

**Petras, Siteia**  
**The Pre- and Proto-palatial cemetery in context**

*Acts of a two-day conference held at the Danish Institute at  
Athens, 14-15 February 2015*

Edited by  
*Metaxia Tsipopoulou*



Monographs of the Danish Institute at Athens  
Volume 21

*This volume is dedicated to all those individuals who participated over the years  
in the excavation, conservation, study, site development and publication  
of the results.*

*This lofty vision for Petras and its region was made possible by their hard work,  
dedication and support.*

*Petras, Siteia – The Pre- and Proto- palatial cemetery in context*

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Front cover:

The Petras cemetery (photo M. Tsipopoulou) and Protopalatial silver signet ring from HT 9 (photo C. Papanikolopoulos)

Graphic design: Garifalia Kostopoulou and Metaxia Tsipopoulou

Back cover: Excavation of House Tomb 1, Room 6. Prof. S. Triantaphyllou (photo G. Kostopoulou).

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The conference participants gathered in the courtyard of the Danish Institute at Athens 15 February 2015

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# Abbreviations

## Archaeological periods

EBA	Early Bronze Age
EH	Early Helladic
EM	Early Minoan
FN	Final Neolithic
LH	Late Helladic
LM	Late Minoan
LN	Late Neolithic
LBA	Late Bronze Age
MBA	Middle Bronze Age
MH	Middle Helladic
MM	Middle Minoan
MN	Middle Neolithic

## Petras Area

HT	House Tomb
R	Room
L	Lakkos
P	Petras
PTSK	Petras Cemetery

PTSOU	Petras Rock Shelter
Σ-palace	Stratigraphical trenches of the palace
W	Wall

## Other

A.S.L.	Above Sea Level
diam.	diameter
gr	gram
h	height
kg	kilogram
w	width
wt	weight
th	thickness
lt	liter
MMD	Mean Measure of Divergence
MNI	Minimum Number of Individuals
NISP	Number of Identifiable Specimens
SM	Archaeological Museum, Siteia
vol.	volume

The form of the English language for the native speakers (British or American) was the author's choice. For the non-native speakers the American form was used.

# Bibliographic Abbreviations

AAA – Archaïologika Analekta Athinon

*ActaPalaeobot* – Acta Palaiobotanica

AJA – American Journal of Archaeology

AJPA – American Journal of Physical Anthropology

AJS – American Journal of Sociology

*AmJHumBiol* – American Journal of Human Biology

*AnnMathStat* – Annals of Mathematical Statistics

AR – Archaeological Reports

*Arachne* – (on-line access to the CMS, with corrected information and enhanced illustrations) <http://arachne.uni-koeln.de/drupal/?q=de/node/access> date March 2016.

*ArchDelt* – Archaeologikon Deltion

*ArchEph* – Archaeologike Ephemeris

AS – O. Krzyszkowska, *Aegean seals: an introduction* (BICS Suppl. 85), London.

*ASAtene* – Annuario della Scuola Archeologica Italiana di Atene

*BAR-IS* – British Archaeological Reports, International Series

*BCH* – Bulletin se correspondance hellénique

*BICS* – Bulletin of the Institute of Classical Studies of the University of London

*BSA* – Annual of the British School at Athens

*CHIC* – J.-P. Olivier and L. Godart, *Corpus hieroglyphicarum inscriptionum Cretae* (Études Crétoises 31), Athens and Rome 1996.

*CMS* – Corpus der minoischen und mykenischen Siegel, Berlin 1964-2000, Mainz 2002-

*CretChron* – Kretika Chronika

*EtCret* – Études Crétoises

*JAS* – Journal of Archaeological Science

*JMA* – Journal of Mediterranean Archaeology

*Kentro* – Kentro: The Newsletter of the INSTAP Study Center for East Crete

*MA* – Monumenti Antichi

*OJA* – Oxford Journal of Archaeology

*Prakt* – Praktika tes en Athenais Archaeologikes Etaireias

*SIMA* – Studies in Mediterranean Archaeology

*SMEA* – Studi Micenei ed Egeo-Anatolici



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# Mobility patterns and cultural identities in Pre- and Proto-palatial central and eastern Crete\*

