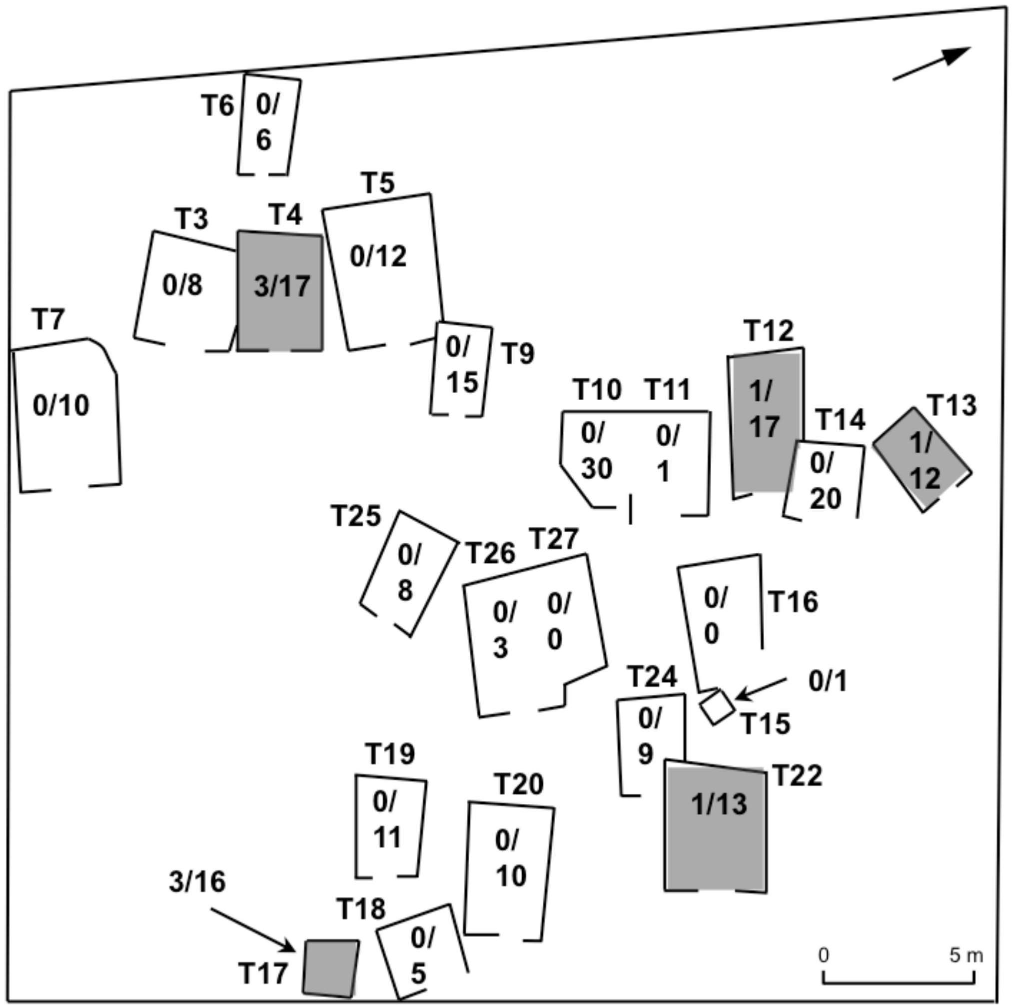

Figure 5.14. Distribution of individuals showing metopic sutures at Tsepi (number of present/number of observed). Shaded graves indicate positive expressions.

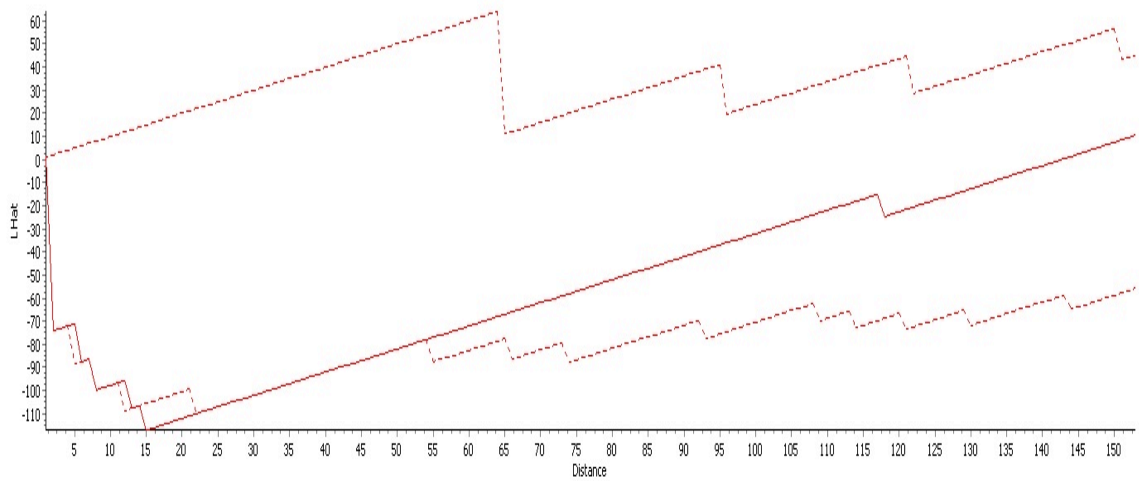

Figure 5.15. Ripley's K bivariate extension analysis of presence of metopic suture at Tsepi. The dotted lines indicate the 95% confidence interval. The LHat line illustrates whether or not individuals with metopic suture are spatially associated or disassociated with other individuals with metopic suture.

A relatively high number of rotated premolars were observed in the Tsepi cemetery sample. A total of 12 cases were observed including five cases of rotated mandibular first premolars ($p = 0.06$ based on the frequency in the cemetery sample), six cases of rotated mandibular second premolars ($p = 0.11$ based on the frequency in the cemetery sample), and two cases of rotated maxillary first premolars ($p=0.04$ based on the frequency in the cemetery sample) (Table 5.10). The four cases of rotated mandibular first premolars come from graves T4, T19 (two individuals, one a female), and T24 (Table 5.10). A statistically significant binomial probability was observed for the co-occurrence of two cases of rotated mandibular first premolar (one of them a female) in grave T19 ($p = 0.02$) (Table 5.10). The six cases of rotated mandibular second premolars come from graves T4 (two individuals, one male), T10, T12 (female), T17 (female), and T20, but none of them produced a statistically significant probability (Table 5.10). The two cases of rotated upper first premolars are located in graves T13 and T25 (female), both showing binomial probabilities statistically significant at the 0.1 level (Table 5.10). When all the cases of rotated premolars (N = 12) are examined by sex, females show a higher percentage (33%). Only one male showed a rotated premolar (8%), while sex was not observable for the remaining individuals (58%). Overall, ten graves include individuals with premolar rotation (Fig. 5.16). Graves T4 and T19 show grouping of individuals with rotated premolars (Fig. 5.16). With the exception of T4 (that contains 3 cases) and T25, the graves with premolar rotation are clustered together (Fig. 5.16). The results of the bivariate extension of Ripley's K show a tendency toward clustering in small distances of individuals with rotated mandibular first premolars (Fig. 5.17) and individuals with rotated mandibular second premolars (Fig. 5.18). The observed, generally negative LHat shows clustering that is marginally significant only in very small inter-individual distances, between pairs of individuals, in the case of rotated first premolars (Fig. 5.17).

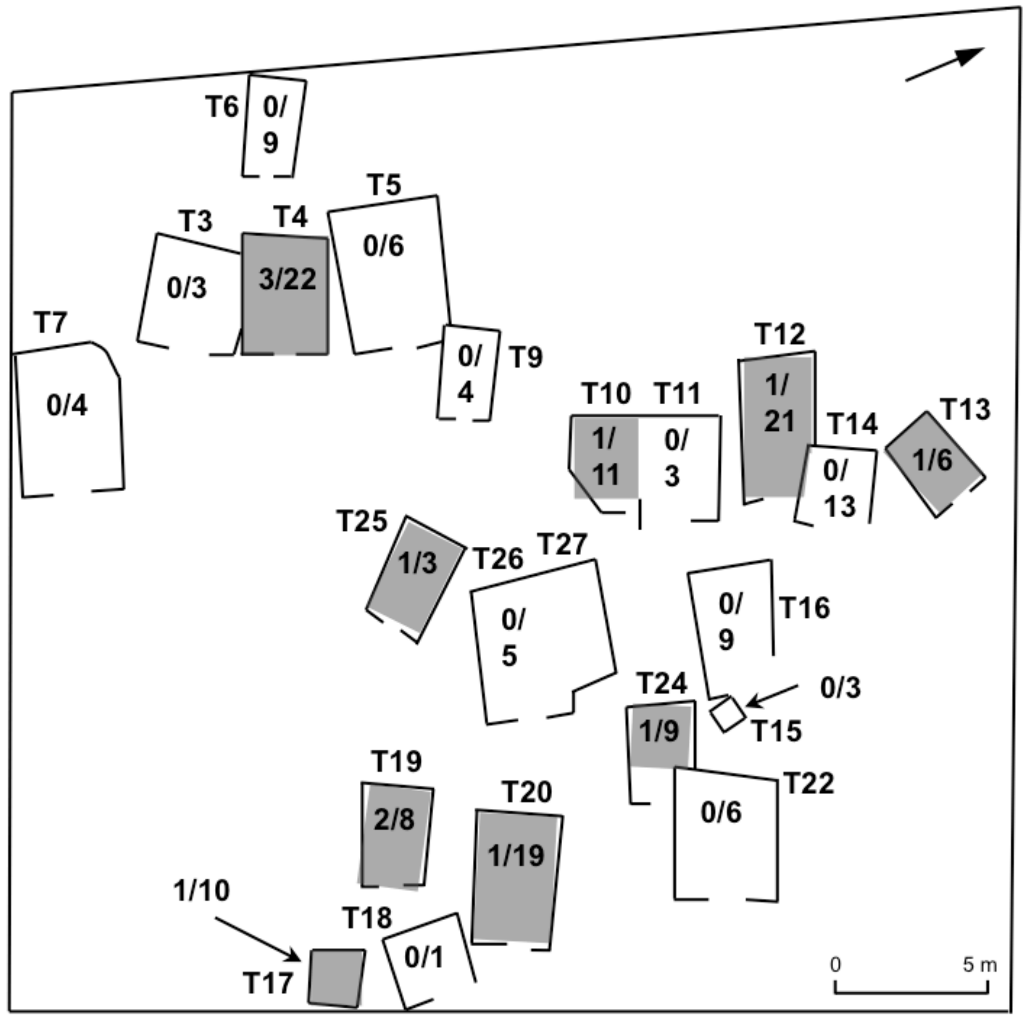

Figure 5.16. Distribution of individuals showing rotated premolars at Tsepi (number of present/number of observed). Shaded graves indicate positive expressions. All cases of rotated premolars are combined in this figure, including mandibular first and second and maxillary first premolars. Note the multiple individuals in T4 and T19.

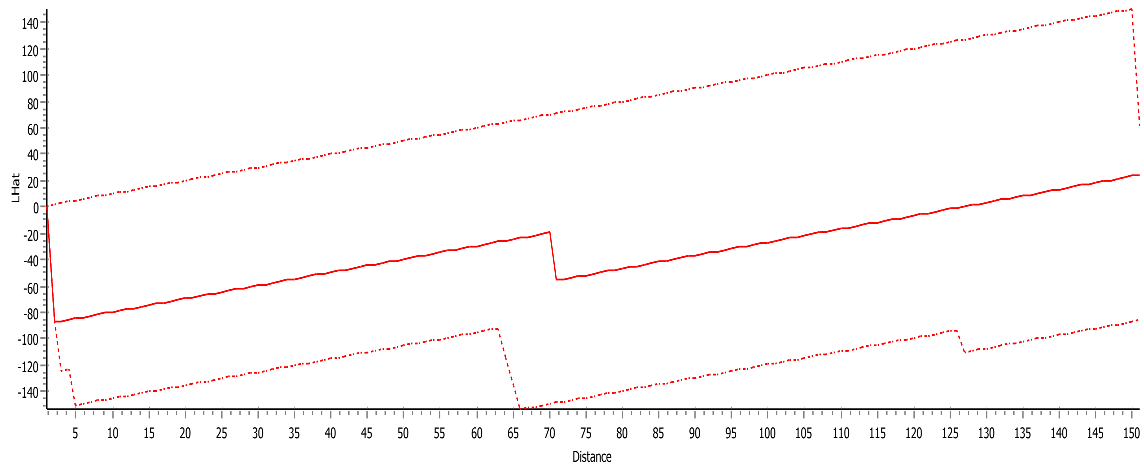

Figure 5.17. Ripley's K bivariate extension analysis of presence of rotation for mandibular first premolar (LP1) at Tsepi. The dotted lines indicate the 95% confidence interval. The LHat line illustrates whether or not individuals with LP1 rotation are spatially associated or disassociated with other individuals with LP1 rotation.

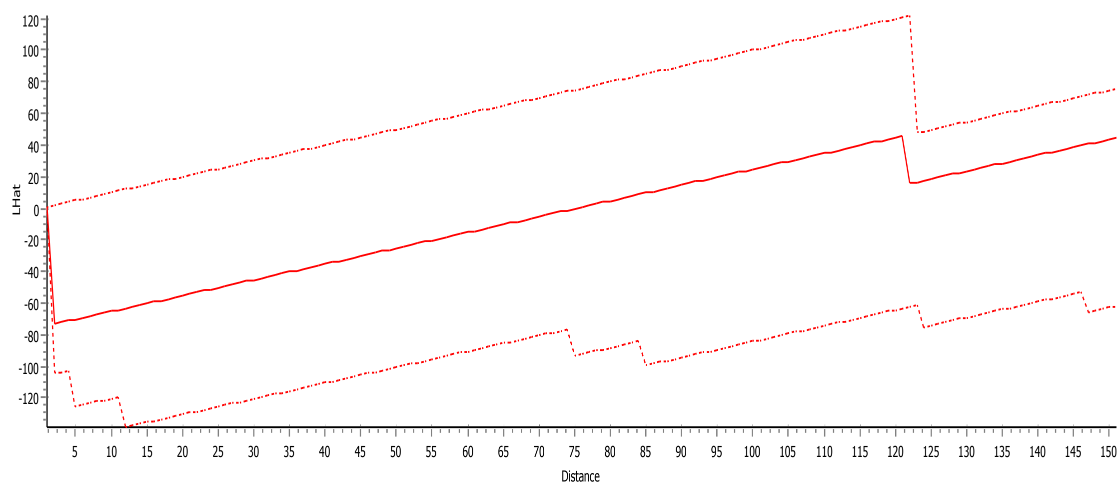

Figure 5.18. Ripley's K bivariate extension analysis of presence of rotation for mandibular second premolar (LP2) at Tsepi. The dotted lines indicate the 95% confidence interval. The LHat line illustrates whether or not individuals with LP2 rotation are spatially associated or disassociated with other individuals with LP2 rotation.

Mesiodistal compression of maxillary second molars was observed in 12 cases (p = 0.11 based on the frequency in the cemetery sample) (Table 5.10). Graves T4, T10, and T19 include two cases each, while graves T5, T6, T7, T11, T17, and T25 contain a single case each (Table 5.10). Only the co-occurrence of two individuals with compressed maxillary second molars in T10 produced a statistically significant binomial probability at the 0.1 level (p = 0.09) (Table 5.10). Of the 12 individuals in total, only two were sexed, a male individual from T4 and a female individual from T25. Interestingly, five out of the 12 cases of compressed maxillary second molars belong to juveniles. This shows a high degree of similarity between juveniles that form the natal component (83%, n = 6 for juveniles included in the dataset). Specifically, T6 includes a child of 8 years old (± 24 months), T10 includes a child of 7 years old (± 24 months), T17 includes an older child/young adolescent of about 12 years old (± 36 months), and T19 includes two children of 6 and 7 years old (± 24 months). The co-presence of the trait in an adult and a juvenile in T10, as well as the co-presence in two juveniles in T19 are in accordance with a familial use of the graves. The distribution of the trait generally shows clustering in adjacent graves (e.g., T4 and T5) (Fig. 5.19). Co-occurrence of the trait is observed in Graves T10 and T11 that share the same enclosure. Note that graves T4 and T19 again show co-occurrence of the trait. The results of the bivariate extension of Ripley's K show a generally negative Lhat and a tendency for clustering of individuals with compressed maxillary second molars (Fig. 5.20). The clustering is marginally significant only in very small inter-individual distances, such as pairs of individuals (Fig. 5.20).

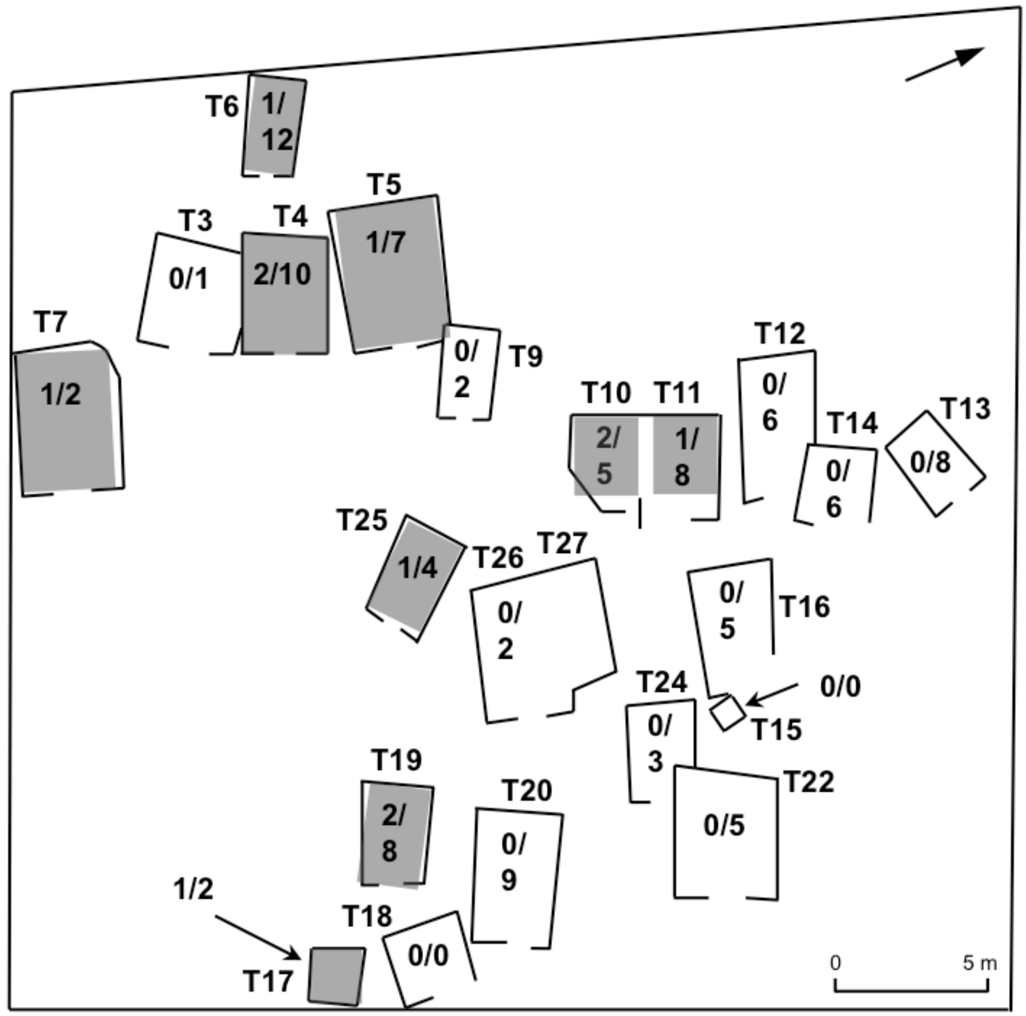

Figure 5.19. Distribution of individuals showing mesiodistally compressed maxillary second molars at Tsepi (number of present/number of observed). Shaded graves indicate positive expressions. Note the multiple individuals in T4, T19, and T10, as well as the co-presence of the trait in T10 and T11 that share a common enclosure.

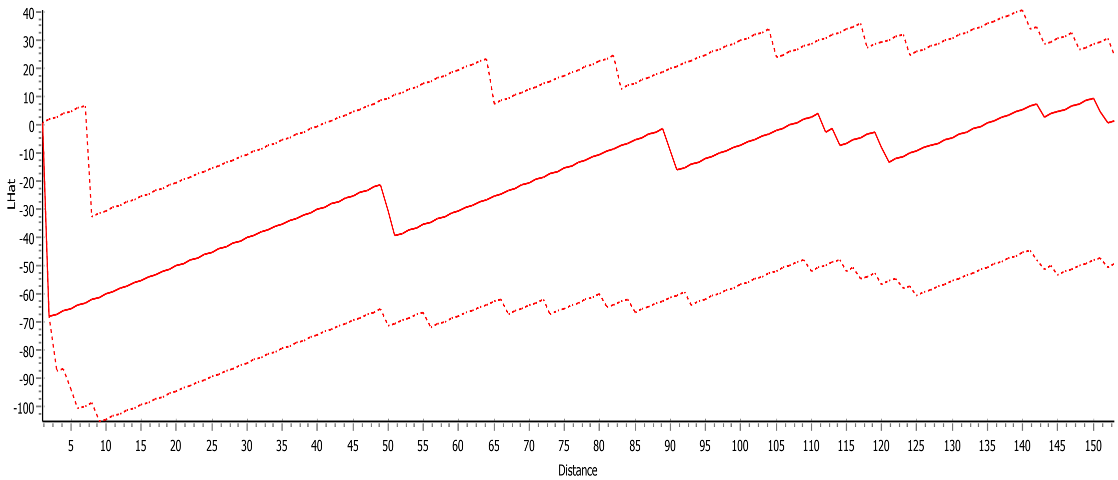

Figure 5.20. Ripley's K bivariate extension analysis of presence of mediodistally compressed maxillary second molars (UM2) at Tsepi. The dotted lines indicate the 95% confidence interval. The LHat line illustrates whether or not individuals showing compressed UM2 are spatially associated or disassociated with other individuals showing compressed UM2.

Interruption grooves were observed in six upper central incisors out of 104 observable, showing a low probability of 0.06 (the probability equals the frequency for the cemetery) (Table 5.10). Single cases were observed in six graves (T6, T12, T13, T14, T19, T20), none of them statistically significant (Table 5.10). Sex was estimated only for a probable female individual from T20. Furthermore, interruption grooves had a much higher frequency in maxillary lateral incisors as expected. Of the 92 observable lateral incisors, 22 showed interruption grooves (Table 5.10). In total, twelve graves included individuals with interruption groove on the maxillary lateral incisors (Table 5.10). Graves T13 and T19 included four cases, T6 included 3 cases, and T10 and 20 included 2 cases (Table 5.10). Graves T4, T5, T6, T11, T12, T14, T16, and T22 included a single case each (Table 5.10). Adjacent graves share the trait, when the central and lateral incisors are combined (Fig. 5.24). The results of the bivariate extension of Ripley's K show marginally statistically significant dispersion of individuals with interruption grooves on the maxillary central incisors in small inter-individual distances, and clustering (non-significant) for larger distances (Fig. 5.22). The dispersion in smaller inter-individual distances reflects the lack of co-occurrence of the trait in a single grave, while the clustering in larger individual distances reflects the co-occurrence of the trait in adjacent graves. The results of the bivariate extension of Ripley's K show clustering of individuals with interruption grooves on the maxillary lateral incisors that is statistically significant clustering in small inter-individual distances (Fig. 5.23).

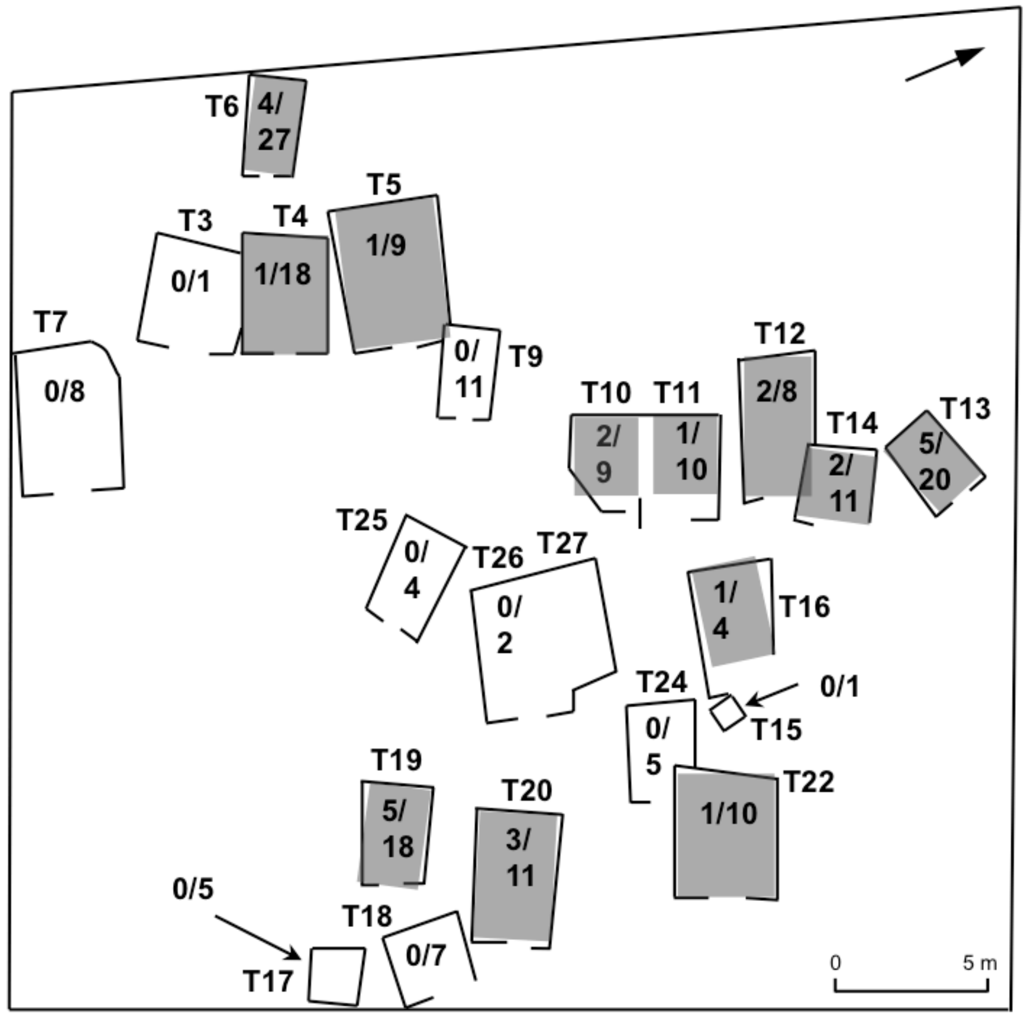

Figure 5.21. Distribution of individuals showing interruption grooves on maxillary incisors at Tsepi (number of present/number of observed). Shaded graves indicate positive expressions. Both maxillary central and lateral incisors are combined in this figure. The largest number of individuals sharing the trait occur in T6, T13, T19, and T20.

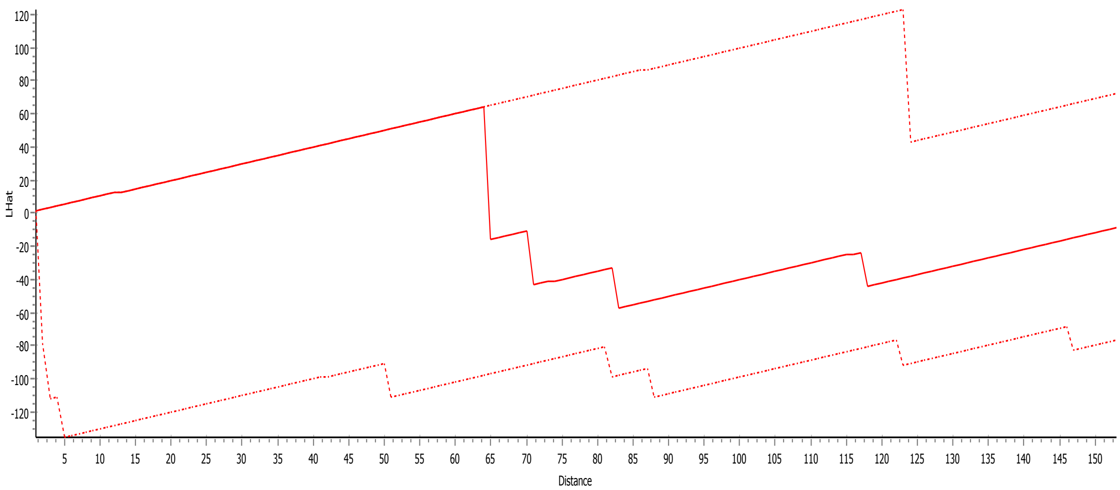

Figure 5.22. Ripley's K bivariate extension analysis of presence of interruption groove for maxillary central incisors (UI1) at Tsepi. The dotted lines indicate the 95% confidence interval. The LHat line illustrates whether or not individuals with an UI1 interruption groove are spatially associated or disassociated with other individuals with an UI1 interruption groove. The observed LHat shows marginally significant dispersion for distances up to 70 units (between grave distances, roughly) and then a clustering tendency for distances larger than 70 units that is not however significant.

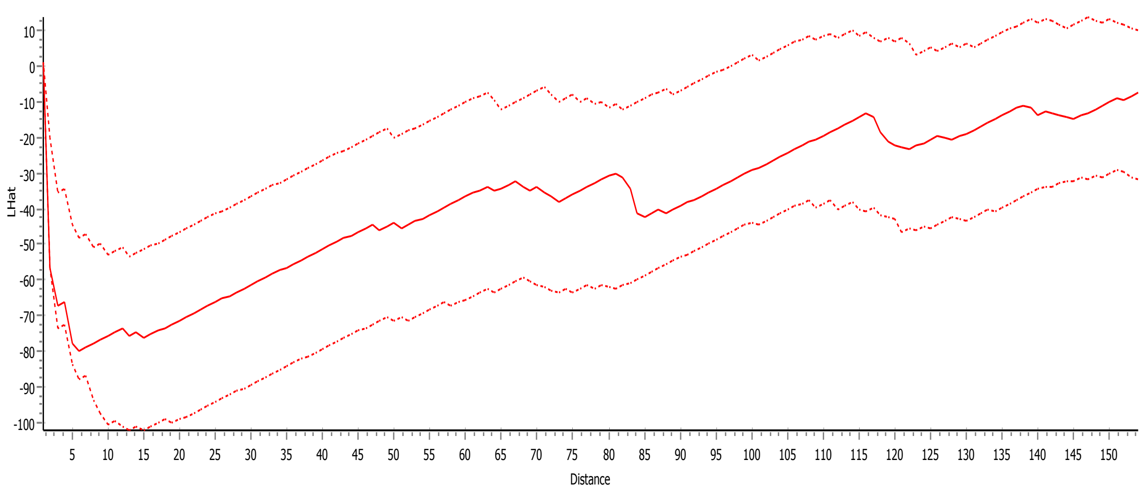

Figure 5.23. Ripley's K bivariate extension analysis of presence of interruption groove for maxillary lateral incisors (UI2) at Tsepi. The dotted lines indicate the 95% confidence interval. The LHat line illustrates whether or not individuals with an UI2 interruption groove are spatially associated or disassociated with other individuals with an UI2 interruption groove. The observed LHat is generally negative indicating clustering that is marginally significant in smal inter-individual distances (between 3 individuals).

Postmarital Residence Analysis

The trait frequencies for the original and trimmed datasets are presented in Tables 5.11 and 5.12. For the original dataset, the determinant for the male covariance matrix is 2.870E-12 (Table 5.13), and the determinant for the female covariance is 3.954E-13 (Table 5.14). The male to female determinant ratio is 7.259 (natural log = 0.861) (Table 5.15). Even though the F-test gives a p-value significant at the 0.05 level, the randomization p-value is 0.982, and thus highly non-significant (Table 5.15). For the trimmed dataset, the determinant for the male covariance matrix is 0.000103962 (Table 5.16) and the determinant for the female covariance is 0.000068 (Table 5.17). The male to female determinant ratio is 1.530 (natural log = 0.185), and both the F-test and the randomization p-values are non-significant (0.340 and 0.596 respectively) (Table 5.15). The ratios of the male to female covariance matrices for both datasets indicate higher mobility for male individuals, even though the results are not statistically significant.

Table 5.11. Observed trait frequencies by sex for the original dataset (number present/ number observed).

Sex Trait	Male (n = 28)	Female (n = 39)
Metopic suture	3/26	4/36
Supraorbital notch	19/23	23/28
Parietal foramen	3/24	4/32
Lambdoidal ossicles	12/21	12/21
Parietal notch bone	2/23	3/32
Auditory exostosis	2/26	2/36
Suprameatal spine	12/28	12/39
Mastoid foramen	7/27	3/33
Sutura mendosa	2/27	1/36
Retromastoid process	1/24	3/34
Occipital foramen	2/27	2/31

Table 5.12. Observed trait frequencies by sex for the trimmed dataset (number present/ number observed).

Sex Trait	Male (n = 18)	Female (n = 19)
Metopic suture	2/18	1/19
Suprameatal spine	8/18	8/19
Lambdoidal ossicles	10/18	10/19
Mastoid foramen	4/18	3/19
Parietal foramen	3/18	4/19

Table 5.13. Male covariance matrix for the original dataset.

Trait[a]	MS	SON	PF	LO	PNB	AE	SMS	MF	SM	ÎRMP	OF
MS	0.10615	-0.02964	0.02767	-0.00877	-0.01429	-0.09598	-0.04615	-0.02333	-0.01000	-0.00649	-0.01000
SON	-0.02964	0.15020	-0.02895	0.00833	0.00654	0.01429	0.01779	0.01299	0.01732	0.01170	0.01732
PF	0.02767	-0.02895	0.11413	-0.03216	-0.01429	-0.01299	-0.00543	0.00395	-0.00593	-0.00789	0.03360
LO	-0.00877	0.00833	-0.03216	0.25714	0.04737	0.02105	0.08571	-0.06429	0.04286	0.02574	-0.01053
PNB	-0.01429	0.00654	-0.01429	0.04737	0.08300	0.03896	0.00198	0.02597	0.03896	-0.00585	-0.00866
AE	-0.01087	0.01429	-0.01299	0.02105	0.03896	0.07385	0.00308	0.02167	0.03500	-0.00433	-0.00667
SMS	-0.04615	0.01779	-0.00543	0.08571	0.00198	0.00308	0.25397	-0.08120	0.04274	0.02355	0.00427
MF	-0.02333	0.01299	0.00395	-0.06429	0.02597	0.02167	-0.08120	0.19943	-0.02154	-0.01186	0.01846
SM	-0.01000	0.01732	-0.00593	0.04286	0.03896	0.03500	0.04274	-0.02154	0.07123	-0.00395	-0.00615
RMP	-0.00649	0.01170	-0.00789	0.02574	-0.00585	-0.00433	0.02355	-0.01186	-0.00395	0.04167	-0.00181
OF	-0.01000	0.01732	0.03360	-0.01053	-0.00866	-0.00667	0.00427	0.01846	-0.00615	-0.00181	0.07123

Determinant |C♂| = 2.870E-12

[a] Trait abbreviations: MS, metopic suture; SON, supraorbital notch; PF, parietal foramen; LO, lambdoidal ossicles; PNB, parietal notch bone; AE, auditory exostosis; SMS, suprameatal spine; MF, mastoid foramen; SM, sutura mendosa; RMP, retromastoid process; OF, occipital foramen.

Table 5.14. Female covariance matrix for the original dataset.

Trait[a]	MS	SON	PF	LO	PNB	AE	SMS	MF	SM	ÎRMP	OF
MS	0.1016	0.0142	-0.0099	0.0183	0.0207	-0.0076	-0.0032	-0.0103	-0.0038	-0.0097	-0.0079
SON	0.0142	0.1521	0.0316	-0.0178	-0.0158	0.0154	0.0595	0.0237	0.0062	0.0119	-0.0310
PF	-0.0099	0.0316	0.1129	0.0025	-0.0062	0.0283	0.0202	-0.0171	-0.0049	-0.0171	-0.0133
LO	0.0183	-0.0178	0.0025	0.2576	0.0160	0.0323	-0.0152	0.0146	0.0172	0.0172	-0.0037
PNB	0.0207	-0.0158	-0.0062	0.0160	0.0877	-0.0037	0.0020	-0.0026	-0.0037	-0.0119	-0.0033
AE	-0.0076	0.0154	0.0283	0.0323	-0.0037	0.0540	0.0095	-0.0034	-0.0019	-0.0065	-0.0053
SMS	-0.0032	0.0595	0.0202	-0.0152	0.0020	0.0095	0.2186	0.0000	-0.0087	-0.0294	-0.0215
MF	-0.0103	0.0237	-0.0171	0.0146	-0.0026	-0.0034	0.0000	0.0852	0.0310	0.0308	0.0291
SM	-0.0038	0.0062	-0.0049	0.0172	-0.0037	-0.0019	-0.0087	0.0310	0.0278	0.0294	-0.0012
RMP	-0.0097	0.0119	-0.0171	0.0172	-0.0119	-0.0065	-0.0294	0.0308	0.0294	0.0829	0.0000
OF	-0.0079	-0.0310	-0.0133	-0.0037	-0.0033	-0.0053	-0.0215	0.0291	-0.0012	0.0000	0.0624

Determinant |C♀| = 3.954E-13

[a] Trait abbreviations: MS, metopic suture; SON, supraorbital notch; PF, parietal foramen; LO, lambdoidal ossicles; PNB, parietal notch bone; AE, auditory exostosis; SMS, suprameatal spine; MF, mastoid foramen; SM, sutura mendosa; RMP, retromastoid process; OF, occipital foramen.

Table 5.15. Ratios of determinants for male and female covariance matrices for the two datasets.

	|C♂| / |C♀|	ln(|C♂| / |C♀|)	F-test	P-value	Randomization P-value
Original Dataset	7.259	0.861	1.303	0.013	0.982
Trimmed Dataset	1.530	0.185	1.101	0.340	0.596

Table 5.16. Male covariance matrix for the trimmed dataset.

Trait	MS	SMS	LO	MF	PF
MS	0.10458	-0.05229	-0.00654	-0.02614	0.03922
SMS	-0.05229	0.26144	0.09150	-0.04575	-0.01961
LO	-0.00654	0.09150	0.26144	-0.07190	-0.03922
MF	-0.02614	-0.04575	-0.07190	0.18301	0.01961
PF	0.03922	-0.01961	-0.03922	0.01961	0.14706

Determinant |C♂| = 0.000103962

Table 5.17. Female covariance matrix for the trimmed dataset.

Trait	MS	SMS	LO	MF	PF
MS	0.05263	0.03216	-0.02924	-0.00877	-0.01170
SMS	0.03216	0.2573	-0.0117	-0.0146	0.0175
LO	-0.02924	-0.01170	0.26316	0.02339	-0.00585
MF	-0.00877	-0.01462	0.02339	0.14035	-0.03509
PF	-0.01170	0.01754	-0.00585	-0.03509	0.17544

Determinant |C♀| = 0.000068

Limitations to the Study

Temporal Scope

Given that cemeteries are used for periods of time (long or short), cemetery skeletal samples do not include only individuals who were simultaneously alive, but also individuals who were not simultaneously alive and, thus, had zero probability of mating (Cadien et al., 1974:196). Therefore, skeletal samples cannot be equated with biological ("living") populations. Skeletal samples include lineages that consist of "a temporally ordered sequence of populations, presumably with genetic continuity" (Cadien et al., 1974:196). Differences in the temporal scope and "catchment area", i.e., "the portion of a broad mating network represented by any single cemetery" (Stojanowski and Schillaci, 2006:53), can greatly affect inter-cemetery comparisons. One should keep in mind that in skeletal populations the mating pool for each generation will be different and that redistribution of genetic variability will take place in each generation (Stojanowksi and Schillaci, 2006:66; see Konigsberg work, 1987, 1988, 1990a,b). Thus, as discussed previously, males and females biologically will be more variable when they are "spouses" (following an exogamous pattern), but less variable when they represent parent – offspring relationships. Even though intra-cemetery analysis is not affected by biases introduced by the comparison of inappropriate samples (e.g., non-contemporaneous, used for different periods of time, different mating networks, different size), control over the temporal duration is of great importance, particularly for the genetic variability potentially introduced by postmarital residence practices (e.g., exogamy).

The cemetery of Tsepi dates to the Early Helladic I, though recent finds might push the date back to the Final Neolithic. Some graves show continuation in the early phases of the Early Helladic II. Based on ceramic styles, the relevant date for Tsepi is between 3100/3000 – 2650 BC (see discussion in Chapter 4), suggesting use of the cemetery over several centuries.[240] Tsepi consists of graves that contain multiple individuals and were periodically re-used. The large number of individuals included in each grave (up to 27) at Tsepi, suggest a long duration for each grave (depending also on whether or not different graves were used simultaneously). As is the case for prehistoric cemeteries with collective graves, the duration of use for each grave and issues of contemporaneity between different graves is open to question. In the Aegean, collective graves are generally presumed to be family graves (see detailed discussion in Chapter 3).

A commonly cited estimation figure of contributing family members and "population" size over time is Bintliff's (1977) model for the Early Minoan communal tombs of Mesara on Crete (e.g., Day et al., 1998). Bintliff (1977:639-641) proposed that considering a nuclear family size of seven members (based on estimates for Medieval families where of the five offspring, only two were likely to survive to reproduce), one family is expected to produce 20 bodies per century: this figure resulted from 5 bodies per generation (generation set at 25 years) consisting of the three surviving offspring and two immature deaths). This estimation further assumes that the communal graves were used exclusively and consecutively by nuclear family members. However, even if graves are assumed to be family sepultures, when marital patterns are considered (i.e., whether or not tombs include spouses and the offspring's spouses) the picture becomes highly complex. As generations progress, the inclusion (or not) of the spouses of the offspring, and later on their own offspring etc., the number of individuals included in one grave can be highly variable depending on duration and selection of "grave members" (e.g., inclusion of other social group members and/or extended family members such as maternal or paternal uncles, etc.).

The results of the radiocarbon analysis only yielded one date (see Chapter 4, under Chronology). The radiocarbon date comes from the upper layers of T12 and gives a calibrated date between 3629 – 3029 calBC (95% confidence interval) and most likely between 3531 – 3086 calBC (90.1%) (Fig. 4.11). Thus, unfortunately, more information on the contemporaneity of different graves and on the duration of grave use is unavailable.

Sample Biases

Cemetery samples are by definition biased. First, they represent only a portion (often unknown) of the living population. Second, only a segment of the originally buried population is recovered (preservation issues, complete or incomplete excavation). Third, post-excavation factors affect the skeletal assemblages available for study (storage, conservation, selective recovery of skeletal elements). Regarding Tsepi, the full extent of the cemetery is not known. The skeletal assemblage included in this study represents approximately half of the graves excavated to date. Thus, generalized results will remain tentative and will be subject to future reexamination. The time elapsed since excavation introduced further provenance issues that resulted in materials missing (e.g., skeletal samples from T2 and T23) or in unidentified elements (labeling lost or, most frequently, destroyed). An additional issue relevant to this study is the partially excavated tomb chambers. As stated previously, of the 22 graves studied, six still preserve unexcavated bones *in situ*. Consequently, the available grave assemblages do not necessarily represent the complete grave contexts.

Conclusions Based on Biodistance Analysis

The state of preservation and the degree of incompleteness and commingling posed considerable limitations in the amount of data included in this study, as well as methodological restrictions. Variable datasets were constructed and different methods were applied to examine the degree of biological relatedness within grave and within grave groups, as well as postmarital residence. The results of the biodistance analysis revealed several interesting patterns regarding the relationship between cemetery structure and biological relatedness at the cemetery of Tsepi.

Based on the results of univariate and multivariate analyses of mandibular odontometrics, inter-individual biological distances did not follow spatial distances closely. The within-grave skeletal groups did not represent distinct biological groups, while the within-grave biological variation was not always smaller than the across-grave biological variation. Instead, individuals phenotypically similar and presumably biologically related were often interred in different graves. Certain graves did show consistently lower variation indicating that they consisted of closely related individuals. These include T3, T4, and T5 at the western sector of the cemetery, T10 at the middle sector, and T17 and T19 at the eastern sector. In this, the results of the spatial analysis were also highly informative, whereby clustering of rare traits was noted for small inter-individual distances. When young juveniles were included in the analysis (compressed maxillary second molars), they showed a high degree of phenotypic similarity to each other. The juvenile individuals were both biologically and spatially close to each other, as well as to adult individuals expressing the same trait, suggesting a familial use of the graves. However, even the graves that represented phenotypically similar groups of individuals included also individuals that were phenotypically distinct. Thus, assuming that phenotypic similarity represents genetic relatedness, most graves seem to be composed of a core of biologically related individuals and a smaller component of biologically unrelated individuals (T4 presents the best example). This observation is in accordance with a) exogamous practices that add biological variation to the sample, b) the expectation that inclusion of spouses in the same grave will decrease inter-individual adult similarities, and c) the inclusion of individuals in the same grave based on other forms of relations that are not biological, such as social, fictive, or practical kinship.

When groups of graves (based on their location in the cemetery) are examined, a clear spatial patterning emerges. The group of graves from the eastern sector of the cemetery (T17, T19, T20, T22, T24, T25) shows significantly lower variation than the rest of the cemetery, suggesting use by a biologically homogeneous group, probably a kin group (note that T19, T20, and T22 are adjacent graves found in the same row). Furthermore, the graves from the middle sector of the cemetery (T10, T11, T12, T13, T14 that also make a grave row) tend to form a group biologically distinct from both the western and the eastern grave groups. Spatial analysis further revealed morphological similarities for individuals from graves T10 and T11 that share the same enclosure. At the western sector of the cemetery, graves T3, T4, T5, and T6 are consistently clustered together indicating use by a group of closely related individuals (T3, T4, T5 are found in the same row). These represent the most robust group across the different analyses. Individuals from T7, on the other hand, form a different, looser cluster that does not group with the rest of the graves from the western sector. The fact that T7, even though located at the western sector, marks the beginning of a separate row of graves, supports the use of grave rows by different kin groups based on biological relatedness (unfortunately, the skeletal material from the rest of the graves from that row are not available for study). The results of the biodistance analysis indicate that overall biological grouping takes place not within graves but within grave clusters and particularly within grave rows. Graves do include closely related individuals, but closely related individuals also cross cut different graves, suggesting that biological relatedness is the major, but not the only factor for inclusion in a specific grave.

Finally, the results of the postmarital residence analysis showed higher male mobility. Generally, female individuals exhibited greater biological similarities (both metric and morphological), while male individuals were more dispersed. This suggests that females formed a less variable and less mobile group, while males formed a more variable and thus more mobile group. The pattern observed at Tsepi is suggestive of uxorilocal (or matrilocal) postmarital practices, whereby females are more stable and remain in the native group, while males come to the community from a larger genetic pool. The lack of statistical significance does not necessarily reject the biological significance, while it might also reflect a looser pattern, an overall trend of incoming males that would also have exceptions. Not every male individual had to come from a different group. Likewise, male individuals born in the community would progressively share similarities, especially in long-term. These results present us with an interesting picture for the Early Helladic society where postmarital residence and its social correlates remain unexplored. Any interpretations will remain tentative until a larger sample from the cemetery and comparative assemblages are available.

CHAPTER 6

BIOGEOCHEMICAL ANALYSIS

Background

Over the last four decades, biogeochemistry has progressively been applied to bioarchaeological research as a direct means for addressing human behavior and has grown to be an established field in archaeological science. Since its initial archaeological applications in the 1970s, isotopic analysis has primarily focused on the reconstruction of past human diet given that the isotopic composition of the diet is generally represented in the consumer's tissues. More recently, a major development in the field has been the use of biogeochemical analysis to address past human residential mobility and migration. The methodology, introduced to bioarchaeology from environmental and ecological studies, has successfully been applied to a variety of historic and prehistoric contexts with a wide geographic range, such as the Americas (e.g., Ezzo et al., 1997; Ezzo and Price, 2002, Knudson and Buikstra, 2007; Knudson and Price, 2007; Knudson et al., 2004, 2014; Price et al., 1994, 2000), Africa (Stojanwoski and Knudson, 2011; Cox and Sealy, 1997), and northern-central Europe (e.g., Bentley et al., 2003, 2004; Montgomery et al., 2005; Knudson et al., 2012; Price et al., 1998, 2001).

Strontium moves from bedrock into the food chain via soil and groundwater, and ultimately into the human skeleton by substituting for calcium in the hydroxyapatite of skeletal tissues (Carr et al., 1962; Comar et al., 1957; Ericson, 1985; Ezzo, 1994; Hodges et al., 1950; Kulp et al., 1957; Kulp et al., 1962; Odum, 1951; Rehnberg et al., 1969;

Rivera, 1964; Toots and Voorhies, 1965; Turekian and Kulp, 1956a). Radiogenic strontium isotope values ($^{87}Sr/^{86}Sr$) are not substantially fractionated by biological processes, thus the radiogenic strontium isotopic composition of human bone and teeth reflects the isotopic composition of strontium in the individual's diet and water sources, which in turn reflects the bioavailable strontium of the geological region and habitat from which the strontium in the food and water sources was obtained (Bentley, 2006; Ericson, 1985; Price et al., 2002). Specifically, dental enamel reflects the composition of the strontium sources consumed during childhood diet because it forms during early childhood and does not remodel (Ericson, 1985). Consequently, differences between the isotopic signatures of skeletal tissues that form in different ontogenetic stages and the isotopic signature of the region in which the individual died can reveal changes in the residential history of the individual, as long as local food and water sources were consumed (Bentley, 2006; Ericson, 1985; Ezzo et al., 1997; Price et al., 1994; Price et al., 2002).