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## Abstract

Prepalatial and Protopalatial Crete is characterized by extensive contact networks across the island as well as with the broader southern Aegean. Although these networks have been identified by means of various material cultural remains, the extent to which their formation and maintenance was based on demic diffusion remains elusive. Furthermore, recent studies have highlighted the cultural heterogeneity characterizing Cretan communities of the time, despite the aforementioned contact networks. This heterogeneity raises questions regarding the genetic identity and cohesion of Minoan populations. The current chapter explores human mobility in central and eastern Crete during the Prepalatial and Protopalatial period in order to assess the degree of gene flow in this region and time period. Our results reveal interesting patterns of biological affinity among Cretan groups, possibly associated with intermarriage or other forms of group mobility. It appears that in most cases cultural contacts were accompanied by gene flow, but notable exceptions have also been identified. In addition, the pronounced biodistance of specific Cretan communities from others is suggestive of genetic heterogeneity in Prepalatial and Protopalatial eastern and central Crete, although further research, encompassing material from more sites across the island, is required in order to explore these issues more comprehensively.

## Introduction

Prepalatial and Protopalatial Crete is characterized by pronounced cultural diversity, which raises questions regarding the traditional notion of a single population inhabiting the island.<sup>1</sup> However, at the same time, important cultural similarities and

corresponding contact networks have been identified across Crete and the broader southern Aegean.<sup>2</sup> The aim of our study is to examine the biological, that is, the genetic distance between Prepalatial and Protopalatial Cretan groups in order to determine the degree of genetic heterogeneity on the island

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possible, as well as for providing the facilities for the examination of the dental remains.

1 Legarra Herrero 2009.

2 Papadatos & Sofianou 2012; Papadatos & Tomkins 2013; Papadatos & Sofianou 2013; Renfrew 1972; Wilson *et al.* 2008.



**Fig. 1.** Sites under study. Map processed by E. Nikita.

and assess the extent to which the observed cultural networks can be associated with human mobility in the context of marital networks or other forms of gene flow. At this point it must be clarified that ‘gene flow’ denotes human mobility and the resulting interbreeding between members of different groups.<sup>3</sup>

Our current work largely builds on a recent publication by Triantaphyllou and her colleagues,<sup>4</sup> which combined macroscopic skeletal analysis with strontium isotope analysis and supported at a preliminary level the cultural, rather than demic, diffusion of *Cycladica* to north Crete since it found no gene flow between Crete and the Cyclades, at least not on a scale that could be identified in a distinct way from the human skeletal remains. This chapter narrows the methodological approach by using only macroscopic osteoarchaeological analysis and no biochemical tests, but it broadens the database by incorporating material from both the eastern and central parts of the island, allowing for improved resolution in the biodistance analysis.

The archaeological sites that have been examined in the context of the current study, described in more detail in the Materials and Methods section, are Moni Odigitria and Koumasa in central Crete, as

well as Kephala-Petras, Pezoules and Livari-Skiadi in the eastern part of the island (Fig. 1). These sites demonstrate an interesting pattern of participation in cultural exchange networks across the eastern and central part of the island, as well as beyond.

More specifically, the Vasiliki and light-on-dark wares found at Moni Odigitria exhibit stylistic similarities with the Mirabello area in east Crete, suggesting either the import of the pottery itself or of the technology required to make it.<sup>5</sup> The typology of the metal artifacts (e.g., daggers, tweezers, scrapers) has parallels across Crete as similar artifacts have been found at Koumasa, Pyrgos, Hagia Photia, Platanos, Mochlos, Kamilari, Lebena, Palaikastro and other sites.<sup>6</sup> In addition, obsidian and metals were common in Mesara and they had been imported from the Cyclades through gateway communities on the north Cretan coast.<sup>7</sup> Finally, the raw material required for valuable objects, such as ivory, had been imported from the eastern Mediterranean.<sup>8</sup>

In Livari-Skiadi, the dark gray burnished ware exhibits parallels with Moni Odigitria and Kephala-Petras, while some of the pottery belonging to the

<sup>3</sup> Relethford 2010.

<sup>4</sup> Triantaphyllou *et al.* 2015.

<sup>5</sup> Branigan & Campbell-Green 2010.

<sup>6</sup> Branigan 2010b.

<sup>7</sup> Carter 2010; Doonan *et al.* 2007.