The method is based on the variation of $^{87}Sr/^{86}Sr$ values between different geological terrains according to geological age and geochemical composition of the local bedrock (Ericson, 1985; Faure and Powell, 1972; Turekian and Kulp, 1956b). The radiogenic isotope ^{87}Sr is formed over time by the radioactive decay of ^{87}Rb with a half life of about 4.88×10^{10} years (Faure and Powell, 1972). Radiogenic strontium isotope values on the earth's crust are a function of the relative abundances of $^{87}Rb/^{87}Sr$ and the age of rocks (Faure and Powell, 1972; Turekian and Kulp, 1956b). The abundances of ^{87}Sr are normalized to the stable isotope ^{86}Sr and are reported as the $^{87}Sr/^{86}Sr$ ratio in order to allow for comparison between different samples (see review of the method in Bentley, 2006). However, the $^{87}Sr/^{86}Sr$ ratio in the underlying bedrock geology and that in the biologically available sources is not always isomorphic. Different factors (e.g., weathering and atmospheric contributions) can affect the $^{87}Sr/^{86}Sr$ rations entering the food chain. Thus, to control for the within-region variation of $^{87}Sr/^{86}Sr$ levels in bedrock, soil, and water, the use of fauna and a variety of environmental samples has been established for the characterization of the locally bioavailable $^{87}Sr/^{86}Sr$ ranges (e.g., Bentley et al., 2004; Evans and Tatham, 2004; Hodell et al., 2004; Price et al., 2002; Wright, 2005).

Furthermore, as with all scientific methodologies, radiogenic strontium isotope analysis has specific limitations (see Bentley, 2006; Knudson, 2011; Price, 2008). Given the impact that biogeochemical applications can have on interpretations of archaeological mobility and migration, these limitations should be carefully considered. First of all, a well understood principle is that biogeochemical analysis can identify individual mobility, what is often called "first-generation" immigrants (Knudson, 2011; Knudson and Price, 2007). Secondly, the biogeochemical signature enters the skeleton through diet, thus paleodiet and paleomobility are intimately linked (Ericson, 1985; Turekian and Kulp, 1956a). The successful identification of non-local individuals depends on the consumption of local food and water resources: non-local diet (e.g., imported foods or treatment of foods with non-local ingredients) will result in non-local signatures (Knudson, 2011). Consequently, dietary practices should be addressed in order to account for the sources of dietary strontium in a given population.

As stated earlier, strontium substitutes for calcium in the hydroxyapatite of skeletal tissues due to the similar chemical structure of the two elements (Dolphin and Eve, 1963; Haghiri, 1964; Lee, 1959; Mauchline and Templeton, 1966; Rosenthal et al., 1970; Turekian and Kulp, 1956a). As a result, the main dietary intake of strontium comes from food sources high in calcium. However, animals absorb calcium preferentially over strontium (Burton and Wright, 1995). Thus, plants, particularly legumes, nuts, and seeds, contribute significantly in the strontium uptake, whereas meat and fish (flesh) even though rich in strontium contribute much less (Alexander and Nusbaum, 1959; Burton and Wright, 1995; Lambert and Weydert-Homeyer, 1993). Likewise, the contribution of dairy products, otherwise high in calcium, to the strontium intake is low (Ezzo, 1994; Knudson et al., 2012). Thus, marine diets for example will not necessarily affect the ingested $^{87}Sr/^{86}Sr$ values, unless whole fish (i.e., with bones) are consumed.

Other factors that can affect $^{87}Sr/^{86}Sr$ values are marine diets and marine environments (Ericson, 1985). Seawater has a homogeneous $^{87}Sr/^{86}Sr$ value throughout the globe at any given (geologic) time (between 0.707-0.709), currently at $^{87}Sr/^{86}Sr$ = 0.7092 (Bentley, 2004; Veizer, 1989). Thus, heavy consumption of strontium from marine sources can affect the $^{87}Sr/^{86}Sr$ values by bringing them closer to the seawater signature. Here, the type of marine resources would play a role. The consumption of fish bones, as commonly happens with small fish, that are high in calcium would have a greater effect in $^{87}Sr/^{86}Sr$ values than the consumption of fish flesh (e.g., Knudson et al., 2012). Another means of incorporating the seawater strontium signature is the consumption of sea salt that contains significant amounts of strontium (Fenner and

Wright, 2014; Wright, 2005). Depending on the strontium sources for any given population, consumption of sea salt (considering also food preparation and preservation, such as salt-cured meat and/or fish) can have a significant impact on strontium isotopic signature; it is estimated that the effect of sea salt will be greater in cases where dietary strontium intake is low (Fenner and Wright, 2005).

Due to marine aerosol in the atmosphere and in precipitation (sea spray effect), the seawater value can affect coastal locations, particularly low elevation wet sites (Kennedy et al., 1998; Vitousek et al., 1999; Whipkey et al., 2000). The atmospheric contribution thus can significantly affect the biologically available strontium in coastal sites, especially in locations with older soils and highly weathered bedrock, producing a discrepancy between observed values and values expected based on the substrate strontium values, an effect well studied in Hawaii (Whipkey et al., 2000). This effect decreases as distance from the coast and elevation increase: in inland locations, for example, weathering of the parental bedrock dominates over atmospheric contribution (Capo et al., 1998; Whipkey et al., 2000). Hence, in coastal and island settings this factor should be carefully addressed (Knudson et al., 2012; Laffoon et al., 2012).

Furthermore, it should be well understood that radiogenic strontium values are not unique. Different locations can have similar geochemical signatures, thus possible mobility between geochemically similar regions might not be expressed in the skeletal elements (Ericson, 1985). Finally, radiogenic strontium isotope values are commonly reported in the fifth decimal place (Bentley, 2006). Thus, an understanding of the dietary composition and the intra- and inter-regional geochemical variation is crucial to the interpretation of past human mobility.

Use of Strontium Concentrations and Isotopes in Paleodietary Studies

The application of elemental concentrations of alkaline earths, such as strontium and barium for the reconstruction of paleodiet has long been noted (Burton and Price, 1990, 2000; Burton and Wright, 1995). The variation of the ratio of barium to strontium, reported as log(Ba/Sr), can be used to distinguish between marine and terrestrial resources (Burton and Price, 1990). Barium is incorporated into the hydroxyapatite of the skeleton through diet and similarly to strontium is preferentially eliminated in comparison to calcium absorption (Burton and Price, 1990; Elias et al., 1982). Thus, higher trophic levels will show lower log(Ba/Sr) values and marine environments will show significantly lower log(Ba/Sr) values than terrestrial environments given that seawater is enriched in strontium relatively to barium (Burton and Price, 1990). Human bone samples from the Americas with predominantly terrestrial diets show a mean $\log(Ba/Sr) = -0.25 \pm 0.16$ (1σ, $n = 20$) and $\log(Ba/Sr) = -0.18 \pm 0.18$ (1σ, $n = 31$) from coastal and inland sites respectively, whereas human bones samples with predominantly marine diets show a mean $\log(Ba/Sr) = -1.56 \pm 0.19$ (1σ, $n = 90$) (Burton and Price, 1990). Desert environments, however, can be a confounding factor due to the strontium enrichment of desert soils (Burton and Price, 1990; Perelman, 1977 cited in Burton and Price, 1990). Human bone samples from inland desert sites with a terrestrial diet show mean $\log(Ba/Sr) = -1.27 \pm 0.30$ (1σ, $n = 30$), mimicking marine diets (Burton and Price, 1990). Given the temperate climate in Greece, the effect of desert environments is expected to be absent in this study. In addition, the plant/meat ratio in the diet can affect the Ba/Sr value given that barium is more fractionated than strontium relatively to calcium, resulting in a lower Ba/Sr value (reduced Ba/Ca compared to Sr/Ca) when meat consumption is increased (Elias et al., 1982; Burton and Price, 1990). Thus, the value of Ba/Sr can indicate large dietary differences between marine and terrestrial resources, while small dietary differences could be masked (Burton and Price, 1990).

A recent development that has significant implications for paleodietary studies is stable strontium isotope analysis that is based on trophic level fractionation within any given ecosystem (Knudson et al., 2010). The method was applied originally in geology and geochemistry following advances in mass spectrometry (bracketing standard) that allow measurement of the very small mass differences between ^{86}Sr and ^{88}Sr previously undetectable (Fietzke and Eisenhauer, 2006; Ohno and Hirata, 2007; Yang et al., 2008). It has been used to examine fractionation based on temperature (Fietzke and Eisenhauer, 2006; Rüggeberg et al., 2008), soil production and weathering processes (de Souza et al., 2010; Halicz et al., 2008), and it was only recently introduced to archaeology as a paleodietary indicator (Knudson et al., 2010). Following standardized notations, stable strontium isotope data are reported as $\delta^{88/86}Sr$ normalized to the strontium standard reference material NBS-987 following $\delta^{88/86}Sr = (^{88/86}Sr_{sample}/^{88/86}Sr_{NBS\text{-}987}) \times 1000 - 1000$) (Fietzke and Eisenhauer, 2006). In order to distinguish between the two types of analysis, I refer here to $^{87}Sr/^{86}Sr$ values as radiogenic strontium isotope analysis and to $\delta^{88/86}Sr$ values as stable strontium isotope analysis (following Knudson et al., 2010:2353).

Strontium isotopes do in fact fractionate during their intake into the skeleton and the lighter isotope ^{86}Sr is preferentially incorporated over the heavier ^{88}Sr (see Knudson et al., 2010:2353). Mass-dependent strontium isotope fractionation results in $\delta^{88/86}$Sr depletion through trophic levels, contrary to the fractionated enrichment through trophic levels observed in light stable isotopes, e.g., δ^{15}N (Knudson et al., 2010). Therefore, higher trophic levels such as carnivores will show lower $\delta^{88/86}$Sr values than herbivores, which in turn will show lower $\delta^{88/86}$Sr values than plants, which will accordingly be lower than soil and bedrock (Knudson et al., 2010). In marine ecosystems, seawater will show higher $\delta^{88/86}$Sr values than large carnivorous fish, which in turn will show higher $\delta^{88/86}$Sr than smaller herbivorous and/or omnivorous fish, followed by bivalves (Knudson et al., 2010). Overall, marine ecosystems show higher $\delta^{88/86}$Sr values than terrestrial ecosystems. Furthermore, skeletal elements that form during breastfeeding are expected to show depleted $\delta^{88/86}$Sr values (i.e., lower) compared to post-weaning forming skeletal tissues due to the effect of breast milk that reflects the higher trophic level of the mother, following the trophic level effect of nursing shown in the light stable isotope systems of nitrogen, carbon, and oxygen. Thus, stable strontium isotope analysis can potentially provide information on weaning practices, as well.

Variation in stable strontium isotopes should be examined within any given ecosystem, to account for potential differences in absolute values for each trophic level introduced by geologic and environmental differences. This requires the ecosystem-specific characterization of baseline $\delta^{88/86}$Sr data for different trophic levels. Nevertheless, the variation in $\delta^{88/86}$Sr variation per trophic level will follow the general pattern of depleted fractionated, as described. Published water $\delta^{88/86}$Sr values include $\delta^{88/86}$Sr = 0.31-0.38‰ for seawater (Halicz et al., 2008), $\delta^{88/86}$Sr = 0.40‰ for lake water, and $\delta^{88/86}$Sr = 0.25‰ for tap water (cited in Knudson et al., 2010:2354). Marine ecosystems show values of $\delta^{88/86}$Sr = 0.26 – 0.28‰ for bivalves (*Crassostrea virginica* shell and *Protothaca staminea* shell respectively), $\delta^{88/86}$Sr = 0.08‰ for large carnivorous fish (*Thunnus* sp., meat), and $\delta^{88/86}$Sr = -0.09‰ (*Scomber* sp., meat). In Andean terrestrial ecosystems, modern small herbivore bones (*Cava porcellus*, guinea pig) exhibit $\delta^{88/86}$Sr = -0.21 – -0.07‰ (n = 8), while modern large herbivores bones (*Lama glama*, *Bos Taurus*, *Caprinae*) exhibit $\delta^{88/86}$Sr = -0.44 – -0.21‰ (n = 3) (Knudson et al., 2010). Archaeological large herbivore bones (*Lama glama* or *Vicunga pacos*, camelids) show $\delta^{88/86}$Sr = -0.28 – 0.05‰ (n = 8), while an archaeological omnivore specimen (*Canis familiaris*, bone) shows $\delta^{88/86}$Sr = 0.08‰ (Knudson et al., 2010). Modern Andean land snail shells show $\delta^{88/86}$Sr = 0.04 – 0.24‰ (n = 5) (Knudson et al., 2010).

The application of stable strontium isotope analysis for paleodietary reconstruction in the Andes showed clear dietary patterns between Chiribaya Alta and other Chiribaya-affiliated sites (Knudson et al., 2010). Human stable strontium isotope data (bone and enamel) from Chiribaya-affiliated sites range from $\delta^{88/86}$Sr = -0.48 – 1.19‰ with a mean $\delta^{88/86}$Sr = -0.24 ± 0.25‰ (1σ, n = 58) (Knudson et al., 2010). The stable strontium isotope results were not affected by geochemical variation between different sites as observed through ^{87}Sr/^{86}Sr values. Regarding weaning, a general trend of lower values in pre-weaning elements with a mean value for first molars of $\delta^{88/86}$Sr = -0.39 ± 0.08‰ (1σ, n = 11), compared to higher values measured in post-weaning elements such as third molars that show mean $\delta^{88/86}Sr = -0.23 \pm 0.1‰$ (1σ, n = 1) and bone samples that show mean $\delta^{88/86}Sr = -0.25 \pm 0.21‰$ (1σ, n = 21) (Knudson et al., 2010). However, very low $\delta^{88/86}Sr$ values were observed in third molars and bone samples, indicating the need for further research in order to evaluate the weaning effect in stable strontium isotope analysis.

Overall, there is great potential for the investigation of paleodiet through stable strontium isotope analysis and future research regarding the application of the method is well warranted. One of the major advantages of this new methodology is that researchers can obtain both radiogenic $^{87}Sr/^{86}Sr$ values and $\delta^{88/86}Sr$ values from the same samples, thus minimizing destructive analysis of archaeological specimens. Furthermore, mass-dependent strontium isotope analysis not only can provide paleodietary information based on hydroxyapatite that is preserved more commonly than collagen, but also can trace directly the dietary origin of strontium into the human organism complementing, thus, paleomobility studies through radiogenic strontium isotope analysis.

Biogeochemistry in the Aegean

In the last two decades, biochemical analysis of human remains has been widely applied to archaeological studies for the reconstruction of past human behavior. Paleodietary studies in the Aegean go back to the work of J. Lawrence Angel who used elemental concentrations to reconstruct diet and health (Angel and Bisel, 1986; Bisel and Angel, 1985). Elemental analysis was also used to examine dietary patterns in EBA Manika on Euboea (Bartoli et al., 2001). The use of stable isotope analysis (carbon and nitrogen) for paelodietary reconstruction has seen a wide application in Greek bioarchaeology (e.g., Bourbou and Garvie-Lok, 2009; Bourbou and Richards, 2007; Bourbou et al., 2011, 2013; Garvie-Lok, 2001; Ingvarsson-Sundström et al., 2009; Lagia et al., 2007; Papathanasiou, 2003; Papathanasiou et al., 2009; Petroutsa, 2007; Petroutsa and Manolis, 2010; Petroutsa et al., 2007, 2009; Richards and Hedges, 2008; Richards and Vika, 2008; Triantaphyllou, 2001; Triantaphyllou et al., 2008; Vika, 2009; Vika et al., 2009). In contrast, isotopic studies for the identification of residential mobility in the Aegean based on radiogenic strontium (Nafplioti, 2007, 2008, 2009a,b, 2010, 2011; Richards et al., 2008) and stable oxygen isotope analyses (Garvie-Lok, 2009; Nafplioti, 2010) are a recent phenomenon. One study used $\delta^{34}S$ analysis in bone collagen to examine geographic origins in an Early Bronze Age mass burial in Thebes, central Greece (Vika, 2009). The existing geological and environmental variability in the area under study and the expected variation in the consumed food and water sources indicate great potential, both methodological and analytical, for the application of biogeochemistry and paleomobiilty research in prehistoric Aegean.

Overall, stable carbon and nitrogen isotope analysis on bone collagen in Neolithic and Bronze Age samples indicates consumption mainly of C_3 terrestrial plants, which in some cases includes a portion of C_4 plants and diets that seem to have been based on terrestrial protein (either directly through meat or through dairy products); inclusion of marine foods is shown to be scarce (Lagia et al., 2007; Papathanasiou, 2003; Papathanasiou et al., 2009; Petroutsa, 2007; Petroutsa et al., 2007; Petroutsa and Manolis, 2010; Petroutsa et al., 2009; Richards and Hedges, 2008; Richards and Vika, 2008;

Triantaphyllou, 2001; Triantaphyllou et al., 2008). Consumption of marine resources was identified for several individuals from the Grave Circles at Mycenae attributed to either Mycenaean diets shifting away from marine sources in later times or to consumption of marine diets only from the elites (Richards and Hedges, 2007). Regarding Early Bronze Age skeletal assemblages in particular that are relevant to this project, stable carbon and nitrogen isotope analysis has shown terrestrial diets with minor or no marine component for Thebes (Vika, 2009). In the EH ossuary of Perachora in coastal Corinthia, diet was based heavily on C_3 plants and terrestrial protein, while some individuals showed consumption of mixed terrestrial and low-trophic level marine resources (Petroutsa et al., 2007). Thus, an effect on strontium isotopic composition due to the consumption of marine foods is expected to be minimal or inexistent.

However, a recent analysis of archaeological fish bone collagen samples (n = 41) from different trophic levels indicates that Aegean fish show overall lower $\delta^{15}N$ than Atlantic fish, thereby emphasizing the importance of regional ecosystem studies (Vika and Theodoropoulou, 2012). Marine fish showed $\delta^{13}C$ = -15.13‰ − -10.11‰ (excluding a single low value of $\delta^{13}C$ = -19.20 ‰) and $\delta^{15}N$ = 6.10‰ – 11.61‰, euryhaline fish showed $\delta^{13}C$ = -19.57‰ − -7.30‰ and $\delta^{15}N$ = 3.56 ‰ and 12.12‰, and freshwater fish shoed $\delta^{13}C$ = -20.80‰ − -11.93‰ and $\delta^{15}N$ = 4.91‰ and 10.90‰ (Vika and Theodoropoulou, 2012:6). Thus, these results suggest that fish consumption in the Aegean based on comparisons with oceanic ecosystems might have been underestimated (Vika and Theodoropoulou, 2012).

As far as paleomobolity research is concerned, radiogenic strontium isotope analysis was applied to examine Neanderthal mobility in Lakonis, southern Peloponnese (Richards et al., 2008; see critique in Nowell and Horstwood, 2009). A Neanderthal third molar found in a cave site dated to 44,000 – 38,000 BP was incrementally sampled using laser ablation. The enamel samples from the third molar gave mean $^{87}Sr/^{86}Sr = 0.7106 \pm 0.0002$ (1σ, n = 9), while the dentine samples showed identical values of $^{87}Sr/^{86}Sr = 0.7089$ (n = 2). A deer specimen from the cave showed $^{87}Sr/^{86}Sr = 0.7126 \pm 0.0004$ (1σ, n = 4) for enamel, and $^{87}Sr/^{86}Sr = 0.7085 - 0.7086$ (n = 2) for the dentine. A rhino specimen from the cave showed $^{87}Sr/^{86}Sr = 0.7098 \pm 0.0003$ (1σ, n = 10) for the enamel, and $^{87}Sr/^{86}Sr = 0.7093 – 0.7094$ (n = 2) for the dentine. The $^{87}Sr/^{86}Sr$ values of the Neanderthal and deer dentine, and the rhino enamel and dentine reflect the local limestone $^{87}Sr/^{86}Sr$ signature, as would be expected due to post-depositional contamination. However, the Neanderthal enamel shows a non-local signal indicating residence in a different geochemical zone during tooth formation. The closest locale that could give this signature is at a 20 km distance and is composed of mid-Triassic porphyritic andesite. The deer enamel also exhibited non-local, high $^{87}Sr/^{86}Sr$ values, probably reflecting the same region.

Two rigorous, unpublished MA theses from the University of Alberta used radiogenic strontium isotope analysis to identify mobility in the Peloponnese. In thirteenth century AD Corinth human enamel samples gave $^{87}Sr/^{86}Sr = 0.70829 – 0.71004$ (n = 10) (Lê, 1006). Archaeological sheep/goat samples from the same site showed $^{87}Sr/^{86}Sr = 0.70852 – 0.70874$ (n = 5), while a soil sample gave $^{87}Sr/^{86}Sr =$

0.70884 (Lê, 1006). Following a thorough discussion for the determination of the local $^{87}Sr/^{86}Sr$ range, two of the ten analyzed individuals were identified as non-locals (Lê, 2006). Radiogenic strontium isotope analysis was used in the valley of Stymphalos in Corinthia (Leslie, 2012). Human enamel values from Late Roman/Early Byzantine Stymphalos (fourth – sixth centuries AD) showed $^{87}Sr/^{86}Sr$ = 0.70831 – 0.71224 (n = 15), while human enamel values from Late Medieval Zaraka (fourteenth – fifteenth centuries AD) showed $^{87}Sr/^{86}Sr$ = 0.70864 – 0.71122 (n = 5). Hellenistic (second century AD) faunal samples (sheep/goat and pig) ranged from $^{87}Sr/^{86}Sr$ = 0.70801 – 0.7096 and showed mean $^{87}Sr/^{86}Sr$ = 0.70881 ± 0.0007 (1σ, n = 5) (Leslie, 2012). Two Roman (first century AD) faunal samples (sheep/goat and pig) showed $^{87}Sr/^{86}Sr$ = 0.71490 – 0.72330 (n = 2) (Leslie, 2012). The $^{87}Sr/^{86}Sr$ values measured particularly in the Roman faunal samples are much higher than the $^{87}Sr/^{86}Sr$ signal expected for the valley that is composed mainly of limestone. Discussing the possibility of contamination and of a currently unknown source of higher $^{87}Sr/^{86}Sr$ values in the location under study, the author plausibly attributed the high faunal values to the mobility of the sampled animals and the transportation of livestock over long distances. Thus, accepting a local range that is generally in agreement with the local geology including the nearby coastal regions, three individuals were identified as non-locals (Leslie, 2012).

Most radiogenic strontium isotope analyses in the Aegean have been conducted by Nafplioti (2007, 2008, 2009a,b, 2010, 2011). Most of her work focused upon Late Bronze Age material (Nafplioti, 2007, 2008, 2009). Nafplioti (2007, 2008) used radiogenic strontium analysis to examine the presence of Mycenaean groups on the northern coast of Crete and test the theory of a Mycenaean domination on Late Minoan Knossos. According to Nafplioti (2008), the thirteen individuals analyzed from graves viewed as intrusive all showed values local to Knossos area, similar to local values exhibited by eighteen sampled individuals buried in MM graves in the area, predating the Mycenaean migration. Human enamel values from the Knossos area on central Crete showed $^{87}Sr/^{86}Sr$ = 0.70848 – 0.70923 with mean $^{87}Sr/^{86}Sr$ = 0.70899 ± 0.00014 (1σ, n = 30). Human bone values from the area showed $^{87}Sr/^{86}Sr$ = 0.70900 – 0.70904 and mean $^{87}Sr/^{86}Sr$ = 0.70903 ± 0.00002 (1σ, n = 3). Archaeological faunal samples from Knossos (pig, cow, sheep/goat) exhibited $^{87}Sr/^{86}Sr$ = 0.70853 – 0.70909 with mean $^{87}Sr/^{86}Sr$ = 0.70893 ± 0.00022 (1σ, n = 5). Modern snail samples from Knossos showed $^{87}Sr/^{86}Sr$ = 0.70895 – 0.70903 and mean $^{87}Sr/^{86}Sr$ = 0.70899 ± 0.00003 (1σ, n = 4). Thus, the identification of the analyzed individuals as exhibiting a $^{87}Sr/^{86}Sr$ signature local to the area is likely correct. However, it should be noted here that these values are very close to the seawater $^{87}Sr/^{86}Sr$ values corresponding not only to the local limestone bedrock, but also raises the possibility of marine food consumption. Nafplioti (2008) further concluded that none of the Knossos individuals could have come from Mycenae based on the values exhibited by land snail shell samples sampled from Mycenae. Snail shells from Mycenae showed $^{87}Sr/^{86}Sr$ = 0.70823 – 0.70833 and mean $^{87}Sr/^{86}Sr$ = 0.70827 ± 0.00004 (1σ, n = 4). The range for Mycenae given by the shells, however, is very close to the one observed for the Knossos baseline samples. Furthermore, the two locations show generally a similar underlying geology: the main geologic formation at Mycenae is Triassic – Lower Jurassic limestone, compared to the Mio-Pliocene marine deposits and Cretaceous and

Neogene limestone (Higgins and Higgins, 1996; IGME, 1983). Triassic – Jurassic limestone should exhibit ca. $^{87}Sr/^{86}Sr$ = 0.707 – 0.708 and Cretaceous and Cenozoic limestone should exhibit ca. $^{87}Sr/^{86}Sr$ = 0.707 – 0.709 (McArthur et al., 2012; Veizer, 1989). Thus, even though there can be some variation, the expected $^{87}Sr/^{86}Sr$ values for the two regions are similar, thus mobility between them might not be detectable through radiogenic strontium isotope ratios.

The low variation in $^{87}Sr/^{86}Sr$ isotopic compositions in these two regions is further exemplified by Nafplioti's (2009) later work on Grave Circle A at Mycenae. Human enamel samples from Mycenae showed $^{87}Sr/^{86}Sr$ = 0.70822 – 0.70882 and mean $^{87}Sr/^{86}Sr$ = 0.70856 ± 0.00019 (1σ, n = 11). An archaeological pig sample showed $^{87}Sr/^{86}Sr$ = 0.70808. Using as local range the average value of the four land snails ± 2σ, showing $^{87}Sr/^{86}Sr$ = 0.70818 – 070835, Nafplioti (2009) identified only two individuals as locals to Mycenae ($^{87}Sr/^{86}Sr$ = 0.70822 – 0.70826), and the other nine individuals showing $^{87}Sr/^{86}Sr$ = 0.70849 – 0.70882 as non-locals. Even though she acknowledged the possibility that the $^{87}Sr/^{86}Sr$ might reflect marine food consumption that has been identified in the same data set (Richards and Hedges, 2007), Nafplioti (2009) argued further that this pattern could represent post-marital residence patterns given that seven of the nine individuals were male. Hence, it becomes clear that the use of the fourth decimal point as an indicator for inter-regional $^{87}Sr/^{86}Sr$ differences, especially in areas with potential underlying geochemical and environmental similarities (e.g., distance from the coast), can highly over-represent the identification of non-local individuals. Furthermore, the use of snail shells are expected to show very narrow $^{87}Sr/^{86}Sr$ ranges that might not reflect the catchment area available to humans; thus very small differences should be treated with caution. It should also be noted that, as discussed previously, reporting $^{87}Sr/^{86}Sr$ values in the fifth decimal point is a standard practice.

Further work by Nafplioti (2007) on Bronze Age Crete has provided radiogenic strontium isotope data for a number of sites. On central Crete, human enamel samples from LM Episkopi showed $^{87}Sr/^{86}Sr$ = 0.70847 – 0.70907 and mean $^{87}Sr/^{86}Sr$ = 0.70867 ± 0.00035 (1σ, n = 3), while human enamel and human bone showed $^{87}Sr/^{86}Sr$ = 0.70910 (n = 1) and $^{87}Sr/^{86}Sr$ = 0.70915 (n = 1) from LM Maroulas (Nafplioti, 2007). On eastern Crete, human enamel samples exhibited $^{7}Sr/^{86}Sr$ = 0.70855 – 0.70893 and mean $^{87}Sr/^{86}Sr$ = 0.70875 ± 0.00013 (1σ, n = 6), and human bone samples exhibited $^{7}Sr/^{86}Sr$ = 0.70856 – 0.70886 (n = 2) from MM – LM Myrtos Pyrgos, while human enamel from EM – MM Palaikastro showed $^{7}Sr/^{86}Sr$ = 0.70911 (n = 1) (Nafplioti 2007). On western Crete, human enamel from LM Palama showed $^{7}Sr/^{86}Sr$ = 0.70892 – 0.70959 and mean $^{87}Sr/^{86}Sr$ = 0.70911 ± 0.00020 (1σ, n = 8), and human bone showed $^{7}Sr/^{86}Sr$ = 0.70902 – 0.70913 (n = 2) (Nafplioti, 2007). At LM Margarites, human enamel showed $^{7}Sr/^{86}Sr$ = 0.70898 – 0.70904 and mean $^{87}Sr/^{86}Sr$ = 0.70900 ± 0.00003 (1σ, n = 3), and human bone showed $^{7}Sr/^{86}Sr$ = 0.70908 (n = 1). Finally, at LM Kastelos human enamel samples showed $^{7}Sr/^{86}Sr$ = 0.70901 – 0.70905 and mean $^{87}Sr/^{86}Sr$ = 0.70904 ± 0.00002 (1σ, n = 3) (Nafplioti, 2007).

Nafplioti (2007) also used radiogenic strontium isotope analysis to examine the archaeological hypothesis of Mycenaean groups moving to Naxos island, that she also rejected. On Naxos island, at the LBA Aplomata cemetery human enamel showed

$^{87}Sr/^{86}Sr$ = 0.70904 – 0.71047 and mean $^{87}Sr/^{86}Sr$ = 0.70958 ± 0.00062 (1σ, n = 4), while human bone showed $^{87}Sr/^{86}Sr$ = 0.70943 – 0.70968 (n = 2); human enamel samples from EC Aplomata graves exhibited $^{87}Sr/^{86}Sr$ = 0.70941 – 0.70945 (n = 2) (Nafplioti, 2007). At the LBA Kamini, human enamel showed $^{87}Sr/^{86}Sr$ = 0.70943 – 0.70947 and mean $^{87}Sr/^{86}Sr$ = 0.70945 ±0.00002 (1σ, n = 3) and human bone showed $^{87}Sr/^{86}Sr$ = 0.70954 (Nafplioti, 2007). At LBA Tsikniades, human enamel samples showed $^{87}Sr/^{86}Sr$ = 0.70902 – 0.70951 and mean $^{87}Sr/^{86}Sr$ = 0.70930 ± 0.00018 (1σ, n = 5), while human bone from the site showed $^{87}Sr/^{86}Sr$ = 0.70949 (n = 1) (Nafplioti, 2007). Archaeological faunal enamel samples from the Chora of Naxos (northeastern island) showed $^{87}Sr/^{86}Sr$ = 0.70945 (cow) – 0.71004 (pig) (Nafplioti, 2007).

At the Mesolithic site of Maroulas on the island of Kythnos, human enamel samples showed $^{87}Sr/^{86}Sr$ = 0.70886 – 0.70918 and mean $^{87}Sr/^{86}Sr$ = 0.70904 ±0.00012 (1σ, n = 8) (Nafplioti, 2010). Five archaeological faunal samples were used to determine the local range (average ± 2σ) at $^{87}Sr/^{86}Sr$ = 0.70908 – 0.70922. The human samples fall well within the local range or are very close to the lower limit suggesting a local origin. Using comparative baseline samples, Nafplioti (2010) rightfully noted that Kythnos, Keos, and eastern Attica show similar $^{87}Sr/^{86}Sr$ values reflecting the common underlying geology.

Overall, the available human enamel values for Bronze Age skeletal samples from Crete, Naxos, and the Argolid (Mycenae) show $^{87}Sr/^{86}Sr$ = 0.70822 – 0.71047 and mean $^{87}Sr/^{86}Sr$ = 0.70900 ± 0.00033 (1σ, n = 80) (using data from Nafplioti, 2007, 2008, 2009). When the single high value of $^{87}Sr/^{86}Sr$ = 0.71047 measured in human enamel from LBA

Aplomata cemetery on Naxos is excluded, the rest of the Bronze Age human enamel values show $^{87}Sr/^{86}Sr = 0.70822 – 0.70959$ and mean $^{87}Sr/^{86}Sr = 0.70898 \pm 0.00028$ (1σ, n = 79). Admittedly, the variation in the observed $^{87}Sr/^{86}Sr$ isotopic compositions after the exclusion of the high value is relatively low. This could result from a general similarity in the underlying geology of the sampled regions, mainly limestone and marine sediments with the exception of Naxos that includes older granites that are expected to show higher $^{87}Sr/^{86}Sr$ values, illustrated also in an archaeological pig enamel value of $^{87}Sr/^{86}Sr = 0.71004$ (Nafplioti 2007, 2011). In addition, the majority of the measured values are close to the $^{87}Sr/^{86}Sr$ ratio expected for seawater ($^{87}Sr/^{86}Sr = 0.7092$) that could reflect consumption of marine resources (and/or sea salt), as well as a sea spray effect given the coastal location of many of the sampled sites (as has been noted for other coastal locations, e.g., Knudson et al., 2012). A similar trend is observed in the Mesolithic human $^{87}Sr/^{86}Sr$ values from Kythnos island that range from $^{87}Sr/^{86}Sr = 0.70886 – 0.70918$ (n = 9) (data from Nafplioti, 2010). Thus, it becomes clear that the discrimination of locally bioavailable $^{87}Sr/^{86}Sr$ ranges for the identification of paleomobility in the Aegean needs careful consideration and needs to be conservative in areas with values clustering around ca. $^{87}Sr/^{86}Sr = 0.708 – 0.709$. By the same token, the use of the fourth decimal place as a cutoff for $^{87}Sr/^{86}Sr$ local baselines is not appropriate for this area as it can highly overestimate the identification of non-local individuals (cf. Nafplioti, 2007, 2008, 2009). However, the overall geological variation across the Aegean still suggests great potential for the application of $^{87}Sr/^{86}Sr$ analysis. This is exemplified by the high $^{87}Sr/^{86}Sr$ isotopic signatures observed on Naxos island, as well as in the high $^{87}Sr/^{86}Sr$ values observed in archaeological human and faunal samples from historic Corinth and Stymphalos (Lê, 2006; Leslie, 2012). The future Aegean paleomobility studies require further, detailed sampling of a variety of archaeological and modern samples to establish the locally bioavailable $^{87}Sr/^{86}Sr$ values for different Aegean regions. In this, the work by Nafplioti (2011) using archaeological fauna and human bone, and modern snails is an excellent beginning and will be discussed in the next section.

Physical and Geological Setting for the Study Area

Despite the small surface area (approximately 132,000 km^2), Greece and the Aegean region show remarkable topographic diversity, with a high and steep relief, and a very indented coastline[241]. Greece is a narrow peninsula with 72% of the land within 40 km (25 miles) from the sea, while no distance is greater than approximately 160 km (100 miles) from the sea (Anastassiades, 1949; Bintliff, 1977). At the same time, and despite its strong maritime character, Greece is mountainous, with only one-third of the country being less than 210 m high (700 ft.) (Anastassiades, 1949). The highest mountain is Mount Olympus in northern Greece, with the highest peak at 2911m (9,550 ft.); the highest point on the Cyclades is Mount Zas on Naxos, 1,010 m above sea level. The Pindus mountain range runs across the center of the mainland on a northwest-to-southeast axis, which continues in the Peloponnese, roughly dividing the country in western and eastern halves. The regional differentiation between eastern and western Greece is further augmented by the differences between the Aegean Sea (associated with the former) and the Ionian Sea (associated with the latter). As an example, only a few small parts of the Aegean Sea are deeper than 1000 m (in the Cretan Basin and the North Aegean Trough); on the contrary, in the Ionian Sea, water depths exceeding 4000 m are found in the Hellenic Trench (Pe-Piper and Piper, 2002). The diverse topography and microclimatic variability have played a major role in the development of regional differences throughout Aegean history and prehistory (e.g., settlement patterns, land use, economy), particularly between western and eastern Greece, northern and southern Greece, and of course the mainland and islands.

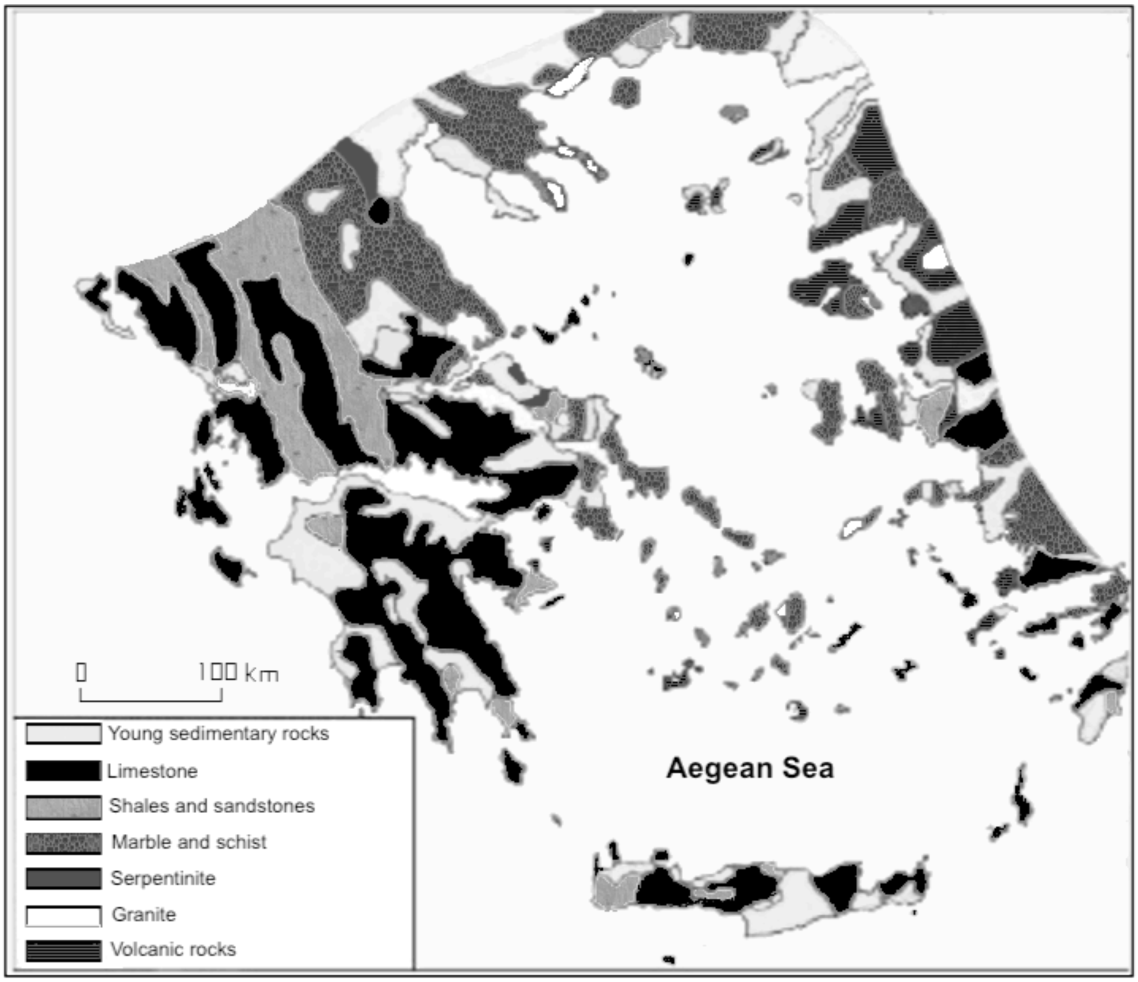

Figure 6.1. Simplified geologic map of the Aegean region (modified after Higgins, 2009:393, Fig. 2).

Since the Miocene, the microplate of the Aegean has been one of the most rapidly extending areas of continental crust in the world, with the southern Aegean moving southwestward relatively to Eurasia (Jackson, 1994; Pe-Piper and Piper, 2001). Thus, Greece is also characterized by high seismicity, and even though volcanic activity is neither widespread nor frequent, it had major impacts on both landscape and human activities (e.g., Theran eruption). Furthermore, the complex collisional orogeny in Greece is a result of the convergence of the African and Eurasian plates throughout late Mesozoic and Cenozoic time; the present Hellenic subduction zone and South Aegean island arc mark the subduction of the African beneath the Eurasian plate (Pe-Piper and Piper, 2001). With reference to the geomorphology of the region under study, Attica, Cyclades, Thessaly, and western Macedonian mountains belong to the Pelagonian ridge, which shows a major NW-SE depression as the Plain of Thessaly-Volos Bay, continuing as a gulf separating Euboea from the mainland and into the submerged Cycladic island zone (Bintliff, 1977; Higgins and Higgins, 1996). The Cycladic islands are formed by the peaks of the former Alpine mountains of the Pelagonian ridge surrounded by a vast submerged zone, the southern Aegean Sea, forming the Attic-Cycladic metamorphic belt (Bintliff, 1977; Higgins and Higgins, 1996). In particular, the Cyclades are formed by the exposed heights of two ridges extending out from the Greek mainland: the southwestern ridge is a prolongation of the Attic peninsula (Kea, Kythnos, Seriphos, Siphnos, Kimolos, Melos, Folegandros, and Sikinos), while the northeastern crest is an extension of the island of Euboea (Andros, Tinos, Mykonos, Delos, Syros, Paros, Naxos, Amorgos, and Ios), the two merging at their southern end (Santorini, Anaphi).

The long and complex geologic history characterized by high seismicity, tectonic activity, volcanism, and metamorphism that resulted in a wide variety of geologic formations in Greece and the Aegean region. The most common formations in Greece are Triassic and Jurassic limestone (e.g., Pelagonian zone, Sub-Pelagonian zone, Parnassos zone), marble (e.g., Attic-Cycladic metamorphic zone), schist, and gneiss (Higgins 2009;

Higgins and Higgins, 1996) (Fig. 6.1). Greece is covered mainly by soils produced by the weathering of limestone and marble (e.g., terra rossa of hard limestone origin, rendzina of soft limestone origin), alluvial soils, and beach-rock (Anastassiades, 1949; Higgins and Higgins, 1996). Additionally, the southern Aegean and Ionean belts are covered by dry Mediterranean forest soils, either alkaline or acidic, while the soils in the northern belt and the mountainous parts of central and southern Greece are acidic chestnut and gray forest soils, formed by non-calcareous parent materials (Anastassiades, 1949).

Greece is divided in geotectonic zones based on geological and seismo-tectonic history (Fig. 2). Here, I provide a brief description of the geological composition of each zone following Higgins and Higgins (1996) and IGME (1983). The Pelagonian Zone forms a major part of continental Greece and consists mainly of Upper Cretaceous and Triassic limestone, including areas of Paleozoic to Triassic gneiss, schist, and amphibolites (central Greece, north of Larissa; northern Greece at Mt. Vernon, Florina/Kastoria). Lacustrine and terrestrial deposits of conglomerates, sand, marls, and clays occur in northern Euboea and eastern Boeotia. The northern and central part of the Pindus Zone consists mainly of flysch, while the southern part (including Crete) consists of Upper Cretaceous limestones (mainly biomicrites) –and Jurassic limestone. The northern part of the Gavrovo Zone consists of flysch, Paleocene to Middle Eocene limestone and Cretaceous limestone that continue to the western Peloponnese; on Crete, it consists mainly of Upper Triassic - Jurassic limestone and dolomites. Permian-Triassic phyllites also occur on Crete, in some cases with patches of gypsum.

The Ionian Zone at western Greece, consists mainly of flysch with subsections of Upper Cretaceous limestone (at the Parga area), Paleocene – Upper Eocene limestone at the north (Mt. Tyrfi). The Ionian island of Corfu is composed mainly of Triassic breccias (central part), Triassic and Jurassic limestone (northern part) and Neogene lacustrine and marine deposits. Northwestern Peloponnese (Elis) is composed mainly of alluvial and Pliocene marine deposits. Cephalonia and Zayknthos islands are composed mainly of Upper Cretaceous limestone. The Parnassos-Giona Zone consists mainly of Upper and Lower Cretaceous limestone, Jurassic limestone, and flysch.

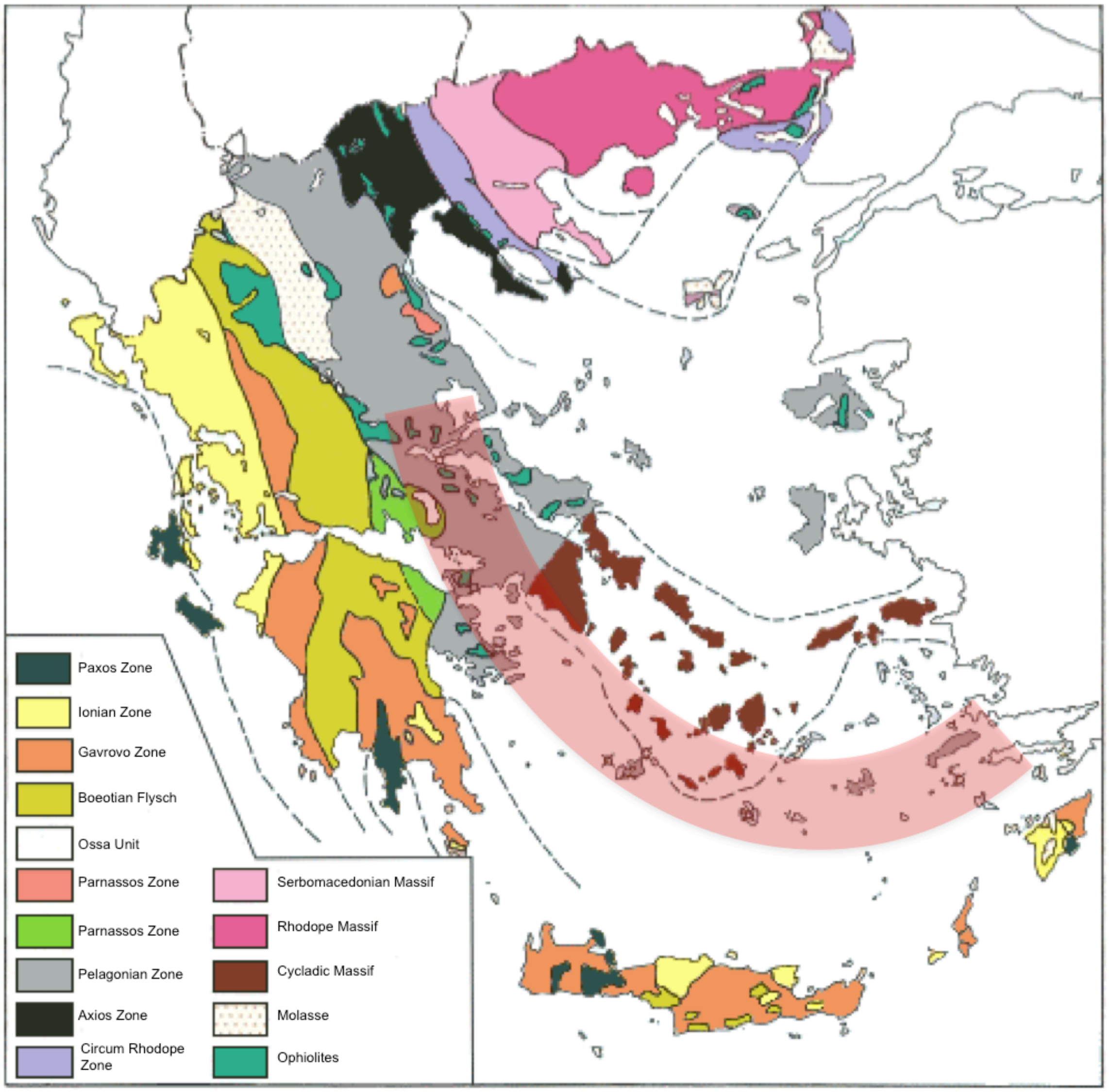

Figure 6.2. Map of Greece showing the geotectonic zones of the Aegean region (modified after IGME, 1983). The light red arc marks the Hellenic Volcanic Arc (after Ninkovich and Hays, 1972).

Turning to northern Greece, the Axios Zone consists mainly of alluvial deposits (Thessaloniki region), Upper Cretaceous limestone, and Upper Miocene – Pliocene lacustrine and terrestrial deposits (eastern Chalkidiki). Central Chalkidiki is composed mainly of Triassic – Jurassic schist, sandstone, marble or quartzite, phyllite, diabase, and limestone, Mesozoic igneous rocks (granites, granodiorites, and monzonites) at the central and eastern leg. Northern Macedonia and Rhodope are composed mainly of amphibolite and gneiss. Paleozoic igneous rocks occur at the north and northeast of Nestos River. Marbles occur along Rhodope and on the island of Thasos. Ophiolites occur in smaller patches in northern Greece (Mt. Smolikas, Pindus Mountain Range, Epirus), to the northwest of Lamia, in northern Euboea, and on Lesvos island.