<sup>8</sup> Michelaki & Vasilakis 2010.

dark-on-light ware appears to have been imported from the Mesara-Asterousia region.<sup>9</sup> Similarly, some of the silver jewellery from Livari-Skiadi has parallels in Mesara-Asterousia and may have been imported from there, or from Kephala-Petras.<sup>10</sup> Some of the copper daggers and the dark burnished pottery belonging to the so-called 'Kampos Group' show parallels in the north Cretan coast and the Cyclades.<sup>11</sup> Finally, the obsidian blades found at Livari-Skiadi are reminiscent of Cycladic influences; however, they are shorter than the Cycladic ones, suggesting a local tradition, while they also resemble obsidian blades from Mesara.<sup>12</sup>

The pottery from Kephala-Petras exhibits similarities with sites across Crete, both in the typology of the pots and in technological characteristics.<sup>13</sup> In addition, the typology of the house tombs falls within the broader Minoan house tomb tradition, as similar funerary structures have been found at many sites, such as Archanes, Malia and Palaikastro.<sup>14</sup> The typology of golden jewellery has parallels in Mochlos, Chrysolakkos, Hagios Charalambos, Platanos and other Cretan sites, while variations of the silver jewellery found at Kephala-Petras have been identified in the Cyclades, on the western coast of Asia Minor, and at Mesara, Malia and Hagia Photia.<sup>15</sup> Contacts with the Cyclades are further attested in the form of the 'Kampos Group' pottery, silver jewellery and fragments of marble figurines with folded arms, and in raw material, such as Melian obsidian and copper.<sup>16</sup>

Koumasa is one of the richest tholos tomb cemeteries of the Prepalatial and Protopalatial periods in central Crete. The grave goods found at Koumasa

include many imports and objects made with imported raw materials. The participation of Koumasa in broad networks of exchange can be interpreted based on the fact that it was one of the strongest centers in southern Crete.<sup>17</sup> Indeed, Koumasa demonstrates the largest number of Cycladic or Cycladic-influenced figurines, outside of sites along the north coast of the island, as well as copper daggers, seals, golden objects and stone vessels. It must be stressed that the presence of Cycladic objects does not necessarily imply direct contact with the Cyclades, rather it supports contact with sites on the north-central Cretan coast, where Cycladic objects and *Cycladica* in general were abundant.<sup>18</sup>

At the time of writing this chapter there was no published information regarding the material culture from Pezoules Kato Zakros. However, a recent survey in the broader region of Kato Zakros appears to support cultural contacts between this region and broader eastern and central Crete during the Prepalatial and Protopalatial periods. In the current edited volume Platon and Tsiboukaki offer information on the material culture from Pezoules and its association with the rest of Crete.<sup>19</sup>

The above brief outline highlights the cultural contacts developed among all sites under study, while at the same time each site appears to have participated in distinct networks. Despite extensive research on the material culture of the time, the extent to which the observed cultural similarities and accompanying contact networks can be linked to human mobility remains unknown. This is an issue that will be explored here by assessing the biological/genetic relatedness of the above Cretan groups in order to determine the presence of marital networks or other mechanisms of gene flow.

9 Papadatos 2015a.

10 Papadatos 2015b.

11 Papadatos 2015a; 2015c.

12 Carter 2015.

13 Nodariou 2012.

14 Betancourt 2012.

15 Tsipopoulou 2012b.

16 D'Annibale 2012; Tsipopoulou 2012b.

17 Legarra Herrero 2011.

18 Panagiotopoulos 2012; Panagiotopoulos forthcoming.

19 Platon & Tsiboukaki this volume.

## Materials and Methods

The human dental remains from Kephala-Petras, Koumasa, Livari-Skiadi, Moni Odigitria and Pezoules Kato Zakros were studied macroscopically in order to calculate the biodistance among these assemblages. Sample sizes are provided in Table 1. With the exception of Pezoules and Koumasa, the osteoarchaeological study of all assemblages has recently been completed and the relevant results have either been published or are currently in preparation for publication.<sup>20</sup>

The cemetery at Kephala-Petras lies 1 km east of the modern town of Siteia. The material included in the current study originates in the burial Rock Shelter, which was used from the Early Minoan IB to Middle Minoan IB/IIA, ca. 2900-1875/1850 BC,<sup>21</sup> as well as House Tombs 2 and 5. House Tomb 2 spans the Early Minoan III to Middle Minoan II, ca. 2200-1875/1800 BC, while House Tomb 5 was in use from the Early Minoan III to the Middle Minoan IA, ca. 2200-1925/1900 BC. There is, therefore, an overlapping period of approximately 350 years when the burial Rock Shelter and the house tombs under study were in contemporary use.<sup>22</sup> The Livari-Skiadi material originates in a tholos tomb and a burial rock shelter. Both the tholos tomb and the rock shelter were in use from the Early Minoan IB to Early Minoan IIB, ca. 2900-2200 BC; however, the rock shelter continued to be used until the Early Minoan III, ca. 2200-2100/2050 BC.<sup>23</sup> The material from Pezoules Kato Zakros consists of articulated and disarticulated remains originating in tombs A and B.<sup>24</sup> Tomb A appears to have originally been a house tomb but it was later remodeled as a tomb enclosure. Tomb B was built during the reconstruction phase of Tomb A and it formed a tomb en-

Assemblage	No. of examined teeth
Kephala-Petras Rock Shelter	475
Kephala-Petras HT 2	73
Kephala-Petras HT 5	353
Livari-Skiadi tholos	127
Livari-Skiadi Rock Shelter	355
Moni Odigitria Tholoi	123
Pezoules	81
Koumasa Tholos B	352

**Table 1.** Sample sizes.

Note: The material from Moni Odigitria originates in Tholos A (34 teeth) and the ossuary (89 teeth). These assemblages have been pooled for reasons explained in the text.

closure from the beginning. The material found in both tombs dates from the Middle Minoan IB to the Middle Minoan IIB (ca. 1925/1900-1750/1700 BC), but one or two pots from Tomb A may date to the MMIA (ca. 2100/2050-1925/1900 BC).<sup>25</sup>

Regarding central Crete, the Moni Odigitria assemblage originates from tholos tomb A and the ossuary where the skeletal remains from tholos Tomb B must have been transferred. The remains from tholos Tomb A date to the Early Minoan I–Early Minoan II, ca. 3100-2200 BC, while the material from the ossuary dates to the Early Minoan I–Middle Minoan IB, ca. 3100-1875/1850 BC.<sup>26</sup> In the current study the material from these two assemblages has been pooled on the grounds of the small sample sizes, especially from tholos Tomb A. This practice is valid given the large temporal overlap in the usage of the two funerary structures. Note that all analyses were repeated encompassing only material from the ossuary, and gave the same results as the ones presented below for the pooled dataset. Finally, the

20 Triantaphyllou 2009; 2010; 2012, in press; Triantaphyllou *et al.* in press.

21 Tsipopoulou 2010; Tsipopoulou 2012b.

22 Tsipopoulou 2012b.

23 Papadatos 2015a.

24 Becker 1975.

25 Platon & Tsiboukaki this volume.

26 Branigan & Campbell-Green 2010.

Maxilla	Mandible
Labial curvature (I1)	Root number (C)
<i>Shoveling (I1)</i>	Tome's root (P1)
Double shoveling (I1)	<i>Lingual cusp (P2)</i>
<i>Interruption groove (I2)</i>	<i>Protostylid (M1)</i>
<i>Tuberculum dentale (I2)</i>	Cusp 6 (M1)
Peg/reduced (I2)	<i>Cusp 7 (M1)</i>
<i>Bushman canine (C)</i>	Anterior fovea (M1)
Distal accessory ridge (C)	Cusp number (M1)
<i>Root number (P1)</i>	<i>Root number (M1)</i>
Cusp 5 (M1)	Deflecting wrinkle (M1)
Carabelli's trait (M1)	Distal trigonid crest (M1)
<i>Enamel extension (M1)</i>	<i>Hypoconulid (M2)</i>
Hypocone (M2)	Groove pattern (M2)
Root number (M2)	Root number (M2)
Peg-shaped (M3)	Maxilla or mandible
Parastyle (M3)	Odontome (P)

**Table 2.** Nonmetric traits under study.

Note: Traits in italics are the ones that remained in the dataset after the removal of the nondiagnostic and intercorrelated characters.