The Cycladic Zone consists mainly of marble, dolomite, limestone, and schist. The Cycladic islands are composed mainly of marbles, gneisses, schists, amphibolites, and limestones. Triassic granites, granodiorites, and monzonites occur in Seriphos, northeastern Tenos, Mykonos, Delos, as well as on western Ikaria. Plio-Pleistocene volcanic rocks (rhyolites, rhyodacites, dacites, andesites, trachytes and/or tuffs) occur on southern Antiparos, Kimolos, Polyegos, Antimelos, Melos (also Quaternary), and Santorini. Mio-Pliocene and Quaternary volcanic rocks occur on Patmos, southern Kos, Nisyros, Aghios Efstratios, Lemnos and Lesvos. Quaternary volcanic rocks occur in the Methana peninsula and Aegina island. Quaternary volcanic activity forms the Hellenic Volcanic Arc, extending from Thebes and Thessaly, but mainly from the Saronic Gulf (including Susaki in Corinthia, Methana, and Aegina) to the northwest, south to the islands of Melos and Santorini, to the islands of Kos and Nisyros to the southeast

(Francalanci et al., 2005; Ninkovich and Hays, 1972; Pe, 1975; Pe-Piper and Piper, 2005).

Attica that forms the core of this study consists mainly of marble, dolomite, and schist (Fig. 6.3). The northwestern border of Attica including Mt. Aigaleo and Mt. Parnes consists of Triassic – Jurassic limestones of the Pelagonian zone, similar to the ones found in Boeotia, Thessaly, AND central Euboea (Higgins and Higgins, 1996; IGME, 1983). Athens schist forms the top layers of a series of schists, cherts, ophiolites, and Cretaceous to Eocene limestones and flysch (Higgins and Higgins, 1996:26). The southern and eastern part of Attica, including Mt. Hymettus, Mt. Penteli, and the areas of Marathon and Lavrion, consist of Jurassic schist-chert formations and sandstones, and marbles similar to the ones in the Cycladic metamorphic belt (IGME, 1983). The Attic basins were filled with Plio-Pleistocene lacustrine and terrestrial deposits including conglomarates, sandstones, clays, and marls (IGME, 1983). The Marathon plain consists mainly of Holocene alluvial deposits and sandstone (coastal zone), Triassic and Cretaceous limestone and marbles, and schist (Seni et al., 2004; IGME, 1983).

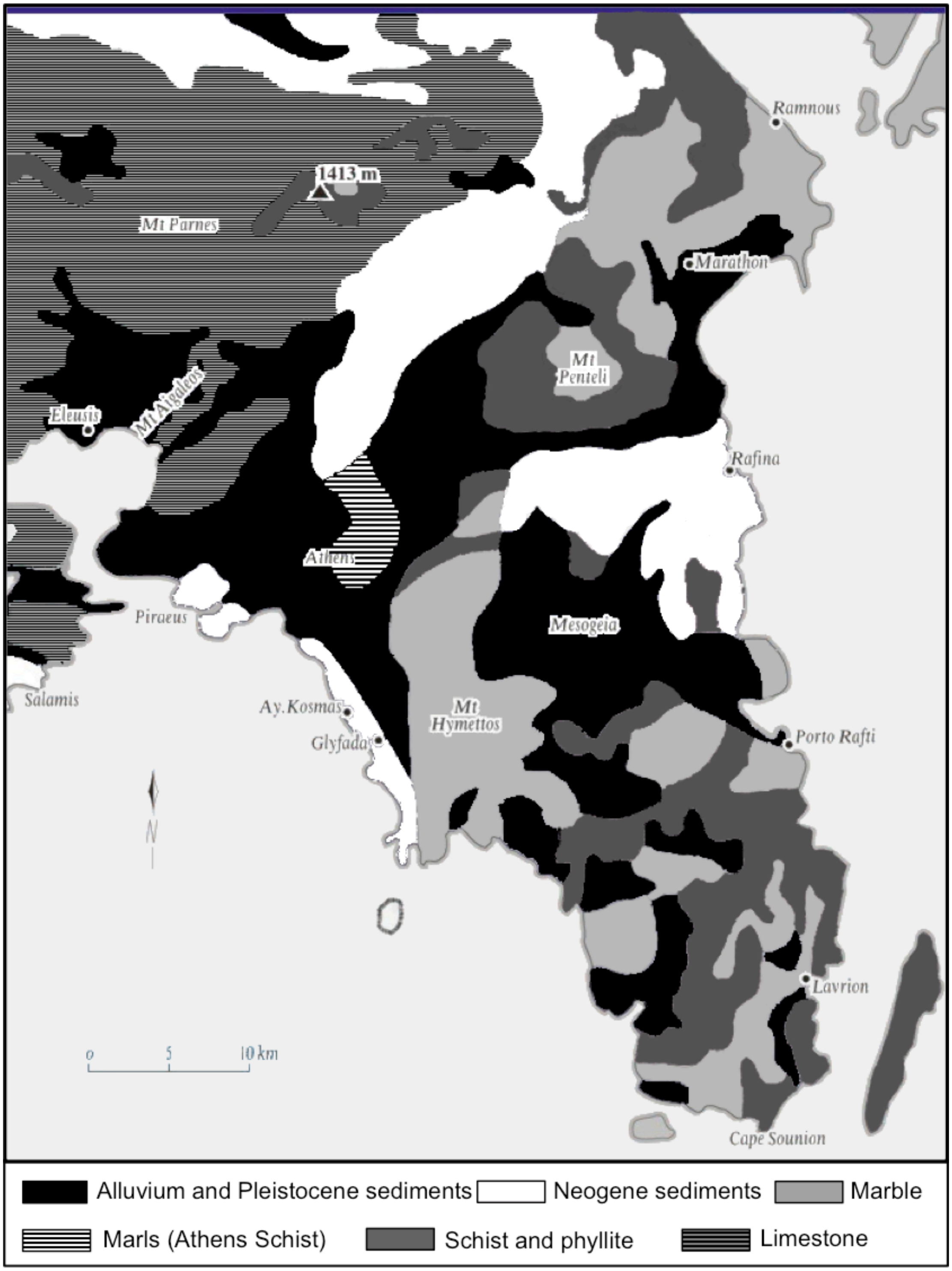

Figure 6.3. Geologic map of Attica (modified after Higgins and Higgins, 1996:27, Fig. 3.1).

Geochemical Setting

Significant geochemical work has taken place in the Aegean, mostly on igneous rocks, that can provide us with rich $^{87}Sr/^{86}Sr$ datasets for different bedrock formations from various locations. In northern Greece, biotite granodiorite samples from Sithonia in Chalkidiki showed $^{87}Sr/^{86}Sr$ = 0.70620, while granites from Rhodope (northeastern Greece) showed $^{87}Sr/^{86}Sr$ = 0.70691 – 0.70692 (Juteau et al., 1986). Whole-rock samples granites of the Vardar Zone (Fig. 6.2) show $^{87}Sr/^{86}Sr$ = 0.71237 – 0.71241 (at Fanos), $^{87}Sr/^{86}Sr$ = 0.72602 (at Platania), while from the same zone gneiss shows $^{87}Sr/^{86}Sr$ = 0.71877 (at Pigi) and mylonite shows $^{87}Sr/^{86}Sr$ = 0.73509 (at Skra) (Anders et al., 2005); one rhyolite samples shows $^{87}Sr/^{86}Sr$ = 0.705328 (at Mikro Dassos) (Anders et al., 2005). In Thrace, tertiary granitoid intrusive formations showed $^{87}Sr/^{86}Sr$ = 0.70633 – 0.70835 (Del Moro et al., 1988). In the northeastern Aegean, on Lesvos island Lower Miocene shoshonite show $^{87}Sr/^{86}Sr$ = 0.7086 (n = 1, whole rock analysis) (Pe-Piper and Piper, 1992, 2001).

In central Aegean, whole-rock Middle Miocene adakites at central and eastern Euboea showed $^{87}Sr/^{86}Sr$ = 0.7095-0.7097 (n=4, andesites and dacites) (Pe-Piper and Piper, 2001), while shoshonites from the Euboecos showed $^{87}Sr/^{86}Sr$ = 0.7086 – 0.7098 (n = 4) (Pe and Glendhill, 1975; Pe-Piper and Piper, 2001). Unmetamorphosed limestones from northern and central Euboea exhibited $^{87}Sr/^{86}Sr$ = 0.70712 – 0.70756 (Late Cretaceous at Psachna), $^{87}Sr/^{86}Sr$ = 0.70649 – 0.70684 (Late Jurassic at Prokopion), $^{87}Sr/^{86}Sr$ = 0.70698 – 0.70804 (Late Triassic at Steni Dirphyos), $^{87}Sr/^{86}Sr$ = 0.70737 – 0.70770 (Permian, at Aidypsos) (Tremba et al., 1975). In southern Euboea, marbles showed $^{87}Sr/^{86}Sr$ = 0.70758 – 0.70877 (Late Cretaceous) and $^{87}Sr/^{86}Sr$ = 0.70671 – 0.70822 (Triassic – Jurassic) (Tremba et al., 1975). In Attica, white marbles from the Classical quarries at Mt. Penteli in Attica (Pentelikon marble) showed mean $^{87}Sr/^{86}Sr$ = 0.70824 ± 0.0003 (1σ, n = 25), and mean $^{87}Sr/^{86}Sr$ = 0.70738 ± 0.0002 (1σ, n = 17) at Mt. Hymettus (Brilli et al., 2005). Available data from Classical marble quarries also exist for eastern Naxos that showed mean $^{87}Sr/^{86}Sr$ = 0.70789 ± 0.0002 (1σ, n = 20), for Paros that showed mean $^{87}Sr/^{86}Sr$ = 0.70748 ± 0.0003 (1σ, n = 29), and for Thasos that showed mean $^{87}Sr/^{86}Sr$ = 0.70773 ± 0.0002 (1σ, n = 48) (Brilli et al., 2005). Higher $^{87}Sr/^{86}Sr$ values were reported for Lavrion, where Miocene granitoids showed $^{87}Sr/^{86}Sr$ = 0.71058 (n = 1) (Altherr et al., 1988) and biotite granodiorite showed $^{87}Sr/^{86}Sr$ = 0.71041 (Juteau et al., 1986).

On Skyros island, Middle Miocene andesites showed $^{87}Sr/^{86}Sr$ = 0.70886 – 0.70888 (n = 2) (Pe-Piper and Piper, 2001). On Samos island, Minor Upper Miocene-Quaternary granitoid rocks (western Samos) showed $^{87}Sr/^{86}Sr$ = 0.70605 – 0.70716 (Mezger et al., 1985), while mafic volcanic rocks, part of the Bodrum Volcanic Complex, show $^{87}Sr/^{86}Sr$ = 0.7059 – 0.7066 (n = 2) (Robert et al., 1992). Whole-rock samples from Miocene granitoids on Samos showed $^{87}Sr/^{86}Sr$ = 0.70605 – 0.70716 with a mean $^{87}Sr/^{86}Sr$ = 0.70655 ± 0.0005 (1σ, n = 12) (Altherr et al., 1988). Miocene granitoids on Ikaria island showed $^{87}Sr/^{86}Sr$ = 0.71295 – 0.71595 (Altherr et al., 1988; see also Altherr and Siebel, 2002).

Turning to the Cyclades, Syros exhibited low $^{87}Sr/^{86}Sr$ values where metamorphosed rock samples (metabasites) showed $^{87}Sr/^{86}Sr$ = 0.70317 – 0.70460 (n = 9)

(Seck et al., 1996). The Miocene granitoids that occur in several of the Cycladic islands generally show higher $^{87}Sr/^{86}Sr$ signatures of $^{87}Sr/^{86}Sr$ = 0.70922 – 0.71198 on Seriphos and $^{87}Sr/^{86}Sr$ = 0.70598 – 0.71266 with a mean $^{87}Sr/^{86}Sr$ = 0.71032 ± 0.002 (1σ, n = 8) on Mykonos (Altherr and Siebel, 2002; Altherr et al., 1988). On Tinos island, Miocene granitoids showed $^{87}Sr/^{86}Sr$ = 0.71180 – 0.71216 and mean $^{87}Sr/^{86}Sr$ = 0.71198 ± 0.0002 (1σ, n = 4) (Altherr et al., 1988). Available geochemical data also exist for the phyllite, seprentinites, and amphibolite-facies rocks on Tinos. A phyllite sample (whole-rock) from the northeastern part (Kleftovouni) showed $^{87}Sr/^{86}Sr$ = 0.71850, while phyllite whole-rock samples around the Tinos Chora (Stavros) at the southeastern part, showed $^{87}Sr/^{86}Sr$ = 0.70373 – 0.70565 (Bröcker and Franz, 1998). Schist samples from various locations throughout Tinos (Blueschist and Greenschist of the Intermediate Unit that occurs widely on the island) showed $^{87}Sr/^{86}Sr$ = 0.70459 – 0.72562, schist of the Basal Unit from Panormos (northwestern island) showed $^{87}Sr/^{86}Sr$ = 0.70842, and leukogranite whole-rock samples showed $^{87}Sr/^{86}Sr$ = 0.71877 – 0.72590 (eastern part, close to Falatados) (Bröcker and Franz, 1998). Thus, a wide range of $^{87}Sr/^{86}Sr$ ratio is reported for Tinos. On Andros, chlorite schist (from the western part of the island) showed $^{87}Sr/^{86}Sr$ = 0.70796, while mica schist samples showed $^{87}Sr/^{86}Sr$ = 0.70761 – 0.70948, greenschist showed $^{87}Sr/^{86}Sr$ = 0.70774, meta-acidite samples showed $^{87}Sr/^{86}Sr$ = 0.70627 – 0.70727, and calcschist showed $^{87}Sr/^{86}Sr$ = 0.70894 (Bröcker and Franz, 2006).

Naxos island is basically composed of a metamorphic complex (mainly mica schists and marbles) and a granodioritic mass (Andriessen et al., 1979) and showed generally high $^{87}Sr/^{86}Sr$ values. A whole-rock sample of schist (metavolcanic layer) from the southeastern tip of Naxos showed $^{87}Sr/^{86}Sr = 0.70930$ (Andriessen et al., 1979). Whole-rock granite samples from northern Naxos show a range of $^{87}Sr/^{86}Sr = 0.71418 – 0.72282$ with a mean $^{87}Sr/^{86}Sr = 0.71600 \pm 0.003$ (1σ, n = 9) (Andriessen et al., 1979). Granodiorite samples from the western part of the Naxos island exhibited a range of $^{87}Sr/^{86}Sr = 0.71056 – 0.71724$ and mean $^{87}Sr/^{86}Sr = 0.71231 \pm 0.003$ (1σ, n = 21) (Andriessen et al., 1979). Miocene granitoids from the island showed $^{87}Sr/^{86}Sr = 0.710820 – 0.710890$ (Altherr and Siebel, 2002; Altherr et al., 1988). Whole-rock samples of granodiorite from Ios island also showed high values of $^{87}Sr/^{86}Sr = 0.71183 – 0.71721$ (Henjes-Kunst and Kreuzer, 1982).

At the northwestern part of the Hellenic Volcanic Arc (Fig. 6.2), two groups are distinguished geochemically, the southern group of the Saronic Gulf showing generally lower $^{87}Sr/^{86}Sr$ values and the northern group around the Volos area that shows generally higher $^{87}Sr/^{86}Sr$ values, with the exception of a single sample from Isthmus (Sousaki area) that shows a very high value ($^{87}Sr/^{86}Sr = 0.7134$) (Pe and Glendhill, 1975). Volcanic rocks at the Saronic Gulf show $^{87}Sr/^{86}Sr = 0.7058 – 0.7074$ on Poros island (Francalanci et al., 2005; Pe and Glendhill, 1975), mean $^{87}Sr/^{86}Sr = 0.70584 \pm 0.001$ (1σ, n = 5) (Pe and Glendhill, 1975) with a range between $^{87}Sr/^{86}Sr = 0.704 – 0.7067$ (Francalanci et al., 2005) on Aegina island, and mean $^{87}Sr/^{86}Sr = 0.70613 \pm 0.0004$ (1σ, n = 4) (Pe, 1975) ranging between $^{87}Sr/^{86}Sr = 0.7057 – 0.7066$ (Francalanci et al., 2005) on the Methana peninsula. Samples from the northern part show $^{87}Sr/^{86}Sr = 0.7089$ at Aghios Ioannis, $^{87}Sr/^{86}Sr = 0.7091$ at Porphyrion, $^{87}Sr/^{86}Sr = 0.7098$ at Achilleion, and $^{87}Sr/^{86}Sr = 0.7056$

at Likhades (Pe and Glendhill, 1975). At the eastern part of the Arc, volcanic rocks on the Nisyros island show a range of $^{87}Sr/^{86}Sr$ = 0.7037 – 0.7050 (Pe and Glendhill, 1975).

A wide range of $^{87}Sr/^{86}Sr$ values has been published for Santorini. Volcanic rocks on Santorini showed $^{87}Sr/^{86}Sr$ = 0.704 – 0.708 with a mean value of $^{87}Sr/^{86}Sr$ = 0.70532 ±0.0005 (1σ, n = 6) (Pe and Glendhill, 1975). Phyllitic schist from Athinios harbor (central part) showed $^{87}Sr/^{86}Sr$ = 0.713, limestone (marble) from Prophitis Elias (northern part) showed $^{87}Sr/^{86}Sr$ = 0.7074; volcanic rocks from Santorini, Nea and Palaia Kammeni islands rangd from $^{87}Sr/^{86}Sr$ = 0.704 – 0.708 (n = 8) (Puchelt and Hoefs, 1971). Very high strontium isotopic compositions for volcanic rocks from Santorini, Nea and Palaia Kammeni islands were also reported ranging from $^{87}Sr/^{86}Sr$ = 0.713 – 0.736 (n = 5) and were attributed to ^{87}Sr contamination due to contact with older sediments or acid igneous rocks (Pichler and Kußmaul, 1972; Puchelt and Hoefs, 1971; cf. Barton et al., 1983; Pe and Glendhill, 1975). Fresh lavas (basalts – dacites) from the island showed a lower range of $^{87}Sr/^{86}Sr$ = 0.70472 – 0.70509 with mean $^{87}Sr/^{86}Sr$ = 0.70494 ± 0.00011 (1σ, n = 19), while fresh lavas from Melos island (dacites – rhyolites) exhibited a range of $^{87}Sr/^{86}Sr$ = 0.70540 – 0.70620 (n = 7) (Barton et al., 1983). Altered lavas from Santorini showed a range of $^{87}Sr/^{86}Sr$ = 0.70531 – 0.70573, whereas altered lavas from Melos exhibited a higher range of $^{87}Sr/^{86}Sr$ = 0.70653 – 0.70662 (Barton et al., 1983). Additional geochemical studies on recent Santorini lavas gave $^{87}Sr/^{86}Sr$ = 0.7040 – 0.7053 for Skaros and $^{87}Sr/^{86}Sr$ = 0.7046 – 0.7050 for Nea Kammeni (Briqueu et al., 1986). Lavas from Melos exhibited $^{87}Sr/^{86}Sr$ = 0.70412 – 0.70713 (Briqueu et al., 1986). A more narrow range was observed in the volcanic rocks (basalts and mostly rhyolites) on Kimolos and Polyegos islands, $^{87}Sr/^{86}Sr$ = 0.70456 – 0.70638 (Francalanci et al., 2007). A whole-rock analysis from a volcanic series on Patmos island showed $^{87}Sr/^{86}Sr$ = 0.70489 (Wyers and Barton, 1987). Dacites from Kos showed a ratio of $^{87}Sr/^{86}Sr$ = 0.7042 (cited in Francalanci et al., 2005). Granitoid formations from Kos showed $^{87}Sr/^{86}Sr$ = 0.70678 (Juteau et al., 1986) and $^{87}Sr/^{86}Sr$ = 0.70440 – 0.70737 and mean $^{87}Sr/^{86}Sr$ = 0.70638 ± 0.0009 (1σ, n = 14; Miocene formations) (Altherr et al., 1988).

As a final note, a brief overview of Asia Minor values follows (coast of western Turkey) (Fig. 6.1). At Bergama (Pergamon) at the north, Pliocene andesites showed $^{87}Sr/^{86}Sr$ = 0.70563 – 0.70770 and other Pliocene calc-alkaline rocks (dacite, trachyandesite, rhyolite) showed $^{87}Sr/^{86}Sr$ = 0.70752 – 0.70914, while Pliocene alkaline rocks showed $^{87}Sr/^{86}Sr$ = 0.70774 (Güleç, 1991). At Izmir (Smyrna), Miocene andesites showed $^{87}Sr/^{86}Sr$ = 0.70863 – 0.70879 (Güleç, 1991). Further inland, At Bigadiç, Pliocene andesites showed $^{87}Sr/^{86}Sr$ = 0.70704 and Miocene andesites showed $^{87}Sr/^{86}Sr$ = 0.70706 – 0.70864. At Simav, Pliocene trachandesites showed $^{87}Sr/^{86}Sr$ = 0.70792 and Pliocene dacites showed $^{87}Sr/^{86}Sr$ = 0.70847, while Miocene dacites and rhyolites showed $^{87}Sr/^{86}Sr$ = 0.70802 − 0.70948. Miocene trachyandesite from Gördes showed $^{87}Sr/^{86}Sr$ = 0.70799, and Quaternary alkaline volcanic rocks at Kula showed $^{87}Sr/^{86}Sr$ = 0.70313 – 0.70353 (Gülaç, 1991). To the south, at Söke Pliocene andesites showed $^{87}Sr/^{86}Sr$ = 0.70501, while Miocene andesites showed $^{87}Sr/^{86}Sr$ = 0.70670 and Miocene dacites showed $^{87}Sr/^{86}Sr$ = 0.70953 (Güleç, 1991). At Denizli, Pliocene trachyandesites showed $^{87}Sr/^{86}Sr$ = 0.70363, while Pliocene andesites showed $^{87}Sr/^{86}Sr$ = 0.70866 (Güleç, 1991). At Bodrum, on the southern coast across Samos, Miocene alkaline rocks at Bodrum showed $^{87}Sr/^{86}Sr = 0.07353$, while Miocene calc-alkaline rocks showed $^{87}Sr/^{86}Sr = 0.70716 – 0.70747$ (Güleç, 1991); a latite sample showed $^{87}Sr/^{86}Sr = 0.705$ (Pe and Glendhill, 1975) and granite samples showed $^{87}Sr/^{86}Sr = 0.70596$ (Juteau et al., 1986).

The observed geological and geochemical variability in Greece thus justify the application of radiogenic strontium isotope analysis for the examination of paleomobility in the Aegean region. Using the local geological compositions as a starting point (IGME, 1983), as well as published geochemical studies, significantly lower $^{87}Sr/^{86}Sr$ values (< 0.707, mainly ranging from 0.703 – 0.706) are expected for regions in the Hellenic Volcanic Arc, comprised of volcanic rocks and recent lavas, including the peninsula of Methana and the island of Aegina in the Saronic Gulf (Pe, 1975), the Cycladic islands of Milos, Santorini, and Kimolos (Barton et al., 1983; Briqueu et al., 1986; Francalanci et al., 2007), and the islands of Patmos, Yali, and Nisyros in the Dodecanese (Wyers and Barton, 1987). On the contrary, regions with older granites are expected to show significantly high $^{87}Sr/^{86}Sr$ values (> 0.711), such as the islands of Ios, Mykonos, Serifos, and Tinos, as well as the island of Ikaria in the Eastern Sporades (Altherr et al., 1988; Henjes-Kunst and Kreuzer, 1982) (Fig. 6.2). However, I should note the common and extensive limestone formations (Fig. 6.1) and suggest that they should be treated with caution, given also the potential effect of sea spray, sea salt, and potential marine diets.

Bioarchaeological Applications

To account for the within region $^{87}Sr/^{86}Sr$ variation in bedrock, soil, and water, the use of faunal and environmental samples has been As discussed earlier, the application of biogeochemical methods for the identification of past human mobility is a recent phenomenon in the Aegean region. The following $^{87}Sr/^{86}Sr$ values are obtained from raw data measured in archaeological and modern fauna, archaeological human bone, and modern snail shells published in Nafplioti (2011). However, the ranges of biologically available strontium used here do not always correspond with the ones used by Nafplioti (2011); when the sample size is two only the raw range of data is reported. In several cases of land snail shell analysis, Nafplioti (2009, 2011) combined samples from different snail samples into one prior to analysis assuming minor inter-sample variation. Here, these values are treated as a single sample and not as an average under the indication of "combined".

The highest $^{87}Sr/^{86}Sr$ values were observed in northeastern Aegean. Archaeological fauna (pig and sheep/goat) from Agio Galas on Chios island showed $^{87}Sr/^{86}Sr = 0.710534 – 0.71187$ with mean $^{87}Sr/^{86}Sr = 0.71116 \pm 0.0067$ (1σ, n = 3). Archaeological faunal samples (sheep/goat, cow) from the EBA site of Manika at Chalkis on central Euboea exhibited $^{87}Sr/^{86}Sr = 0.70869 – 0.70927$ with mean $^{87}Sr/^{86}Sr = 0.708971 \pm 0.00021$ (1σ, n = 5). Archaeological faunal samples (sheep/goat, cow, pig) from Late Neolithic Tharrounia on central Euboea showed $^{87}Sr/^{86}Sr = 0.70873 – 0.71110$ with mean $^{87}Sr/^{86}Sr = 0.70954 \pm 0.00135$ (1σ, n = 3). The high value of $^{87}Sr/^{86}Sr = 0.71110$ that came from a sheep/goat was excluded by Nafplioti (2011) as an outlier and probably reflects an animal non-local to the region. Thus, the range for Tharrounia is $^{87}Sr/^{86}Sr$ = 0.70873 – 0.70879 (n = 2). At EBA Perachora in Corinthia, an archaeological pig sample showed $^{87}Sr/^{86}Sr$ = 0.70866, very close to the range of $^{87}Sr/^{86}Sr$ = 0.70865 – 0.70859 given by two modern land snail shells. At Mycenae in the Argolid, an LBA pig sample showed $^{87}Sr/^{86}Sr$ = 0.70808, while four snail samples showed $^{87}Sr/^{86}Sr$ = 0.70823 – 0.70833. A very similar value comes from the nearby Tiryns where a modern land snail sample showed $^{87}Sr/^{86}Sr$ = 0.70826 ("combined"). Mesolithic fauna from Franchthi Cave (wild boar and deer) in southern Argolid showed $^{87}Sr/^{86}Sr$ = 0.70850 – 0.70923 and mean $^{87}Sr/^{86}Sr$ = 0.70818 ± 0.00037 (1σ, n=3). "Combined" snail samples from Koilada and Kranidi in southern Argolid gave $^{87}Sr/^{86}Sr$ = 0.70815 and $^{87}Sr/^{86}Sr$ = 0.70845 respectively. In southeastern Attica, archaeological pig samples from Kitsos Cave exhibited $^{87}Sr/^{86}Sr$ = 0.70840 – 0.70931 with mean $^{87}Sr/^{86}Sr$ = 0.70894 ± 0.00048 (1σ, n = 3). Late Neolithic pig samples from Kephala on Keos island showed $^{87}Sr/^{86}Sr$ = 0.70895 – 0.70927 (n = 2). These values were comparable to modern snail samples from the port area (at Korissia) on Keos that showed $^{87}Sr/^{86}Sr$ = 0.70860 – 0.70888 with mean $^{87}Sr/^{86}Sr$ = 0.70870 ± 0.00016 (1σ, n = 3). Thus, when the archaeological and modern values are combined, the local range for Keos is estimated at $^{87}Sr/^{86}Sr$ = 0.70832 – 0.70941 (average ± 2σ, n = 5). On Kythnos island, Mesolithic and Bronze Age faunal samples (wild/boar and sheep/goat) exhibited $^{87}Sr/^{86}Sr$ = 0.70911 – 0.70918 with mean $^{87}Sr/^{86}Sr$ = 0.70915 ± 0.00003 (1σ, n = 5). An archaeological pig specimen from Antiparos Cave showed $^{87}Sr/^{86}Sr$ = 0.70932. On Naxos island, archaeological fauna (pig, cow) from Chora (western island) showed $^{87}Sr/^{86}Sr$ = 0.70950 – 0.71004 (n = 2), while snail samples from Tsikniades (central island) showed $^{87}Sr/^{86}Sr$ = 0.70926 – 0.70928. Archaeological human bone from Naxos Chora exhibited $^{87}Sr/^{86}Sr$ = 0.70943 – 0.70968 with mean $^{87}Sr/^{86}Sr$ = 0.70955 ± 0.00013 (1σ, n = 3), while an archaeological human bone sample from Tsikniades showed $^{87}Sr/^{86}Sr$ = 0.70949. When all values are combined, the range for Naxos is estimated at $^{87}Sr/^{86}Sr$ = 0.70903 – 0.71002 (average ± 2σ, n = 8).

In the Dodecanese, modern snail samples from Kos showed a range of $^{87}Sr/^{86}Sr$ = 0.70821 – 0.70847 and mean $^{87}Sr/^{86}Sr$ = 0.70830 ± 0.00015 (1σ, n = 3), while an archaeological sheep/goat specimen from Rhodes exhibited $^{87}Sr/^{86}Sr$ = 0.70837. Turning to Crete, at Knossos archaeological faunal specimens (sheep/goat, pig, and cow) showed $^{87}Sr/^{86}Sr$ = 0.70853 – 0.70909 and mean $^{87}Sr/^{86}Sr$ = 0.70891 ± 0.0002 (1σ, n = 8). Archaeological human bone from Knossos showed $^{87}Sr/^{86}Sr$ = 0.70900 – 0.70904 and mean $^{87}Sr/^{86}Sr$ = 0.70902 ± 0.00002 (1σ, n = 3). Modern land snail samples from Knossos showed $^{87}Sr/^{86}Sr$ = 0.70895 – 0.70902 and mean $^{87}Sr/^{86}Sr$ = 0.70899 ± 0.00003 (1σ, n = 4). Archaeological human bone samples from Myrtos Pyrgos on the southern coast of central Crete showed $^{87}Sr/^{86}Sr$ = 0.70886 (n = 2), while archaeological human bone specimens from Margarites, Maroulas, and Kastelos on western and central Crete gave $^{87}Sr/^{86}Sr$ = 0.70908 (n = 1), $^{87}Sr/^{86}Sr$ = 0.70915 (n = 1), and $^{87}Sr/^{86}Sr$ = 0.70905 (n = 1) respectively. A modern rabbit sample from Ano Asites on central Crete showed $^{87}Sr/^{86}Sr$ = 0.70896. Finally, archaeological human bone from Chania on the northern coast of western Crete showed $^{87}Sr/^{86}Sr$ = 0.70902 – 0.70913 (n = 2).

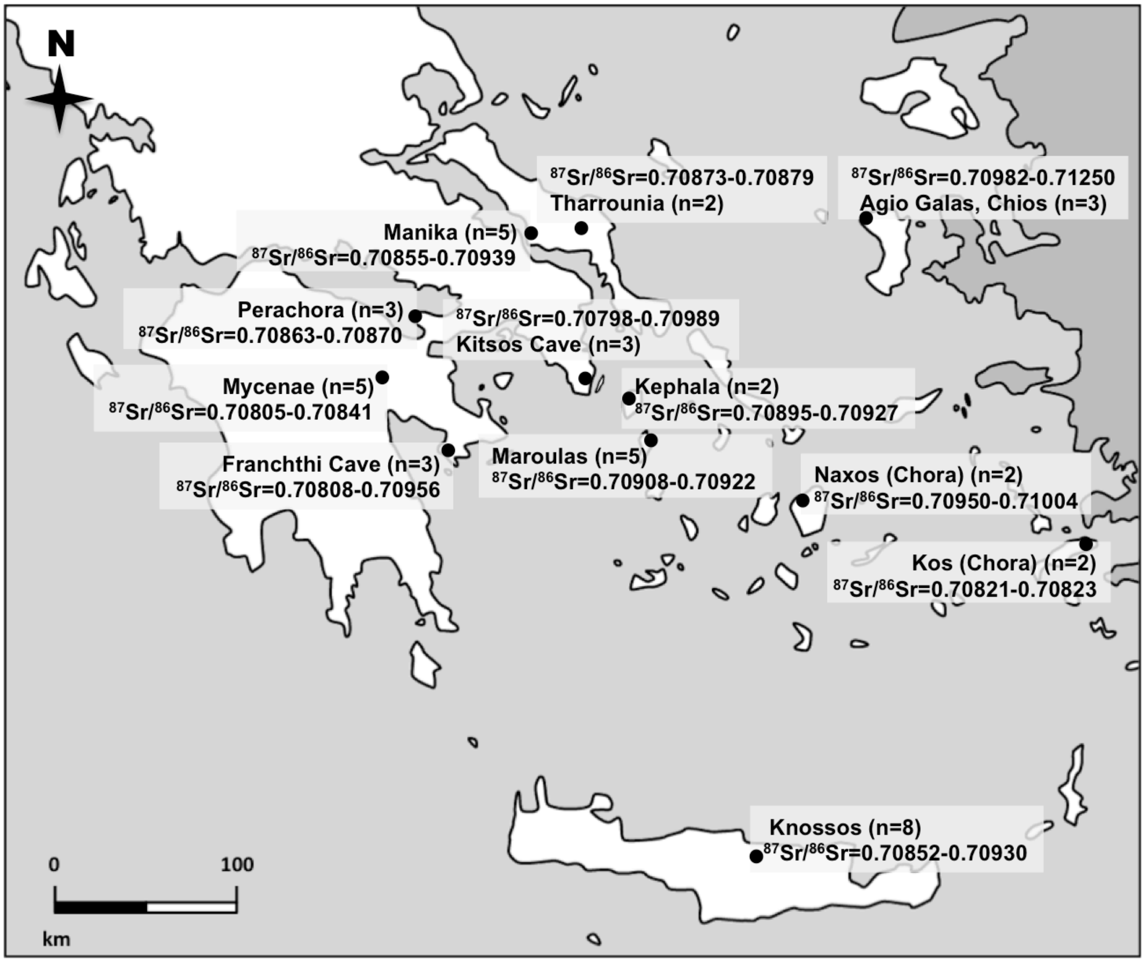

Figure 6.4. Map of southern Aegean showing radiogenic strontium isotope signatures from archaeological fauna using published data (Nafplioti, 2011). The estimation of local ranges is based on the formula: average value ± 2σ; when n = 2 the range of the two values is given.

Materials and Sampling Strategy

Tsepi Cemetery

To elucidate the geographic origins of the individuals buried in the Tsepi cemetery, radiogenic strontium isotope analysis was performed. The goal of the biogeochemical analysis was to examine a representative sample of the cemetery population, including individuals from all graves, all sexes, and all ages, as well as life-history changes in order to further address the nature of mobility, e.g., individuals relocated as young children or later in life, as outlined by the research question of this study. The poor preservation and lack of completeness due to commingling limited sampling selection. Sampling targeted individuals that provided the most information, including sex, age, and burial location (within tomb).

In total, 75 individuals were sampled, forming about 30% of the available skeletal sample from the southern half of the cemetery (Appendix C). These consist of 32 females (or probable females), 23 males (or probable males), 14 individuals of indeterminate sex, and 6 children (Appendix C). First molars were preferentially selected, however enamel from teeth that form in different ages was sampled (Fig. 6.5).[242] Crown formation of first molars begins *in utero* (at about 7 ± 2 months *in utero*) and is completed by about 3 ± 1 years, reflecting diet in late prenatal life and infancy (roughly the first 3 years of life) (Buikstra and Ubelaker, 1994:51). Second molars and second premolars reflect diet in young childhood (3 – 7 ± 2 years), and third molars reflect diet in late childhood/early adolescence (9 – 12 ± 3 years) (Buikstra and Ubelaker, 1994:51). Sampled teeth also included one canine reflecting diet between 9 months and 4 ± 1 years, and one maxillary central incisor reflecting diet between approximately 6 ± 3 months and 4 ± 1 years (Buikstra and Ubelaker, 1994:51). For 17 out of the 75 individuals (23%), multiple dental elements that form in different ages were sampled, with a total of 100 enamel samples. Finally, to establish the local $^{87}Sr/^{86}Sr$ range for Tsepi (Marathon), 15 archaeological faunal enamel samples from graves and associated contexts at Tsepi were analyzed, including cattle, pig, and sheep/goat (Table 6.1).

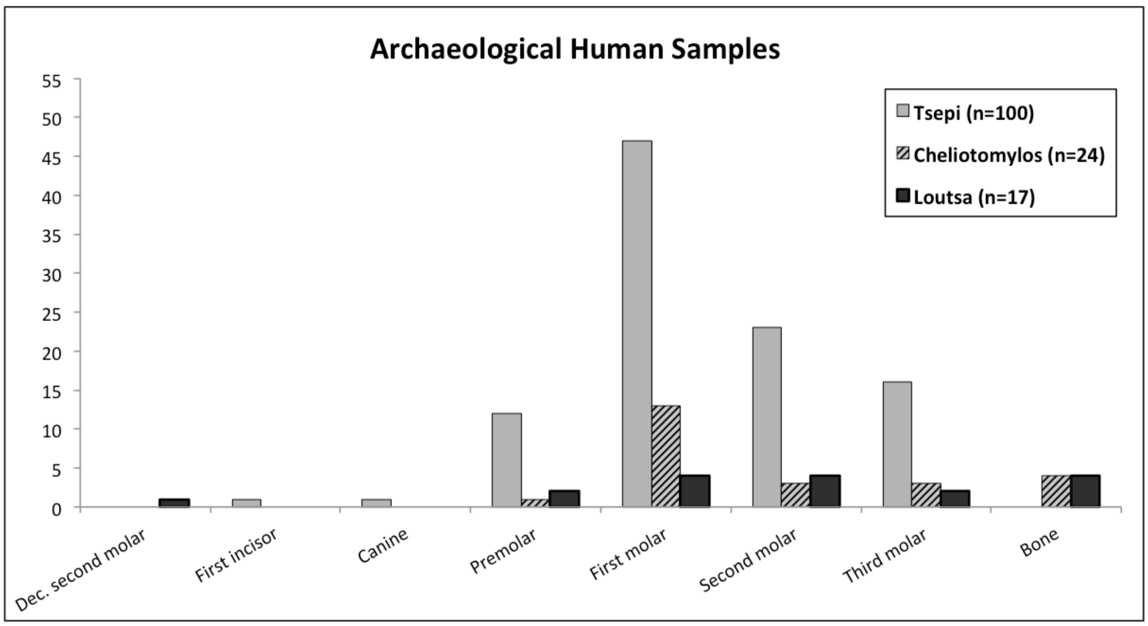

Figure 6.5. Archaeological human samples (materials) for each site.

Comparative Archaeological Samples

To provide comparative archaeological data generally contemporaneous with Tsepi from surrounding regions, two smaller EH skeletal assemblages were sampled. The comparative assemblages consist of a) the two EH graves from Loutsa in eastern, coastal

Attica, about 30 km south of Marathon and b) the EH well assemblage from Cheliotomylos in Corinth, in northern Peloponnese (adjacent to Attica), at about 115 km from Marathon (Appendix C). From the Cheliotomylos assemblage, fifteen individuals were sampled, including six females (or probable females), four males (or probable males), and five children. For five individuals, multiple dental and/or bone samples were analyzed, with a total of twenty-four samples (Fig. 6.5). Bone, contrary to enamel that forms early in life, keeps remodeling throughout life and, thus, represents diet in the last years of an individual's life. From Loutsa, fourteen teeth and four bones were sampled (Fig. 6.5).

Table 6.1. Description and contextual information for archaeological faunal samples from the cemetery of Tsepi.

Lab #	Specimen #	Tomb[a]	Species	Material
ACL-6159	TSEP-V45-F1	UN	*Bos taurus*	Incisor
ACL-6160	TSEP-85-F1	UN	*Bos taurus*	Incisor
ACL-6161	TSEP-T4-F1	T4	*Bos taurus*	Incisor
ACL-6162	TSEP-T5-F1	T5	*Caprinae*	Premolar
ACL-6163	TSEP-T5-F2	T5	*Sus scrofa*	Incisor
ACL-6164	TSEP-T5-F3	T5	*Bos taurus*	Incisor
ACL-6165	TSEP-T6-F1	T6	*Bos taurus*	Incisor
ACL-6166	TSEP-T6-F2	T6	*Sus scrofa*	Incisor
ACL-6167	TSEP-T6-F3	T6	*Bos taurus*	Molar
ACL-6168	TSEP-T6-F4	T6	*Caprinae*	Molar
ACL-6169	TSEP-T10-F1	T10	*Caprinae*	Premolar
ACL-6170	TSEP-T11-F1	T11	*Caprinae*	Molar
ACL-6171	TSEP-T13-F1	T13	*Bos taurus*	Incisor
ACL-6172	TSEP-T22-F1	T22	*Sus scrofa*	Incisor
ACL-6173	TSEP-T24-F1	T24	*Bos taurus*	Incisor

[a]Abbreviations: T, Tomb; UN, unknown tomb provenance.

Environmental Baseline Samples

To detect mobility between different regions, modern fauna, snails, and water samples were analyzed to determine the locally bioavailable $^{87}Sr/^{86}Sr$ from a number of regions, including a large number of islands. Sampled regions were selected based on relevance to this study, areas of archaeological significance, geochemical composition, and availability/access. Small herbivore mammals with a small foraging range have been shown to provide a useful baseline for estimating the local strontium sources available to humans and for characterizing the locally bioavailable strontium ranges (Evans and Tatham, 2004; Knudson and Price, 2007; Knudson et al., 2004; Price et al., 2002). In this study, modern hare (*Lepus europaeus*) and wild rabbit (*Oryctolagus cuniculus*) bone and enamel samples were collected and analyzed (n = 119) (Appendix D). Hares and wild rabbits live and feed in the wild and have relatively small home ranges. They are legally hunted for food by officially recognized hunting clubs in Greece; in collaboration with the Hellenic Hunters Confederation and local hunting clubs, hare and rabbit bones were collected from hunters from the regions under study for chemical analysis (Appendix D). One wild boar (*Sus* scrofa) was analyzed. The wild boar has a much larger foraging range, thus its value will reflect a larger area. The systematic use of modern game as a baseline is innovative and could be of great value in biogeochemical research for paleomobility. Finally, land snails (n = 17) and fresh water samples (n = 10) were collected from different regions (Tables 6.2, 6.3).

Paleodietary Reconstruction

All archaeological human samples (n = 141) were analyzed for stable strontium isotopes in order to provide paleodietary data. A subset of the archaeological faunal samples from Tsepi cemetery was also analyzed for $\delta^{88/86}Sr$ (n = 9). To generate baseline data for different trophic levels in the Aegean context, a subset of the modern faunal and environmental samples (three modern hare, one land snail, three water samples), as well as thirteen fish samples were analyzed for $\delta^{88/86}Sr$ values.

Laboratory Methodology

All archaeological and modern samples were prepared at the Archaeological Chemistry Laboratory at Arizona State University by the author following established methodologies (Knudson and Buikstra, 2007; Knudson and Price, 2007). Archaeological tooth and bone specimens were mechanically cleaned by abrasion in order to remove the outermost layers that are most susceptible to diagenesis (Budd et al., 2000; Montgomery et al., 1999; Waldron, 1981, 1983; Waldron et al., 1979). Approximately 10 - 15 milligrams of tooth enamel or 500 milligrams of bone were then removed with a Dremel rotary tool equipped with a diamond engraving point or cutter. The mechanically cleaned bone specimens were first chemically cleaned through successive washes with 0.8 M acetic acid (CH_3COOH) and distilled Millipore water and then ashed at 800^{o}C. Land snail shells were treated the same as bone. For modern samples, 4 – 6 milligrams of enamel powder or bone ash were used. For samples analyzed also for stable strontium isotope analysis as well, 6 – 10 milligrams were used. The powdered tooth enamel, bone or shell ash was dissolved in 0.5 mL of 5M nitric acid (HNO_3). For water samples, approximately 20 mL of liquid were evaporated.

The strontium was then separated from the sample matrix using EiChrom SrSpec resin loaded into the tip of a glass column in the Trace Metal Clean Lab at the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry at Arizona State University. Total resin volume was approximately 50 µL and was used once for sample elution and then discarded. Volume of loaded sample was always 250 µL. The resin was further cleaned in the column with repeated washes of deionized Millipore water and conditioned with 750 µL of HNO_3. The dissolved samples were loaded in 250 µL of 5M HNO_3, further washed in 500 µL of 5M HNO_3, and finally the strontium was eluted with 1000 µL of deionized Millipore H_2O. For all samples analyzed for mass-dependent ($\delta^{88/86}$Sr) strontium isotope analysis a 50 µL pre-chemistry aliquot was analyzed for elemental concentrations in a Thermo-Finnigan quadrupole inductively coupled plasma mass spectrometer (Q-ICP-MS) at the ASU W.M. Keck Foundation Laboratory by Dr. Gwyneth Gordon. In order to ensure that ^{88}Sr/^{86}Sr fractionation during ion-exchange chromatography was not adversely affecting the results, the column yield was determined by analyzing pre- and post-chemistry aliquots and had to be at least 90% (de Souza et al., 2010; Knudson et al., 2010).

All samples were analyzed in a Thermo-Finnigan Neptune multi-collector inductively coupled plasma mass spectrometer (MC-ICP-MS) at the W.M. Keck Foundation Laboratory, by Dr. Gwyneth Gordon. For mass-dependent ($\delta^{88/86}$Sr) strontium analysis sample-standard bracketing was used by analyzing the National Institute of

Standards and Technology Standard Reference Material strontium carbonate standard (NIST SRM-987) before and after each sample, and using the average of these two measurements when calculating $^{88}Sr/^{86}Sr_{NBS-987}$ to determine $\delta^{88/86}Sr$ (de Souza et al., 2010; Ehrlich et al., 2001, 2004; Fietzke and Eisenhauer, 2006; Halicz et al., 2008; Knudson et al., 2010). On the days the samples were analyzed, strontium carbonate standard SRM-987 yielded a value of $^{87}Sr/^{86}Sr = 0.71025 \pm 0.00016$ (2σ, n = 50) and $^{87}Sr/^{86}Sr = 0.71025 \pm 0.00006$ (2σ, n = 190). The measured values can be compared to analyses of SRM-987 using a thermal ionization mass spectrometer (TIMS), where $^{87}Sr/^{86}Sr = 0.71026 \pm 0.00002$ (2σ) (Stein et al., 1997), that using an identical MC-ICP-MS where $^{87}Sr/^{86}Sr = 0.71025 \pm 0.00006$ (2σ) (Balcaen et al., 2005).

Biogeochemical Results

The archaeological human enamel samples from the EH cemetery of Tsepi show a range of $^{87}Sr/^{86}Sr = 0.70894 - 0.71056$ with a mean value of $^{87}Sr/^{86}Sr = 0.70919 \pm 0.00024$ (1σ, n = 100) (Appendix E). The archaeological faunal enamel samples from the cemetery of Tsepi range from $^{87}Sr/^{86}Sr = 0.70894 - 0.70919$ with a mean value of $^{87}Sr/^{86}Sr = 0.70908 \pm 0.00010$ (1σ, n = 15) (Table 6.5). The archaeological human enamel and bone samples from the EH well of Cheliotomylos range from $^{87}Sr/^{86}Sr = 0.70851 - 0.70905$ with a mean value of $^{87}Sr/^{86}Sr = 0.70870 \pm 0.00020$ (1σ, n = 24) (Appendix E). The archaeological human enamel and bone samples from the EH graves at Loutsa range from $^{87}Sr/^{86}Sr = 0.70900 - 0.70923$ with a mean value of $^{87}Sr/^{86}Sr = 0.70907 \pm 0.00006$ (1σ, n = 17) (Appendix E). The modern faunal samples range $^{87}Sr/^{86}Sr = 0.70757 -$

0.71068 with a mean value of $^{87}Sr/^{86}Sr = 0.70875 \pm 0.00054$ (1σ, n = 120) (Appendix D). The modern snail shell samples show $^{87}Sr/^{86}Sr = 0.70773 - 0.70908$ and mean $^{87}Sr/^{86}Sr = 0.70847 \pm 0.00034$ (1σ, n = 17) (Table 6.2). The water samples range from $^{87}Sr/^{86}Sr = 0.70684 - 0.70923$ with an average value of $^{87}Sr/^{86}Sr = 0.70817 \pm 0.00077$ (1σ, n = 10) (Table 6.3). The fish bone samples range from $^{87}Sr/^{86}Sr = 0.70914 - 0.70919$ (n = 12) matching the seawater ratio. One fish sample shows a lower value of $^{87}Sr/^{86}Sr = 0.70817$, but this is a species that can also be found in brackish water.

Turning to paleodietary results, human enamel samples from Tsepi show mean log(Ba/Sr) = -1.30 ± 0.25 (1σ, n = 100) and mean $\delta^{88/86}Sr = -0.23 \pm 0.15‰$ (1σ, n = 93) (Appendix E). The human enamel and bone samples from Cheliotomylos exhibit mean log(Ba/Sr) = -1.32 ± 0.29‰ (1σ, n=24) and mean $\delta^{88/86}Sr = -0.26 \pm 0.16‰$ (1σ, n = 24). The human enamel and bones samples from the Loutsa graves show mean log(Ba/Sr) = -1.25 ± 0.43‰ (1σ, n = 17) and mean $\delta^{88/86}Sr = -0.19 \pm 0.17‰$ (1σ, n = 17) (Appendix E). The archaeological faunal samples from Tsepi show mean log(Ba/Sr) = -0.63 ± 0.30 (1σ, n = 15) and mean $\delta^{88/86}Sr = -0.25 \pm 0.13‰$ (1σ, n = 24) (Table 6.5). The modern hare samples show mean $\delta^{88/86}Sr = -0.31 \pm 0.09‰$ (1σ, n = 3) and mean log(Ba/Sr) = -0.45 ± 0.45 (1σ, n = 3) (Appendix D). The land snail sample shows a value of $\delta^{88/86}Sr = 0.24‰$ and log(Ba/Sr) = -1.32 (Table 6.2). The modern water samples exhibit $\delta^{88/86}Sr = -0.16 \pm 0.09$ ‰ (1σ, n = 3) and log(Ba/Sr) = -0.97 ± 0.22 (1σ, n = 3) (Table 6.3). Finally, the fish samples show mean $\delta^{88/86}Sr = 0.13 \pm 0.08‰$ (1σ, n=13) and mean log(Ba/Sr) = -1.99 ±0.51 (1σ, n = 13) (Table 6.4).

Table 6.2. Description and biogeochemical data for snail shell baseline samples.

Lab #	Specimen #	Species	Provenance	$^{87}Sr/^{86}Sr$	$\delta^{88/86}Sr$
ACL-6129	AEG-LS26	*Helicidae*	Aegina island, Lazarides	0.70818	NA
ACL-6130	AEG-LS27	*Helicidae*	Aegina island, Lazarides	0.70773	NA
ACL-6134	AEG-LS21	*Helicidae*	Marathon, Plasi	0.70891	NA
ACL-6135	AEG-LS22	*Helicidae*	Marathon, Plasi	0.70908	NA
ACL-6136	AEG-LS23	*Helicidae*	Marathon, Plasi	0.70903	NA
ACL-6137	AEG-LS24	*Helicidae*	Marathon, Tsepi	0.70845	0.24
ACL-6138	AEG-LS25	*Helicidae*	Marathon, Tsepi	0.70841	NA
ACL-6139	AEG-LS7	*Helicidae*	Methana, Kammeni Hora	0.70836	NA
ACL-6140	AEG-LS8	*Helicidae*	Methana, Kammeni Hora	0.70829	NA
ACL-6141	AEG-LS9	*Helicidae*	Methana, Kammeni Hora	0.70825	NA
ACL-6149	AEG-LS1	*Helicidae*	Santorini, Exomitis	0.70832	NA
ACL-6150	AEG-LS2	*Helicidae*	Santorini, Exomitis	0.70823	NA
ACL-6152	AEG-LS4	*Helicidae*	Santorini, Akrotiri	0.70830	NA
ACL-6153	AEG-LS5	*Helicidae*	Santorini, Akrotiri	0.70846	NA
ACL-6155	AEG-LS11	*Helicidae*	Lavrion (Thorikos), Mine 3	0.70860	NA
ACL-6156	AEG-LS12	*Helicidae*	Lavrion (Thorikos), Mine 3	0.70876	NA
ACL-6157	AEG-LS13	*Helicidae*	Lavrion (Thorikos), Mine area	0.70861	NA

Table 6.3. Description and biogeochemical data for modern water baseline samples.

Lab #	Specimen #	Sample	Provenance	$^{87}Sr/^{86}Sr$	$\delta^{88/86}Sr$
ACL-5784	LADN-W1	river	Ladonas River (springs)	0.70791	NA
ACL-5785	LZRD-W1	cistern	Aegina (Lazarides)	0.70684	NA
ACL-5786	LZRD-W2	cistern	Aegina (Lazarides)	0.70719	NA
ACL-5788	CRNT-W1	fountain	Ancient Corinth (Hadji Mustafa)	0.70829	0.13
ACL-5789	CRNT-W2	spring	Ancient Corinth (Kokkinovrysi)	0.70860	NA
ACL-5790	CRNT-W3	spring	Ancient Corinth (Tiles)	0.70850	NA
ACL-5791	CRNT-W4	spring	Ancient Corinth (Cheliotomylos)	0.70860	0.08
ACL-5792	MRTH-W1	fountain	Marathon, Oenoe spring	0.70893	0.26
ACL-5793	MRTH-W2	stream	Marathon, Makaria Pigi	0.70923	NA
ACL-5794	STMP-W1	spring	Stymphalia	0.70758	NA

Table 6.4. Description and biogeochemical data for modern fish bone samples.

Lab #	Specimen #	Species	Common name	$^{87}Sr/^{86}Sr$	$\delta^{88/86}Sr$	log (Ba/Sr)
ACL-6100	AEG-F9	*Epinephelus costae*	grouper	0.70918	0.04	-2.60
ACL-6105	AEG-F9	*Spicara smaris*	picarel	0.70919	0.12	-1.64
ACL-6106	AEG-F17	*Spicara smaris*	picarel	0.70919	0.11	-1.60
ACL-6107	AEG-F19	*Spicara smaris*	picarel	0.70917	-0.01	-1.53
ACL-6108	AEG-F19	*Thunnus thynnus*	tunna	0.70918	0.14	-1.98
ACL-6111	AEG-F40	*Thunnus thynnus*	tunna	0.70921	0.17	-2.60
ACL-6114	AEG-F60	*Sarda sarda*	bonito	0.70914	0.25	-2.14
ACL-6115	AEG-F61	*Sarda sarda*	bonito	0.70917	0.26	-1.98
ACL-6116	AEG-F62	*Sparus aurata*	sea bream	0.70919	0.08	-2.24
ACL-6117	AEG-F63	*Sparus aurata*	sea bream	0.70918	0.15	-2.32
ACL-6118	AEG-F64	*Sparus aurata*	sea bream	0.70919	0.11	-2.28
ACL-6119	AEG-F65	*Scorpaena notata*	red scorpion fish	0.70919	0.14	-2.24
ACL-6123	AEG-F72	*Atherina hepsetus*	sand smelt	0.70817	0.08	-0.77

Table 6.5. Biogeochemical data for archaeological faunal samples from the cemetery of Tsepi.

ACL #	Specimen #	Ca/P	U/Ca	Nd/Ca	log (Ba/Sr)	$^{87}Sr/^{86}Sr$	$\delta^{88}Sr/^{86}Sr$
ACL-6159	TSEP-V45-F1	2.1	7.1E-08	2.0E-07	-0.34	0.70889	NA
ACL-6160	TSEP-85-F1	2.1	2.5E-08	1.7E-07	-0.63	0.70915	NA
ACL-6161	TSEP-T4-F1	2.2	5.5E-07	2.2E-07	-0.34	0.70902	NA
ACL-6162	TSEP-T5-F1	2.1	5.7E-06	2.6E-06	-0.55	0.70908	0.04
ACL-6163	TSEP-T5-F2	2.1	1.3E-06	1.8E-06	-1.23	0.70903	-0.23
ACL-6164	TSEP-T5-F3	2.1	1.4E-07	2.4E-07	-0.72	0.70917	-0.38
ACL-6165	TSEP-T6-F1	2.1	3.2E-07	2.8E-07	-0.49	0.70910	NA
ACL-6166	TSEP-T6-F2	2.1	1.9E-06	3.1E-06	-1.12	0.70907	-0.29
ACL-6167	TSEP-T6-F3	2.1	1.2E-06	5.0E-07	-0.52	0.70914	-0.30
ACL-6168	TSEP-T6-F4	2.1	3.4E-06	1.2E-06	-0.17	0.70902	NA
ACL-6169	TSEP-T10-F1	2.2	8.3E-07	2.2E-07	-0.56	0.70919	-0.19
ACL-6170	TSEP-T11-F1	2.1	3.9E-07	1.6E-06	-0.48	0.70911	-0.38
ACL-6171	TSEP-T13-F1	2.1	2.6E-08	2.0E-07	-0.61	0.70916	-0.30
ACL-6172	TSEP-T22-F1	2.1	1.4E-06	9.1E-07	-1.08	0.70918	-0.21
ACL-6173	TSEP-T24-F1	2.1	6.4E-08	1.3E-07	-0.60	0.70884	NA

Discussion of Biogeochemical Data

Diagenesis

Before the discussion of the results, the quality of the data and the possibility of diagenetic contamination (i.e., post-depositional chemical alteration) of the archaeological samples need to be addressed. Dental enamel has been shown to be resistant to diagenetic contamination (Budd et al., 2000; Lee-Thorp and Sponheimer, 2003; Rink and Schwarz, 1995; Sillen, 1989). To assess the biogenic signature of the samples, all archaeological samples included in the study were analyzed for elemental concentrations (n = 156). The mineral composition of human bone has a Ca/P mass ratio of 2.16, thus significant deviations can reflect chemical alteration and diagenetic mineral addition (Buikstra et al., 1989; Lambert et al., 1991; Price et al., 1992; Sillen, 1989). Moreover, rare earth elements such as uranium and neodymium are almost absent in chemically unaltered bone. Specifically, uranium uptake is associated with the chemical interaction between bone, soil, and groundwater in the burial environment and can be a good indicator of diagenetic processes (Kohn et al., 1999; Millard and Hedges, 1995). Uranium and neodymium concentrations are very low in all archaeological samples (Tables 5, 6). The archaeological human enamel samples show a mean value of Ca/P = 2.1 ± 0.07 (1σ, n = 100), mean Ca/P = 2.0 ± 0.01 (1σ, n = 20), and mean Ca/P = 2.1 ± 0.02 (1σ, n = 13) for Tsepi, Cheliotomylos, and Loutsa respectively, thus indicating a biogenic signal (Table 6.3). Likewise, the archaeological faunal enamel samples from Tsepi show a mean value of Ca/P = 2.1 ± 0.03 (1σ, n = 15). The archaeological human bone samples show a mean value of Ca/P = 2.1 ± 0.06 (1σ, n = 4) and mean Ca/P = 2.4 ± 0.77 (1σ, n = 4) for Cheliotomylos and Loutsa respectively. Overall, all archaeological samples exhibit a biogenic signature excepting the four bone samples from Loutsa that show higher Ca/P values than expected. This indicates that the chemical composition of the Loutsa bones samples is affected by post-depositional factors and might not represent chemical composition during life. However, diagenesis gives a "local" signal, given that it reflects the chemical composition of the burial environment (Price, 2008; Price et al., 2002). Hence, the bone samples can still be used for the characterization of the local $^{87}Sr/^{86}Sr$ range.

Paleomobility

Perhaps the most challenging aspect of biogeochemical investigation of paleomobility is the establishment of what constitutes a local zone. Here, archaeological fauna recovered from the Tsepi graves is used to characterize the local range. As stated earlier, the archaeological faunal enamel samples range from $^{87}Sr/^{86}Sr = 0.70894 - 0.70919$ with a mean value of $^{87}Sr/^{86}Sr = 0.70908 \pm 0.00010$ (1σ, n = 15) (Fig. 6.6). Specifically, the faunal samples from Tsepi show a mean value of $^{87}Sr/^{86}Sr = 0.70906 \pm 0.00013$ (1σ, n = 8), mean $^{87}Sr/^{86}Sr = 0.70909 \pm 0.00008$ (1σ, n = 4), and mean $^{87}Sr/^{86}Sr = 0.70910 \pm 0.00007$ (1σ, n = 3) for cattle, pig, and sheep/goat respectively. Thus, variation in measured faunal $^{87}Sr/^{86}Sr$ values is very low and there are no inter-species differences. Following the formula given by Price et al. (2002) (mean value ± 2σ), the local range for the Tsepi cemetery group is set at $^{87}Sr/^{86}Sr = 0.70887 – 0.70928$. This is in agreement with the $^{87}Sr/^{86}Sr$ values measured in environmental samples from Marathon (Fig. 6.6). The two water samples from Marathon range from $^{87}Sr/^{86}Sr = 0.70893 – 0.70923$. The latter value matches closely seawater $^{87}Sr/^{86}Sr$ values, probably due to sampling close to the mouth of the stream. Both sampled springs, Oenoe and Makaria, are known from antiquity and represent the main drinking water sources in Marathon. Snail shell samples from Marathon showed $^{87}Sr/^{86}Sr = 0.70878 \pm 0.00032$ (1σ, n = 5). The two snail samples from the Tsepi cemetery showed $^{87}Sr/^{86}Sr = 0.70841 – 0.70845$ that were the lowest values in the area. The Tsepi snails were also lower than the local range established by the archaeological fauna recovered from Tsepi cemetery. It should be noted that the two snail samples were collected from a burial context (T19) and, thus, could have been transported. The three snail samples sampled from the coastal site of Plasi showed $^{87}Sr/^{86}Sr = 0.70891 – 0.70908$ probably reflecting the sea water value. Two hare samples from eastern Attica showed $^{87}Sr/^{86}Sr = 0.70860 – 0.70899$. The combined modern samples from Marathon range from $^{87}Sr/^{86}Sr = 0.70841 – 0.70923$ with a mean value of $^{87}Sr/^{86}Sr = 0.70885 \pm 0.00029$ (1σ, $n = 9$). When the formula (mean value $\pm 2\sigma$) is applied, the local range for the locally bioavailable strontium at Marathon is set at $^{87}Sr/^{86}Sr = 0.70826 – 0.70943$. The local range determined by the variety of environmental samples is wider than the one determined by the archaeological fauna and acknowledging the time-difference, it is expected to represent a more comprehensive set of $^{87}Sr/^{86}Sr$ values biologically available in Marathon.

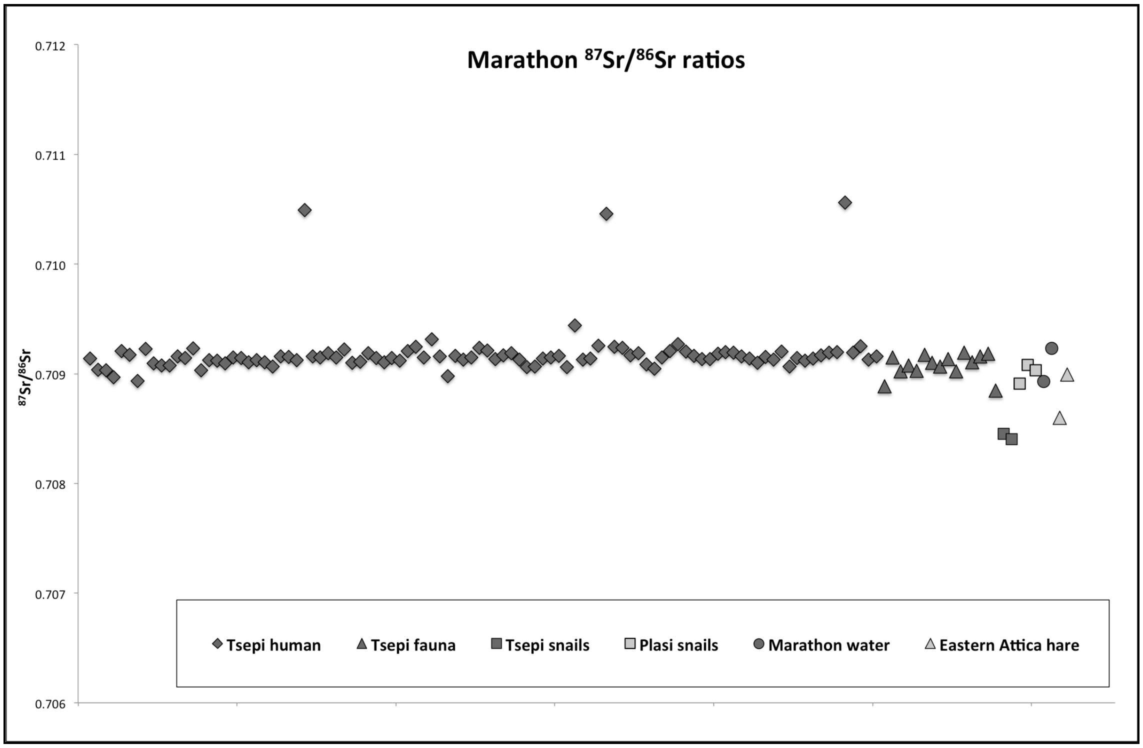

Figure 6.6. Radiogenic strontium isotope values for archaeological and modern specimens from Tsepi cemetery and the Marathon area.

With regard to the human values, the vast majority of the enamel samples fall well within the local range characterized by archaeological fauna (Fig. 6.7). Sample (ACL-5114) is a bit higher ($^{87}Sr/^{86}Sr = 0.70944$) and could potentially suggest a non-local individual; however, it falls within the local range estimated for Marathon, thus it will be considered local. Only three samples (ACL-5080, ACL-5118, and ACL-5148) are clearly outside the local range ($^{87}Sr/^{86}Sr = 0.71049$, $^{87}Sr/^{86}Sr = 0.71046$, and $^{87}Sr/^{86}Sr = 0.71056$ respectively) indicating a non-local provenance (Fig. 6.7).

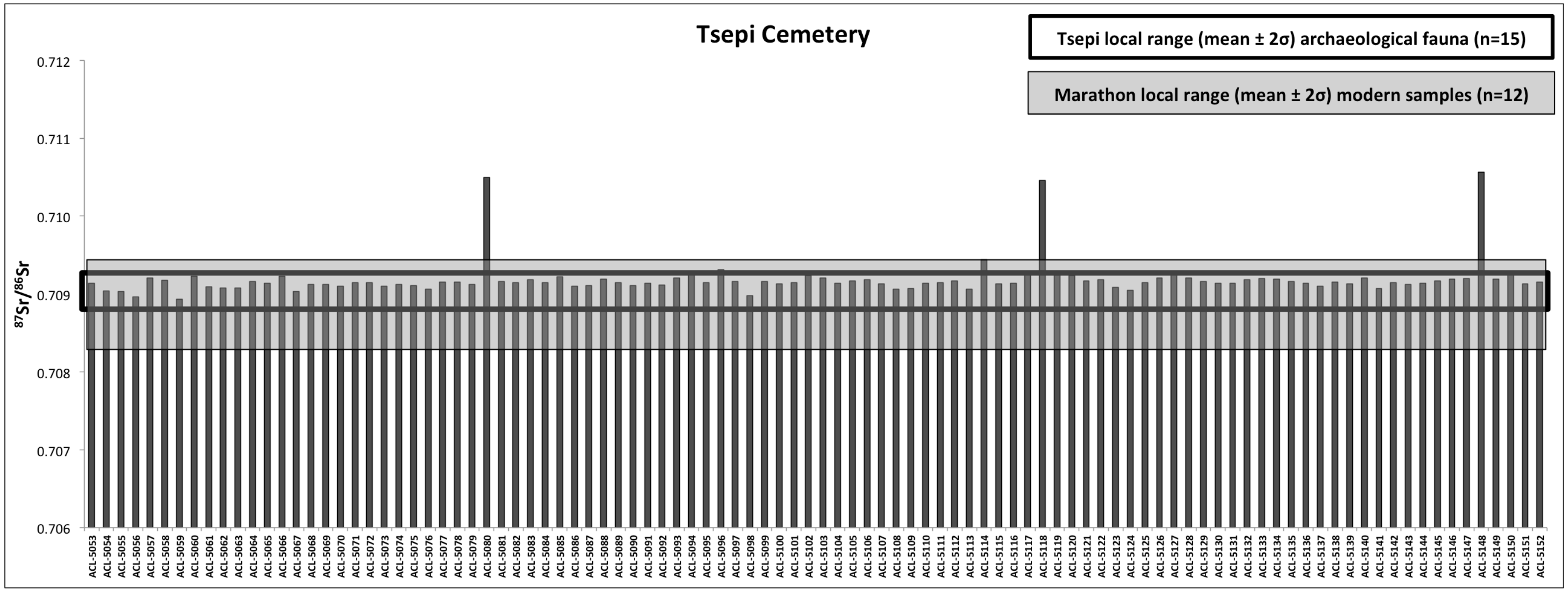

Figure 6.7. Radiogenic strontium isotope values from archaeological human enamel from individuals buried in the EH cemetery of Tsepi. The local $^{87}Sr/^{86}Sr$ ranges determined by archaeological fauna and modern environmental samples for Tsepi and Marathon are illustrated with rectangular shapes.

Overall, the Tsepi sample shows very low variation in measured $^{87}Sr/^{86}Sr$ values (Fig. 6.7), suggesting great similarity in the strontium sources in the food and water consumed and imbibed. This is further illustrated by the descriptive statistics for the Tsepi dataset that shows a narrow range and low measures of dispersion (standard deviation, standard error, variance, and coefficient of variation) (Table 6.6). Descriptive statistics can also be useful in evaluating local vs. non-local individuals (Knudson 2011; Knudson and Tung 2011; Wright 2005). After the removal of the three outliers, the distribution of the Tsepi dataset becomes normal with a lower variance, confirming that it does represent the local group (Table 6.6). Furthermore, the measured $^{87}Sr/^{86}Sr$ values show low inter-tooth and intra-individual variability. There are no significant differences between different teeth and, thus, no differences associated with different developmental ages. The examination of enamel from multiple teeth that develop in different ages for 17 out of the 75 individuals (23%) also show, with the exception of one non-local individual, very low variation –values are nearly identical– between early infancy, young childhood, and late childhood (Fig. 6.8). This is in agreement with a non-mobile, locally raised group.

Thus, of the 75 individuals that were sampled from Tsepi, three are identified as non-local (4%). The non-local signatures come from first molars that represent diet (and, by association, residence) during infancy (first three years of life). Sample ACL-5118 is a probable female (partial mandible recovered) from T16. Sample ACL-5148 is a young female from T25 (cranium). Sample ACL-5080 is a young adult male from T7, which comes from the second *in situ* skeleton found in the grave. Three molars (first, second, third) were analyzed for the individual from T7 (ACL-5080, ACL-5081, ACL-5082). Interestingly, the first molar shows a clear non-local signature ($^{87}Sr/^{86}Sr = 0.71049$), whereas the second and third molars show a local signature with nearly identical values ($^{87}Sr/^{86}Sr = 0.70916$ and $^{87}Sr/^{86}Sr = 0.70915$ respectively) (Fig. 6.8; Sample TSEP-T7-3). This allows us to follow the residential history of this individual throughout childhood and early adolescence and to specify the time that the change in residence (through diet) took place. During infancy ($0 - 3 \pm 1$ years) the individual from T7 lived (and fed) in a different location. By the time of young childhood ($3 - 7 \pm 2$ years), the individual had moved to the Tsepi area, where he stayed throughout childhood and early adolescence ($9 - 12 \pm 3$ years). Thus, individual T7-3 came to the Tsepi area as an infant, presumably with his parents/family, where he spent the rest of his childhood. This does not represent adult relocation due to postmarital residence, but rather familial relocation.

Table 6.6. Descriptive statistics for radiogenic strontium isotope data for the human enamel samples from the cemetery of Tsepi.

	Complete dataset	Trimmed dataset
Mean	0.70919	0.70915
Median	0.70915	0.70915
Mode	0.70914	0.70914
Standard deviation	0.00024	0.00007
Standard error	0.00002	0.00001
Sample variance	0.00000	0.00000
Coefficient of variation	0.03425	0.00994
Kurtosis	24.91060	3.24759
Skewness	4.89743	0.29630
Minimum	0.70894	0.70894
Maximum	0.71056	0.70944
Range	0.00163	0.00051
N	100	97

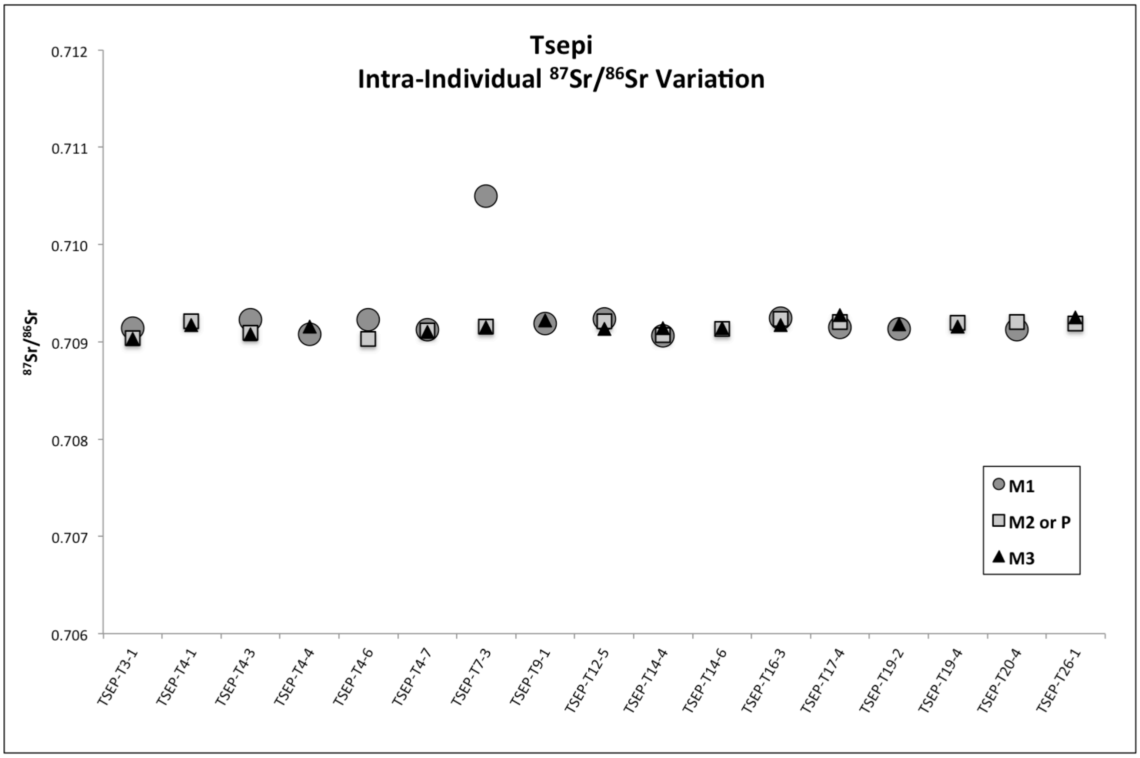

Figure 6.8. Measured radiogenic strontium isotope values for different teeth from seventeen individuals buried in the Tsepi cemetery showing intra-individual variation and residential history (M1, first molar; M2, second molar; P, premolar; M3, third molar).

Moving to the geographic/geologic origins of the non-local individuals, interestingly the three non-local $^{87}Sr/^{86}Sr$ signatures are similar to each other ($^{87}Sr/^{86}Sr$ = 0.71046 − 0.71056) (Fig. 6.7). This indicates that the three individuals came from the same location, where they spent their infancy. Origins from a single locale might show a link between Tsepi and a certain region suggesting the presence of specific social networks. To further determine the possible origin of these three individuals a discussion of the extensive baseline generated for different Aegean regions follows.

Baseline

Three types of modern samples were analyzed in this study to examine the locally bioavailable $^{87}Sr/^{86}Sr$ values in different regions. The snail shell samples show mean $^{87}Sr/^{86}Sr = 0.70847 \pm 0.00034$ (1σ, n = 17) (Table 6.2; Fig. 6.9). The modern hare/wild rabbit samples show mean $^{87}Sr/^{86}Sr = 0.70875 \pm 0.00054$ (1σ, n = 120) (Appendix D; Fig. 6.10). The water samples show mean $^{87}Sr/^{86}Sr = 0.70817 \pm 0.00077$ (1σ, n = 10) (Table 6.3; Fig. 6.11).

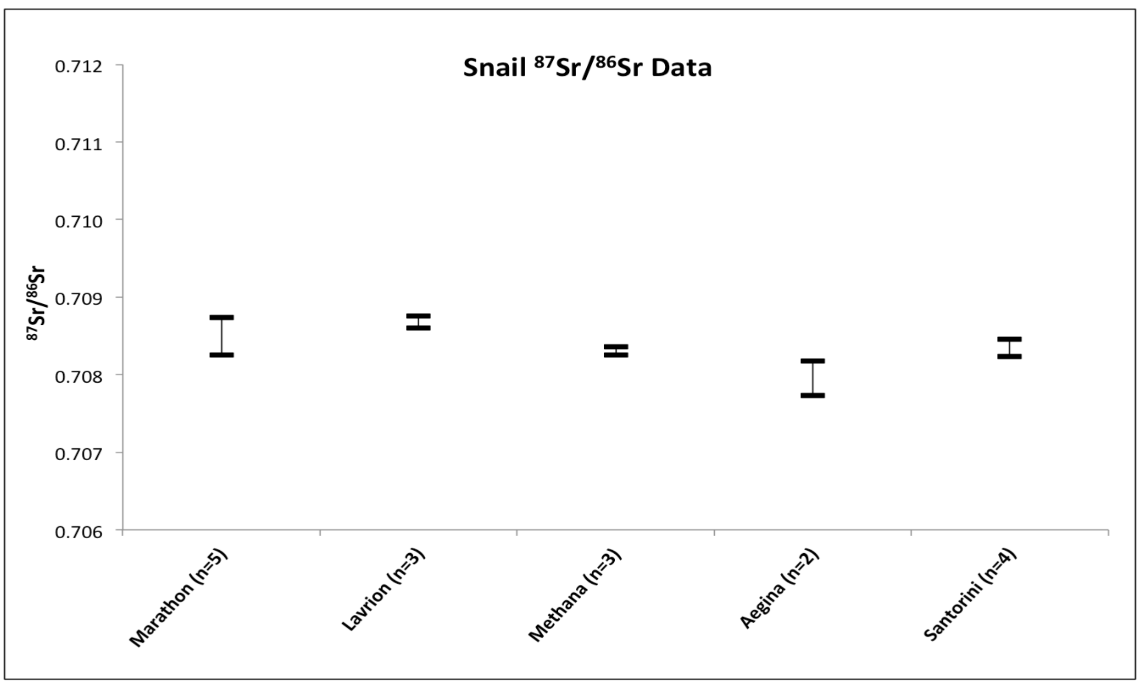

Figure 6.9. Radiogenic strontium isotope data (ranges) measured in snail shell samples per region.

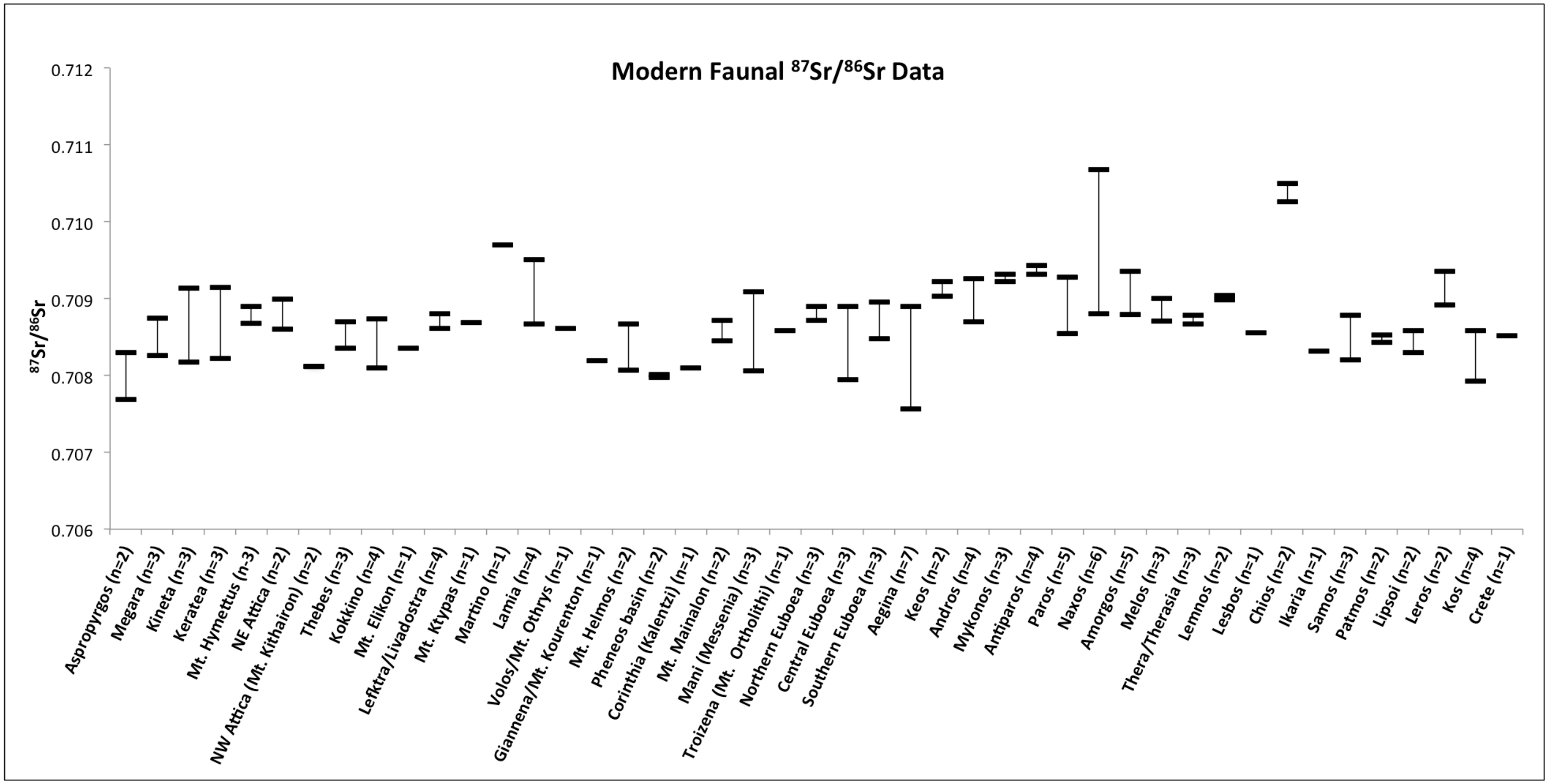

Figure 6.10. Radiogenic strontium isotope data (ranges) measured in modern hare, wild rabbit, and wild boar samples (n = 120) per region.

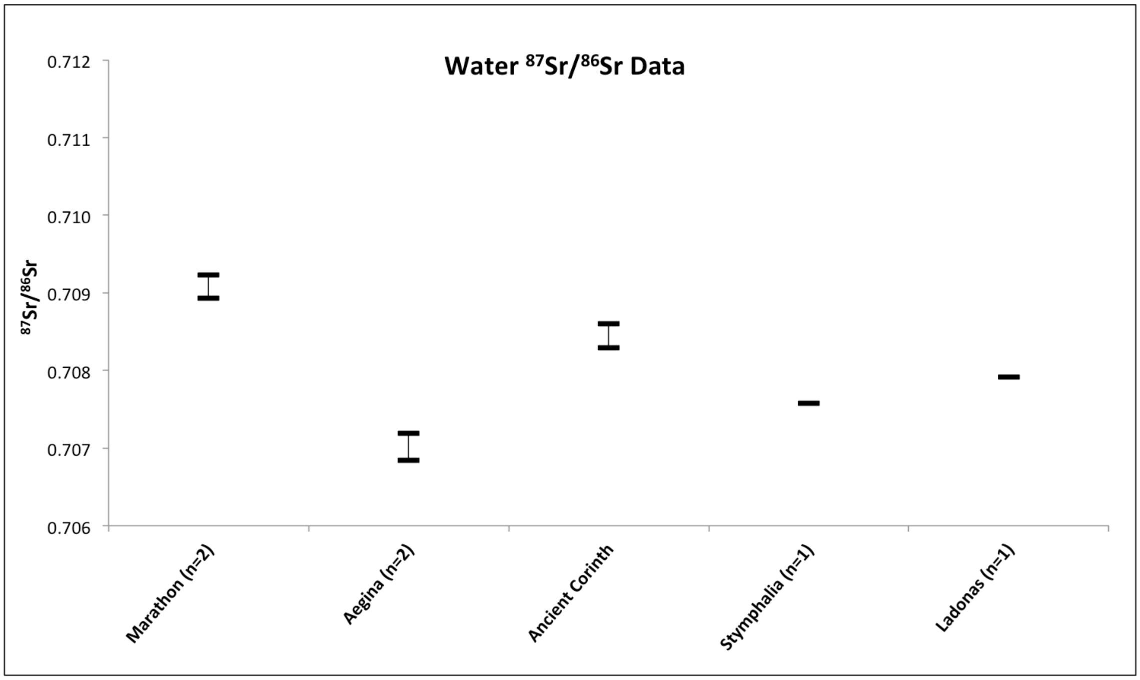

Figure 6.11. Radiogenic strontium isotope data (ranges) measured in water samples per region.

Modern faunal samples in Attica range from $^{87}Sr/^{86}Sr$ = 0.70769 – 0.70914 (n = 18) (Fig. 6.10). Specifically, fauna from the southwestern part of Mt. Parnes shows a range of $^{87}Sr/^{86}Sr$ = 0.70769 – 0.70830 (n = 2), while fauna from the region between Mt. Geraneia and Mt. Pateras in western Attica ranges from $^{87}Sr/^{86}Sr$ = 0.70818 – 0.70914 (n = 4) (Fig. 6.10). The faunal samples from northwestern Attica, at the foothills of Mt. Kithairon show values of $^{87}Sr/^{86}Sr$ = 0.70812 (n = 2) (Fig. 6.10). Mt. Hymettus fauna exhibits mean $^{87}Sr/^{86}Sr$ = 0.70880 ± 0.00011 (1σ, n = 3) (Fig. 6.10). The fauna from central Attica, at Keratea, at the Mesogaia and Lavreotiki regions shows mean $^{87}Sr/^{86}Sr$ = 0.70878 ± 0.00049 (1σ, n = 3) (Fig. 6.10). These values are in accordance with the data published for the Kitsos Cave at southern Attica in Lavrion, $^{87}Sr/^{86}Sr = 0.70894 \pm 0.00048$ (1σ, n = 3) (Nafplioti, 2011) (Fig. 6.4). Eastern Attica shows a range of $^{87}Sr/^{86}Sr = 0.70860 – 0.70899$ (n = 2) (Fig. 6.10). At Marathon, as previously discussed, modern snail samples show $^{87}Sr/^{86}Sr = 0.70841 – 0.70908$ (n = 5) (Fig. 6.9) and water samples show $^{87}Sr/^{86}Sr = 0.70893 – 0.70923$ (n = 2) (Fig. 6.11).

In general, northwestern Attica exhibits lower $^{87}Sr/^{86}Sr$ values than southeastern Attica (Fig. 6.12). When the aforementioned formula (average ± 2σ) is applied to northwestern Attica that is composed of Triassic – Jurassic limestone (Mt. Parnes and Mt. Kithairon), the local range is set at $^{87}Sr/^{86}Sr = 0.70754 – 0.70858$ (n = 4) (Fig. 6.12). Closer to the southern coast of western Attica, at Megara and Kineta (limestone; lacustrine, marine, and alluvial sediments), the local range is determined at $^{87}Sr/^{86}Sr = 0.70778 – 0.70934$ (average ± 2σ, n = 6) (Fig. 6.12). Mt. Hymettus, composed mainly of marbles, and central Attica shows a local range of $^{87}Sr/^{86}Sr = 0.70858 – 0.70901$ (average ± 2σ, n = 3) (Fig. 6.10). At the Mesogeia and Lavreotiki area, composed mainly of schist-chert formations, when the data from the hare (n = 3) (Fig. 6.10) and snail (n = 3) (Fig. 6.9) samples are combined, the local range is estimated at $^{87}Sr/^{86}Sr = 0.70808 – 0.70936$ (average ± 2σ, n = 6) (Fig. 6.12). Finally, for the northeastern Attic coast, the local range is estimated at $^{87}Sr/^{86}Sr = 0.70826 – 0.70943$ (average ± 2σ, n = 9) as discussed in detail for Marathon (Fig. 6.12).

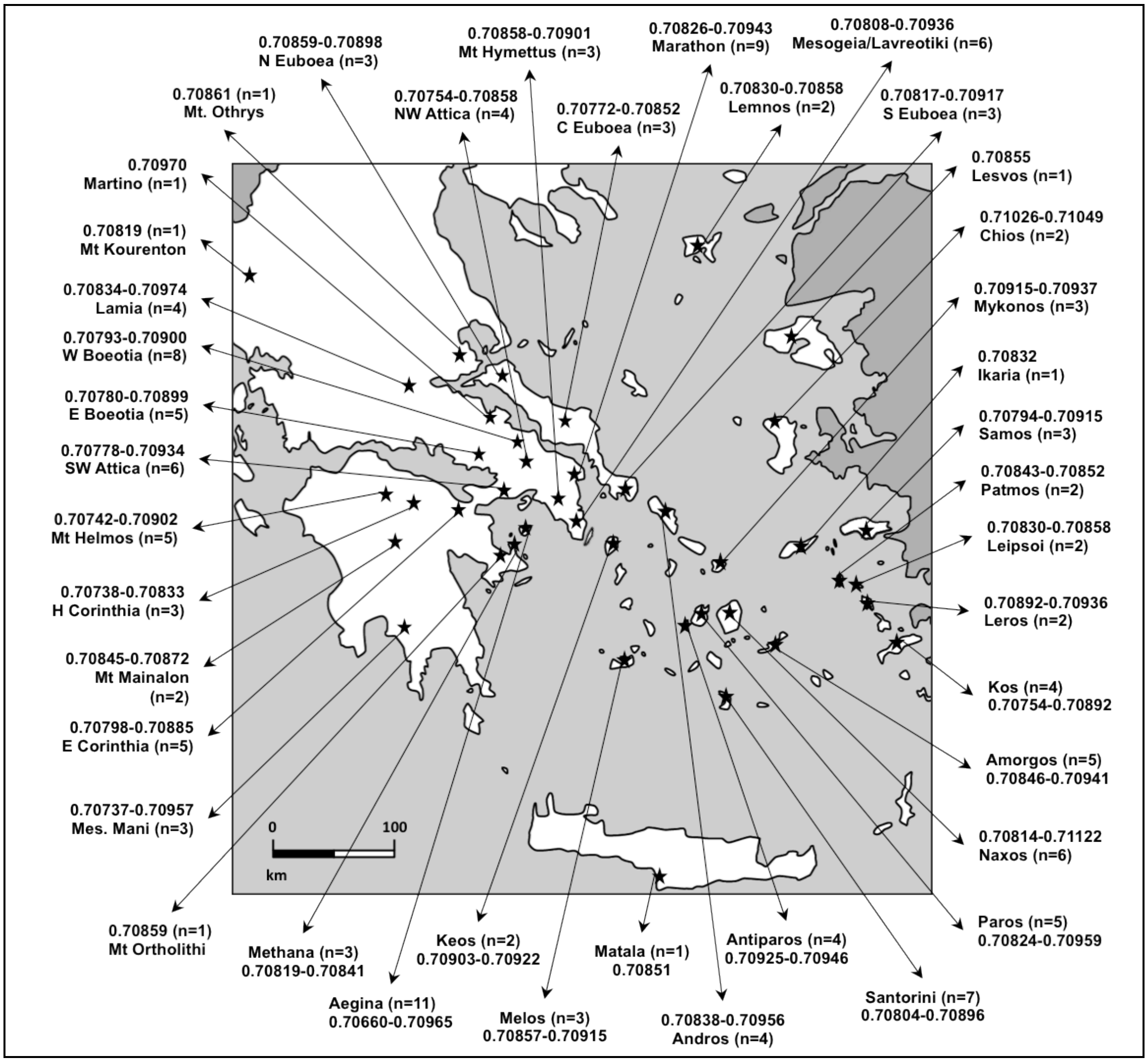

Figure 6.12. Map of the Aegean showing radiogenic strontium isotope signatures ($^{87}Sr/^{86}Sr$) in modern hare, wild rabbit, wild boar, snail shells, and water samples measured in this study. When n ≥ 3, the estimation of the local ranges follows the formula: average value ± 2σ (see text for description). When n = 2, the range of the two values is given; thus, these ranges are usually more narrow. When n = 1, the single value is given.

Moving to Boeotia in central Greece, to the north of Attica, hare samples from Thebes that lies on Plio-Pleistocene lacustrine and terrestrial sediments and Holocene alluvial deposits, shows mean $^{87}Sr/^{86}Sr = 0.70858 \pm 0.00020$ (1σ, n = 3) (Fig. 6.10). Hare samples from coastal southwestern Boeotia, composed mainly of Triassic – Jurassic limestone exhibits mean $^{87}Sr/^{86}Sr = 0.70865 \pm 0.00018$ (1σ, n = 5) (Fig. 6.10). Thus, a local range of $^{87}Sr/^{86}Sr = 0.70793 – 0.70900$ (average ± 2σ, n = 8) is estimated for western Boeotia (Fig. 6.12). Fauna from northeastern Boeotia, composed mainly of Holocene alluvial deposits, Upper Cretaceous limestone, and Plio-Pleistocene lacustrine and terrestrial sediments, shows $^{87}Sr/^{86}Sr = 0.70840 \pm 0.00030$ (1σ, n = 5) (Fig. 6.10), that gives a local range of $^{87}Sr/^{86}Sr = 0.70780 – 0.70899$ (average ± 2σ, n = 5) (Fig. 6.12).

Further north, a faunal sample from Martino (area of alluvial deposits and limestone) shows $^{87}Sr/^{86}Sr = 0.70970$ (n = 1) (Fig. 6.10). At Ypati on Mt. Oiti (close to Lamia) composed mainly of flysch and alluvial deposits close to the Sperheios River, faunal samples show mean $^{87}Sr/^{86}Sr = 0.70904 \pm 0.00035$ (1σ, n = 4) (Fig. 6.10) that can provide us with a local range of $^{87}Sr/^{86}Sr = 0.70834 – 0.70974$ (average ± 2σ, n = 4) (Fig. 6.12). A faunal sample from Mt. Othrys in Volos, an area with Upper Cretaceous and Triassic – Jurassic limestones, flysch, and schist shows $^{87}Sr/^{86}Sr = 0.70861$ (n = 1) (Fig. 6.10); this is the only wild boar specimen included in this study (Appendix D). Wild boars have a large foraging range, thus this value should represent a wider catchment area. A single faunal specimen from Epirus, in northwestern Greece, from Hinka at Mt.

Kourenton (close to Giannena), composed of marls and sandy limestones, flysch, and Paleocene – Upper Eocene limestones, shows $^{87}Sr/^{86}Sr$ = 0.70819 (n = 1) (Figs. 6.10, 6.12).

Turning to the Peloponnese (southern Greece), the village of ancient Corinth lies on Plio-Pleistocene marine deposits, mainly marls, clays, sand and conglomerates (IGME, 1983; Higgins and Higgins, 1996). Water samples from ancient Corinth show mean $^{87}Sr/^{86}Sr$ = 0.70849 ± 0.00015 (1σ, n = 4) (Fig. 6.11). A faunal sample from the nearby Mt. Fokas (Kalenzti) that is composed of similar deposits, shows $^{87}Sr/^{86}Sr$ = 0.70810 (n = 1) (Fig. 6.10). Thus, considering all samples, the local range for eastern Corinthia is estimated at $^{87}Sr/^{86}Sr$ = 0.70798 – 0.70885 (average ± 2σ, n = 5) (Fig. 6.12), that is generally lower than the values observed in Attica (with the exception of western Attica). At the Pheneos Basin on the mountains of Corinthia, composed mainly of phyllite and Upper Cretaceous limestone (IGME, 1983), faunal samples range from $^{87}Sr/^{86}Sr$ = 0.70797 – 0.70801 (n = 2) (Fig. 6.10). A water sample from the Stymphalos spring in mountainous Corinthia, set on limestone and alluvial deposits (Higgins and Higgins, 1996; IGME, 1983) also shows a lower value of $^{87}Sr/^{86}Sr$ = 0.70758 (n = 1) (Fig. 6.11). Thus, for highland Corinthia, the local range is estimated at $^{87}Sr/^{86}Sr$ = 0.70738 – 0.70833 (average ± 2σ, n = 3) (Fig. 6.12).

At Kalavryta on Mt. Helmos that lie on Upper Cretaceous limestone, Jurassic and Cretaceous flysch, and Plio-Pleistocene conglomerates (IGME, 1983), faunal samples show $^{87}Sr/^{86}Sr$ = 0.70807 – 0.70867 (n = 2) (Fig. 6.10). Water from the springs of the Ladonas River at Mt. Helmos shows $^{87}Sr/^{86}Sr$ = 0.70791 (n = 1) (Fig. 6.11). Thus, the local range for Mt. Helmos is estimated at $^{87}Sr/^{86}Sr$ = 0.70742 – 0.70902 (average ± 2σ, n = 3) (Fig. 6.12). At Mt. Mainalon in Arcadia (central Peloponnese), composed mainly of Mesozoic – Eocene limestones and dolomites and flysch, faunal samples show $^{87}Sr/^{86}Sr$ = 0.70845 – 0.70872 (n = 2) (Fig. 6.10). Hare specimens from the western Mani peninsula, composed mainly of Cretaceous – Eocene limestones and Pliocene deposits, show $^{87}Sr/^{86}Sr$ = 0.70847 ± 0.00055 (1σ, n = 3) (Fig. 6.10), and thus provide an estimate of $^{87}Sr/^{86}Sr$ = 0.70737 – 0.70957 (average ± 2σ, n = 3) (Fig. 6.12). On northeastern Peloponnese, a hare specimen from Troizina, on Mt. Ortholithi, composed mainly of Jurassic limestones, schists, and flysch (IGME, 1983), shows $^{87}Sr/^{86}Sr$ = 0.70859 (n = 1) (Fig. 6.10).

Moreover, snail samples from the Methana peninsula that is composed of Quaternary volcanic rocks (including, andecites and dacites) (Higgins and Higgins, 1996; IGME, 1983) show $^{87}Sr/^{86}Sr$ = 0.70830 ± 0.0001 (1σ, n = 3) (Fig. 6.9) and provide an estimate of $^{87}Sr/^{86}Sr$ = 0.70819 – 0.70841 (average ± 2σ, n = 3) for the local range (Fig. 6.12). The observed range is higher than the $^{87}Sr/^{86}Sr$ values expected given the young volcanic bedrock. Turning to the Saronic Gulf, a variety of samples were taken from the island of Aegina that is also composed mainly of Quaternary volcanic rocks. The northern part of the island is composed of Pliocene marine deposits and limestone; the central and southern island (as well as the northeastern tip) is composed of Quaternary volcanic rocks with small patches of alluvium, while Mt. Oros (southeastern Aegina) is composed of andesite lavas (Higgins and Higgins, 1996; IGME, 1983). Wild rabbit samples from Aegina central and southwestern Aegina show $^{87}Sr/^{86}Sr$ = 0.70757 –

0.70890 and mean $^{87}Sr/^{86}Sr$ = 0.70850 ± 0.0006 (1σ, n = 7) (Fig. 6.10). However, the two lower values ($^{87}Sr/^{86}Sr$ = 0.70757 – 0.70767) come from parts of Mt. Oros on eastern Aegina, thus there seems to be a pattern in intra-island $^{87}Sr/^{86}Sr$ variation. In addition, water samples from cisterns at Lazarides, the village with the highest elevation on the island, show low $^{87}Sr/^{86}Sr$ = 0.70684 – 0.70719 (n = 2) (Fig. 6.11), while snail samples from Lazarides show $^{87}Sr/^{86}Sr$ = 0.70773 – 0.70818 (n = 2) (Fig. 6.9). Thus, when all the values are combined, a wide range is estimated for the whole island, at $^{87}Sr/^{86}Sr$ = 0.70660 – 0.70965 (average ± 2σ, n = 11) (Fig. 6.12). However, when the differences observed between the different regions on the island are taken into consideration, then the local ranges are estimated at $^{87}Sr/^{86}Sr$ = 0.70875 – 0.70894 (average ± 2σ, n = 5) for central and southwestern Aegina, and at $^{87}Sr/^{86}Sr$ = 0.70660 – 0.70846 (average ± 2σ, n = 6) for the eastern Aegina (Fig. 6.13).

Hare specimens were sampled from northern, central, and southern Euboea that is separated from the mainland by the narrow strait of Euboean Gulf. Northern Euboea is composed mainly of Neogene sediments, schists, and igneous rocks (peridotites) (Higgins and Higgins, 1996; IGME, 1983). Based on hare samples that show mean $^{87}Sr/^{86}Sr$ = 0.70879 ± 0.00010 (1σ, n = 3) (the exact locale is not known) (Fig. 6.10), the range for northern Euboea can be estimated at $^{87}Sr/^{86}Sr$ = 0.70859 – 0.70898 (average ± 2σ, n = 3) (Fig. 6.12). Central Euboea is mainly composed of Triassic – Jurassic limestone, schist and phyllites, marbles, and Neogene sediments (Higgins and Higgins, 1996; IGME, 1983). The hare samples show mean $^{87}Sr/^{86}Sr$ = 0.70812 ± 0.00020 (1σ, n = 3) (unknown exact locale) (Fig. 6.10) and provide a local range of $^{87}Sr/^{86}Sr$ = 0.70772 – 0.70852 (average ± 2σ, n = 3) for central Euboea (Fig. 6.12). Finally, southern Euboea that forms part of the Cycladic – Metamorphic Belt, is composed mainly of marble and schist often with marble intercalations, cipolines (sometimes with schist), phyllites, and marble and dolomites (IGME, 1983). The region of Karystos where the hare samples are derived, is bascially composed of schist. The hare samples show mean $^{87}Sr/^{86}Sr$ = 0.70867 ± 0.00025 (1σ, n = 3) (Fig. 6.10) and provide a local range of $^{87}Sr/^{86}Sr$ = 0.70817 – 0.70917 (average ± 2σ, n = 3) (Fig. 6.12). Overall, central Euboea shows lower $^{87}Sr/^{86}Sr$ values than northern and southern, while southern Euboea shows overlap with eastern Attica (Fig. 6.12).

Moving to the Cyclades, the island of Keos, the one closest to Attica, is composed mainly of gneiss and schist (Higgins and Higgins, 1996; IGME, 1983). Hare samples show $^{87}Sr/^{86}Sr$ = 0.70903 – 0.70922 (n = 2) (Fig. 6.10). Hare samples from the island of Andros, composed mainly of gneiss and schist (IGME, 1983) show mean $^{87}Sr/^{86}Sr$ = 0.70897 ± 0.00029 (1σ, n = 4) (Fig. 6.10) and provide an estimated range of $^{87}Sr/^{86}Sr$ = 0.70838 – 0.70956 (average ± 2σ, n = 4) for the island (Fig. 6.12). The islands of Paros and Antiparos are also composed mainly of gneiss, schist, and marble or limestone (IGME, 1983). Hare samples from Paros show $^{87}Sr/^{86}Sr$ = 0.70891 ± 0.00034 (1σ, n = 5) (Fig. 6.10) and an estimated range of $^{87}Sr/^{86}Sr$ = 0.70824 – 0.70959 (average ± 2σ, n = 5) for the island (Fig. 6.12). Wild rabbits from Antiparos show mean $^{87}Sr/^{86}Sr$ = 0.70935 ± 0.00005 (1σ, n = 4) (Fig. 6.10), thus the range of locally bioavailable strontium for the island is estimated at $^{87}Sr/^{86}Sr$ = 0.70925 – 0.70946 (average ± 2σ, n = 4) (Fig. 6.12).

Archaeological fauna from the Cave of Antiparos showed $^{87}Sr/^{86}Sr = 0.70932$ (n = 1) (Nafplioti, 2011) (Fig. 6.4).

The island of Mykonos, to the contrary, is composed of Tertiary granites, granodiorites, and monzonites (IGME, 1983). Wild rabbit samples from southeastern Mykonos show $^{87}Sr/^{86}Sr = 0.70926 \pm 0.00006$ (1σ, n = 3) (Fig. 6.10) and thus provide a range of $^{87}Sr/^{86}Sr = 0.70915 – 0.70937$ (average ± 2σ, n = 3) (Fig. 6.12). The range given for Mykonos is much lower than expected based on the bedrock and published geochemical studies and reflects the seawater $^{87}Sr/^{86}Sr$ ratio. Naxos is the largest Cycladic island. It consists of granites (western), gneiss and schist (central), and marbles and crystalline limestones (eastern) (IGME, 1982). Interestingly, the island of Naxos exhibits the highest variation with values ranging from $^{87}Sr/^{86}Sr = 0.70881 – 0.71068$ and a mean ratio of $^{87}Sr/^{86}Sr = 0.70968 \pm 0.00077$ (1σ, n = 6) (Fig. 6.10). The two higher $^{87}Sr/^{86}Sr$ values ($^{87}Sr/^{86}Sr = 0.71056 – 0.71068$) are observed in samples derived from the central, more mountainous part of the island that might be less affected by sea spray. The higher values observed are in accordance with the overall geology of the island and published geochemical studies for the island. High $^{87}Sr/^{86}Sr$ values were also measured in archaeological human and faunal specimens from the island (Nafplioti, 2007, 2011). Based on this study, the range for Naxos is estimated at $^{87}Sr/^{86}Sr = 0.70814 – 0.71122$ (average ± 2σ, n = 6) (Fig. 6.12). The island of Amorgos is composed mainly of Triassic – Jurassic limestone and flysch (IGME, 1983). Hare samples from southern Amorgos show $^{87}Sr/^{86}Sr = 0.70894 \pm 0.00024$ (n = 5) (Fig. 6.10) and provide an estimated range of $^{87}Sr/^{86}Sr = 0.70846 – 0.70941$ (average ± 2σ, n = 5) for the island (Fig. 6.12).

The volcanic islands, Melos, Santorini, and the small island of Therasia are composed of Quaternary and Plio-Pleistocene volcanic rocks (IGME, 1983). Hare and wild rabbit samples from Melos show $^{87}Sr/^{86}Sr$ = 0.70886 ± 0.00014 (n = 3) (Fig. 6.10) and give an estimated range of $^{87}Sr/^{86}Sr$ = 0.70857 – 0.70915 (average ± 2σ, n = 3) for the island (Fig. 6.12). Wild rabbits from northern Santorini (Thera) and central Therasia show $^{87}Sr/^{86}Sr$ = 0.70874 ± 0.00006 (n = 3) (Fig. 6.10). Snail samples from southern Santorini show $^{87}Sr/^{86}Sr$ = 0.70833 ± 0.00010 (n = 4) (Fig. 6.9). The range of locally bioavailable strontium at Santorini is estimated at $^{87}Sr/^{86}Sr$ = 0.70804 – 0.70896 (average ± 2σ, n = 7) respectively (Fig. 6.12). Thus, neither of the islands shows the low $^{87}Sr/^{86}Sr$ values expected based on the volcanic substrate and the published geochemical studies for the Hellenic Volcanic Arc. Given the coastal locations, the observed values probably reflect an ocean spray effect.

A hare sample from the island of Ikaria (exact location unknown), which is composed of granites (western half), marble and gneiss (Higgins and Higgins, 1996; IGME, 1983), shows $^{87}Sr/^{86}Sr$ = 0.70832 (n = 1) (Fig. 6.10). The island of Samos is composed of marble, schist, and Neogene sediments (Higgins and Higgins, 1996). Hare samples from Samos show mean $^{87}Sr/^{86}Sr$ = 0.70854 ± 0.00030 (n = 3) (Fig. 6.10), estimating a range of $^{87}Sr/^{86}Sr$ = 0.70794 – 0.70915 (average ± 2σ, n = 3) (Fig. 6.12). In the Dodecanese, the island of Patmos is composed of Quaternary and Plio-Pleistocene volcanic rocks (IGME, 1983). Hare samples from Patmos show $^{87}Sr/^{86}Sr$ = 0.70843 – 0.70852 (n = 2) (Fig. 6.10), not reflecting the volcanic bedrock. Hare samples from the adjacent island of Leipsoi that is composed of Triassic – Jurassic limestone show

$^{87}Sr/^{86}Sr$ = 0.70830 – 0.70858 (n = 2) (Fig. 6.10). The island of Leros is composed of Upper Paleozoic schists, phyllites, and limestones (IGME, 1983); hare samples from Leros show $^{87}Sr/^{86}Sr$ = 0.70892 – 0.70936 (n = 2) (Fig. 6.10). The island of Kos is composed of volcanic rocks (Quaternary tuffs), flysch, Neogene sediments and alluvial deposits (Higgins and Higgins, 1996; IGME, 1983). Wild rabbits from both northern and southern Kos show $^{87}Sr/^{86}Sr$ = 0.70823 ± 0.00035 (n = 4) (Fig. 6.10), providing an estimated range of $^{87}Sr/^{86}Sr$ = 0.70754 – 0.70892 (average ± 2σ) (Fig. 6.12). These data are in agreement with published values measured in snail samples from Kos island that showed $^{87}Sr/^{86}Sr$ = 0.70821 – 0.70847 (n = 3) (Nafplioti, 2011) (Fig. 6.4).

In northeastern Aegean, the island of Lemnos is composed mainly of Mio-Pleistocene volcanic rocks, Eocene – Oligocene molasses, and alluvial deposits (IGME, 1983). Wild rabbit samples from different parts of the island show $^{87}Sr/^{86}Sr$ = 0.70830 – 0.70858 (n = 2) (Fig. 6.10). The island of Lesvos has a complex geology. It consists mainly of volcanic rocks, ophiolites, schists, phyllites, and limestones (IGME, 1983). A hare sample from Lesvos shows $^{87}Sr/^{86}Sr$ = 0.70855 (n = 1) (Fig. 6.10). The northeastern part of the island of Chios is composed of detrital formations with intercalations of volcanic tuffs and Paleozoic limestones; the majority of the island is composed of Triassic - Jurassic limestone, while the southwestern part is composed of Neogene marine sediments (IGME, 1983). Hare samples from both northeastern and southern Chios show higher values of $^{87}Sr/^{86}Sr$ = 0.71026 – 0.71049 (n = 2) (Fig. 6.10). These values are in agreement with published values from archaeological faunal specimens from the Cave of Agio Gala in northeastern Chios that ranged from $^{87}Sr/^{86}Sr$ = 0.71053 – 0.71187 (n = 3)

(Nafplioti, 2011) (Fig. 6.4). A single hare specimen from the southern coast of central Crete (close to Matala), composed of alluvial and marine deposits, showed $^{87}Sr/^{86}Sr$ = 0.70851 (n = 1) (Fig. 6.10).

Finally, the intra-regional and inter-sample variability observed in the areas for which multiple types of modern environmental samples are available is worthy of further consideration (Fig. 6.13). Variation in radiogenic strontium isotope signatures within and between different types of baseline samples is an issue that has been addressed, adding also to the importance of the characterization of biologically available strontium values (see Bentley et al., 2004; Price et al., 2002). In this study, the coastal locations of Marathon and the islands of Aegina and Santorini included values close to the sea water $^{87}Sr/^{86}Sr$ signal (Fig. 6.13). However, different sampling locations often produced different $^{87}Sr/^{86}Sr$ signatures, even between distances of a few kilometers. At Marathon, the snail samples from the cemetery of Tsepi showed lower $^{87}Sr/^{86}Sr$ values than the snail samples from the coastal site of Plasi (which were closer to the sea water value), located only approximately 2.5 km away. As discussed previously, the snail samples from Tsepi were also lower than the archaeological faunal samples from the cemetery (again, note that the snail specimens were collected from a burial context). Nevertheless, the $^{87}Sr/^{86}Sr$ values of the Tsepi snails were close to the local hare sample (Fig. 6.13). On the island of Aegina, for which the largest number of modern samples is available, the $^{87}Sr/^{86}Sr$ values from sampling locations closer to the coast are generally similar to the sea water value, while they become significantly lower as the distance from the coast and the altitude increase in accordance with the underlying volcanic geology (see previous analytical description) (Fig. 6.13). The lowest values that match the expected volcanic substrate come from the water samples (cisterns), while the wild rabbit values are a bit higher, probably averaging a wider range of resources (Fig. 6.13). With regards to the island of Santorini, the snail specimens sampled at the southern part of the island show slightly lower values than the wild rabbit specimens from the northwestern part of the island and the adjacent Therasia (Fig. 6.13). Despite the common volcanic geology across this island complex, the wild rabbit values are closer to the sea water signature (Fig. 6.13).

Generally, the hare and wild rabbit samples, as well as the snail samples show narrow ranges depending on their sampling locations. The water samples show more variability, possibly reflecting different groundwater sources. In the case of Ancient Corinth, three of the four springs sampled (Cheliotomylos, Tiles, Kokkinovrysi) show nearly identical values ($^{87}Sr/^{86}Sr = 0.70850 – 0.70860$) due to the common underground origin (Table 6.11; Fig. 6.13). The fourth spring (Hadji-Mustafa fountain) originates from the hill of Acrocorinth and shows a slightly lower value ($^{87}Sr/^{86}Sr = 0.70829$) (Table 6.11; Fig. 6.13). Thus, even though the water springs are only within a few kilometers distance, they can have different values reflecting the different origins of the springs. As a result, it becomes clear that regional signatures can be very sensitive to sampling locations, as well as to the types of specimens sampled. Furthermore, the more diverse the specimens analyzed, the broader seems to be the resulting range, highlighting again the importance of the characterization of the locally bioavailable strontium ranges.

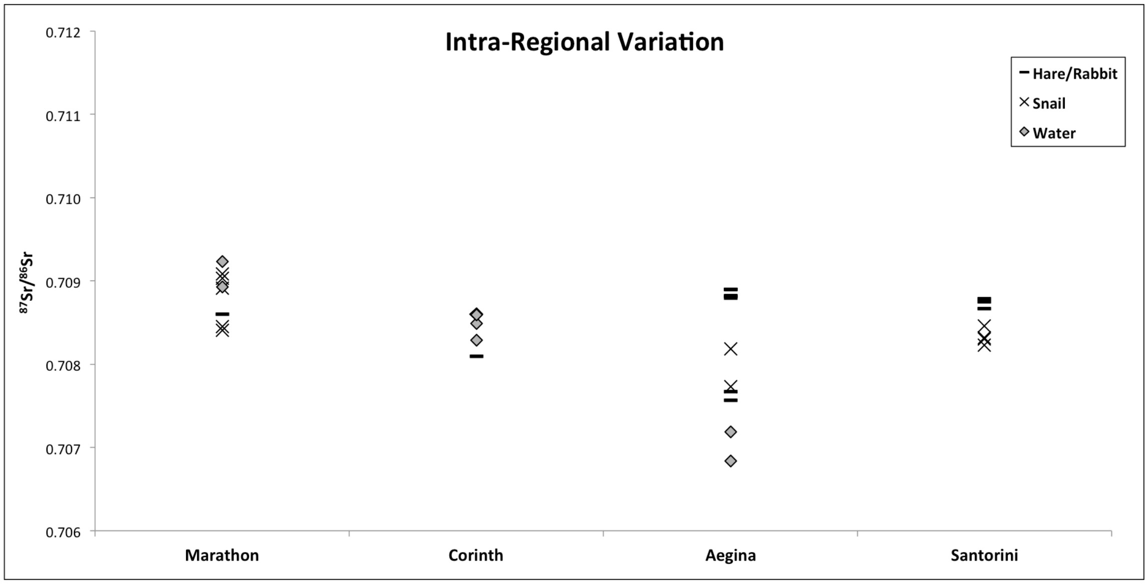

Figure 6.13. Intra-regional variation in radiogenic strontium isotope values measured in different types of modern environmental samples.

Comparative Archaeological Sample

Two smaller Early Bronze Age skeletal assemblages were analyzed to provide comparative archaeological data. These two assemblages are only discussed here briefly in relation to Tsepi cemetery; a detailed description will be provided elsewhere. At Cheliotomylos in Ancient Corinth, human enamel samples range from $^{87}Sr/^{86}Sr = 0.70852 – 0.70905$ and show mean $^{87}Sr/^{86}Sr = 0.70873 \pm 0.00020$ (1σ, n = 20) (Appendix E). Human bone samples show mean $^{87}Sr/^{86}Sr = 0.70854 \pm 0.00002$ (1σ, n = 4) (Appendix E). At Artemida (Loutsa) on the coast of eastern Attica, human enamel samples show from $^{87}Sr/^{86}Sr = 0.70900 – 0.70923$ and mean $^{87}Sr/^{86}Sr = 0.70907 \pm 0.00006$ (1σ, n = 14). Human bone from Artemida shows mean $^{87}Sr/^{86}Sr = 0.70905 \pm 0.00001$ (1σ, n = 4). Thus, when the local range formula is applied, the human bone samples give an estimate of $^{87}Sr/^{86}Sr = 0.70850 – 0.70858$ (average ± 2σ, n = 4) and $^{87}Sr/^{86}Sr = 0.70902 – 0.70907$ (average ± 2σ, n = 4) for Cheliotomylos and Artemida respectively. Note, here, the very narrow ranges provided by the human bone values in both sites.

When the three sites are compared, the enamel values from Loutsa show the lowest variation (Fig. 6.14). The Loutsa assemblage has the smallest sample size. However, the very narrow range of the Loutsa values are in agreement with a small, local community represented by the two EH graves. The Loutsa $^{87}Sr/^{86}Sr$ values are very close to the $^{87}Sr/^{86}Sr$ value for seawater reflecting the coastal location, as well as potential consumption of marine resources (paleodiet will be discussed in detail in the following section). Moreover, the $^{87}Sr/^{86}Sr$ range estimated by the human bone samples in Loutsa falls well within the local range estimated for Marathon and eastern, coastal Attica, as would be expected given the similar geology of the two regions and their relatively close location. Thus, differences between the two locations will probably not be detected in $^{87}Sr/^{86}Sr$ signatures.

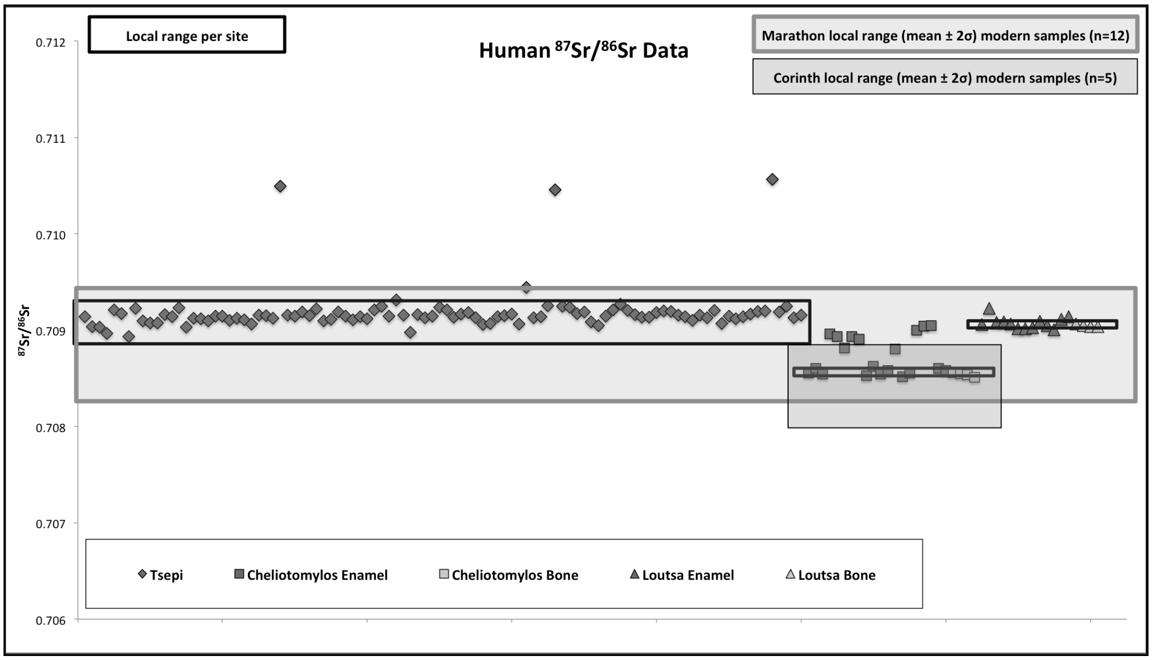

Figure 6.14. Radiogenic strontium isotope data for all archaeological human specimens included in this study. The local range at Tsepi cemetery was determined using archaeological faunal samples (average ± 2σ, n = 15). The local ranges at Cheliotomylos and Loutsa were determined using the human bone values (average ± 2σ, n = 4). See text for details.

The Cheliotomylos assemblage from the village of Ancient Corinth shows an interesting pattern. Three individuals, a child (CHEL-79), an adult male (CHEL-80), and an adult probable female (CHEL-81) show values higher than both the range determined by human bone and by modern samples, however the values are close to the upper range of the modern samples (Fig. 6.14). The highest $^{87}Sr/^{86}Sr$ values ($^{87}Sr/^{86}Sr > 0.709$) come from individual CHEL-03, an adult female, suggesting an origin non-local to the ancient Corinth (Fig. 6.14). The intra-individual comparison of the values of CHEL-03 shows that she consumed a very similar diet from infancy to adolescence (Fig. 6.15). This suggests that she came to the area as an adult. However, the values are close to the seawater $^{87}Sr/^{86}Sr$ ratio; thus, potential consumption of marine resources or sea salt might have affected the $^{87}Sr/^{86}Sr$ signature. This possibility will be addressed in the following section where paleodiet will be specifically examined.

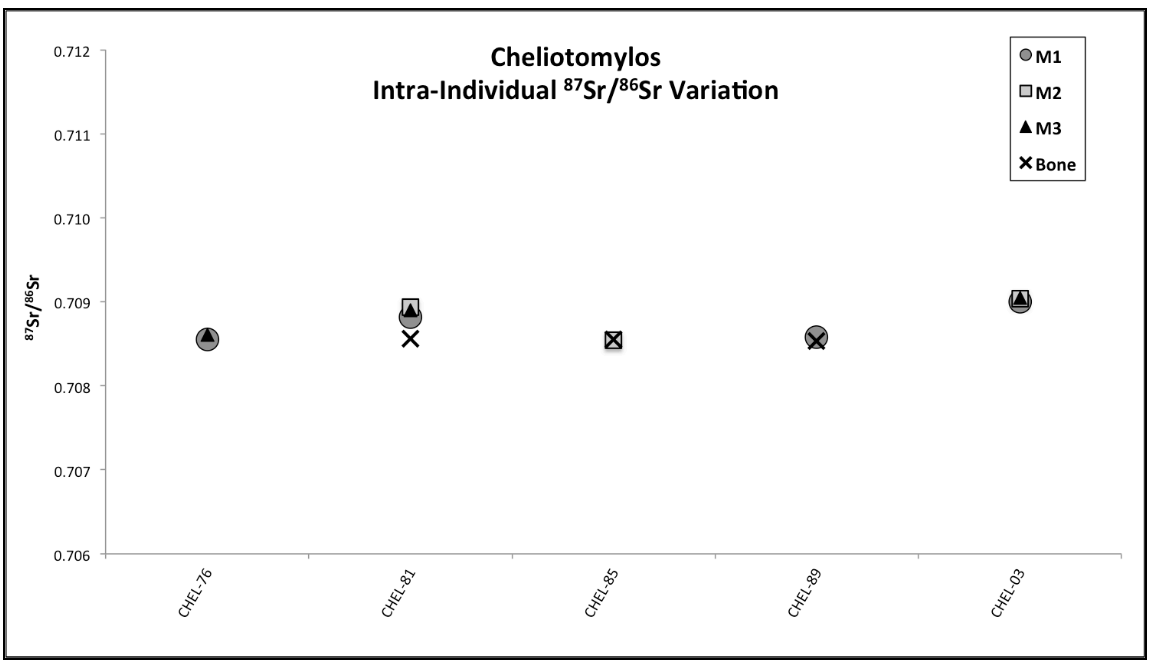

Figure 6.15. Radiogenic strontium isotope data per individual from Cheliotomylos (M1, first molar; M2, second molar; M3, third molar).

Paleodiet

To determine different trophic levels for terrestrial and marine ecosystems in the Aegean, a series of faunal and environmental samples (n = 27) were analyzed for stable strontium isotopes and elemental concentrations. The baseline samples from the Aegean exhibit the trophic level variation expected both for $\delta^{88/86}Sr$ values and log(Ba/Sr) systems (Fig. 6.16). The log(Ba/Sr) values show a clear distinction between marine and terrestrial ecosystems (Fig. 6.17). All fish samples show values lower than log(Ba/Sr) = -1.53, with the exception of sample ACL-6123 (Mediterranean sand smelt) that has a higher value (log(Ba/Sr) = -0.77). All terrestrial samples, including the fresh water samples, show values higher than log(Ba/Sr) = -1.32. Omnivorous specimens (pigs) form a cluster between log(Ba/Sr) = -1.23 − -1.08, separated from the values of the herbivores that range from log(Ba/Sr) = -0.72 − -0.48. The lower log(Ba/Sr) values of the omnivores compared to the ones of the herbivores probably reflect some consumption of meat. Considering the stable strontium isotope results, the fish samples show the highest $\delta^{88/86}Sr$ values, clustering with the land snail and water samples, all with positive values with the exception of specimen ACL-6107 (Fig. 6.17). The highest $\delta^{88/86}Sr$ values ($\delta^{88/86}Sr$ = 0.25 − 0.26) come from bonitos, which are carnivorous fish. In terrestrial systems, the omnivorous and herbivorous specimens show lower $\delta^{88/86}Sr$ values, with a range of $\delta^{88/86}Sr$ = -0.19 − -0.38‰, with the exception of one sheep/goat sample that shows a higher value of $\delta^{88/86}Sr$ = 0.04‰.

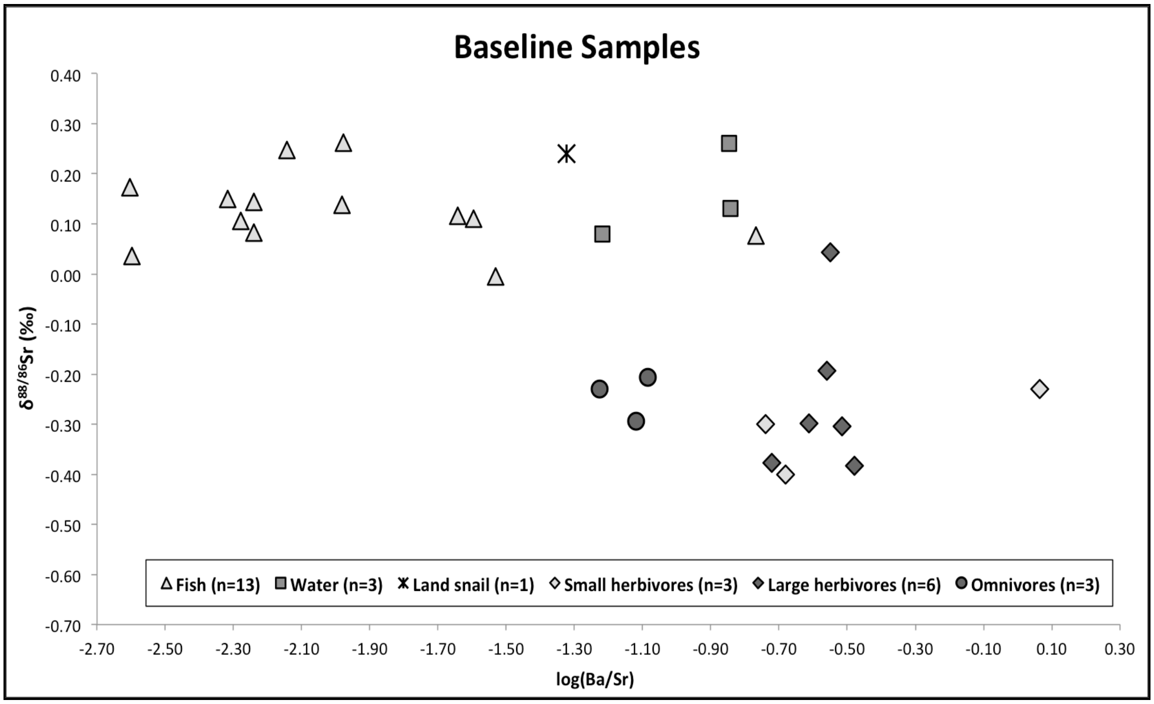

Figure 6.16. Stable strontium isotope ($\delta^{88/86}$Sr) and elemental concentrations (log(Ba/Sr) for baseline samples included in this study.

Turning to the human values, the human log(Ba/Sr) values show similar ranges in all three EH sites (Fig. 6.17). The human samples show values that fall within both terrestrial and marine ecosystems indicating variation in dietary resources. Values lower than log(Ba/Sr) = -1.50 matching the marine samples make up 24% in Tsepi (n = 100), 29% in Cheliotomylos (n=24), and 30% in Loutsa (n = 17). In the cemetery of Tsepi, 24 samples (24%) show log(Ba/Sr) values lower than -1.50, indicating a marine diet. All human log(Ba/Sr) values are generally lower than the ones observed in herbivores, reflecting consumption not only of marine resources, but possibly of meat products as well as indicated also by the omnivore values. In Cheliotomylos and Loutsa where human bone samples are available, the bone log(Ba/Sr) values all cluster together, showing higher values for both log(Ba/Sr) and $\delta^{88/86}Sr$ than the ones measured in the enamel samples (Appendix E). Given that the Loutsa bone samples showed a possible diagenetic signature, the observed values could be the result of post-depositional contamination. Still, considering that the Cheliotomylos bone samples showed a biogenic signal, these differences might reflect changes in the diet during the last years of life. Finally, the $\delta^{88/86}Sr$ ranges of all three archaeological human samples, particular the one observed in Tsepi individuals, are much larger than the ones observed in the herbivore and omnivore faunal samples, indicating consumption of significantly more variable strontium diets.

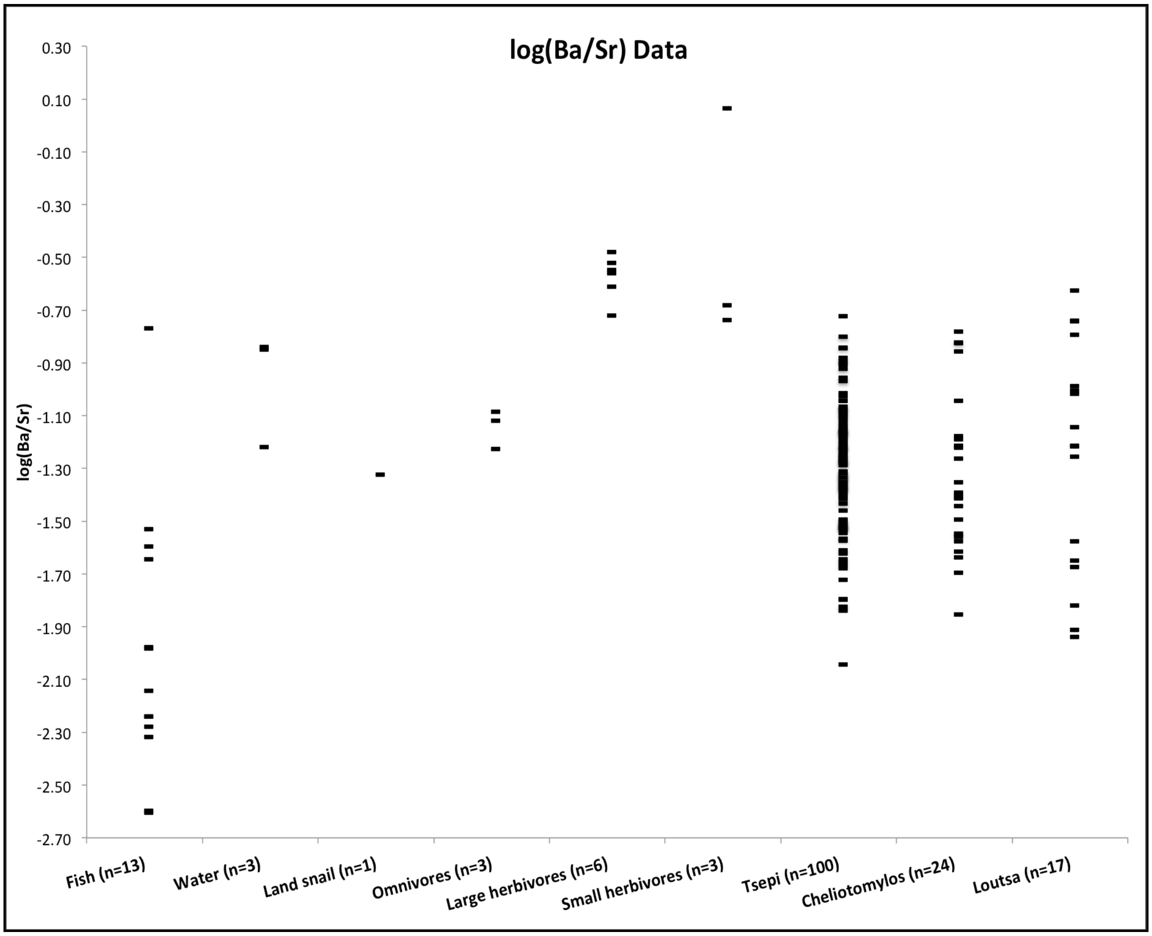

Figure 6.17. Elemental concentrations (log(Ba/Sr) for the archaeological and modern samples included in this study.

A slightly different picture is given by the stable strontium isotope results. The human values from the three sites show again wide ranges of $\delta^{88/86}$Sr values falling under both marine and terrestrial ecosystems (Fig. 6.18). The Tsepi enamel samples show a wide range of $\delta^{88/86}$Sr = -0.66 – 0.14‰ with mean $\delta^{88/86}$Sr = -0.23 ± 0.15‰ (1σ, n = 93). The Tsepi sample shows very low $\delta^{88/86}$Sr values suggesting consumption of strontium from higher terrestrial trophic levels. Specifically, eight individuals from Tsepi show

$\delta^{88/86}Sr$ values lower than the ones measured in the faunal samples ($\delta^{88/86}Sr < -0.40‰$). Furthermore, six individuals (a total of seven samples) show positive $\delta^{88/86}Sr$ values suggesting consumption of strontium from marine resources. Interestingly, the lowest $\delta^{88/86}Sr$ values observed in Tsepi come from female individuals, while the highest $\delta^{88/86}Sr$ values come from male individuals suggesting possible sex-based dietary differences (Fig. 6.19). This pattern indicates consumption of high trophic level resources by both sexes, but from different environments: males consumed strontium from marine resources, while females consumed strontium from high trophic level terrestrial resources. Given that Tsepi is a coastal site, this could potentially reflect differential access to resources based on occupation and social roles: if men were more closely associated with the sea and participated in marine activities (e.g., seafaring, fishing), then they might be expected to consume more marine resources. This pattern, however, could also reflect community differences. Moreover, there is no pattern based on burial location (e.g., grave), suggesting that the same resources were probably available to the whole cemetery population/community (Fig. 6.20). Interestingly, the high $\delta^{88/86}Sr$ values from Tomb 3 (Fig. 6.20) come from a male skeleton (TSEP-T3-1) that formed the last *in situ* burial. Intra-individual variation shows that TSEP-T3-1 consumed marine resources throughout childhood and higher marine trophic levels in late childhood – early adolescence (third molar), suggesting an overall different diet than the rest of the individuals (Fig. 6.21). The consumption of marine resources might have affected the radiogenic strontium isotope values of these individuals; thus, a possible non-local origin might not be detected given that their $^{87}Sr/^{86}Sr$ values are close to the seawater signature

(Appendix E). Thus, the dietary differences could be potentially related with a different community.

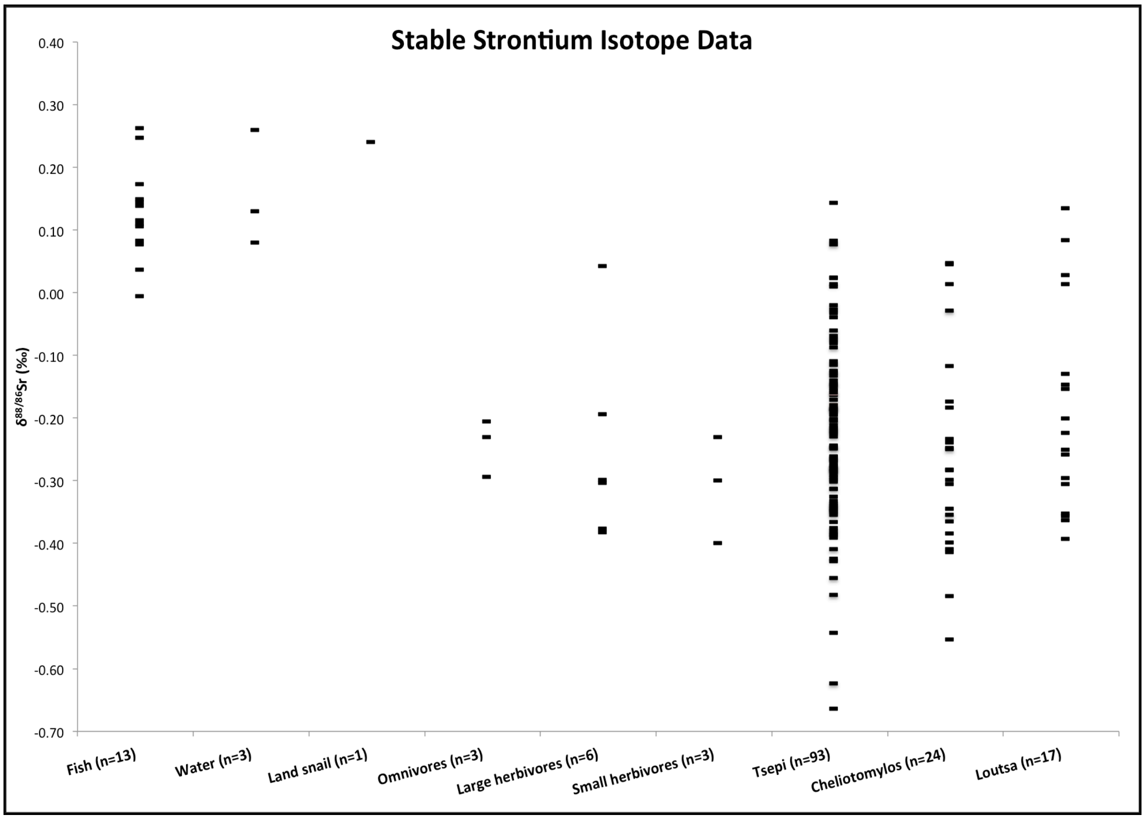

Figure 6.18. Stable strontium isotope data ($\delta^{88/86}Sr$) for the archaeological and modern samples included in this study.

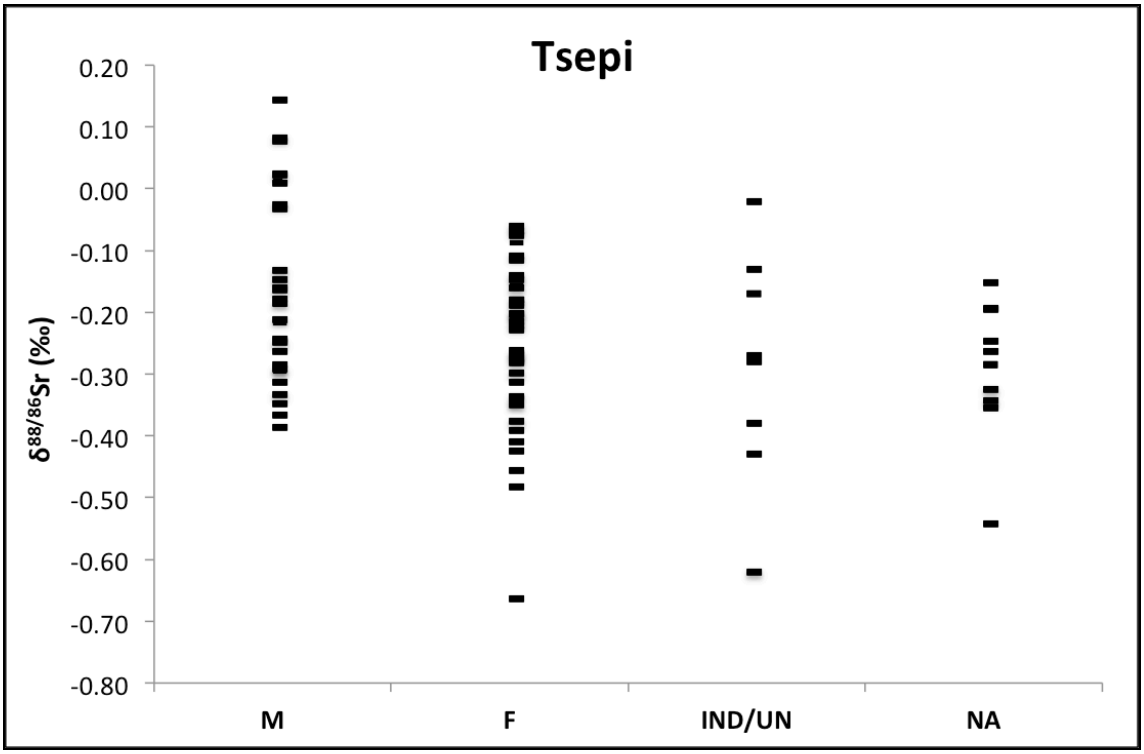

Figure 6.19. Variation in stable strontium isotopes ($\delta^{88/86}Sr$) according to sex in the cemetery of Tsepi.

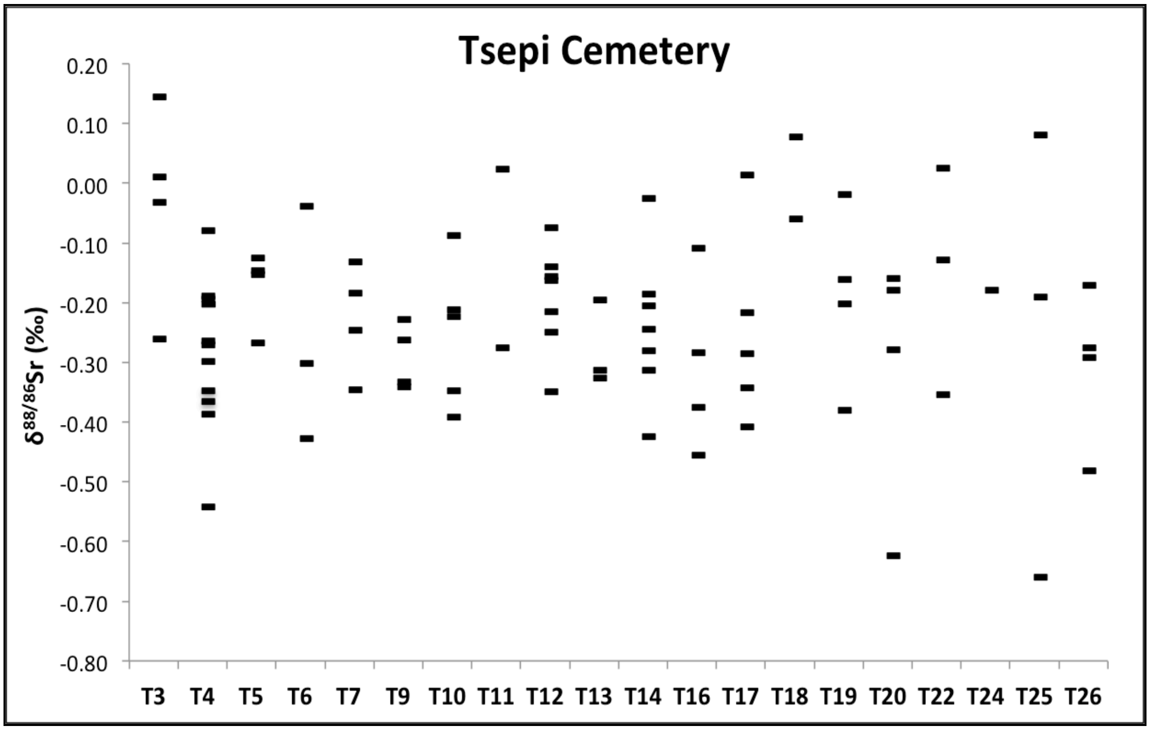

Figure 6.20. Variation in stable strontium isotopes ($\delta^{88/86}Sr$) based on burial location (tomb number) in the cemetery of Tsepi.

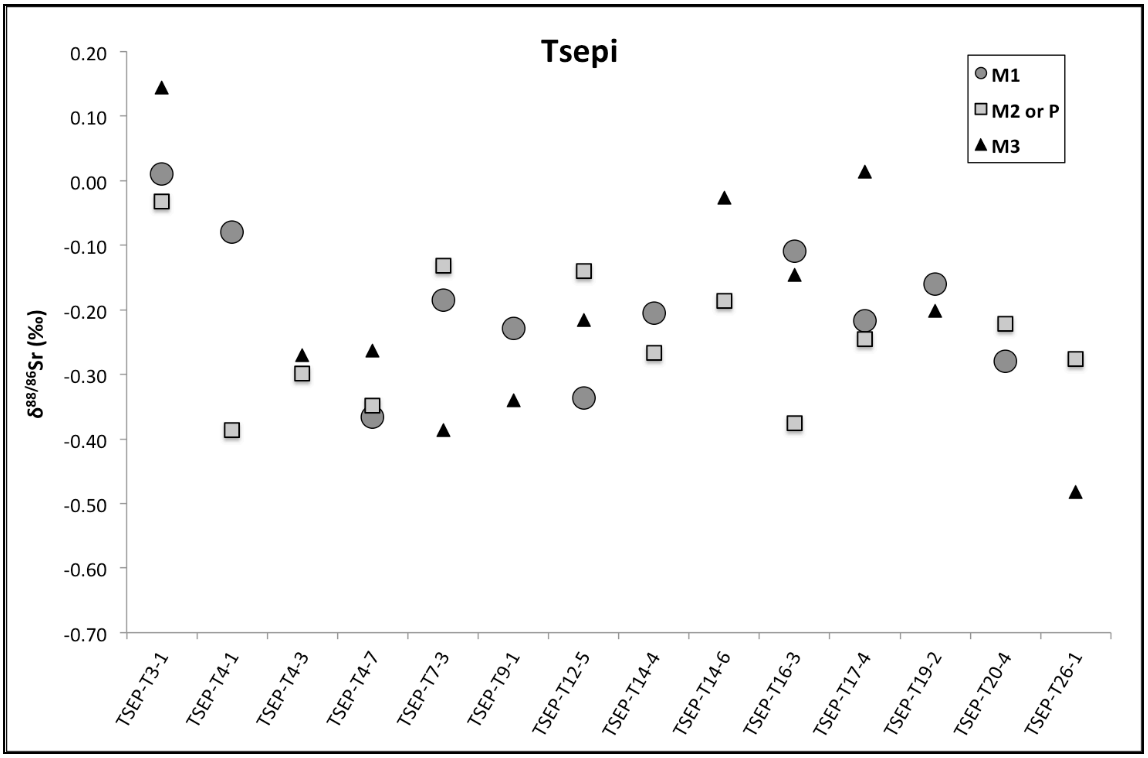

Figure 6.21. Intra-individual variation in stable strontium isotope ($\delta^{88/86}Sr$) values measured in Tsepi cemetery (M1, first molar; M2 or P, second molar or premolar; M3, third molar).

With regard to inter-tooth variation, teeth that formed during nursing are expected to exhibit lower $\delta^{88/86}Sr$ values, reflecting the higher trophic level of the mother's diet through breast milk, compared to teeth that form after weaning. At Tsepi, first molars show mean $\delta^{88/86}Sr$ = -0.23 ±0.14‰ (1σ, n=45) ranging from $\delta^{88/86}Sr$ = -0.66 – 0.08‰, second molars show mean $\delta^{88/86}Sr$ = -0.24 ±0.14‰ (1σ, n=32) ranging from $\delta^{88/86}Sr$ = -0.62 – 0.08‰, and third molars show mean $\delta^{88/86}Sr$ = -0.19 ±0.18‰ (1σ, n=14) ranging from $\delta^{88/86}Sr$ = -0.48 – 0.14‰. First and second molars show very similar $\delta^{88/86}Sr$ values, thus showing no differences in trophic level between the different ages (Fig. 6.22). Third molars do show higher $\delta^{88/86}Sr$ values compared to first and second molars, suggesting strontium intake from a lower trophic level. Overall, all three classes of teeth show relatively similar $\delta^{88/86}Sr$ values (Fig. 6.22). In the majority of the cases, there seems to be considerable variation in diet during life; however, there is no pattern based on dental element (i.e., age). However, first molars start forming *in utero* and complete enamel formation by approximately the age of 3 years, thus they probably represent both pre- and post-weaning diets. Thus, the lack of difference in $\delta^{88/86}Sr$ values between early and late forming teeth may suggest that the weaning process begun before the age of 3 ± 1 years. This is further illustrated by the examination of dietary differences during an individual's life history based on dental elements that form in different ages (Fig. 6.21). However, it is also possible that dietary differences based on weaning were not detected through the $\delta^{88/86}Sr$ isotope analysis. This hypotehis can be tested through other lines of isotopic evidence, such as stable nitrogen, carbon, and oxygen isotope analyses that have been shown to reflect weaning effects (e.g., Bourbou et al., 2013; Herring et al., 1998; Richards et al., 2002; Schurr, 1998; White et al., 2004; Wright and Schwarcz, 1998, 1999).

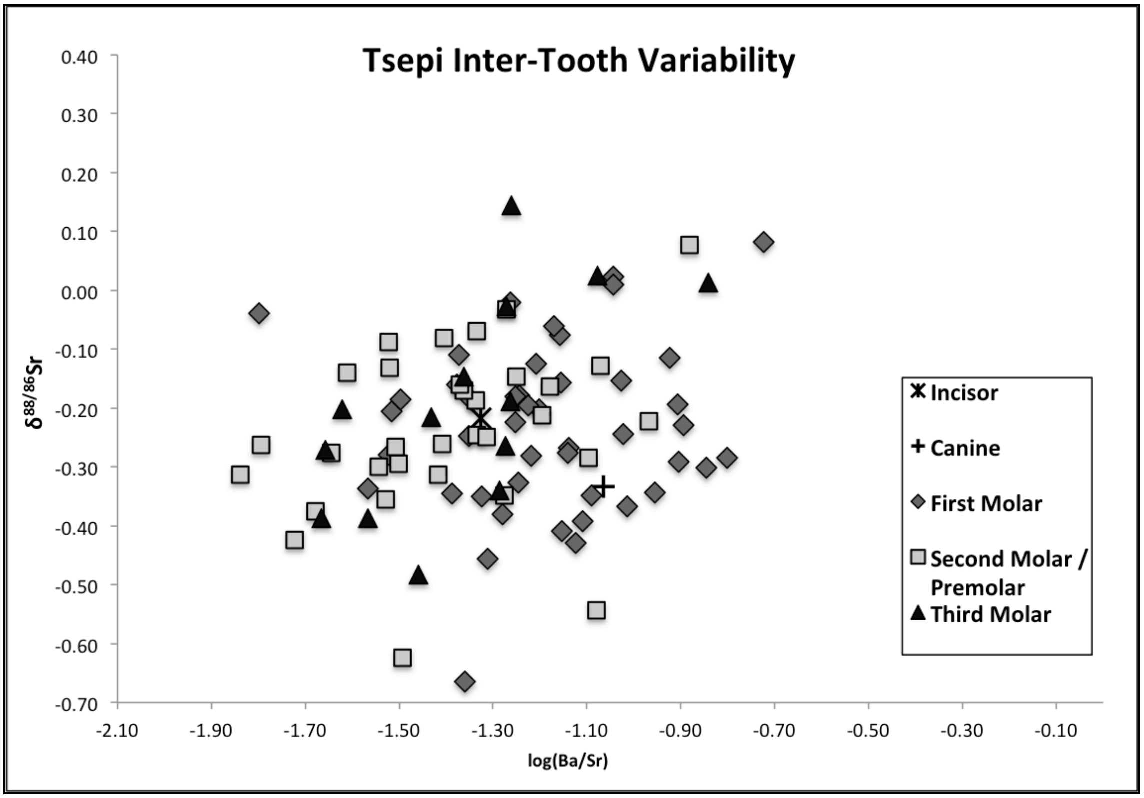

Figure 6.22. Stable strontium isotope ($\delta^{88/86}$Sr) and elemental (log(Ba/Sr)) data for different teeth analyzed from the cemetery of Tsepi.

A similar pattern is observed in the comparative archaeological samples, where the different classes of teeth do not show differences in their $\delta^{88/86}$Sr values (Figs. 23, 24). However, regarding Loutsa and Cheliotomylos where bone samples are also available, there is a clear difference between enamel and bone $\delta^{88/86}$Sr values. In both sites, bone samples show $\delta^{88/86}$Sr values much higher than the ones measured in enamel from the same sites. This could in fact indicate the introduction of higher levels of marine resources in the diet during the later years of life. This is also evident when the intra-individual $\delta^{88/86}$Sr variation is examined in Cheliotomylos (Fig. 6.23). For the five individuals for whom multiple elements are available, inter-tooth differences are not consistent with a post-weaning effect; however the bone samples are always much higher than the dental elements from the same individuals.

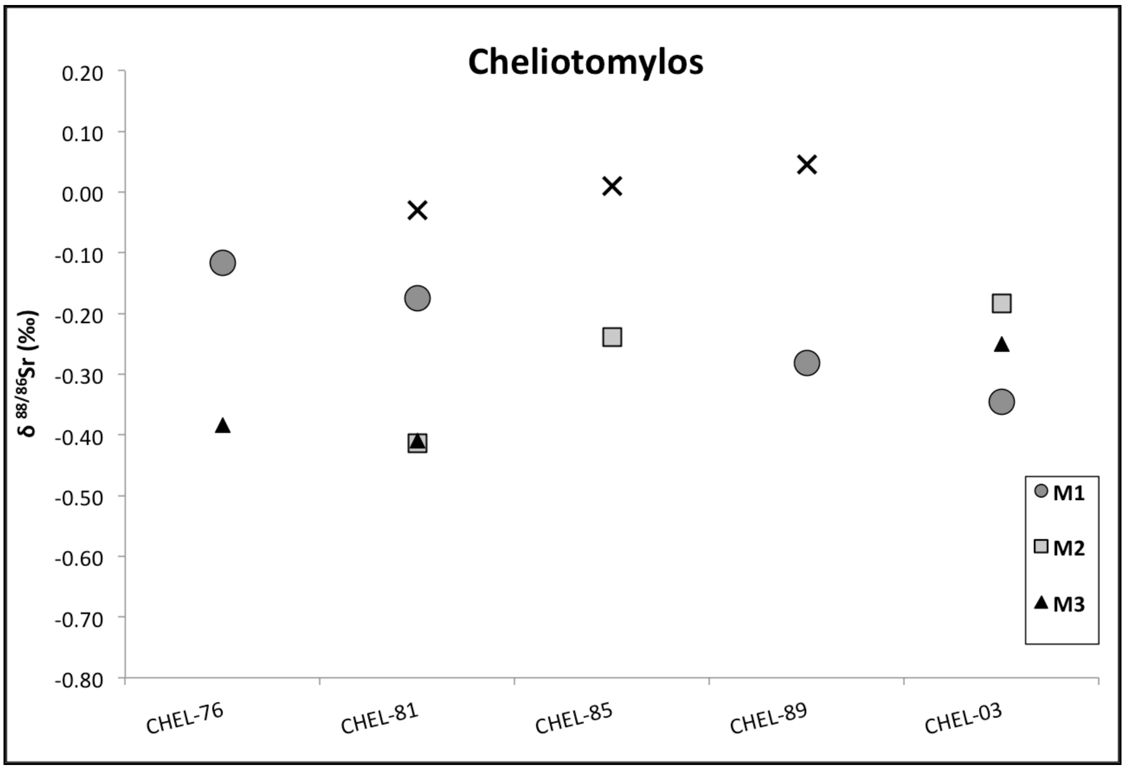

Figure 6.23. Intra-individual variation in stable strontium isotope ($\delta^{88/86}$Sr) values measured in Cheliotomylos.

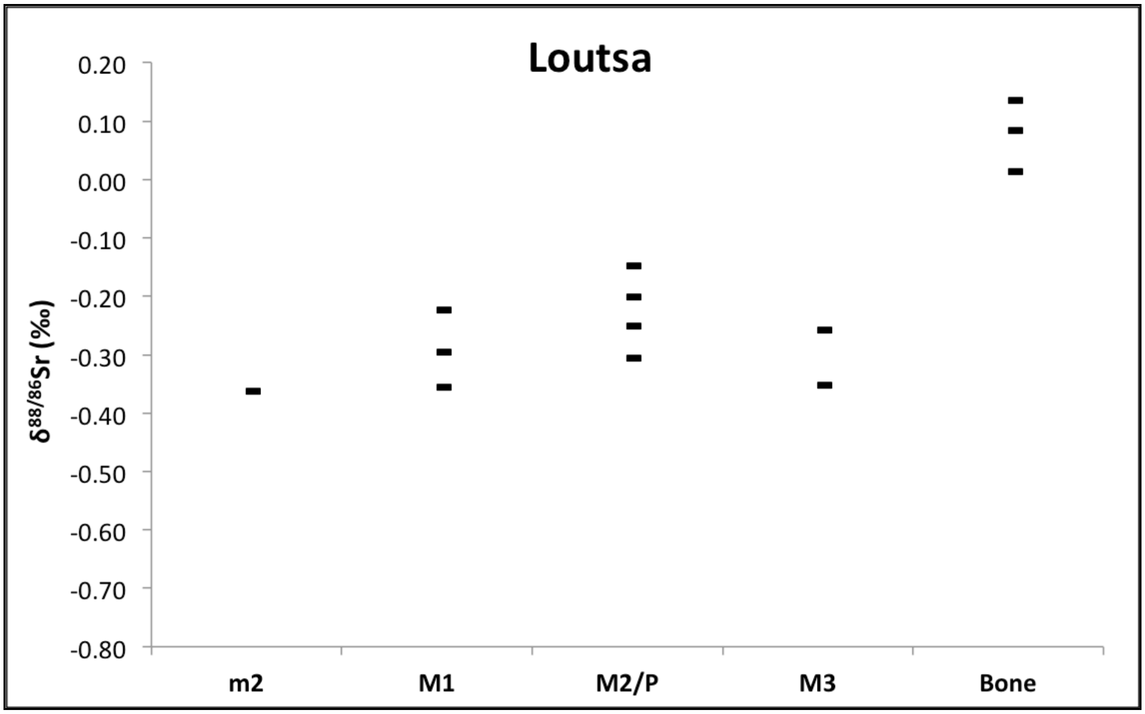

Figure 6.24. Stable strontium isotope ($\delta^{88/86}Sr$) values measured in different elements in the Loutsa graves (m2, deciduous second molar; M1, first molar; M2/P, second molar or premolar; M3, third molar).

Overall, the observed $\delta^{88/86}Sr$ variation is larger in Tsepi compared to the other two archaeological sites indicating great variation in dietary sources and also access to strontium from higher trophic levels, both marine and terrestrial (Fig. 6.18). Granted, the sample sizes are different, but the high and low $\delta^{88/86}Sr$ enamel values in Tsepi are not observed in the other two archaeological assemblages. Cheliotomylos and Loutsa show minimum values of $\delta^{88/86}Sr$ = -0.55‰ and $\delta^{88/86}Sr$ = -0.39‰ respectively. In Cheliotomylos, four individuals (five samples in total) show values lower than $\delta^{88/86}Sr$ = -0.40‰. Only the bones samples from Cheliotomylos and Loutsa show values higher than

$\delta^{88/86}Sr$ = -0.10‰ (Appendix E). This indicates that the individuals buried in Tsepi had access to a more variable diet and that they consumed strontium from higher trophic levels, both marine and terrestrial, during their childhood and adolescence in comparison to the other two EH sites. This is in accordance with a more prominent position of Tsepi in the EH world, as well as a more variable (and larger) community, as suggested by the spatial organization of the cemetery and the finds. This difference is particularly evident when the $\delta^{88/86}Sr$ values from Tsepi cemetery are compared to those from the two graves at Loutsa that share a similar habitat on the western coast of Attica. The Loutsa enamel samples show a much more narrow $\delta^{88/86}Sr$ range. The four bone sample from Loutsa do show a clear difference with much higher $\delta^{88/86}Sr$ values; however, the poor bone preservation might indicate a diagenetic signal.

When the $\delta^{88/86}Sr$ values for the Aegean area generated in this study are compared with the published $\delta^{88/86}Sr$ values from the Andes (Knudson et al., 2010), some interesting patterns emerge. First of all, the baseline samples show not only a similar trend, but also similar baseline values between the Andean and Aegean contexts. This validates the use of stable strontium isotope analysis as a paleodietary indicator and suggests that geological and geochemical differences in fact do not affect the trophic level variation expressed in $\delta^{88/86}Sr$ values. Even though further research in different ecosystems is needed, the lack of significant inter-regional differences in the baseline might support the use of samples from multiple regions for the characterization of trophic level ranges, again within any given ecosystem. The human samples from the Aegea and the Andes do show significant differences in the measured $\delta^{88/86}Sr$ values, reflecting the different dietary practices.

Conclusions Based on Biogeochemical Data

When the relationship between paleodiet and paleomobility at Tsepi is examined, it is clear that the three individuals identified as non-locals based on their radiogenic strontium isotope signature show neither extreme $\delta^{88/86}Sr$ values nor extreme log(Ba/Sr) values (Fig. 6.25). Thus, the individuals exhibiting non-local geochemical signals consumed diets similar to the majority of the archaeological populations. This further ensures that the identification of the three non-local individuals is not affected by the consumption of marine resources, given that they exhibit strontium intake from terrestrial sources (Figs. 6.18, 6.25). However, the six individuals from Tsepi (a total of seven samples) that exhibit positive $\delta^{88/86}Sr$ indicative of a marine diet, show $^{87}Sr/^{86}Sr$ values very close to the seawater signature (ranging between $^{87}Sr/^{86}Sr = 0.70903 – 0.70932$) that falls within the Tsepi local $^{87}Sr/^{86}Sr$ range. In this case, a heavy consumption of marine resources might be masking an originally higher or lower geochemical signature by mimicking the seawater $^{87}Sr/^{86}Sr$ value. Thus, the potential non-local geologic origin of these individuals might not be detectable through $^{87}Sr/^{86}Sr$ analysis, but could be elucidated through future stable oxygen isotope analysis. Stable oxygen isotopes enter the human skeleton mainly through the ingestion of water and can reflect environmental variation (for a review of the method, applications, and limitations see Knudson, 2009).

As a result, stable oxygen isotope analysis can be used to supplement strontium isotope analysis in the identification of past mobility between different geochemical and environmental zones.

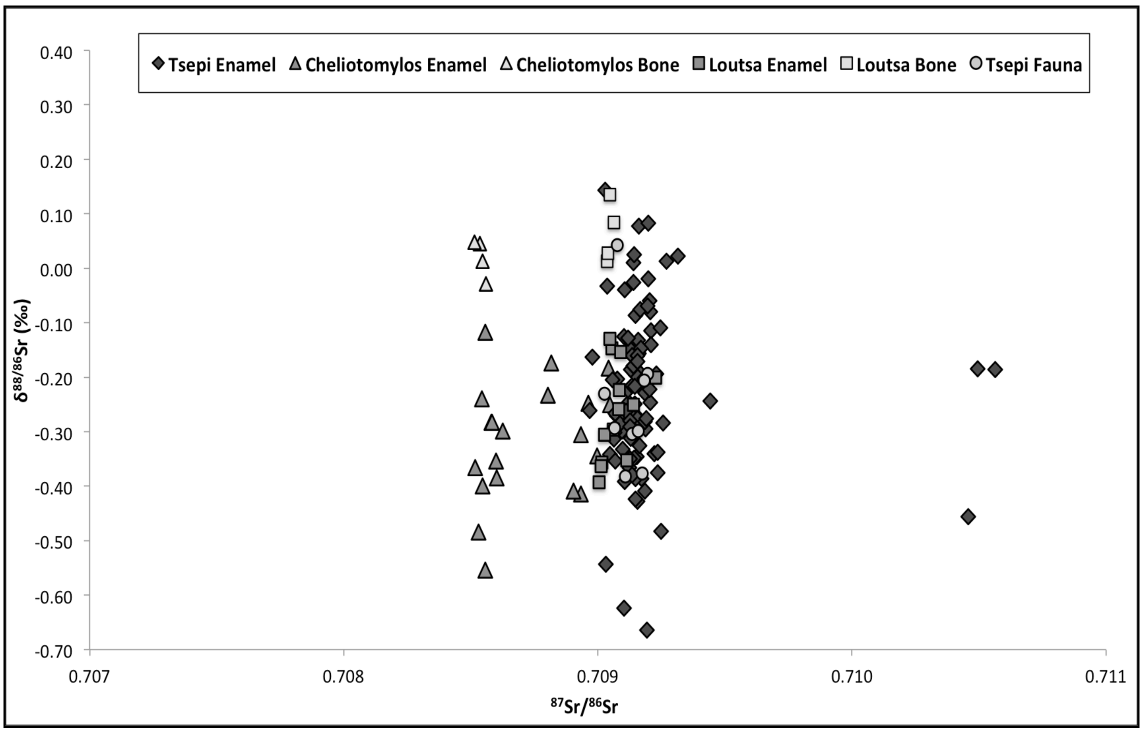

Figure 6.25. Stable strontium ($\delta^{88/86}$Sr) and radiogenic strontium (^{87}Sr/^{86}Sr) isotope values in archaeological human and faunal samples.

Regarding the possible geographic origin of the three non-local individuals, as discussed previously the non-local ^{87}Sr/^{86}Sr signatures are very similar to each other ^{87}Sr/^{86}Sr = 0.71046 − 0.71056 (Fig. 6.25); this suggests provenance from the same location where they spent their infancy. Based on the ranges of locally bioavailable

$^{87}Sr/^{86}Sr$ values generated in this study (Fig. 6.13), only two locations show similar values: Naxos in the Cyclades and Chios in northeastern Aegean. Two modern hare bone samples from central Naxos analyzed here show $^{87}Sr/^{86}Sr = 0.71056 – 0.71068$ ($^{87}Sr/^{86}Sr = 0.70881 – 0.71068$, n = 6; for the whole island). Two hare samples from both northern and southern Chios show $^{87}Sr/^{86}Sr = 0.71026 – 0.71049$. These are also the only two locations that show similar, high $^{87}Sr/^{86}Sr$ values in published data measured in archaeological specimens (Nafplioti, 2007, 2011). On northeastern Chios (Cave of Agio Galas), archaeological fauna (two pigs, one sheep/goat) showed $^{87}Sr/^{86}Sr = 0.71053 –$ 0.71187 (Nafplioti, 2011). On western Naxos, a pig specimen showed $^{87}Sr/^{86}Sr = 0.71004$ and a human enamel sample showed $^{87}Sr/^{86}Sr = 0.71047$ from the Late Cycladic cemetery of Aplomata (Nafplioti, 2007, 2011). Geochemically, both Naxos and Chios are valid. However, given the strong Cycladic character at Tsepi, the distance, as well as the extensive Early Cycladic habitation and cemeteries on Naxos island, Naxos is considered the most probable origin based on the currently available data. Nevertheless, any specification of geographic origins should remain tentative. Radiogenic strontium isotope signatures are not unique. Different regions can have similar, or even identical, values. Thus any region with a similar geochemical composition constitutes a possible origin. Furthermore, the human isotopic values respresent an averaging of dietary sources, thus mixing of diverse isotopic diets could also have occurred. Thus, the “geolocation” of indiviudals should be treated with caution.

Based on $^{87}Sr/^{86}Sr$ data from rocks and geological samples, values close to $^{87}Sr/^{86}Sr = 0.71050$ are measured in several locations, mostly of granitoid formations that include several of the Cyclades such as Mykonos (see previous section under "geochemical setting"). However, when modern baseline samples were analyzed to determine the locally bioavailable strontium, the $^{87}Sr/^{86}Sr$ ranges were lower, closer to a marine signature. Two studies reported a similar value for a granodiorite location at Lavrion (Altherr et al., 1988; Juteau et al., 1986); however, none of the environmental, biological samples analyzed in this study confirmed it. All Attic values are much lower.

Overall, the $^{87}Sr/^{86}Sr$ results based on modern environmental samples analyzed in this study reevaluate the application of biogeochemical analysis in the area and indicate future directions for research. The systematic analysis of modern game proved to be a useful tool for the determination of the locally bioavailable strontium. Moreover, it suggests that the discrimination of local $^{87}Sr/^{86}Sr$ ranges and the identification of paleomobility in the Aegean needs caution, given the overlapping geochemical signatures and the possible sea spray and sea salt effect. In several cases, modern faunal and snail samples did not match the $^{87}Sr/^{86}Sr$ values expected given the local geochemical composition and showed instead $^{87}Sr/^{86}Sr$ values closer to a marine signature. In this, the paleodietary reconstruction of the strontium sources through stable strontium isotope analysis proves to be an invaluable tool. By the same token, the use of the fourth decimal place as a cutoff for $^{87}Sr/^{86}Sr$ local baselines is generally not appropriate for this area, and that the third decimal place should be preferred (*cf.*, Nafplioti, 2007, 2008, 2009*).* The observed intra-regional variation suggests that the combined use of different types of environmental samples can provide us with more comprehensive datasets for the biologically available strontium in different regions. Additional archaeological faunal samples will help greatly in measuring regional strontium variation and geochemical characterization in the southern Aegean. Finally, different isotope systems such as stable oxygen or lead isotopes that explain different sources of variation (e.g., different environmental zones) can supplement radiogenic strontium isotope analysis for the identification of paleomobility.

CHAPTER 7

DISCUSSION AND CONCLUSIONS

This dissertation addresses the role of kinship and residential mobility during the formation of late Final Neolithic and Early Helladic I Attica (ca. 3500 – 2650 BC), focusing upon the Early Helladic cemetery of Tsepi at Marathon (eastern Attic coast). Tsepi constitutes the earliest example of the formal spatial organization of a cemetery on the Greek mainland and consists of communal tombs commonly interpreted as family graves. Due to the strong Cycladic influences on grave good types and tomb architecture, Tsepi has also contributed to enduring debates over the nature of the interaction between the east-central Greek mainland and the central Aegean islands. Archaeological hypotheses on the kin-based structure of the formal cemetery, marriage practices and mate exchange, and relocation were tested using biological (inherited dental and cranial features) and biochemical (radiogenic strontium isotopes) data.

Cemetery Structure and Biological Relatedness

Overall, the results of the biodistance analysis showed a relationship between spatial organization and biological relatedness. Graves did contain closely related individuals, but not exclusively. In general, graves seem to be composed of a core of biologically related individuals and a smaller component of biologically unrelated individuals. This observation is in accordance a) with exogamous practices that add biological variation to the sample, b) with the expectation that inclusion of spouses in the same grave will decrease inter-individual adult similarities, and c) with the inclusion of individuals in the same grave based on other forms of relations that are not biological, such as social, fictive, or practical kinship. The graves with the lowest biological variation were T3, T4, and T5 in the western sector of the cemetery, T10 in the middle sector, and T17 and T19 in the eastern sector. Graves T3 and T19 are among the oldest graves in the cemetery based on the remodeling of an earlier cist grave into the more complex grave type that became typical at Tsepi. Thus, even though tomb usage has a biological foundation, individual tombs are not necessarily restricted to nuclear families.

The interplay between grave location and biological distance is, however, stronger. The spatial organization of graves generally depends on biological relatedness, wherein groups of graves and particularly rows of graves include closely related individuals. This broadly supports a biological kin structure for the Tsepi cemetery reflecting, again, the presence of kin groups beyond the nuclear family level. This pattern is stronger in the westernmost and easternmost grave groups. Ethnographic evidence from Greece shows that the inclusion of individuals in specific tombs can be a highly complex process that is based on the negotiation of family status, resulting in a permanent social statement. The same was true for the selection of individuals as "founders" of new tombs. The presence of closely related individuals in different graves thus might also reflect the "founders" of new graves based on their kinship and possibly other social roles.

Postmarital Residence Practices

Overall, the observed biological diversity at Tsepi supports exogamous mating practices. The results of the postmarital residence analysis, even though not significant statistically, show higher mobility for male individuals. Of the three individuals identified as non-locals biogeochemically, two were female and one was male. Even though the sample and the difference are too small to indicate sex-specific patterns, the presence of two non-local female individuals suggests that mobility was not restricted to males. However, there is a possibility that the two females moved to Tsepi not as adult "brides", but as young children, as was the case with the male non-local individual. The generally homogeneous, local geochemical signature at Tsepi suggests that in the case of incoming mates (spouses), their place of origin was either from nearby communities or from locations further away that had a biogeochemical signal similar to Tsepi and eastern Attica (as is the case also for some of the Cycladic islands closer to the Attic coast).

The identification of greater male mobility suggests uxorilocal (or matrilocal) postmarital practices, wherein female individuals form the stable, natal group of the community, while male individuals were coming in from a wider genetic pool. Based on the ethnographic and ethnohistoric data, matrilocal practices were traditionally common in the Aegean islands, while they were generally absent on the mainland. In the matrilocal islands, the higher male mobility was associated to a great degree with the maritime nature of the communities and the nautical activities of the men, who were absent for long periods of time. Acknowledging the limitations of ethnographic parallels, we may nevertheless tentatively conclude that this pattern may suggest analogous practices at Tsepi. Thus, the active participation of the Tsepi people in the maritime networks functioning during the later 4th and early 3rd millennia in the southern Aegean is plausible, supporting the idea that Cycladic people were not the sole agents of maritime trade. The identification of marine resource consumption for six male individuals is of great interest. This sex-based dietary difference could in fact be connected to male social and/or occupational roles closely associated with the sea, also suggesting maritime activities. Furthermore, the marine diets of these six male individuals could potentially be masking a non-local origin, given that seawater values are within the local range for Tsepi and eastern Attica.

Residential Mobility

Based on radiogenic strontium isotope data, the vast majority of individuals buried at Tsepi show a local geographic origin (96%, n = 75). Thus, traditional archaeological hypotheses regarding the "colonization" of coastal Attica by Cycladic islanders are rejected by the present analysis. The heavy Cycladic influences at Tsepi were not accompanied by immigration (i.e., unidirectional movement of a group) from the islands.

Three of the 75 individuals analyzed from Tsepi were found to show non-local geographic origins. Based on their diets, these three individuals spent at least their infancy in a location geochemically distinct from Tsepi and eastern Attica. The fact that all three non-local individuals show very similar geochemical signatures suggests that they came from the same location. The common provenance might reflect a link between

Tsepi and a single locale, suggestive of a specific inter-regional social network. The directionality of the relocation suggests a privileged interaction between Tsepi and another region. Based on the database of geochemical signatures generated in this study as well as published data (Nafplioti, 2007, 2011), the most probable origin of the three individuals seems to be the island of Naxos in the Cyclades. An origin from Naxos is supported by modern fauna (this study), archaeological fauna (Nafplioti, 2007, 2011), and archaeological human enamel samples (Nafplioti, 2007). Naxos is the largest Cycladic island; it has the most diverse habitat (mountains, water sources, arable land), as well as extensive evidence for a flourishing Early Cycladic population. However, provenance from other locations with similar geochemical signatures is also plausible. As discussed in detail in Chapter 6, radiogenic strontium isotope signatures are not unique. In addition, the human radiogenic strontium isotope values can result from a mixing of dietary sources. Thus, "geolocation" of individuals should be avoided, as it is not necessarily accurate.

The cemetery distribution for the three non-local individuals is illustrated in Fig. 7.1. These non-local individuals are generally located in the middle rows of the cemetery, showing a relative concentration (T7 is located in the western section, but in its easternmost row) (Fig. 7.1). The two female individuals are located in the same grave row, in the middle sector (Fig. 7.1). This spatial pattern is generally in accordance with the result of the biodistance analysis, whereby graves from the western sector (T3, T4, T5, T6) and the eastern sector (T19, T20, T22, T17, T18) showed the lowest biological variation.

The three graves (T7, T16, T25) are not distinct, based on the number of finds included in the graves (see figures in Chapter 4). However, all three contained a small amphora (*amphoriskos* following terminology in Pantelidou-Gofas, 2005), a vessel associated with the Cycladic islands, including Naxos (Pantelidou-Gofas, 2005:303). Small amphorae were found in eight of the graves included in this study (T3, T7, T10, T12, T13, T16, T19). This might indicate an association of the vessel with a non-local (in this case possibly Cycladic) origin (38%, n = 8). Furthermore, the three graves with the non-local individuals all contained animal bone palettes. As discussed in detail in Chapter 4, animal bone palettes were a very common find in the Tsepi graves included in this study. In terms of grave finds, T7 is distinct in that it contained a fragment of litharge (the mostly lead by-product yielded by cupellation, a metallurgical technique for the extraction of pure silver from lead-rich galena ore). The litharge from T7 (Pantelidou-Gofas, 2005a:66-68, pl. 8:3) is not only unique as a gravegood at Tsepi, but is also unique in any prehistoric Greek cemetery context. Its presence might indicate an intimate link with metallurgical activities that should be further explored in future research. Finally, T16 also contained a Bratislava lid that is associated with northern and central Greece, and not with the islands (Pantelidou-Gofas, 2005a: 117-118, 314-316, pl. 18:1).

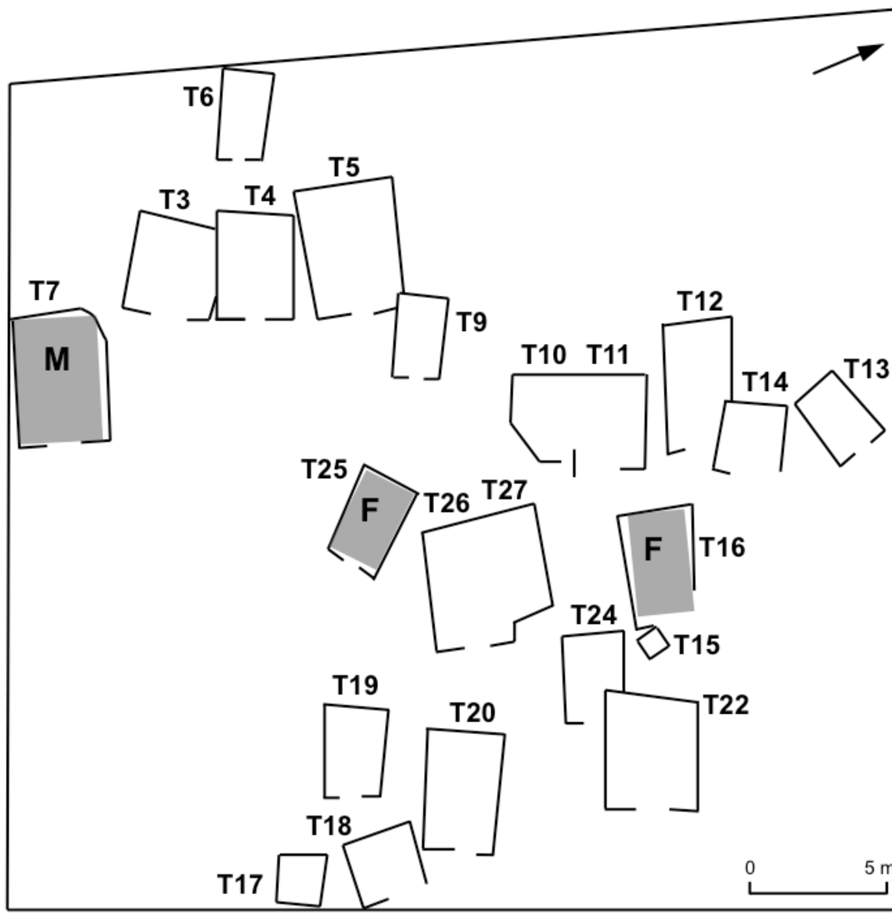

Figure 7.1. Schematic plan of the graves under study at Tsepi cemetery indicating the burial location of non-local individuals (shaded graves). Letters inside the graves indicate the sex of the non-local individuals: M, Male; F, Female.

The presence of non-local individuals in different graves indicates that they were fully integrated in the community. The non-local individuals from T16 and T25 were found among the secondary burials in these two graves. The non-local individual from T7 is one of the two *in situ* skeletons found at the entrance of the grave who were probably the last interments. Thus, the non-local male of T7 was included in the grave during the latest phases of the grave's usage, suggesting the presence of social ties that integrated the individual into an already established grave, and thus social, context. The fact that the male individual from T7 moved to Tsepi as a late infant or a young child (approximately by the age of 4 years ± 1 year) does not represent adult relocation (e.g., postmarital), but presumably familial relocation. Overall, burial location was not determined by provenance. The inclusion of non-local individuals in different tombs becomes even more interesting when one considers their similar biogeochemical signatures. The burial of the non-local individuals that probably shared a common geographic origin did not follow the relocation pattern. Thus, in the case of Tsepi, the non-local individuals should not be identified as "foreigners" given that they were fully incorporated in the communal burial program.

Kinship and Relocation at Tsepi cemetery

Overall, the results present us with a local character for the cemetery sample. This observation is in agreement with the local production of ceramics that are, otherwise, Cycladic in style (Pantelidou-Gofas, 2005a). Thus, the bioarchaeological analysis also testifies to the formation of a regional culture in coastal Attica that developed an autonomous communal identity through the assimilation of both Helladic and Cycladic features and practices. The location of Tsepi on the coast would allow for the circulation of artifacts and ideas. However, given that mobility need not be accompanied by relocation, local origins do not necessarily signify a non-mobile, less "international" group. On the contrary, the integration of the non-local individuals suggests open boundaries. The suggestive maritime character of the community also supports an active participation of the Attic people in maritime activities.

The spatial organization of the cemetery depended to a great extent on biological relatedness. However, biological relatedness was a major, but not the sole factor for inclusion in a grave and in a grave row. Thus, the within-grave groupings of individuals probably depended not only on biological kinship, but also on other forms of kinship (e.g., affinal) and social roles. This finding is suggestive of a complex set of inter-personal relationships and collective identities that determined burial location. Prehistoric Aegean archaeology often neglects or underestimates the social significance of communal graves, cemetery organization, and associated rituals observed at Tsepi and other Early Helladic cemeteries. The coexistence of primary and secondary burials in clearly demarcated graves, the intentional breaking of vessels, the deposit pits, and the possible feasting and libations indicate the practice of elaborate, most likely periodic (i.e., temporally discrete, but recurring) funerary rituals and a very early ancestor cult. The inclusive secondary treatment of the deceased points to the strong communal aspect of the burial program. The re-opening of the graves provided living relatives with the opportunity to interact with their ancestors and to intentionally affirm and negotiate their relations, thereby actively shaping collective memory. The elaborate and complex grave structure served as the visible statement of the collective ancestors who remained in their selective groupings in perpetuity. Formalized organization of composite graves and cemetery space, and the ceremonial multi-staged burial program that followed kin lines thus emerged at Tsepi around the middle of the 4th millennium BC or shortly thereafter as part of the new social realities presaging the beginning of the local Early Bronze Age.

Conclusions

By integrating osteological, biochemical, archaeological, and ethnographic data, this study applied a contextualized and interdisciplinary bioarchaeological analysis to a region where archaeological studies of kinship and mobility have traditionally been typological. The aim was to shift the focus of prehistoric Aegean scholarship from material distributions and bounded cultures to more fluid concepts of human interaction and mobility. The intra-cemetery biodistance analysis elucidated Early Helladic intra-site biological variation that is imperative for future comparisons of populations at a regional scale. Postmarital residence analysis revealed an association between postmarital and postmortem (i.e., burial) residence. The biogeochemical analysis provided great insight into the patterns of prehistoric human mobility and relocation in the southern Aegean. This study generated a large database of isotopic signatures for a number of regions around the Aegean that can be of great use in future paleomobility research. The systematic use of modern game as a baseline also showed great potential for biogeochemical applications. Finally, dietary inferences presented new information on marine resource consumption and a potential sex-based dietary difference. Hence, this study directly addressed the structure of local social systems and social processes in the western Aegean at the transition from the Late Neolithic to the Early Bronze Age.

On a regional scale, this study contributed to long-lasting debates on the nature of kinship, mate exchange, mobility, and inter-regional contacts by answering questions on grave use, cemetery structure, marriage practices, and residential relocation in the prehistoric Aegean. The ethnographic data showed regional variation in the conceptualization and practice of kinship and postmarital residence and provided emic anthropological parallels for the interplay between kinship, postmarital residence, and mortuary treatment. The potential materialization of social roles in mortuary contexts through burial placement allows us to address the formation, experience, and negotiation of individual and collective identities and apply a more nuanced approach to the behavioral reconstruction of past societies and their biocultural histories. Social practices such as kinship relations, marital patterns, and mobility are intimately linked with processes of community formation. Thus, on a broader scale, this study added to the anthropological investigation of biological and marital kinship, and residential relocation as diachronic mechanisms of integration, adaptation, or differentiation.

This work falls under the paradigm of North American bioarchaeology, wherein interdisciplinary methodologies are applied to problem-oriented research. Aegean bioarchaeology has yet to fulfill its true potential at an international level. The outcome of this study indicates a promising future for the analytical tools of biodistance and biogeochemistry in Aegean archaeological inquiry that can have an impact beyond the Aegean region. Given how little is known of the Early Helladic people, the results of this study are subject to further testing and refinement. Building on this work, future intra- and inter-cemetery comparative studies of Early Helladic skeletal assemblages will aid greatly in our understanding of the Aegean Early Bronze Age and can inform prehistoric collective grave use, kinship patterns, mate exchange, and residence practices. Expanding biogeochemical research in more regions for both archaeological and modern datasets will allow for a more detailed reconstruction of residential relocation. The use of additional, complementary isotope systems (e.g., stable oxygen isotope analysis) will also provide a more holistic understanding of Aegean mobility that can be applied to other contexts. Investigation of changes in cemetery organization and mobility throughout time will also address diachronic patterns. Thus, the avenues for future research have great prospects, especially when bioarchaeological studies are fully incorporated in larger archaeological research designs. In this, the recently discovered Early Helladic cemeteries in Attica and Euboea will not only change the Early Helladic funerary landscape, but will also shed light on the social landscape of the Aegean Early Bronze Age.

NOTES

[1] See Humphreys (1980b) on family tombs and tomb cult in ancient Athens.
[2] Hero cults venerate a hero, named or not but usually local; tomb cults can be any cult that takes place at a tomb (contemporaneous or old) for any length of time (according to Whitley, 1994:214). Hero cults took place at heroes' tombs, but also in hero shrines. Heroes can be defined as the powerful dead worshipped by the Greeks, often forming a class inbetween gods and men (Kearns, 2003:693).
[3] For tomb cults and hero cults see Alcock, 1991; Antonaccio, 1994, 1995; Coldstream, 1976; Humphreys, 1980b; Morris, 1988; Whitley, 1994.
[4] Blegen saw the practice as continuous throughout the Dark Ages; the presence of offerrings in the Dark Ages was later challenged (e.g., Coldstream, 1976).
[5] Antonaccio (2006) discusses the *Tritopatores* or *Tritopatreis* as collective ancestors and recipients of cult, especially in Attica, whom she links to the Thrice Hero mentioned in Linear B. The communal ancestor-worship of *Tritopatores* ("fathers of the third generation") is also mentioned in the sacred calendars of Marathon (see Harding, 2007:18).
[6] A particularly poignant example of such creation took place in the fourth century BC Peloponnese. When the Arcadians formed their federal league during the 360s, the neighboring region of Triphylia (literally, 'Land of Three Tribes') was incorporated into this political entity. In order to strengthen the bond between the two regions, a new hero, Triphylos, was created. This Triphylos was said to be a son of Lykaon, the chief ancestor of all the other Arcadian sub-groups. The new ancestral order was literally set in stone through a dedication made by the League at Delphi in the early 360s. The monument consisted of statues representing each ancestor (male and female) accompanied by an inscription explaining the various genealogical relationships linking their descendants (Beck, 1997; Nielsen, 2002).
[7] Based on the textual evidence that after 451/0 double endogamy within the citizen group was demanded by law (see Morris, 1991:157).
[8] Morris' work has not escaped criticism (e.g., Humphreys, 1990; Patterson, 2006).
[9] Small (1995) discusses the relationship between textual and archaeological evidence at length arguing that the former should not be privileged over the latter; the two should be independent, and each should be used to check the reliability of the other. Given that this study focuses on prehistory, however, this valid point is irrelevant here.
[10] In Athens, there were three laws regulating funerary and monumental display: (a) one by Solon ca. 600 BC, (b) one in the early 5th century, and (c) one by Demetrios of Phaleron ca. 317 BC. Solon's legislation targeted elaboration during funerals, whereas Demetrios' targeted funerary monument display. However, such phenomena were not restricted to Athens. See Garland, 1989 and Morris, 1992.
[11] See references and brief overview in Small, 1995:166; cf. Morris, 1992:103-155.
[12] Small (2002:164-165) calls it Grave Circle B by mistake.
[13] Social groups can be defined as collections of individuals who recurrently interact in an interconnected set of roles (Keesing, 1975:10).

[14] For early Greek kinship, see Humphreys, 1979; Pomeroy, 1985, 1997; Varto, 2009. For cousin marriage, see Thompson (1967). Phratries played an important role in Attica, as also in Delphi, Arcadia, and elsewhere (Lambert, 1999).
[15] Marital relationships are specifically addressed here through postmarital residence patterns.
[16] The term kindred refers to a general cultural category consisting of a person's circle of relatives.
[17] These points may also apply to the Aegean, as will be discussed later.
[18] See Just, 2009 for a critical review on the history of Greek ethnography and its relationship with the wider field of the anthropology of kinship. Major ethnographic works took place in the 1960s and 1970s. There are also several accounts of Greece and Greek customs from travelers throughout the centuries (e.g., Rodd, 1894; Stanford and Finopoulos, 1984).
[19] The institution of dowry is a complex matter that showed great variation both geographically and chronologically. On the variety of matrimonial benefits, such as the 'bride-price' (when the family of the groom had to provide money or other gifts to the bride's family before marriage as an exchange) or the male 'dowry' common in the Cyclades, see Alexakis, 1984; Handman, 1989; Kasdagli, 1991).
[20] Including expatriates such as Greek-Americans, as Andromedas (1957) so appropriately notes. Herzfeld (1985:282) describes the differences in terminology found on Rhodes, including terms for different degrees of cousins. See Alexakis, 1975 for kinship structure and terminology in Thrace; Karachristos, 2004 for Syros; Vernier, 1984 for Karpathos.
[21] *Soi* is a Turkish word of Mongolian origin that originally meant 'bone' and was used to denote patrilateral kin (Alexakis, 1996:171). For the usage of the word *soi* and the various nuances of the word in associated meanings of 'kind' in colloquial Greek language in cases irrelevant to family affairs, see Panourgia, 1995:138, indicating the importance of the word in Greek ideologies.
[22] See discussion in Herzfeld, 1983.
[23] Adoption is another form of non-biological kinship (e.g., Dubisch, 1976). Often a childless couple would adopt a nephew (e.g., Vernier, 1984).
[24] Customarily (though nowadays these rules are loosened) a person would baptize only girls or only boys to avoid future complications with intermarrying (mentioned also in Chock, 1974).
[25] Marriage between first cousins (sixth degree) was officially prohibited by the Church in the 7th century, while marriage between second cousins (seventh degree) was prohibited in 1166 (see Savorianakis, 2000 for references and Du Boulay, 1984 for discussion on the symbolic links between blood and spiritual ties).
[26] In a Muslim community at Bodrum in Asia Minor marriages between first and second cousins were frequent (Mansur, 1972).

[27] 'Traditional', as used here, refers to the older, rural communities, whereas 'modern' refers to the urban societies occurring mainly after the 1960s and 1970s.
[28] Another suffix used is -focal, which includes interpretations of behavior and power not relevant to this study (e.g., Papataxiarchis, 1995).
[29] They also provided an explanatory and descriptive diagram to illustrate the different residence patterns in the studied community (Casselberry and Valavanes, 1976:216).
[30] Sarakatsani are Greek-speaking transhumant shepherds living in communities organized by strong ties of kinship (Campbell, 2002).
[31] Koutsovlachs originate in the Balkans. They are Greek Orthodox and speak both Greek and a Romanian dialect (Campbell, 2002; Schein 1971, 1973).
[32] For the extensive ethnographic work on Methana, see also Clarke (1988, 2001a, 2001b). Arvanitika (a southern Albanian dialect) was traditionally spoken on the Methana peninsula, along with Greek (Forbes, 2007).
[33] The people of Richia (Zarakas) also speak Arvanitika (Hart, 1992).
[34] However, neighborhoods that consisted of patrilocal households were also common in non-Arvanitika villages in the Peloponnese, such as in Kynouria (personal observation). Naming of neighborhoods (and in some cases of small villages) after the common last name of the agnatic group was also a frequent phenomenon.
after the common last name of the agnatic group was common in many villages, such as in Kynouria, non-Arvanitika (personal observation).
[35] Fourni was populated by the descendants of Albanian settlers (in the 14th-15th century) and the inhabitants spoke both Greek and Arvanitika. The economy of the village was based on olive production supplemented by herding, cultivation, and seafaring (Gavrielides, 1976).
[36] Movement of females with dowry towards the urban centers and the urban tendency for uxorilocality took place after 1950, associated with the general trend for rural to urban migration (Alexakis, 1996; Friedl, 1962; Sant Cassia and Bada, 1992; Sutton, 1983; Vermeulen, 1983).
[37] Herzfeld's ethnographic work on Crete focused on a mountainous village in the vicinity of Rethymnon (central Crete).
[38] Meganisi is a small island located to the east of Lefkas. The ethnographic study took place in a village on the northern side of the island (Just, 2000).
[39] At the village of Aghios Petros (southeastern part of the island) with an economy based on olive oil and wine production.
[40] Couroucli (1985) discussed the strong Venetian influence on Corfu and the Ionian islands in general, contrary to the Ottoman influence observed in the Eastern Aegean.
[41] Herzfeld (1991) mentions the different words for *sogambros* in Rhodes and Crete.
[42] He defines matrifocality as the "complex of practices and values that support female role dominance" (Papataxiarchis, 1995:220, after Smith, 1973 and Gonzalez, 1970).
[43] The eldest daughter inherited the maternal house (Herzfeld, 1983).

[44] In the publication Casselberry and Valavanes (1976) use pseudonyms for the village and island under study.
[45] Men spent several months (from March or April until the end of October) working along the north African coast sponge-diving; fishermen were also absent for most of that time, while sailors would return to the island every two or three years (in more recent times, sailors return home once a year and stay for a couple of months) (Zahariou-Mamaligka, 1986).
[46] Dimitriou-Kotsoni (1993) reported the use of matronymics also on the islands of Ikaria, Tinos, Fourni, and Leipsoi. For example, Nick (son) of Mary instead of Nick (son) of John that characterized the virilocal mainland.
[47] This is in accordance with the tendency observed in the Cyclades (Naxos, Mykonos, Kea, Paros, Santorini, Sifnos) and the islands of southeastern Aegean (Karpathos, Kasos, Telos, Nisyros), also in Lesvos and Skopelos.
[48] Published originally as Nisos Island (Kenna, 1976).
[49] The island's economy was based on either farming or fishing and trade.
[50] Ethnographic work at an agricultural, non-coastal village (Dubisch, 1976).
[51] Based on 17th century notarial documents. The island had a population of 6,000 to 7,000 and the economy was based mainly on agriculture.
[52] For more information on Keos, including population size and economy in 19th and 20th century, see the thorough accounts of Alexakis (1996-1997) and Sutton (1991).
[53] Papataxiarchis (1995) classifies Ios as matrifocal, but in Currier (1976) it is not clear whether or not there was a matrilocal or a patrilocal residence preference.
[54] Focusing on the large village of Arnaia.
[55] Lavreotiki, like many areas in Attica, was populated by southern Albanians (Arvanites) in the 14th and 15th centuries, who intermixed with the Greek-speaking inhabitants but kept their Arvanitika dialect until recently, as evidenced also by Albanian toponyms (Alexakis, 1996).
[56] Peristiany's (1968, 1976) ethnographic work took place at the highland village of Alona and the neighboring villages. In 1976, the Alona population had dropped to 500 residents.
[57] The village of Argaki. When Loizos first conducted fieldwork at the end of the 1960s, Argaki's large population (about 1,500 residents) consisted mainly of Greek Cypriots and a minority of Turkish Cypriots cohabiting in amicable relations. Now Argaki is in the Turkish part of the island.
[58] Peyia had 1,110 residents in 1921 and 1,300 residents in 1980; fieldwork took place in the late 1970s (Sant Cassia, 1982).
[59] 97% of the Greek population in Greece is at least 'nominally' Greek Orthodox (US Department of State, 2002). Greek expatriates and their descendants generally retain the Greek Orthodox faith: in the United States there are approximately 1.5 million Greek Orthodox (Greek Orthodox Archdiocese of America, 2015).

[60] Another interesting difference between Greek and American cemeteries is the fact that funerary inscriptions in Greece always include the age at death.
[61] Cremation of citizens or foreign aliens whose religious faith allows for cremation became legal in Greece in 2006 (Hellenic Parliament, 2006). The presidential decree allowing for the construction of crematories was published in 2009 (Hellenic Parliament, 2009). However, to this day no crematories exist in Greece and cremation, when desired, has to take place in other countries, usually Bulgaria.
[62] The funerary customs of the Orthodox Church and the Greek popular beliefs are remarkably similar to the ones observed in ancient Athens; however, the meaning behind these similarities is often contested (c.f., Garland, 1985:xii). For the funerary customs in rural Greece see the seminal work by Danforth (1982). For antiquity see the classic studies by Garland (1985) and Kurtz and Boardman (1971).
[63] Families can choose to cite their dead predecessors by name.
[64] In the large, urban cemeteries where space is limited and fees high, exhumation takes place as soon as possible. In order to keep the remains in the urban cemeteries' ossuaries, an annual fee must be paid. If the fee is not paid for more than four or five years, the remains are emptied in an underground pit. The practice of exhumation and the plethora of "unclaimed" skeletons in Athenian cemeteries gave rise to the creation of the modern, documented skeletal reference collection currently housed at the University of Athens (Eliopoulos, 2006; Eliopoulos et al., 2007).
[65] In some cases, family tombs are located in a separate part of the cemetery and are used to receive the bones of family members after exhumation, but not for inhumations.
[66] The two villages are Paradeisia and Palaiochori, both in Arcadia (central Peloponnese).
[67] Same term is used today in urban cemeteries for the pit containing the unclaimed exhumed remains (Eliopoulos, 2006).
[68] This was the case in both villages of my parents' origins located in different parts in Arcadia (see above, n. 55). This is why the bones of my grandfathers' fathers could not be interred in the family tombs –their bones rested commingled in the communal ossuary.
[69] Areas that had a noble class (e.g., the island of Corfu).
[70] The details for the exhumation of remains form part of the legislation for the use of cemeteries, run by the local municipalities.
[71] To the contrary, in the case of saints or martyrs the lack of decomposition and the natural mummification of the body is considered a sign of holiness.
[72] Today, especially in urban cemeteries where the lack of space is imminent and exhumation takes place in two years, the partially decomposed bodies are reburied in a separate section of the cemetery called "the undissolved" (*adialyta)* with a temporary marker for another year (Eliopoulos, 2006).
[73] The mourning period particularly for women is characterized by black dress and non-participation in social events, among others. Danforth (1982) offers a thorough account of the aspects of female mourning. Also see Hirschon (1983) for the major role women play

in the observance of mortuary rituals and maintenance of graves; the cemetery forms a public, social sphere for women in more traditional settings.

[74] The term "bioarchaeology" was first used in 1972 referring to the study of archaeological faunal remains (Clark, 1972). Since then the term has followed different courses in the United States and the United Kingdom.

[75] This work follows the definition and use of the term by Buikstra (1977, 2006a,b,c).

[76] While fully acknowledging the points articulated by Fotiadis, 1994.

[77] It should be noted here that in Greece archaeology is part of the humanities and does not include training in skeletal biology (and vice-versa). This is currently changing as positions for osteoarchaeology and/or physical anthropology are opening in archaeology departments. The Wiener Laboratory of the American School of Classical Studies at Athens has played a significant role in Aegean archaeological science and human skeletal studies by providing funding, facilities, and research opportunities.

[78] Again, note here that even though the term bioarchaeology is now used widely to describe skeletal studies of Greek skeletal assemblages, the underlying goals of these studies are rarely uniformly the same.

[79] The term Aegean often substitutes for 'Greek' as a geographic reference focusing upon the Aegean Sea, including Cyprus and the west coast of Asia Minor. In prehistory, the term Aegean is preferred over the term Greek in order to avoid arguments over a direct ethnic or linguistic connection between pre-Mycenaean populations antedating proto-historic Late Bronze Age and historic Archaic through modern Greeks (Tartaron, 2008). For reviews of Aegean prehistory and prehistoric archaeology, see Bennet and Galaty, 1997; Cline, 2010; Cullen, 2001a,b; Shelmerdine, 2008; Tartaron, 2008).

[80] The term Helladic is used for the central and southern Greek mainland. Primary references on the topic include Evans (1921), Tsountas (1898), Wace and Blegen (1916-1918).

[81] The following abbreviations and categories follow standard procedures of Aegean prehistoric research: Early Helladic (EH), Middle Helladic (MH), Late Helladic (LH), Early Cycladic (EC), Middle Cycladic (MC), Late Cycladic (LC) Early Minoan (EM), Middle Minoan (MM), and Late Minoan (LM). Also, Late Neolithic (LN), Final Neolithic (FN), Early Bronze Age (EBA), Middle Bronze Age (MBA), and Late Bronze Age (LBA). Other classifications include the ceramic style-based 'culture' alternatives, such as Rachmani and Petromagoula (Final Neolithic Thessaly), Attica-Kephala (Neolithic central and southern mainland and Cyclades), Grotta-Pelos, Pelos-Lakkoudes, Kampos, Keros-Syros, and Kastri (different phases of EBA Cyclades), and Korakou and Eutresis (EBA mainland) (Doumas, 1977:11-27; Rutter, 1983; Renfrew, 1972; see also Alram-Stern, 2004:142-152; Kouka, 2009; Manning, 1994; Maran, 1998a). For Crete, a scheme based on palatial centers is also used, with Prepalatial, Protopalatial, Neopalatial, and Postpalatial as subdivisions, used also for Mycenaean mainland (see Manning, 1994).

[82] For the chronology of the EBA (relative and radiocarbon dating), see Alram-Stern (2004:142-215), Coleman (1992, 2000:125-127, 2011), Kouka (2009), and Manning (1995, 1997, 2010).

[83] Note Rutter's (2001:116) emphasis on the importance of human remains as evidence for migrations and population movements, as well as for the interpretation of these marked changes and hybridizations of ceramic repertoires.

[84] Major references on the EH period include: Cosmopoulos (1991a,b), Pullen (1985, 1994, 2003a, 2008), Rutter (2001), Weiberg (2007). See also Alram-Stern (2004); Maran (1998a); Rambach (2000).

[85] A discussion of the emergence of the Neolithic and the debate on endemic development versus adoption of agricultural subsistence and economy is well beyond the scope of this review (see Halstead, 1996; Hodder, 1990; Perlès, 2001; van Andel, 1995). For reviews of the Greek Neolithic, see Demoule and Perlès (1993), Theochares (1981), and Tomkins (2010). For recent Neolithic discoveries on Crete, see Efstratiou et al. (2013). For the Sporades islands see the earlier work of Efstratiou (1985).

[86] The term Chalcolithic is also used for Final Neolithic, mostly in the German, Turkish, and Cypriot literature.

[87] For a recent work on the Aegean islands during the Neolithic, see Mavridis (2007). See Also Tankosic (2011) for the role of southern Euboea and the nature contacts with the northern Cyclades in the Final Neolithic and the EBA, and Cullen et al. (2013). For the EBA Cyclades see the overviews in Broodbank (2008) and Renfrew (2010).

[88] For the 'emergence of civilization' and state formation in the Aegean, see Branigan (1995), Cherry (1984), Cherry et al. (2004), Dabney, (1995), Halstead (1981, 1995), Galaty and Parkinson (1999); Parkinson and Galaty (2009); Renfrew (1972); Renfrew and Cherry (1986), Renfrew and Shennan (1982); Runners and van Andel (1987); Sherratt (1981), and van Andel and Runnels (1988).

[89] See specifically Alram-Stern (2004:510-512) for the different attitudes towards cultural change during the end of the Final Neolithic and the beginning of the EBA period.

[90] See also Manning's work (1995) on the absolute chronology of the Early Bronze Age, as well as Coleman (1992).

[91] The presence of an earlier pre-Greek population is strongly supported by linguistic evidence. Greek is part of the Indo-European (IE) family of languages. However, Greek contains many words – and especially place names – that are not Greek and/or do not have an IE origin (Beekes, 2010; Fick, 1905; Haley, 1928; Kretschmer, 1896). Traditionally, the suffixes *-ss-* / *-tt-* (e.g., Parnassos and Hymettos) and *-nth-* (e.g., Corinth) have been identified as belonging to one or more substrate languages. When Greek entered into the mix and eventually superseded the substrate language(s), these suffixes were incorporated and thus preserved. Coleman argues that the Greeks followed an initial group of Indo-Europeans who spoke a pre-Greek substrate language in Greece

from the mid-fifth millennium BC. Accordingly, he views the *-nth-* and *-ss/tt-* as Indo-European suffixes, in agreement with Finkelberg, 2005 and contra Beekes, 2010.
[92] For a review of Neolithic metal finds see Zachos (1996, 2007). See also McGeehan-Liritzis (1983, 1989) on the relationship between LN and EBA metalwork.
[93] For copper in EC metallurgy, see Georgakopoulou (2005). See also, Amzallag (2009) for a detailed account of the emergence of copper metallurgy and its role in the Bronze Age.
[94] On Crete, the earliest evidence for metallurgy dates to the FN at Kephala-Petras (Papadatos, 2007).
[95] Note the presence of litharge in a tomb at the EH cemetery of Tsepi that will be discussed in detail later.
[96] The recent finds from Gialou at Spata also have an FN phase (Ntouni et al., 2015).
[97] "Trade" is used here as an inclusive term to describe "a wide range of modes of exchange including commerce for profit, reciprocity, and redistribution" (Rutter, 2001:119 ft. 100). Also, generally defined as "the exchange of good and services within a mercantile or economic framework that may or may not involve currency" (Burns, 2010:291).
[98] Typical Cycladic materials include marble figurines, which more recently feature prominently in studies of embodiment (Barber, 1984; Davis, 1987; Getz-Preziosi, 1987a,b; Mina, 2008), as well as frying pans. The frying pan is a characteristic, peculiar EBA terracotta vase of uncertain use, of a shape specific to the Aegean, although different types can be distinguished on the mainland and in the Cycladic islands. Suggested uses include: plates, mirror-cases, decorative items, and navigational instruments (on the origin, use, and meaning of frying pans see Coleman, 1985). The depiction of longboats (attested only at Chalandriani; Broodbank, 1989, 2000) on frying pans has led to their association with the sea.
[99] Mylonas (1959:149-165) saw Aghios Kosmas as a colony of Cycladic settlers, used as an *emporeio* for obsidian, that lead to the later merging of the Cycladic and Helladic peoples and cultural practices.
[100] Lead isotope analyses have identified the use of copper and silver from Lavrion, Kythnos, and Seriphos on Crete (Gale and Stos-Gale, 1990, 2008).
[101] For an approach to the "international spirit" and maritime identities in the Early Bronze Age Aegean via the analytical framework of embodiment, see Carter (2008b) and Catapoti (2011).
[102] Hirth (1978) used the term "gateway community" in his examination of early inter-regional trade in Mesoamerica.
[103] Thus pushing the presence of the longboat (or a similar craft) back to the Final Neolithic (Papadatos and Tomkins, 2013).
[104] The identification of a matriline for four females found in an eighth century AD tomb in Eleutherna (Crete) based on the common presence of a Carabelli's cusp (a trait that can

have very high frequencies in certain European populations) is considered at least unwarranted (Agelarakis, 2010; cited as an example of matriliny in Driessen, 2012:376, ftn. 2). Driessen (2012) does acknowledge the lack of human skeletal data on the topic and the importance of such contributions.

[105] The etymology of peninsula is *paene* 'almost' + *insula* 'island.'

[106] Within the recent trend of '-scapes,' current studies talk about "seascapes" (e.g., Vavouranakis, 2011), and "islandscapes" (e.g., Broodbank, 2000:21).

[107] However, the exact etymological relationship between *νήσος* and *νήχω* is unclear (Beekes, 2010). The word may be of unknown origin, perhaps a pre-Greek Aegean loan, although Meier-Brügger and Rix, both accomplished Indo-Europeanists, support the association (cited in Beekes, 2010). Note that the origin of the Latin *insula* is also unclear. Significantly, Beekes (2010) notes that words for 'island' differ between different Indo-European languages.

[108] For EC culture, see Barber (1987), Broodbank (2000, 2008); Davis (1987, 2001); Renfrew (1972).

[109] Materials, mostly pottery and obsidian (grave goods?), were recovered on the (ancient) surface of the cemetery within grave enclosures and/or in between graves in Aghios Kosmas (Mylonas, 1959) and in Tsepi (Pantelidou-Gofas, 2005a).

[110] For the Cyclades, see Doumas (1987, 1988) (linked also to population increase). For the Manika tombs in Euboea, see Sapouna-Sakellarakis (1987) (*contra* Sampson, 1987). For Crete, see Bintliff (1977), Karytinos (1988:81 (for a summary of different opinions with references); Murphy (1998), and Soles (1992 with discussion of population units). In Prepalatial Crete, "house tombs" (a specific tomb-type with multiple burials) have been interpreted as tombs reserved for the ruling elites of the local chiefdoms, where there is also evidence for ancestor worship (Soles, 1992).

[111] See also the earlier cemetery of Kephala on Keos in Coleman (1977) and Fowler (2004), but note the lack of consistent grave orientation in Kephala. For EM Cretan cemeteries, see Branigan (1970, 1998), Murphy (1998), and Soles (1992).

[112] On Cyprus, extramural cemeteries with rock-cut and pit tombs, often reused for multiple inhumations, emerged in the Early Bronze Age as well (Keswani, 2004); though note that the Early Cypriot period is later than the EBA on the mainland, beginning at the end of the third millennium BC (Keswani, 2005).

[113] Extramural cemeteries with cremation burials occur in Neolithic Thessaly, such as at Souphli (transitional Middle to Late Neolithic) and Plateia Magoula Zarkou (early Late Neolithic).

[114] Note also the construction of EH buildings on top of the FN pits and graves (Psimogiannou, 2012).

[115] Intramural and extramural are used here to define within settlement and outside the settlement, respectively, regardless of the presence of fortification walls.

[116] Pit 1: two individuals; Pit 3: five individuals; Pit 4: five individuals; Pit 5: five individuals; Pit 6: five individuals; Pit 8: three individuals (Stravopodi, 1993). Both sexes were represented, while the ages included infants (one), young and older children, adolescents, and young and middle adults; each pit contained at least one juvenile (Stravopodi, 1993). There seemed to be a differentiation in the anatomical parts represented in each pit, since the majority of long bones were concentrated in one pit. However, the poor preservation and the complex taphonomic processes greatly complicate any inferences about the exact burial practices.
[117] Kephala has given a single radiocarbon date from seeds (P-1280), calibrated 3711-3507 BC at 91.1% probability (Coleman, 1977:110, 1992:260; 2000:124, 2011:17). The absolute date, however, is much later than expected and is generally disregarded.
[118] Seven of the graves exhibited built above-ground construction in the structures known as platforms, the function and/or purpose of which is not known. Of the forty graves, twenty-seven preserved bones. The majority (n = 17) contained a single inhumation; five graves contained two individuals; one grave contained four individuals; two graves contained 6 individuals; one grave contained 9 individuals; and one grave contained thirteen individuals (Angel, 1977). All ages and both sexes were represented, with a total of 65 individuals (Angel, 1977). The skeletons were found in highly contracted positions either on their right or left side, with the head in some cases pointed towards the west. In three of the graves with multiple inhumations (n. 1, 3, 7), different burial levels were identified, which were in some instances separated by a layer of pebbles (Coleman, 1977:48).
[119] Though in the case of the Cycladic islands one needs to keep in mind the lack of open, flat spaces. The cemeteries were usually sited on sloping (and rocky) ground.
[120] At Chalandriani on Syros, Tsountas (1899), who excavated 490 graves, identified four large clusters, which he considered to reflect different subgroups derived from either villages or tribes. He also attributed the choice of either rectangular or circular grave pits as indicative of affiliation with one of the subgroups. Only ten graves were found to contain two or three (or more?) individuals; of those ten graves, two preserved a complete, *in situ* skeleton on the floor, while remains from other individuals were found on top (Tsountas 1899:83).
[121] The populous site of Chalandriani was not the only EC cemetery on the island. Tsountas (1899) excavated another cemetery with 94 graves at Aghios Loukas at the northwestern end of the island and reports the presence of two or three graves with marble figurines on the western part of the island.
[122] For EH skeletal samples, see Angel (1959), Blegen (1928:43-55), Charles (1962), Fountoulakis (1985, 1987), Koumouzelis (1989-1991).
[123] Weiberg (2007) rightly presents this suggestive regional pattern as a working hypothesis that greatly depends on the available evidence and finds of current and future excavations.

[124] The Cheliotomylos skeletal assemblage forms the core of a different study and will be discussed in detail elsewhere. Here, it was used as a comparative archaeological assemblage for the isotopic analyses (Chapter 6).
[125] The osteological and biochemical study of the human skeletal remains from Ayia Triadha Cave is ongoing by the author.
[126] Whether or not Cheliotomylos should be considered intramural is open to discussion.
[127] At Kephala, the most common grave type was built with walls constructed in small stones (usually schist) and subsequently covered with schist slabs; the form (rectangular, circular, or oval) and size of the tomb chambers varied greatly (Coleman, 1977:45-48). There were also two cist graves that were probably used for children burials (Coleman, 1977:48).
[128] Also, the EH tombs recently discovered at Nea Styra are of monumental construction. The Nea Styra tombs will be discussed in the next chapter.
[129] "Collective" is used here as a general descriptive term to denote graves that contain multiple inhumations, without necessarily representing families.
[130] The construction of Late Helladic III rock-cut chamber tombs on top of Early Helladic I rock-cut chamber tombs at Kalamaki in northwestern Peloponnese (Vassilogamvrou, 1996-1997, 2008) might suggest a link between the mortuary rituals of the two time periods. Some of the EH graves were actually re-used in the LH phase of the cemetery (Vassilogamvrou, 2008).
[131] Tsountas (1898) divided the graves into simple, cist graves that contained one inhumation and double (two-storied) tombs used for multiple inhumations. The same scholar (1898) reported the presence of double graves at Despotiko and Antiparos (he identified up to 7 individuals), which he interpreted as family graves. Doumas (1977, 1987) interprets the grave clusters as representing separate social groups, perhaps families. He views graves with multiple inhumations as replacing the earlier clusters of single graves, which may have been necessary due to a population increase and the associated lack of space. In some cases, graves containing only disarticulated remains were interpreted as ossuaries used only for the secondary burial of remains originally buried in different graves (in the Naxos cemeteries; Stephanos, 1910; Philaniotou, 2008).
[132] In Chalandriani, the left side was more common.
[133] At ancient Elis, both extended and contracted skeletons were recovered in the collective chamber tombs (Rambach, 2007).
[134] The chamber tombs at ancient Elis contained multiple individuals, ranging from two to sixteen based on the number of crania, including *in situ* skeletons. The primary or secondary deposits were often placed in niches (Rambach, 2007).
[135] For Manika, see Sampson (1988:48).
[136] Depending on a variety of conditions such as temperature and condition of the body.
[137] Of course, the bodies could have been tied with ropes and/or cloth to aid in the positioning.

[138] For example, the spread and success of chamber and tholos tombs in the LBA resulted from the ease of access to the burial chamber that they provided (Cavangh and Mee, 1998:117). Cavanagh and Mee (1998) focus on these LBA types because at Aghios Kosmas the entrances were symbolic (i.e., not used to introduce the body to the tomb chamber). However, this is not the case for Tsepi where, as will be discussed in detail later, the entrances and doorways were fully functional.
[139] Acknowledging of course that the same ritual could perhaps result from different processes.
[140] This is in contrast with Crete where EM burial customs have been a large topic in the literature (e.g., Branigan, 1998; Soles, 1991).
[141] Note the argument for ancestor cult in the FN Kephala cemetery on Keos based on the intra-cemetery organization and the funerary use of marble figurines by Talalay (1991). See also Fowler (2004:94-95).
[142] Cf. Sampson (1988:58) who comments on the evidence for respect over the dead and the earlier bones.
[143] Note also the absence of Early Helladic assemblages in discussions of ritualistic feasting in the mortuary sphere as also observed by Weiberg (2013a:36). Recently, Pullen (2011) discussed feasting contexts in Early Helladic settlements at Tsoungiza and Lerna.
[144] Mylonas (1951) did acknowledge the dearth of EH graves.
[145] The Kykladisch – Frühelladisch Mischkultur of Attica (Schachermeyr, 1954, 1955; Renfrew, 1972).
[146] For a detailed account of EH Attic sites up to 2000 see Alram-Stern (2004:537-558); Pullen (1985:122-132, 230-240). Also Forsén (1992:108-125).
[147] For EB II Keos, Wilson (1987:35) argued for a "regional group which formed a cultural and economic bridge between the mainland and the islands" indicating that a clear divide between the Helladic mainland and the Cycladic islands could be observed neither in ceramic nor in strictly geographic terms.
[148]At Alyki in Glyfada/Voula, Papademetriou (1957) excavated a cist grave containing a skeleton in contracted position and EH sherds, adjacent to a Late Helladic child burial. He argued for the presence of an EH cemetery close to the sea, which would also have been used during Mycenaean times. For EH remains, including litharge finds, on the small island of Makronissos immediately adjacent to Attica and across from Lavrion, see Lambert (1972), Spitaels (1982), Theochares (1955).
[149] Preliminary observations during excavation of Grave 14 by the author.
[150] The pottery consists mainly of EH finds with some Mycenaean and Classical finds (Petrakos, 2013).
[151] Aghios Kosmas likewise had a Mycenaean settlement and cemetery (Mylonas, 1959).
[152] Kontopigado also had a Mycenaean phase.

[153] For earlier discoveries of EH remains in western Attica see references in Kaza-Papageorgiou (2006:45).
[154] Part of an EH I pit grave was excavated at Dionysos in northern Attica (Palaiologos and Stefanopoulou, 2015).
[155] For the Lavreotiki area, see also Kapetanios (2013).
[156] An Early Neolithic settlement has also been excavated at Merenda, at the hill where the Olympic Equestrian Facilities were constructed (Kakavogianni et al., 2009). Several Neolithic sites have been excavated in the last decade (see Katsarou et al., 2015; Palaiologos and Stefanopoulou, 2015; Steinhauer, 2015).
[157] The study of the human skeletal remains from the EH graves at Loutsa is in progress by the author.
[158] Preliminary observations during curation of the material from Grave 1 by the author.
[159] The Department of History and Archaeology of the National and Kapodistrian University at Athens recently began a systematic excavation at Plasi that should shed light on the continuous occupation at Marathon. This will hopefully also revive the interest in prehistoric Marathon, after the excavations of Sotiriadis in the 1930s and Mastrokostas and Marinatos in the early 1970s.
[160] Graves of different time periods occur in different locations in the wider Marathon area: Classical in Plasi and Brexiza, Geometric, Archaic, and Classical at Skorpio Potami (close to Arnos) and Skaliza, on the northern slopes of Mt. Agrieliki, as well as in the wider area (Mastrokostas, 1974; Mpanou and Oikonomakou, 2008).
[161] Nea Makri is the oldest Neolithic settlement in Attica (Pantelidou-Gofas, 1995). For recent excavations, see Fotiadi and Papanikolaou (2015).
[162] The site of the cemetery was occupied by a community of five to six extended farming families all bearing the old Byzantine name of Vranas (hence the name of the cemetery), before the expropriation of the land by the Hellenic Ministry of Culture in the 1970s.
[163] Androtion was an Athenian student of Isocrates who wrote a local history of Athens (*Atthis*) in the mid-fourth century BC (Jacoby, 1949).
[164] The ancient sources talk about the Pelasgoi as one of the pre-Greek populations of the Aegean inhabiting the mainland (Hekataios *FGrHist* 1 F 119; Strabo 7.7.1 C321). In Athenian local historiography, Pelasgoi were early on associated with the term Pelargoi, the word for 'Storks.' Philochoros (*FGrH* 328 F 99-101) uses the image of the Pelasgoi as storks (Pelargoi) "who *sailed* in, when the season opened in spring, like migratory birds" (Harding 2008:197; emphasis mine). Note the stress on maritime travel, which thus featured in the emic conceptual framework of the ancient Greeks: movement in the Aegean could be characterized as maritime connectivity (the fragment in question derives from scholium B to Homer, *Il*. 1.594). In any case, for the ancient Greeks the Pelasgoi were a useful concept that served as a bridge between the deep, mythical past with no written records and the contemporary historical reality alive in memory and recent events. They helped to provide a narrative for a unified past that shaped their common

ethnic identity derived from a common Pelasgian origin (Hall, 1997; McInerney, 2014; Sourvinou-Inwood, 2003). On the historic accounts of Hellanikos, Herodotus, Thucydides, and Cleidemus, and for the identification of the Cyclopean (Mycenaean) walls of the Athenian Acropolis as Pelasgian and the arising issues of the Pelasgikon/Pelargikon wall, and the historical, rival relationships between the Athenians and the Pelasgoi, see Harding, 2008; McInerney, 2014: 34-45. On the issue of the contested views of the Pelasgoi as wanderers and as autochthonous in Herodotus see McInerney, 2004:45 ff. For further discussion of the early Athenian traditions concerning the Pelasgoi, see Harding, 2008:24-6, 196-8. For a later historical account, see also Dionysios of Halikarnassos 1.17-30). The Pelasgoi are sometimes associated with Etruscans (Tyrrhenians) (Philochorus and Hellanikos; cf. Herodotus).

[165] Reinterpretation of non-Greek names is a common phenomenon. We see it, for instance, in the case of the Black Sea, whose Persian name was *axšaina*- 'dark-colored,' which sounded enough like Greek ἄξεινος (*axeinos*) 'inhospitable' that it was eventually changed to Εὔξεινος 'Hospitable' as a prophylactic measure. Similarly, the river Euphrates exhibits the Greek prefix Εὐ- 'well, good,' which resulted from the re-working of a local name. For προβάλλω and Τρι-, see Beekes (2010).

[166] Tsepi is an Albanian word meaning 'beak,' used probably due to its location on the beak-like projection of the Kotroni hill (Pantelidou-Gofas, 2005a:11). Arvanites (people originating from southern Albania) settled in Attica starting in the 14th century (Alexakis, 2001).

[167] Repeated episodes of flooding of the Skorpio Potami River were observed at Tsepi (Margoni and Kapetanios, 2015).

[168] This is probably why no bones from Grave 1 were identified during the study of the remains.

[169] I will be using the abbreviation "T" for the numeration of the Tsepi graves (e.g., T1), following Pantelidou-Gofas (2005a). "T" stands both for Tomb and also *Tafos* (i.e., grave in Greek).

[170] Graves excavated by Pantelidou-Gofas (year of excavation is shown in parenthesis for reference to the published excavation summaries by the Archaeological Society at Athens, *Ergon* and *Praktika*): T36 (1998), T33 (1999), T57 (2001), T47, T68 (2005), T45 (2001, 2006), T47, T68 (2005, 2006), T41, T42 (2007), T53, T54 (2008), T43, T50 (2009), T49, T66 (2011), T56, T58 (2012), and T62, T67 (2013). The feature T66 included a stone pile but no grave. Here I include information from *Praktika* through 2009 and *Ergon* through 2013.

[171] Graves excavated during the construction of the new roof are not included in the plan and have not been published in detail (Kapetanios, 2010). No information exists about T70.

[172] With a few exceptions, e.g., T45 (Pantelidou-Gofas, 2001, 2006).

[173] Again, with some exceptions, e.g., oval-shaped T65.

[174] The earlier date of some graves was defined based on their architectural features (Pantelidou-Gofas, 2005a:289).
[175] Thin schist slabs occur in the corbelled graves of Syros, the only Cycladic graves with a side entrance (Doumas, 1977; Tsountas, 1899). Thick limestone slabs were used for the *stómia* in Aghios Kosmas, Manika, and Lithares (in Pantelidou-Gofas, 2005a:292).
[176] Pantelidou-Gofas employed the term *próthyron* used by Mylonas (1959:65) for the graves at Aghios Kosmas.
[177] The access shafts of T19 (Pantelidou-Gofas, 2005a:127-139) and T53 (Pantelidou-Gofas, 2008a:2) consist of two steps.
[178] At EC Ano Kouphonisi, Zapheiropoulou (1984, 2008) reported the placement of an upright quadrangular stone over an inhumation marked by a stone enclosure, interpreting it as a *sema* or grave marker (Zapheiropoulou, 1983, 2008). One case of triangular slabs being used as possible funerary *stelai* has been reported at the EM Aghia Photia cemetery on Crete (Davaras, 1971; Davaras and Betancourt, 2004; Day et al., 1998:135).
[179] In the case of T54, the intentional cessation of use was also supported by the absence of an enclosure and the placement of large cobbles in the access shaft after removal of the enclosure (Pantelidou-Gofas, 2008a).
[180] T41 was fully constructed but not used due to the collapse of its roofing early on; any evidence for *stelai* or a stone pile was missing from this tomb, but the tomb chamber was filled with cobbles (Pantelidou-Gofas, 2007).
[181] Specifically, the western side of the enclosure of T53 forms an opening (the northwestern part) that allows access to the entrance (eastern side) of the enclosure of T42 (Pantelidou-Gofas, 2008a).
[182] Repairs of the various features also indicate the great care taken for the maintenance of the graves.
[183] Mylonas (1959) observed remodeling at the Aghios Kosmas graves. Weiberg (2007) suggested that the addition of the doorway and the *prothyron* might reflect the influence of the chamber tombs at Manika; however, Tsepi is earlier than Manika.
[184] The *prothyron* of T43 shows two phases of construction; it was elongated at a later phase (Pantelidou-Gofas, 2009).
[185] The cemetery of Kephala on Keos that shares similarities with Tsepi is also of an earlier date. Note also that Keos is the Cycladic island closest to the Attic coast.
[186] However, there is no uniformity in size, shape, or location of the platforms (see plan in Coleman, 1977:Pl. 10).
[187] An area paved with small stones and pebbles was discovered in the cemetery of Aghios Kosmas, on top of whose surface there were vases (Area V) (Mylonas, 1959:106ff.). Paved surfaces have also been identified in EM cemeteries on Crete (see Day et al., 2998; Murphy, 1998).
[188] The presence of a stone platform is reported above the EH II cist grave in Elis (Koumouzelis, 1980, 1981).

[189] At Aghios Kosmas the doorways were not functional (Mylonas, 1959).
[190] Weiberg (2007:303-305) considers the possibility that this resemblance was the result of the builders using a form they were familiar with. Tsountas (1899:83) originally suggested that the construction of the graves with an unused entrance, as well as the manner of covering the pits, emulated house construction in EC II Chalandriani on Syros. Note also that the Chalandriani graves were corbelled and dug into the slope of the hill.
[191] Recent excavations on the island of Poros in the Saronic Gulf recovered EH buildings also with uniform orientation, with the entrance generally to the east (Konsolaki-Giannopoulou, 2011).
[192] Tsepi actually bears similarities with cemetery layouts in modern, rural Greece.
[193] The *in situ* skeleton of T21 was found in a contracted position laying on his/her back, placed diagonally in the tomb chamber, with the head in the SE corner, the left arm contracted with the palm on the pelvis and the right arm flexed and wedged against the eastern wall (Pantelidou-Gofas, 2005a:151, fig. 152). T25 contained two superimposed *in situ* skeletons (Pantelidou-Gofas, 2005a:169, fig. 173). Behind the *in situ* skeleton at the entrance of T7, a second *in situ* skeleton was recovered (Pantelidou-Gofas, 2005a:63-68, fig. 56).
[194] The broken covering slabs and lintel of T33, in combination with the discovery of a burial inside the access shaft, suggest that the tomb chamber was considered inaccessible due to risk of collapse. The entrance area of the chamber, however, had been cleared out, thus indicating that unless the slabs broke during the latest interment, the pit had been cleared at a different time (Pantelidou-Gofas, 1999).
[195] Mylonas (1959:118) attributed the similar cases of graves lacking an *in situ* interment to the existence of a second burial procedure in which the deceased was temporarily interred outside the tomb chamber until decomposition had occurred, after which the bones were relocated within the tomb.
[196] T68 contained two *in situ* skeletons (one of them a young juvenile) at the bottom of the tomb chamber, while on top of them skeletal remains from secondary burials were placed (Pantelidou-Gofas 2005b, 2006).
[197] The recovery of the mandibles next to the crania of the *in situ* skeletons, particularly of the two eastern ones, was greatly emphasized by the excavator (Pantelidou-Gofas, 2009). Note that the mandible is a separate bone that detaches from the cranium after decomposition. Based on the photos of the tomb chamber (Pantelidou-Gofas, 2009:Pin.10a,b), the crania of the two skeletons on the east, placed horizontally on top of the neck, were repositioned subsequent to decomposition, at which time the mandibles were likewise repositioned (probably in order to move the crania). Any interpretation must remain tentative, however, until the remains are studied by a specialist. This should be kept in mind also when comments about the intentional detachment of the mandibles are made by the excavator.

[198] Mylonas (1959:107-114) reported finds on the surface of the cemetery at Aghios Kosmas.
[199] The two vessels are similar to pottery found in the Cave of Pan, dated to EH I (Kapetanios, 2010). Further parallels between Tsepi and the Cave of Pan were noticed during the construction of the new roof: a small pit found close to the pylons of the new roof (unreported exact location), probably a bit older than the use of the Tsepi tombs, containing ceramics identical with those of the Late Neolithic phase of the cave (Kapetanios, 2010).
[200] The bone fragment could in fact belong to an animal. Future examination of the bone fragment by a specialist may reveal whether or not it is human, as well as whether or not the degree of burning is commensurate with cremation.
[201] It should be noted that during the study of the human remains from T1−T27 additional potsherds and stone finds were also identified. Thus the number of the grave finds may be altered in the future.
[202] Parallels for these exist in the early Pelos group in the Cyclades and the second Rachmani phase at Pefkakia (Pantelidou-Gofas, 2005a:323).
[203] For the use of obsidian in the EC world, especially the occurrence of obsidian blades in EC burials, see the work of Carter (1998, 1999, 2003, 2007, 2008a,b).
[204] According to Pantelidou-Gofas (2005a:320) three palettes preserve traces of red pigment (from graves T3, T12, and T16).
[205] The palette segment reported from T5 during excavation but was not later found in the Museum (Pantelidou-Gofas, 2005a:53) was also recovered.
[206] On Crete, EM stone palettes were recovered in grave contexts at Palaikastro (Karantzali, 1996:152, fig.135d), Aghia Photia (Karantzali, 1996:46), in the tombs of the Mesara plain at Koumasa (Xanthoudides, 1971:15-16, 45), Porti (Xanthoudides, 1971:64), and Drakones (Xanthoudides, 1971:79), and in the tholos tombs at Aghia Triadha and Marathokephalon (cited in Xanthoudides, 1971:16). Palettes were also recovered in tombs on Mochlos, three of which have four low feet (Seager, 1912:36-37; Soles, 1992:235-236). Xanthoudides (1971:15-17, 129) interpreted the EM palettes as sacred tables of offerings, based on the palettes with feet (including the limestone plaque found in the shrine at Phaistos) and the lack of evidence from grinding or color (contrary to the Cycladic examples that preserve traces of colors and are often found with pestles). Furthermore, he emphasized the similarities between the Cretan, Cycladic, and Egyptian palettes, regardless of their actual use, and argued for a similarity in the burial customs between the Aegean and Egypt (Xanthoudides, 1971: 16-17, 129).
[207] Sampson (1988:71, fig. 84) mentions one more bone object, which, although resembling a palette, he considered to be of unknown use due to its small size and hollow shape.

[208] Four lids from graves (T6.2, T16.1, T33.2, T36.2) (Pantelidou-Gofas, 2005:314-316) and one from the deposit pit 39 (Petrakos, 2000:33-34, fig. 26-27). In Attica, one more lid of this type was recovered in Markopoulo (Alram-Stern, 2004:556; Rambach, 1997).
[209] See Coleman (2011) for discussion and parallels. See also Dousougli and Zachos, (2002).
[210] Maran interprets the distribution of these bowls or lids as evidenec for an exchange network, whereas Coleman interprets it as reflecting a movement of people (as discussed later, on the basis of the local manufacture of these vessels).
[211] Coleman (2011:28) suggests that they were held in a horizontal position when "a standing officiant distributed a substance from the vessels to seated participants."
[212] For available radiocarbon dates, see Coleman (2011:34, n.71).
[213] The tooth is reported as possibly deriving from a shark (Petrakos, 2012), but it has not yet been definitely identified.
[214] I would like to sincerely thank Tatiana Theodoropoulou for her help in the identification of shells.
[215] The cowrie shell (*Cypraeidae*) is a diachronic symbol of fertility due to its shape. Cowrie shells were placed in the eye orbits in one of the Pre-Pottery Neolithic Jericho plastered skulls.
[216] See also discussion on fertility cults in relation to *Pelasgoi* in Cosmopoulos, (1991b:337-365).
[217] Litharge is the by-product of the extraction of silver from argentiferous lead ores through cupellation (see discussion in the previous chapter).
[218] Weiberg's analysis (2007:280) included a smaller number of graves and finds from Tsepi than those included here, but the general pattern to which she drew attention is still the same.
[219] Weiberg (2007:290) counts 55 small finds out of 128 in total. This number is much larger when the finds from the recently excavated graves are included (e.g., the necklace with 17 beads from Grave 58).
[220] Two beads were recovered at Aghios Kosmas (Grave 21) (Mylonas, 1959:98-99).
[221] The appearance of daggers in Greece dates to the Neolithic; in EB I they are found in the eastern Aegean, while they become very common in the EB II (Cosmopoulos, 1991a; see also Renfrew, 1972). For early Aegean metallurgy, see Nakou, 1995.
[222] Bone tubes may be more characteristic of later EB 2 contexts, thus explaining their absence from earlier contexts.
[223] The perforated tooth used as a bead in T58 is not considered here, given that it was included in the previous discussion and graphs on personal ornaments.
[224] I want to sincerely thank Michael MacKinnon, Alex Mulhall, and Angelos Hadjikoumis for their help in the identification of faunal remains.
[225] One explanation for the apparent emphasis on smashing the pots is the belief that the breakage is intended to frighten *Charos* (i.e., Death).

[226] Libation rituals for the dead are also observed, similar to those of antiquity, in which wine is poured onto or over the grave (Politis, 1872).
[227] Observed also today.
[228] Extensive funerary meals (with specific rituals, types of food, roles in preparation) also take place at the house of the deceased for several days. In many instances, the family of the deceased has to prepare and take specific foods to all the neighboring houses, while in other cases the neighbors prepare and take food to the house of the deceased (see also Protodikos, 1860).
[229] See also Kapetanios (2010:33-34) for a parallel with the periodic memorial services in rural Greece.
[230] For comparative deposits, mainly in the Cyclades, see Pantelidou-Gofas (2008b:286-289). Psimogiannou (2012) draws attention to the presence of pits adjacent to graves that contained burnt and broken artifacts (ceramics, obsidian, bones, and shells) in the FN site of Proskynas in Lokris and suggests the practice of mortuary rituals including feasting as a rising social arena.
[231] Doumas (1976, 1977:66, 1979) argued against Marinatos' dating of the cemetery to the EH/EC I and placed Tsepi in EC II based on the burial customs, particularly the presence of multiple burials, which he considered to be a Keros-Syros phenomenon.
[232] For other corrections, such as that for isotopic fractionation, which is given by measuring the $^{13}C/^{12}C$ ratio in every sample, or the reservoir effect, see Hedges (1981) and Taylor (2014).
[233] A discussion of the typological nature of the early biodistance studies (late 19th and early 20th centuries) and of the critique of the field as racist and typological in nature is not relevant to the aims of this paper (see Buikstra and Beck, 2006 for a thorough review of the history of biodistance analysis and bioarchaeology in general; for critiques of biodistance analysis as racist, see Armelagos and Goodman, 1998; Armelagos and van Gerven, 2003; cf. Stojanowski and Buikstra, 2004).
[234] Bioarchaeology and biodistance analyses on Cyprus show different trends from the rest of the Aegean, stimulated again by the pioneering work of J.L. Angel at the island (note the recent biodistance work on Cypriot samples of Harper, 2008).
[235] In recent years, there has been an increase in aDNA studies for the reconstruction of kinship mostly in the LBA (e.g., Bouwman et al., 2008, 2009; Chilvers et al., 2008; for aDNA in the Aegean see also Evison, 2001, Evison et al., 1999). However, problems with aDNA preservation caused by the Greek climate and soil acidity, in addition to sampling restrictions and cost illustrate that aDNA cannot substitute for phenotypic biodistance analyses.
[236] This study includes the osteological material that was exported from Tsepi to Vienna in the early 1970s, by professor Emil Breitinger, a member of Marinatos' original team. With the support of M. Teschler-Nicola (Director, Natural History Museum of Vienna) in collaboration with the Ephorate of Paleoanthropology and Speleology, these remains

were repatriated to the Marathon Museum on November 19, 2010. The repatriated material, which was not further studied by Breitinger, consisted of 34 boxes mainly containing crania. Note the great care placed on the recovery of human skeletal remains, despite the early date of the excavation. Marinatos (1970c, 1971, 1972) very often expressed his gratitude and admiration for Breitinger's participation in the excavation. Marinatos remarked on the "anthropological" (referring here to human remains) importance of the Tsepi cemetery (Marinatos, 1972:5; Orlandos, 1972:5).

[237] The Institute for Aegean Prehistory funded a nine-month professional conservation by conservator Zoe Chalatsi. Professional conservator, Giota Gkioni of the Ephorate of Paleoanthropology and Speleology also worked on the assemblage for a month during her sabbatical in the summer of 2011. Additionally, more than fifteen undergraduate and graduate archaeology students from the University of Athens, as well as undergraduate students from American universities volunteered to participate in the dry and/or wet cleaning of the assemblage, under my supervision. In this, Michel v. Roggenbucke of the Conservation Laboratory of the Museum of Archaeology and History of Art at the National and Kapodistrian University of Athens provided great assistance.

[238] Dead bees and wasps were recovered inside the crates. Contrary to dermestid infestations, bees and wasps affect dry bone.

[239]Abbreviations of dental measurements are as follows: C_1MD, lower canine mesiodistal; C_1BL, lower canine buccolingual; lower P_1MD, first premolar mesiodistal; P_1BL, lower first premolar buccolingual; P_1MDC, lower first premolar mesiodistal cervical; P_1BLC, lower first premolar buccolingual cervical; P_2MD, lower second premolar mesiodistal; P_2BL, lower second premolar buccolingual; P_2MDC, lower second premolar mesiodistal cervical; P_2BLC, lower second premolar buccolingual cervical; M_2MD, lower second molar mesiodistal; M_2BL, lower second molar buccolingual).

[240] For radiocarbon dating in the Early Bronze Age Aegean, see Manning (1995).

[241] Etymologically Aegean derives from the Greek word *αίγες* (goats), which is used as a metaphor for the waves; Aegean means 'wavy', like leaping goats (Doumas, 2004:226).

[242] For the Loutsa skeletal assemblage, one deciduous second molar was sampled, reflecting diet between late fetal life (5 ± 2 months *in utero*) and 1 year (± 4 months) (Buikstra and Ubelaker, 1994:51). From the Cheliotomylos and Loutsa assemblages, bone elements were also sampled. Bone continues to remodel throughout life, thus bone samples reflect diet in the latest years of the individual's life (see Hill, 1998; Jowsey, 1960; Parfitt, 1983).

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APPENDIX A

LIST OF VESSELS RECOVERED FROM THE GRAVES AT TSEPI

Tomb #[a]	Miniature vases	Pyxis	Pyxis-shaped	Aryballoid	Necked jar	Small amphora	Jug	Juglet	Cup	Platter	Lid	Frying pan	Various vessels
T1		1			1					1 stone			
T3						1							
T4									1				
T5			1		1							1	
T6					1			1	1		1		
T7						1							1 bowl (phiale) fragment
T9							1					1	
T10	1 necked jar	1				1	1	1	2				
T11		1					1						
T12	1 necked jar												
T13					1							1	
T16						1					1		
T17					1				1				
T18									1				
T19	1 small amphora	1			2					1 ceramic	1		

Tomb #[a]	Miniature vases	Pyxis	Pyxis-shaped	Aryballoid	Necked jar	Small amphora	Jug	Juglet	Cup	Platter	Lid	Frying pan	Various vessels
T20	1 necked jar												1 dipper (kyathos)
T22		1											
T23			1										
T24	1 pyxis		2										
T25	1 small amphora												
T33	1 necked jar; 1 small amphora								2	1 stone	1		
T36			1		1					1 stone	1		
T42	1 pyxis; 1 small amphora												
T43		1							1				1 basin (fragment)
T49	2 small amphoras	1										1	
T56		1					1			1 ceramic?			
T58										1 stone			

[a] Based on Pantelidou-Gofas, 2005a; for the graves excavated after 2005, see *PAE* and *ERGON*.

APPENDIX B

INTER-TRAIT CORRELATION

Trait[a,b]	MS	SON	PF	LO	PNB	AE	SMS	SMD	MF	SM	RMP
SON	0.144 (0.704) 0.0 (1.0)										
PF	0.203 (0.652) 0.0 (1.0)	0.024 (0.876) 0.0 (1.0)									
LO	0.142 (0.706) 0.0 (1.0)	0.037 (0.847) 0.0 (1.0)	0.167 (0.683) 0.0 (1.0)								
PNB	0.184 (0.668) 0.0 (1.0)	0.131 (0.717) 0.0 (1.0)	0.561 (0.454) 0.0 (1.0)	1.622 (0.203) 0.641 (0.423)							
AE	0.602 (0.438) 0.0 (1.0)	0.897 (0.344) 0.063 (0.801)	0.732 (0.392) 0.002 (0.962)	2.618 (0.106) 1.041 (0.308)	1.996 (0.158) 0.170 (0.680)						
SMS	1.166 (0.280) 0.423 (0.515)	2.429 (0.119) 1.366 (0.242)	0.178 (0.673) 0.0 (1.0)	0.596 (0.440) 0.246 (0.620)	0.008 (0.930) 0.0 (1.0)	0.230 (0.632) 0.0 (1.0)					
SMD	4.786 (0.029)* 3.144 (0.076)	2.562 (0.109) 1.470 (0.225)	0.982 (0.322) 0.334 (0.563)	0.350 (0.554) 0.1 (0.752)	0.008 (0.930) 0.0 (1.0)	2.048 (0.152) 0.819 (0.365)	15.614 (0.0)* 13.613 (0.0)*				
OF	0.552 (0.457) 0.0 (1.0)	0.119 (0.730) 0.0 (1.0)	0.380 (0.538) 0.0 (1.0)	0.091 (0.763) 0.0 (1.0)	0.298 (0.585) 0.0 (1.0)	0.353 (0.552) 0.0 (1.0)	0.305 (0.581) 0.0 (0.985)	0.143 (0.706) 0.0 (1.0)	2.837 (0.092) 1.032 (0.310)	0.183 (0.669) 0.0 (1.0)	0.061 (0.805) 0.0 (1.0)

Trait[a,b]	MS	SON	PF	LO	PNB	AE	SMS	SMD	MF	SM	RMP
MF	1.222 (0.269) 0.247 (0.619)	0.532 (0.466) 0.068 (0.794)	0.166 (0.684) 0.0 (1.0)	0.495 (0.482) 0.086 (0.769)	0.991 (0.320) 0.019 (0.891)	0.668 (0.414) 0.0 (0.988)	1.706 (0.191) 0.902 (0.342)	1.766 (0.184) 0.926 (0.336)			
SM	0.434 (0.510) 0.0 (1.0)	0.640 (0.424) 0.0 (1.0)	0.324 (0.569) 0.0 (1.0)	2.948 (0.086) 1.258 (0.262)	1.996 (0.158) 0.170 (0.680)	3.444 (0.063) 0.470 (0.493)	1.236 (0.266) 0.247 (0.619)	1.039 (0.308) 0.169 (0.681)	0.518 (0.472) 0.0 (1.0)		
RMP	0.552 (0.457) 0.0 (1.0)	0.646 (0.421) 0.0 (1.0)	0.765 (0.382) 0.020 (0.888)	0.835 (0.361) 0.152 (0.696)	0.520 (0.471) 0.0 (1.0)	0.353 (0.552) 0.0 (1.0)	0.305 (0.581) 0.0 (0.985)	0.083 (0.773) 0.0 (1.0)	0.788 (0.375) 0.004 (0.949)	4.893 (0.027)[b] 0.800 (0.371)	
OF	0.552 (0.457) 0.0 (1.0)	0.119 (0.730) 0.0 (1.0)	0.380 (0.538) 0.0 (1.0)	0.091 (0.763) 0.0 (1.0)	0.298 (0.585) 0.0 (1.0)	0.353 (0.552) 0.0 (1.0)	0.305 (0.581) 0.0 (0.985)	0.143 (0.706) 0.0 (1.0)	2.837 (0.092) 1.032 (0.310)	0.183 (0.669) 0.0 (1.0)	0.061 (0.805) 0.0 (1.0)

[a] Trait abbreviations: MS, metopic suture; SON, supraorbital notch; PF, parietal foramen; LO, lambdoidal ossicles; PNB, parietal notch bone; AE, auditory exostosis; SMS, suprameatal spine; SMD, suprameatal depression; MF, mastoid foramen; SM, sutura mendosa; RMP, retromastoid process; OF, occipital foramen.

[b] First number shows Pearson χ^2 and second number shows Yates Corrected χ^2. P-values for each are given in parenthesis.

[b] Pearson χ^2 significant at 0.05. Yates corrected χ^2 not significant. Jaccard binary coefficient for this pairwise comparison was calculated at 0.2.

* Significant at 0.05.

APPENDIX C

CONTEXTUAL AND BIOARCHAEOLOGICAL INFORMATION FOR ARCHAEOLOGICAL HUMAN ENAMEL AND BONE SAMPLES INCLUDED IN BIOGEOCHEMICAL ANALYSES

Lab #	Specimen #	Site	Tomb/Feature	Material[a]	Age[b]	Sex[c]
ACL-5053	TSEP-T3-1.1	Tsepi	T3	LRM1	Ad	M
ACL-5054	TSEP-T3-1.2	Tsepi	T3	LRM2	Ad	M
ACL-5055	TSEP-T3-1.3	Tsepi	T3	LRM3	Ad	M
ACL-5056	TSEP-T3-2	Tsepi	T3	ULM2	Ad	F
ACL-5057	TSEP-T4-1.1	Tsepi	T4	ULM2	Yad	M
ACL-5058	TSEP-T4-1.2	Tsepi	T4	ULM3	Yad	M
ACL-5059	TSEP-T4-2	Tsepi	T4	ULM2	Yad	F?
ACL-5060	TSEP-T4-3.1	Tsepi	T4	URM1	LAO	F
ACL-5061	TSEP-T4-3.2	Tsepi	T4	URM2	LAO	F
ACL-5062	TSEP-T4-3.3	Tsepi	T4	URM3	LAO	F
ACL-5063	TSEP-T4-4.1	Tsepi	T4	ULM1	Yad	F
ACL-5064	TSEP-T4-4.2	Tsepi	T4	ULM3	Yad	F
ACL-5065	TSEP-T4-5	Tsepi	T4	ULM2	Yad	F
ACL-5066	TSEP-T4-6.1	Tsepi	T4	ULM1	C	NA
ACL-5067	TSEP-T4-6.2	Tsepi	T4	ULM2	C	NA
ACL-5068	TSEP-T4-7.1	Tsepi	T4	ULM1	Yad	M
ACL-5069	TSEP-T4-7.2	Tsepi	T4	ULM2	Yad	M
ACL-5070	TSEP-T4-7.3	Tsepi	T4	ULM3	Yad	M
ACL-5071	TSEP-T5-1	Tsepi	T5	LLM1	Ad	IND
ACL-5072	TSEP-T5-2	Tsepi	T5	LLM1	C	NA
ACL-5073	TSEP-T5-3	Tsepi	T5	LLM1	Yad	IND
ACL-5074	TSEP-T5-4	Tsepi	T5	LLM2	Ad	M?
ACL-5075	TSEP-T6-1	Tsepi	T6	ULM1	AO	IND
ACL-5076	TSEP-T6-2	Tsepi	T6	ULM1	YAO	IND
ACL-5077	TSEP-T6-3	Tsepi	T6	URM1	Yad	IND
ACL-5078	TSEP-T7-1	Tsepi	T7	ULM1	Yad	F?
ACL-5079	TSEP-T7-2	Tsepi	T7	LRM1	OC	NA
ACL-5080	TSEP-T7-3.1	Tsepi	T7	ULM1	Yad	M
ACL-5081	TSEP-T7-3.2	Tsepi	T7	ULM2	Yad	M
ACL-5082	TSEP-T7-3.3	Tsepi	T7	ULM3	Yad	M
ACL-5083	TSEP-T9-1.1	Tsepi	T9	URM1	Ad	F
ACL-5084	TSEP-T14-1	Tsepi	T14 *prothyron*	URM2	Ad	F
ACL-5085	TSEP-T9-1.2	Tsepi	T9	ULM3	Ad	F
ACL-5086	TSEP-T9-2	Tsepi	T9	ULC	Ad	M
ACL-5087	TSEP-T9-3	Tsepi	T9	LLM2	AO	NA
ACL-5088	TSEP-T9-4	Tsepi	T9	LLM2	Ad	M?
ACL-5089	TSEP-T10-1	Tsepi	T10	LRP2	Ad	M

Lab #	Specimen #	Site	Tomb/Feature	Material[a]	Age[b]	Sex[c]
ACL-5090	TSEP-T10-2	Tsepi	T10	LLM1	AO	F?
ACL-5091	TSEP-T10-3	Tsepi	T10	LLM1	Yad	F?
ACL-5092	TSEP-T10-4	Tsepi	T10	LRM1	Ad	IND
ACL-5093	TSEP-T10-5	Tsepi	T10	LLM1	Ad	F?
ACL-5094	TSEP-T10-6	Tsepi	T10	LLM1	OC	NA
ACL-5095	TSEP-T10-7	Tsepi	T10	LLP2	Ad	F?
ACL-5096	TSEP-T11-1	Tsepi	T11	LLM1	Ad	M?
ACL-5097	TSEP-T11-2	Tsepi	T11	URM1	Ad	IND
ACL-5098	TSEP-T12-1	Tsepi	T12	LLM2	Ad	M
ACL-5099	TSEP-T12-2	Tsepi	T12	ULM1	Yad	F
ACL-5100	TSEP-T12-3	Tsepi	T12	URM1	Yad	F?
ACL-5101	TSEP-T12-4	Tsepi	T12	URP2	Yad	M?
ACL-5102	TSEP-T12-5.1	Tsepi	T12	URM1	Yad	F?
ACL-5103	TSEP-T12-5.2	Tsepi	T12	URM2	Yad	F?
ACL-5104	TSEP-T12-5.3	Tsepi	T12	URM3	Yad	F?
ACL-5105	TSEP-T12-6	Tsepi	T12	LRM1	Ad	F
ACL-5106	TSEP-T14-2	Tsepi	T14	ULM1	LAO	F?
ACL-5107	TSEP-T14-3	Tsepi	T14	ULP2	Ad	M
ACL-5108	TSEP-T14-4.1	Tsepi	T14 *prothyron*	ULM1	Yad	F
ACL-5109	TSEP-T14-4.2	Tsepi	T14 *prothyron*	ULM2	Yad	F
ACL-5110	TSEP-T14-4.3	Tsepi	T14 *prothyron*	ULM3	Yad	F
ACL-5111	TSEP-T13-1	Tsepi	T13	ULM1	LAO	IND
ACL-5112	TSEP-T13-2	Tsepi	T13	URM1	YC	IND
ACL-5113	TSEP-T13-3	Tsepi	T13	URP1	Ad	F
ACL-5114	TSEP-T14-5	Tsepi	T14	ULM1	Yad	M?
ACL-5115	TSEP-T14-6.1	Tsepi	T14	ULM2	Ad	M
ACL-5116	TSEP-T14-6.2	Tsepi	T14	ULM3	Ad	M
ACL-5117	TSEP-T16-1	Tsepi	T16	LLM1	LAO/Yad	M?
ACL-5118	TSEP-T16-2	Tsepi	T16	LLM1	Yad	F?
ACL-5119	TSEP-T16-3.1	Tsepi	T16	LRM1	Ad	F
ACL-5120	TSEP-T16-3.2	Tsepi	T16	LRM2	Ad	F
ACL-5121	TSEP-T16-3.3	Tsepi	T16	LRM3	Ad	F
ACL-5122	TSEP-T17-1	Tsepi	T17	LLM1	AO	F
ACL-5123	TSEP-T17-2	Tsepi	T17	URP1	Ad	IND
ACL-5124	TSEP-T17-3	Tsepi	T17	ULM1	OC	NA
ACL-5125	TSEP-T17-4.1	Tsepi	T17	ULI1	Ad	M?
ACL-5126	TSEP-T17-4.2	Tsepi	T17	ULP1	Ad	M?

Lab #	Specimen #	Site	Tomb/Feature	Material[a]	Age[b]	Sex[c]
ACL-5127	TSEP-T17-4.3	Tsepi	T17	ULM3	Ad	M?
ACL-5128	TSEP-T18-1	Tsepi	T18	ULM1	LAO	F
ACL-5129	TSEP-T18-2	Tsepi	T18	ULP2	Ad	M
ACL-5130	TSEP-T19-1	Tsepi	T19	LRM1	Ad	IND
ACL-5131	TSEP-T19-2.1	Tsepi	T19	LRM1	Yad	F
ACL-5132	TSEP-T19-2.2	Tsepi	T19	LRM3	Yad	F
ACL-5133	TSEP-T19-3	Tsepi	T19	LRM1	Ad	IND
ACL-5134	TSEP-T19-4.1	Tsepi	T19	URM2	Ad	F
ACL-5135	TSEP-T19-4.2	Tsepi	T19	URM3	Ad	F
ACL-5136	TSEP-T20-1	Tsepi	T20	LRM1	Ad	M?
ACL-5137	TSEP-T20-2	Tsepi	T20	LLM2	Ad	IND
ACL-5138	TSEP-T20-3	Tsepi	T20	LLP2	Ad	M?
ACL-5139	TSEP-T20-4.1	Tsepi	T20	LRM1	AO	F?
ACL-5140	TSEP-T20-4.2	Tsepi	T20	LRM2	AO	F?
ACL-5141	TSEP-T22-1	Tsepi	T22	ULM2	Ad	IND
ACL-5142	TSEP-T22-2	Tsepi	T22	ULM3	Ad	M
ACL-5143	TSEP-T22-3	Tsepi	T22	LLP2	Ad	F?
ACL-5144	TSEP-T24-1	Tsepi	T24	URM1	Ad	F
ACL-5145	TSEP-T24-2	Tsepi	T24	URM2	Ad	M
ACL-5146	TSEP-T25-1	Tsepi	T25	ULM1	Yad	F?
ACL-5147	TSEP-T25-2	Tsepi	T25	URM1	Ad	M
ACL-5148	TSEP-T25-3	Tsepi	T25	URM1	LAO/Yad	F
ACL-5149	TSEP-T26-1.1	Tsepi	T26	LLP2	Ad	F
ACL-5150	TSEP-T26-1.2	Tsepi	T26	LRM3	Ad	F
ACL-5151	TSEP-T26-2	Tsepi	T26	LRM1	Yad	M?
ACL-5152	TSEP-T26-3	Tsepi	T26	LLP1	Ad	IND
ACL-5402	CHEL-76-1	Cheliotomylos	Well shaft	LLM1	Yad	F
ACL-5403	CHEL-76-3	Cheliotomylos	Well shaft	LRM3	Yad	F
ACL-5404	CHEL-77	Cheliotomylos	Well shaft	LLM1	OC	NA
ACL-5405	CHEL-79	Cheliotomylos	Well shaft	LRM1	C	NA
ACL-5406	CHEL-80	Cheliotomylos	Well shaft	LLM1	LAO/Yad	M
ACL-5407	CHEL-81-1	Cheliotomylos	Well shaft	LLM1	Ad	M?
ACL-5408	CHEL-81-2	Cheliotomylos	Well shaft	LLM2	Ad	M?
ACL-5409	CHEL-81-3	Cheliotomylos	Well shaft	LLM3	Ad	M?
ACL-5410	CHEL-83	Cheliotomylos	Well shaft	URM1	AO	F?
ACL-5411	CHEL-84	Cheliotomylos	Well shaft	LLM1	YC	NA
ACL-5412	CHEL-85	Cheliotomylos	Well shaft	URM2	Ad	F?

Lab #	Specimen #	Site	Tomb/Feature	Material[a]	Age[b]	Sex[c]
ACL-5413	CHEL-89	Cheliotomylos	Well shaft	LLM1	LAO/Yad	F
ACL-5414	CHEL-90	Cheliotomylos	Well shaft	URP1	Ad	M
ACL-5415	CHEL-93	Cheliotomylos	Well shaft	LLM1	AO	F
ACL-5416	CHEL-00	Cheliotomylos	Well shaft	LRM1	YC	NA
ACL-5417	CHEL-03-1	Cheliotomylos	Well shaft	LRM1	Ad	F
ACL-5418	CHEL-03-2	Cheliotomylos	Well shaft	LRM2	Ad	F
ACL-5419	CHEL-03-3	Cheliotomylos	Well shaft	LRM3	Ad	F
ACL-5420	CHEL-06	Cheliotomylos	Well shaft	LLM1	AO	M?
ACL-5421	CHEL-08	Cheliotomylos	Well shaft	LLM1	C	NA
ACL-5422	CHEL-81-B1	Cheliotomylos	Well shaft	parietal	Ad	F?
ACL-5423	CHEL-85-B1	Cheliotomylos	Well shaft	mandible	Ad	M?
ACL-5424	CHEL-89-B1	Cheliotomylos	Well shaft	mandible	AO	F
ACL-5425	CHEL-02-B1	Cheliotomylos	Well shaft	mandible	Ad	M?
ACL-6174	LUTS-T1	Loutsa	Grave 1	URM2	OC	NA
ACL-6175	LUTS-T2	Loutsa	Grave 1	URM2	Ad	UN
ACL-6176	LUTS-T4	Loutsa	Grave 1	ULM3	Ad	UN
ACL-6177	LUTS-T5	Loutsa	Grave 1	URM1	OC	NA
ACL-6178	LUTS-T7	Loutsa	Grave 1	ULM1	YC	NA
ACL-6179	LUTS-T9	Loutsa	Grave 1	ULM1	Ad	UN
ACL-6180	LUTS-T19	Loutsa	Grave 1	ULm2	YC	NA
ACL-6181	LUTS-T26	Loutsa	Grave 2	ULP1	Ad	UN
ACL-6182	LUTS-T27	Loutsa	Grave 2	ULP2	OC	UN
ACL-6183	LUTS-T29	Loutsa	Grave 2	LRM2	AO	UN
ACL-6184	LUTS-T30	Loutsa	Grave 2	LLM1	C	UN
ACL-6185	LUTS-T32	Loutsa	Grave 2	URM3	Ad	UN
ACL-6186	LUTS-T34	Loutsa	Grave 2	LRM2	OC	NA
ACL-6187	LUTS-T1-B3	Loutsa	Grave 1	femur	Ad	UN
ACL-6188	LUTS-T1-B7	Loutsa	Grave 1	femur	Ad	UN
ACL-6189	LUTS-T2-B18	Loutsa	Grave 2	femur	Ad	UN
ACL-6190	LUTS-T2-B22	Loutsa	Grave 2	tibia	Ad	UN

[a] Abbreviations for materials sampled: LLM1, lower left first molar; LLM2, lower left second molar; LLM3, lower left third molar; LRM1, lower right first molar; LRM2, lower right second molar; LRM3, lower right third molar; LLP1, lower left first premolar; LLP2, lower left second premolar; LRP1, lower right first premolar; LRP2, lower right second premolar; ULM1, upper left first molar; ULM2, upper left second molar; ULM3, upper left third molar; URM1, upper right first molar; URM2, upper right second molar; URM3, upper right third molar; ULP1, upper left first premolar; ULP2, upper left second premolar; URP1, upper right first premolar; URP2, upper right second premolar; ULI1, upper left first incisor; ULC, upper left canine; ULm2, upper left deciduous second molar.

[b] Abbreviations used for skeletal age: C, child; YC, young child; OC, old child; AO, adolescent; LAO, late adolescent; Ad, adult; YAd, young adult.
[c] Abbreviations used for skeletal sex: F, female; F?, probable female; M, male; M?, probable male; UN, unobservable; IND, indeterminate; NA, non applicable (juvenile).

APPENDIX D

DESCRIPTION AND BIOGEOCHEMICAL DATA FOR MODERN FAUNAL BASELINE SAMPLES

Lab #	Specimen #	Species	Material	Provenance	$^{87}Sr/^{86}Sr$	$\delta^{88/86}Sr$
ACL-4991	ASPR-H1	*Lepus europaeus*	tibia	Aspropyrgos (Mt. Parnes), W Attica	0.70769	NA
ACL-4992	ASPR-H2	*Lepus europaeus*	radius	Aspropyrgos (Mt. Parnes), W Attica	0.70830	NA
ACL-5015	MEGR-H1	*Lepus europaeus*	tibia	Megara (Mt. Pateras), W Attica	0.70826	NA
ACL-5016	MEGR-H2	*Lepus europaeus*	metatarsal	Megara (Mt. Pateras), W Attica	0.70826	NA
ACL-5018	MEGR-H4	*Lepus europaeus*	metatarsal	Megara (Mt. Pateras), W Attica	0.70874	NA
ACL-5017	MEGR-H3	*Lepus europaeus*	humerus	Megara (Mt. Geraneia), W Attica	0.70818	NA
ACL-4995	KINT-H1	*Lepus europaeus*	femur	Kineta (Mt. Geraneia), W Attica	0.70914	NA
ACL-4996	KINT-H2	*Lepus europaeus*	metatarsal	Kineta (Mt. Geraneia), W Attica	0.70880	NA
ACL-4994	KERT-H1	*Lepus europaeus*	tibia	Keratea, Attica (central/southern)	0.70823	NA
ACL-5773	KERT-H3	*Lepus europaeus*	metatarsal	Keratea, Attica (central/southern)	0.70898	NA
ACL-5774	KERT-H4	*Lepus europaeus*	tibia	Keratea, Attica (central/southern)	0.70914	NA
ACL-4997	KRPI-H1	*Lepus europaeus*	ulna	Mt. Hymettus	0.70881	NA
ACL-2795	ATT-H1	*Lepus europaeus*	mandible	Mt. Hymettus	0.70868	NA
ACL-2796	ATT-H2	*Lepus europaeus*	mandible	Mt. Hymettus	0.70890	NA
ACL-5777	MRTH-H1	*Lepus europaeus*	tibia	Eastern Attica	0.70860	NA
ACL-6133	LUTS-H1	*Lepus europaeus*	cranium	Eastern Attica	0.70899	NA
ACL-5044	THEB-H10	*Lepus europaeus*	metatarsal	NW Attica (Mt. Kithairon)	0.70812	NA
ACL-5045	THEB-H11	*Lepus europaeus*	metatarsal	NW Attica (Mt. Kithairon)	0.70812	NA

Lab #	Specimen #	Species	Material	Provenance	$^{87}Sr/^{86}Sr$	$\delta^{88/86}Sr$
ACL-5035	THEB-H1	*Lepus europaeus*	humerus	Thebes	0.70869	NA
ACL-5036	THEB-H2	*Lepus europaeus*	mandible	Thebes	0.70870	NA
ACL-5037	THEB-H3	*Lepus europaeus*	radius	Thebes	0.70835	NA
ACL-5038	THEB-H4	*Lepus europaeus*	tibia	Kokkino (Mt. Ptoon), E Boeotia	0.70810	NA
ACL-5039	THEB-H5	*Lepus europaeus*	tibia	Kokkino (Mt. Ptoon), E Boeotia	0.70816	NA
ACL-5040	THEB-H6	*Lepus europaeus*	tibia	Kokkino (Mt. Ptoon), E Boeotia	0.70830	NA
ACL-5041	THEB-H7	*Lepus europaeus*	radius	Kokkino (Mt. Ptoon), E Boeotia	0.70874	NA
ACL-5042	THEB-H8	*Lepus europaeus*	humerus	Mt. Elikon	0.70835	NA
ACL-5046	THEB-H12	*Lepus europaeus*	tibia	Lefktra/Livadostra, SW Boeotia	0.70880	NA
ACL-5047	THEB-H13	*Lepus europaeus*	tibia	Lefktra/Livadostra, SW Boeotia	0.70869	NA
ACL-5048	THEB-H14	*Lepus europaeus*	metatarsal	Lefktra/Livadostra, SW Boeotia	0.70861	NA
ACL-5049	THEB-H15	*Lepus europaeus*	metatarsal	Lefktra/Livadostra, SW Boeotia	0.70880	NA
ACL-5043	THEB-H9	*Lepus europaeus*	metatarsal	Mt. Ktypas (Ritsona)	0.70869	NA
ACL-5014	MART-H1	*Lepus europaeus*	mandible	Martino (Lokris)	0.70970	NA
ACL-5002	LAMI-H1	*Lepus europaeus*	metatarsal	Lamia (Ypati), Mt. Oiti	0.70906	NA
ACL-5003	LAMI-H2	*Lepus europaeus*	metatarsal	Lamia (Ypati), Mt. Oiti	0.70951	NA
ACL-5004	LAMI-H3	*Lepus europaeus*	metatarsal	Lamia (Ypati), Mt. Oiti	0.70867	NA

Lab #	Specimen #	Species	Material	Provenance	$^{87}Sr/^{86}Sr$	$\delta^{88}/^{86}Sr$
ACL-5005	LAMI-H4	*Lepus europaeus*	metatarsal	Lamia (Ypati), Mt. Oiti	0.70893	NA
ACL-5782	VOLO-H1	*Sus scrofa*	rib	Volos (Mt. Othrys)	0.70861	NA
ACL-6132	GIAN-H1	*Lepus europaeus*	femur	Giannena (Mt. Kourenton)	0.70819	NA
ACL-5764	ACHA-H1	*Lepus europaeus*	metatarsal	Kalavryta (Mt. Helmos)	0.70807	NA
ACL-5765	ACHA-H2	*Lepus europaeus*	metatarsal	Kalavryta (Mt. Helmos)	0.70867	NA
ACL-5768	CRNT-H1	*Lepus europaeus*	metatarsal	Pheneos basin, Corinthia	0.70797	-0.40
ACL-5770	CRNT-H3	*Lepus europaeus*	metatarsal	Pheneos basin, Corinthia	0.70801	-0.30
ACL-5769	CRNT-H2	*Lepus europaeus*	metatarsal	Kalentzi (Mt. Fokas), Corinthia	0.70810	NA
ACL-5766	ARCA-H1	*Lepus europaeus*	metatarsal	Mt. Mainalon, Arcadia	0.70872	NA
ACL-5767	ARCA-H2	*Lepus europaeus*	metatarsal	Mt. Mainalon, Arcadia	0.70845	NA
ACL-2803	BE-H8	*Lepus europaeus*	mandible	Northern Euboea	0.70872	NA
ACL-2804	BE-H9	*Lepus europaeus*	mandible	Northern Euboea	0.70874	NA
ACL-2805	BE-H10	*Lepus europaeus*	mandible	Northern Euboea	0.70890	NA
ACL-2806	KE-H11	*Lepus europaeus*	mandible	Central Euboea	0.70808	NA
ACL-2807	KE-H12	*Lepus europaeus*	mandible	Central Euboea	0.70794	NA
ACL-2808	KE-H13	*Lepus europaeus*	mandible	Central Euboea	0.70834	NA
ACL-2797	KAR-H3	*Lepus europaeus*	mandible	Southern Euboea	0.70895	NA
ACL-2798	KAR-H4	*Lepus europaeus*	mandible	Southern Euboea	0.70848	NA

Lab #	Specimen #	Species	Material	Provenance	$^{87}Sr/^{86}Sr$	$\delta^{88}/^{86}Sr$
ACL-2799	KAR-H5	*Lepus europaeus*	mandible	Southern Euboea	0.70858	NA
ACL-5011	MANI-H1	*Lepus europaeus*	femur	Messeniaki Mani	0.70909	NA
ACL-5012	MANI-H2	*Lepus europaeus*	femur	Messeniaki Mani	0.70825	NA
ACL-5013	MANI-H3	*Lepus europaeus*	radius	Messeniaki Mani	0.70806	NA
ACL-5783	TRZN-H1	*Lepus europaeus*	mandible	Troizena (Mt. Ortholithi)	0.70859	NA
ACL-4977	AEGN-H1	*Oryctolagus cuniculus*	mandible	Aegina	0.70882	NA
ACL-4978	AEGN-H2	*Oryctolagus cuniculus*	mandible	Aegina	0.70890	NA
ACL-4979	AEGN-H3	*Oryctolagus cuniculus*	mandible	Aegina	0.70880	NA
ACL-4980	AEGN-H4	*Oryctolagus cuniculus*	mandible	Aegina	0.70889	NA
ACL-4981	AEGN-H5	*Oryctolagus cuniculus*	mandible	Aegina	0.70882	NA
ACL-5760	AEGN-H6	*Oryctolagus cuniculus*	tibia	Aegina (central island)	0.70757	NA
ACL-5761	AEGN-H7	*Oryctolagus cuniculus*	tibia	Aegina (central island)	0.70767	NA
ACL-2801	KEA-H6	*Lepus europaeus*	mandible	Keos	0.70903	NA
ACL-2802	KEA-H7	*Lepus europaeus*	mandible	Keos	0.70922	NA
ACL-2809	BAN-H14	*Lepus europaeus*	mandible	Andros (northern island)	0.70870	NA
ACL-2810	BAN-H15	*Lepus europaeus*	mandible	Andros (northern island)	0.70919	NA
ACL-2811	NAN-H16	*Lepus europaeus*	mandible	Andros (central-southern island)	0.70874	NA

Lab #	Specimen #	Species	Material	Provenance	$^{87}Sr/^{86}Sr$	$\delta^{88}/^{86}Sr$
ACL-2812	NAN-H17	*Lepus europaeus*	mandible	Andros (central-southern island)	0.70926	NA
ACL-5019	MKNO-H1	*Oryctolagus cuniculus*	cranial bone	Mykonos (southeastern island)	0.70922	NA
ACL-5020	MKNO-H2	*Oryctolagus cuniculus*	mandible	Mykonos (southeastern island)	0.70923	NA
ACL-5021	MKNO-H3	*Oryctolagus cuniculus*	mandible	Mykonos (southeastern island)	0.70932	NA
ACL-4987	ANTP-H1	*Oryctolagus cuniculus*	mandible	Antiparos (central island)	0.70932	NA
ACL-4988	ANTP-H2	*Oryctolagus cuniculus*	mandible	Antiparos (central island)	0.70943	NA
ACL-4989	ANTP-H3	*Oryctolagus cuniculus*	mandible	Antiparos (central island)	0.70935	NA
ACL-4990	ANTP-H4	*Oryctolagus cuniculus*	mandible	Antiparos (central island)	0.70932	NA
ACL-5022	PARS-H1	*Lepus europaeus*	mandible	Paros (southern island)	0.70854	NA
ACL-5023	PARS-H2	*Lepus europaeus*	mandible	Paros (southern island)	0.70871	NA
ACL-5024	PARS-H3	*Lepus europaeus*	mandible	Paros (southern island)	0.70877	NA
ACL-5025	PARS-H4	*Lepus europaeus*	mandible	Paros (southern island)	0.70928	NA
ACL-5026	PARS-H5	*Lepus europaeus*	tibia	Paros (southern island)	0.70927	NA
ACL-2813	DNX-H18	*Lepus europaeus*	mandible	Naxos (northwestern island)	0.70941	NA
ACL-2814	DNX-H19	*Lepus europaeus*	mandible	Naxos (western island)	0.70953	NA
ACL-2815	KNX-H20	*Lepus europaeus*	mandible	Naxos (central island)	0.71068	NA
ACL-2816	KNX-H21	*Lepus europaeus*	mandible	Naxos (southern island)	0.70881	NA

Lab #	Specimen #	Species	Material	Provenance	$^{87}Sr/^{86}Sr$	$\delta^{88}/^{86}Sr$
ACL-2817	ANX-H22	*Lepus europaeus*	mandible	Naxos (central island)	0.71056	NA
ACL-2818	ANX-H23	*Lepus europaeus*	mandible	Naxos (southeastern island)	0.70911	NA
ACL-4982	AMRG-H1	*Lepus europaeus*	mandible	Amorgos (southern island)	0.70935	NA
ACL-4983	AMRG-H2	*Lepus europaeus*	mandible	Amorgos (southern island)	0.70879	NA
ACL-4984	AMRG-H3	*Lepus europaeus*	mandible	Amorgos (southern island)	0.70887	NA
ACL-4985	AMRG-H4	*Lepus europaeus*	mandible	Amorgos (southern island)	0.70880	NA
ACL-4986	AMRG-H5	*Lepus europaeus*	mandible	Amorgos (southern island)	0.70886	NA
ACL-5779	MILO-H2	*Lepus europaeus*	tibia	Melos (western island)	0.70871	NA
ACL-5780	MILO-H3	*Lepus europaeus*	tibia	Melos (western island)	0.70900	NA
ACL-5778	MILO-H1	*Oryctolagus cuniculus*	vertebrae	Melos (southeastern island)	0.70886	-0.23
ACL-5050	THRA-H1	*Oryctolagus cuniculus*	mandible	Santorini (Oia)	0.70867	NA
ACL-5051	THRA-H2	*Oryctolagus cuniculus*	mandible	Therasia (northern island)	0.70878	NA
ACL-5052	THRA-H3	*Oryctolagus cuniculus*	mandible	Therasia (northern island)	0.70875	NA
ACL-5008	LEMN-H1	*Oryctolagus cuniculus*	vertebrae	Lemnos	0.70899	NA
ACL-5775	LEMN-H2	*Oryctolagus cuniculus*	tibia	Lemnos	0.70904	NA
ACL-5776	LESB-H1	*Lepus europaeus*	metatarsal	Lesbos	0.70855	NA
ACL-5762	CHIO-H1	*Lepus europaeus*	mandible	Chios (southern island)	0.71049	NA

Lab #	Specimen #	Species	Material	Provenance	$^{87}Sr/^{86}Sr$	$\delta^{88/86}Sr$
ACL-5763	CHIO-H2	*Lepus europaeus*	mandible	Chios (northern island)	0.71026	NA
ACL-4993	IKAR-H1	*Lepus europaeus*	metatarsal	Ikaria	0.70832	NA
ACL-5029	SAMS-H1	*Lepus europaeus*	metatarsal	Samos	0.70820	NA
ACL-5030	SAMS-H2	*Lepus europaeus*	metatarsal	Samos	0.70864	NA
ACL-5031	SAMS-H3	*Lepus europaeus*	metatarsal	Samos	0.70878	NA
ACL-5027	PATM-H1	*Lepus europaeus*	mandible	Patmos	0.70852	NA
ACL-5028	PATM-H2	*Lepus europaeus*	mandible	Patmos	0.70843	NA
ACL-5006	LEPS-H1	*Lepus europaeus*	mandible	Lipsoi	0.70830	NA
ACL-5007	LEPS-H2	*Lepus europaeus*	mandible	Lipsoi	0.70858	NA
ACL-5009	LROS-H1	*Lepus europaeus*	mandible	Leros	0.70936	NA
ACL-5010	LROS-H2	*Lepus europaeus*	mandible	Leros	0.70892	NA
ACL-4998	KOS-H1	*Oryctolagus cuniculus*	mandible	Kos (northwestern island)	0.70846	NA
ACL-4999	KOS-H2	*Oryctolagus cuniculus*	mandible	Kos (northwestern island)	0.70859	NA
ACL-5000	KOS-H3	*Oryctolagus cuniculus*	mandible	Kos (northwestern island)	0.70794	NA
ACL-5001	KOS-H4	*Lepus europaeus*	mandible	Kos (central/eastern island)	0.70792	NA
ACL-6131	CRET-H1	*Lepus europaeus*	cranium	Crete (Matala), (central/southern)	0.70851	NA

APPENDIX E

BIOGEOCHEMICAL DATA FOR ARCHAEOLOGICAL HUMAN SAMPLES

Lab #	Specimen #	Ca/P	U/Ca	Nd/Ca	log (Ba/Sr)	$^{87}Sr/^{86}Sr$	$\delta^{88}Sr/^{86}Sr$
ACL-5053	TSEP-T3-1.1	2.1	6.1E-06	1.4E-06	-1.04	0.70914	0.01
ACL-5054	TSEP-T3-1.2	2.1	1.3E-06	1.4E-06	-1.27	0.70904	-0.03
ACL-5055	TSEP-T3-1.3	2.2	1.5E-06	1.9E-06	-1.26	0.70903	0.14
ACL-5056	TSEP-T3-2	2.1	1.2E-07	9.4E-07	-1.41	0.70897	-0.26
ACL-5057	TSEP-T4-1.1	2.1	1.9E-07	1.4E-06	-1.40	0.70921	-0.08
ACL-5058	TSEP-T4-1.2	2.1	3.4E-08	1.0E-07	-1.57	0.70917	-0.39
ACL-5059	TSEP-T4-2	2.1	3.3E-07	4.1E-07	-1.57	0.70894	NA
ACL-5060	TSEP-T4-3.1	2.0	2.4E-07	1.5E-06	-1.24	0.70923	NA
ACL-5061	TSEP-T4-3.2	2.1	2.9E-07	1.3E-06	-1.54	0.70909	-0.30
ACL-5062	TSEP-T4-3.3	2.1	1.8E-07	3.6E-07	-1.66	0.70907	-0.27
ACL-5063	TSEP-T4-4.1	2.1	8.1E-07	4.8E-07	-1.20	0.70908	-0.20
ACL-5064	TSEP-T4-4.2	2.2	9.4E-07	9.4E-07	-1.26	0.70916	-0.19
ACL-5065	TSEP-T4-5	2.0	3.2E-07	3.2E-06	-1.19	0.70914	NA
ACL-5066	TSEP-T4-6.1	2.0	6.5E-07	2.1E-07	-0.91	0.70923	-0.19
ACL-5067	TSEP-T4-6.2	2.2	1.7E-06	5.2E-07	-1.08	0.70903	-0.54
ACL-5068	TSEP-T4-7.1	2.0	5.4E-07	1.8E-07	-1.01	0.70913	-0.37
ACL-5069	TSEP-T4-7.2	2.0	1.8E-07	3.4E-07	-1.28	0.70912	-0.35
ACL-5070	TSEP-T4-7.3	2.1	1.5E-07	3.0E-07	-1.27	0.70910	-0.26
ACL-5071	TSEP-T5-1	2.2	0.0E+00	2.1E-07	-1.14	0.70915	-0.27
ACL-5072	TSEP-T5-2	2.0	1.8E-08	2.3E-07	-1.03	0.70915	-0.15
ACL-5073	TSEP-T5-3	2.0	0.0E+00	1.7E-07	-1.21	0.70910	-0.13
ACL-5074	TSEP-T5-4	2.1	2.9E-08	1.2E-06	-1.25	0.70912	-0.15
ACL-5075	TSEP-T6-1	2.1	0.0E+00	6.4E-07	-1.80	0.70911	-0.04
ACL-5076	TSEP-T6-2	2.1	1.9E-07	2.4E-07	-0.84	0.70907	-0.30
ACL-5077	TSEP-T6-3	2.0	1.7E-07	5.2E-07	-1.12	0.70916	-0.43
ACL-5078	TSEP-T7-1	2.1	8.3E-08	2.9E-06	-1.39	0.70915	-0.35
ACL-5079	TSEP-T7-2	2.1	8.1E-08	8.9E-07	-1.35	0.70912	-0.25
ACL-5080	TSEP-T7-3.1	2.0	1.0E-07	1.5E-06	-1.35	0.71049	-0.18
ACL-5081	TSEP-T7-3.2	2.0	1.2E-07	3.9E-06	-1.52	0.70916	-0.13
ACL-5082	TSEP-T7-3.3	2.1	0.0E+00	7.8E-07	-1.67	0.70915	-0.39
ACL-5083	TSEP-T9-1.1	2.1	2.6E-07	1.1E-06	-0.89	0.70919	-0.23
ACL-5084	TSEP-T14-1	2.1	1.1E-07	4.4E-07	-1.72	0.70915	-0.42
ACL-5085	TSEP-T9-1.2	2.1	8.5E-08	1.9E-06	-1.29	0.70922	-0.34
ACL-5086	TSEP-T9-2	2.1	1.1E-07	5.5E-07	-1.07	0.70910	-0.33
ACL-5087	TSEP-T9-3	2.0	0.0E+00	9.6E-07	-1.79	0.70911	-0.26
ACL-5088	TSEP-T9-4	2.1	0.0E+00	3.6E-07	-1.50	0.70919	-0.29
ACL-5089	TSEP-T10-1	2.0	1.1E-06	7.2E-07	-1.20	0.70915	-0.21
ACL-5090	TSEP-T10-2	2.0	1.8E-08	1.3E-07	-1.11	0.70910	-0.39

Lab #	Specimen #	Ca/P	U/Ca	Nd/Ca	log (Ba/Sr)	$^{87}Sr/^{86}Sr$	$\delta^{88}Sr/^{86}Sr$
ACL-5091	TSEP-T10-3	2.0	2.1E-07	4.5E-06	-1.09	0.70914	-0.35
ACL-5092	TSEP-T10-4	2.2	0.0E+00	2.1E-07	-1.25	0.70912	-0.22
ACL-5093	TSEP-T10-5	2.1	3.9E-06	3.4E-06	-0.92	0.70921	-0.12
ACL-5094	TSEP-T10-6	2.0	5.3E-07	2.8E-06	-1.16	0.70925	NA
ACL-5095	TSEP-T10-7	2.0	3.2E-07	2.2E-06	-1.52	0.70915	-0.09
ACL-5096	TSEP-T11-1	2.1	8.8E-07	7.0E-07	-1.04	0.70932	0.02
ACL-5097	TSEP-T11-2	2.1	6.6E-07	0.0E+00	-1.14	0.70916	-0.28
ACL-5098	TSEP-T12-1	2.2	5.0E-07	1.7E-06	-1.18	0.70898	-0.16
ACL-5099	TSEP-T12-2	2.1	5.4E-07	6.2E-07	-1.16	0.70916	-0.16
ACL-5100	TSEP-T12-3	2.1	8.5E-08	2.2E-06	-1.32	0.70913	-0.35
ACL-5101	TSEP-T12-4	2.1	3.4E-07	1.7E-07	-1.31	0.70915	-0.25
ACL-5102	TSEP-T12-5.1	2.1	4.2E-07	2.3E-07	-1.57	0.70924	-0.34
ACL-5103	TSEP-T12-5.2	2.0	4.6E-07	4.0E-06	-1.61	0.70921	-0.14
ACL-5104	TSEP-T12-5.3	2.1	8.6E-07	3.3E-06	-1.43	0.70914	-0.22
ACL-5105	TSEP-T12-6	2.1	5.8E-07	4.4E-07	-1.16	0.70917	-0.08
ACL-5106	TSEP-T14-2	2.2	9.9E-08	5.9E-07	-1.22	0.70919	-0.28
ACL-5107	TSEP-T14-3	2.2	9.8E-08	2.9E-07	-1.84	0.70913	-0.31
ACL-5108	TSEP-T14-4.1	2.0	0.0E+00	2.0E-06	-1.52	0.70906	-0.20
ACL-5109	TSEP-T14-4.2	2.0	0.0E+00	1.7E-06	-1.51	0.70907	-0.27
ACL-5110	TSEP-T14-4.3	2.1	0.0E+00	0.0E+00	-1.83	0.70914	NA
ACL-5111	TSEP-T13-1	2.0	6.5E-07	8.5E-06	-1.23	0.70915	-0.20
ACL-5112	TSEP-T13-2	2.2	1.0E-07	2.0E-07	-1.25	0.70916	-0.33
ACL-5113	TSEP-T13-3	2.2	2.0E-07	1.0E-06	-1.42	0.70906	-0.31
ACL-5114	TSEP-T14-5	2.0	7.9E-07	5.0E-07	-1.02	0.70944	-0.24
ACL-5115	TSEP-T14-6.1	2.1	1.1E-07	1.5E-06	-1.34	0.70913	-0.19
ACL-5116	TSEP-T14-6.2	2.2	1.1E-07	7.0E-07	-1.27	0.70914	-0.03
ACL-5117	TSEP-T16-1	2.0	1.2E-07	1.3E-07	-0.80	0.70926	-0.28
ACL-5118	TSEP-T16-2	2.0	4.9E-08	4.7E-07	-1.31	0.71046	-0.46
ACL-5119	TSEP-T16-3.1	2.0	1.2E-07	1.1E-06	-1.37	0.70925	-0.11
ACL-5120	TSEP-T16-3.2	2.1	3.0E-07	1.5E-06	-1.68	0.70923	-0.38
ACL-5121	TSEP-T16-3.3	2.2	2.3E-07	1.6E-06	-1.36	0.70917	-0.15
ACL-5122	TSEP-T17-1	2.1	4.0E-08	5.6E-07	-1.15	0.70919	-0.41
ACL-5123	TSEP-T17-2	2.2	1.9E-07	8.8E-07	-1.10	0.70909	-0.28
ACL-5124	TSEP-T17-3	2.1	5.6E-08	9.6E-07	-0.96	0.70905	-0.34
ACL-5125	TSEP-T17-4.1	2.2	9.9E-08	5.9E-07	-1.33	0.70915	-0.22
ACL-5126	TSEP-T17-4.2	2.1	2.2E-07	1.1E-07	-1.33	0.70921	-0.25

Lab #	Specimen #	Ca/P	U/Ca	Nd/Ca	log (Ba/Sr)	$^{87}Sr/^{86}Sr$	$\delta^{88}Sr/^{86}Sr$
ACL-5127	TSEP-T17-4.3	2.2	1.7E-06	1.6E-07	-0.84	0.70927	0.01
ACL-5128	TSEP-T18-1	2.1	1.6E-07	3.6E-07	-1.17	0.70920	-0.06
ACL-5129	TSEP-T18-2	2.0	4.5E-06	1.1E-06	-0.88	0.70916	0.08
ACL-5130	TSEP-T19-1	2.2	0.0E+00	1.3E-06	-1.28	0.70914	-0.38
ACL-5131	TSEP-T19-2.1	2.0	1.5E-07	4.4E-07	-1.38	0.70914	-0.16
ACL-5132	TSEP-T19-2.2	2.2	1.0E-07	3.1E-07	-1.62	0.70918	-0.20
ACL-5133	TSEP-T19-3	2.1	0.0E+00	4.5E-07	-1.26	0.70920	-0.02
ACL-5134	TSEP-T19-4.1	2.1	6.8E-07	1.5E-06	-1.34	0.70919	-0.07
ACL-5135	TSEP-T19-4.2	2.1	4.1E-07	5.4E-07	-2.04	0.70916	NA
ACL-5136	TSEP-T20-1	2.1	2.6E-07	9.0E-07	-1.24	0.70914	-0.18
ACL-5137	TSEP-T20-2	2.2	5.2E-08	7.7E-07	-1.49	0.70910	-0.62
ACL-5138	TSEP-T20-3	2.1	0.0E+00	3.2E-07	-1.37	0.70916	-0.16
ACL-5139	TSEP-T20-4.1	2.1	2.4E-08	6.1E-07	-1.52	0.70913	-0.28
ACL-5140	TSEP-T20-4.2	2.1	8.4E-07	4.3E-06	-0.97	0.70920	-0.22
ACL-5141	TSEP-T22-1	2.1	0.0E+00	1.0E-06	-1.53	0.70907	-0.35
ACL-5142	TSEP-T22-2	2.1	5.1E-07	8.6E-07	-1.08	0.70914	0.02
ACL-5143	TSEP-T22-3	2.1	4.3E-07	1.2E-05	-1.07	0.70912	-0.13
ACL-5144	TSEP-T24-1	2.0	3.6E-07	7.2E-07	-1.25	0.70914	-0.18
ACL-5145	TSEP-T24-2	2.0	4.2E-07	1.0E-06	-1.22	0.70917	NA
ACL-5146	TSEP-T25-1	2.0	2.3E-08	1.4E-06	-1.36	0.70919	-0.66
ACL-5147	TSEP-T25-2	2.2	2.9E-06	1.4E-06	-0.72	0.70920	0.08
ACL-5148	TSEP-T25-3	2.2	1.9E-07	7.5E-06	-1.50	0.71056	-0.19
ACL-5149	TSEP-T26-1.1	2.1	9.8E-08	2.7E-06	-1.65	0.70919	-0.28
ACL-5150	TSEP-T26-1.2	2.0	1.2E-07	2.8E-06	-1.46	0.70925	-0.48
ACL-5151	TSEP-T26-2	2.0	1.8E-07	4.9E-07	-0.90	0.70913	-0.29
ACL-5152	TSEP-T26-3	2.2	4.1E-07	1.4E-06	-1.36	0.70916	-0.17
ACL-5402	CHEL-76-1	2.0	3.0E-06	1.4E-07	-1.04	0.70856	-0.12
ACL-5403	CHEL-76-3	2.0	2.8E-07	1.6E-07	-1.41	0.70860	-0.38
ACL-5404	CHEL-77	2.0	6.7E-09	1.0E-07	-1.85	0.70855	-0.40
ACL-5405	CHEL-79	2.0	3.6E-08	1.6E-07	-1.70	0.70896	-0.25
ACL-5406	CHEL-80	2.0	2.2E-07	1.3E-07	-1.21	0.70893	-0.31
ACL-5407	CHEL-81-1	2.0	3.7E-07	5.2E-08	-1.19	0.70882	-0.17
ACL-5408	CHEL-81-2	2.0	8.8E-08	3.9E-08	-1.62	0.70893	-0.41
ACL-5409	CHEL-81-3	2.0	2.4E-07	1.8E-07	-1.35	0.70890	-0.41
ACL-5410	CHEL-83	2.0	2.2E-08	1.7E-07	-1.64	0.70853	-0.48
ACL-5411	CHEL-84	2.1	3.9E-08	1.6E-07	-1.40	0.70862	-0.30

Lab #	Specimen #	Ca/P	U/Ca	Nd/Ca	log (Ba/Sr)	$^{87}Sr/^{86}Sr$	$\delta^{88}Sr/^{86}Sr$
ACL-5412	CHEL-85	2.0	6.1E-08	2.5E-07	-1.22	0.70854	-0.24
ACL-5413	CHEL-89	2.0	3.9E-07	2.2E-07	-1.44	0.70858	-0.28
ACL-5414	CHEL-90	2.0	6.7E-07	3.6E-07	-1.18	0.70880	-0.23
ACL-5415	CHEL-93	2.0	4.9E-07	3.5E-07	-1.39	0.70852	-0.37
ACL-5416	CHEL-00	2.0	9.5E-08	1.9E-07	-1.41	0.70856	-0.55
ACL-5417	CHEL-03-1	2.0	3.1E-08	2.3E-07	-1.56	0.70900	-0.35
ACL-5418	CHEL-03-2	2.0	5.5E-08	2.9E-07	-1.58	0.70904	-0.18
ACL-5419	CHEL-03-3	2.0	6.9E-08	2.8E-07	-1.55	0.70905	-0.25
ACL-5420	CHEL-06	2.0	4.7E-08	1.5E-07	-1.26	0.70860	-0.35
ACL-5421	CHEL-08	2.0	1.3E-07	1.7E-07	-1.49	0.70858	-0.28
ACL-5422	CHEL-81-B1	2.0	1.2E-05	1.0E-07	-0.82	0.70856	-0.03
ACL-5423	CHEL-85-B1	2.1	5.5E-06	1.2E-07	-0.78	0.70855	0.01
ACL-5424	CHEL-89-B1	2.1	1.7E-05	7.0E-08	-0.86	0.70854	0.05
ACL-5425	CHEL-02-B1	2.1	1.3E-05	8.4E-08	-0.83	0.70851	0.05
ACL-6174	LUTS-T1	2.1	1.6E-07	1.9E-07	-1.65	0.70906	-0.15
ACL-6175	LUTS-T2	2.1	2.2E-06	1.5E-07	-0.99	0.70923	-0.20
ACL-6176	LUTS-T4	2.1	2.6E-08	1.5E-07	-1.94	0.70908	-0.26
ACL-6177	LUTS-T5	2.1	2.9E-08	6.5E-08	-1.91	0.70908	-0.22
ACL-6178	LUTS-T7	2.1	3.0E-07	1.2E-07	-1.14	0.70906	-0.30
ACL-6179	LUTS-T9	2.1	1.4E-06	4.5E-07	-1.21	0.70901	-0.36
ACL-6180	LUTS-T19	2.1	4.3E-07	3.7E-07	-1.22	0.70901	-0.36
ACL-6181	LUTS-T26	2.1	1.7E-06	8.3E-07	-1.26	0.70903	-0.31
ACL-6182	LUTS-T27	2.1	4.5E-07	5.4E-07	-1.58	0.70909	-0.15
ACL-6183	LUTS-T29	2.1	1.0E-06	3.8E-07	-1.02	0.70905	-0.13
ACL-6184	LUTS-T30	2.1	6.3E-07	1.0E-06	-1.01	0.70900	-0.39
ACL-6185	LUTS-T32	2.1	3.3E-07	1.3E-06	-1.67	0.70911	-0.35
ACL-6186	LUTS-T34	2.1	1.9E-07	2.5E-07	-1.82	0.70914	-0.25
ACL-6187	LUTS-T1-B3	2.5	1.7E-06	4.7E-07	-0.74	0.70906	0.08
ACL-6188	LUTS-T1-B7	2.5	5.8E-06	1.5E-07	-0.79	0.70905	0.14
ACL-6189	LUTS-T2-B18	2.4	1.4E-06	6.0E-07	-0.74	0.70904	0.01
ACL-6190	LUTS-T2-B22	2.2	1.5E-05	4.7E-06	-0.62	0.70904	0.03

APPENDIX F

COPYRIGHT PERMISSION FOR THE PLAN OF THE CEMETERY OF TSEPI BY THE ARCHAEOLOGICAL SOCIETY AT ATHENS

Η ΕΝ ΑΘΗΝΑΙΣ ΑΡΧΑΙΟΛΟΓΙΚΗ ΕΤΑΙΡΕΙΑ
THE ARCHAEOLOGICAL SOCIETY AT ATHENS
ΔΙΟΙΚΗΤΙΚΕΣ ΥΠΗΡΕΣΙΕΣ – ADMINISTRATIVE SERVICES

Ἀρ. Πρωτ.: 826

Ἀθήνα, 10 Σεπτεμβρίου 2014

Πρός τήν
κ. Ἐλεάννα Πρεβεδώρου
ἀρχαιολόγο
Λεφέβρ 22
117 44 ΑΘΗΝΑ

Ἀξιότιμη κ. Ἐλεάννα Πρεβεδώρου,

Σὲ ἀπάντηση τῆς ἀπό 26/08/2014 αἰτήσεώς σας, σᾶς πληροφοροῦμε ὅτι ἡ Ἐν Ἀθήναις Ἀρχαιολογική Ἑταιρεία παρέχει τήν ἄδεια ἀναδημοσίευσης τοῦ γενικοῦ τοπογραφικοῦ σχεδίου τῆς ἀνασκαφῆς τοῦ πρωτοελλαδικοῦ νεκροταφείου στό Τσέπι Μαραθῶνος, δημοσιευμένο στό βιβλίο τῆς Μ. Παντελίδου-Γκόφα, Τσέπι Μαραθῶνος. Τὸ Πρωτοελλαδικὸ Νεκροταφεῖο, Ἀθῆναι 2005, ἔνθ. πίνακας καί στό ΕΡΓΟΝ 2008, σ. 14, εἰκ. 1.

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