Koumasa material, excavated recently by the University of Heidelberg, represents the lower layers of Tholos B, which date to the Early Minoan II, ca. 2650-2200 BC, based on the preliminary study of the pottery.<sup>27</sup>

The calculation of the biodistances, that is, the biological/genetic distance between the above assemblages, was based on dental nonmetric traits. These traits are morphological characters that may take various expressions, such as an extra root or cusp and others. Studies in modern populations of known genetic affinity have found a strong genetic

determination of the expression of these characters and a high correlation between the biodistances calculated from dental nonmetric traits and those calculated from DNA data.<sup>28</sup> Based on these results, dental nonmetric traits have been employed extensively in osteoarchaeological studies worldwide.<sup>29</sup>

31 nonmetric traits (Table 2) were recorded using the Arizona State University Dental Anthropology System (ASUDAS)<sup>30</sup> and the frequency of each one was calculated per assemblage. For the dichotomization of the ASUDAS ordinal scores into binary categories of presence and absence, the thresholds provided by Turner were used.<sup>31</sup>

Note that the standard practice is to record each trait bilaterally and subsequently use the highest grade of expression in the analysis. In our case, due to the commingled nature of the assemblages, only teeth belonging to the right side of the maxilla and mandible were recorded in order to avoid including the same individuals twice in the dataset, biasing the results.

Although it would have been ideal to examine males and females separately in order to explore issues of matrilocality/patrilocality, this was not feasible due to the commingling the assemblages as part of the secondary treatment of the deceased. Following the standard practice in the study of nonmetric traits, all nondiagnostic traits, that is, traits that did not exhibit at least one statistically significant difference between at least one pair of groups, were removed from the dataset.<sup>32</sup> Similarly, all inter-correlated traits were dropped from the dataset since such traits result in redundant information and may produce biases.<sup>33</sup> The remaining characters

28 Berry 1978; Scott & Turner 1997; Schnutenhaus & Rösing 1998.

29 Hanihara 2010; Irish 2006; Nikita *et al.* 2012; Tomczak & Powell 2003.

30 Turner *et al.* 1991.

31 Turner 1987.

32 Harris & Sjøvold 2004.

33 Sjøvold 1977.

27 Panagiotopoulos 2012.



	Petras RS	Petras HT 2	Petras HT 5	Livari tholos	Livari RS	Moni Odigitria Tholoi	Pezoules	Koumasa Tholos B
<b>Petras RS</b>	0	0.078	0.178	0.151	0.180	0.133	0.007	0.086
<b>Petras HT 2</b>	0.008	0	0.049	0.151	0.160	0.348	0.382	0.077
<b>Petras HT 5</b>	<0.001	0.014	0	0.112	0.216	0.007	0.197	0.004
<b>Livari Tholos</b>	0.01	0.007	0.03	0	0.048	0.004	0.036	0.086
<b>Livari RS</b>	<0.001	0.004	<0.01	0.13	0	0.034	0	0.097
<b>Moni Odigitria Tholoi</b>	0.039	0.002	0.197	0.213	0.154	0	0	0
<b>Pezoules</b>	0.062	<0.001	0.016	0.058	0.121	0.115	0	0.060
<b>Koumasa Tholos B</b>	0.007	0.015	0.389	0.062	0.01	0.361	0.044	0

**Table 3.** MMD values (above the diagonal) and corresponding p-values (below the diagonal).

were used for the calculation of the Mean Measure of Divergence (MMD), one of the primary biodistance measures for nonmetric traits:

$$MMD = \frac{1}{r} \sum_{i=1}^r \left\{ (\theta_{1i} - \theta_{2i})^2 - \frac{1}{n_{1i} + 0.5} - \frac{1}{n_{2i} + 0.5} \right\} \quad (1)$$

Here,  $r$  is the number of traits considered,  $n_{1i}$  is the number of teeth in population 1 examined for trait  $i$ ,  $n_{2i}$  is the number of teeth in population 2 examined for trait  $i$  and  $\theta_{1i}$  and  $\theta_{2i}$  are the transformed frequencies. The Freeman–Tukey angular transformation was adopted to correct for small sample sizes.<sup>34</sup> The MMD results were visualized by means of Multi-dimensional Scaling (MDS). For the calculation of the MMD and the corresponding p-values, a macro designed by the first author was used, while MDS was performed in SPSS version 21.0.

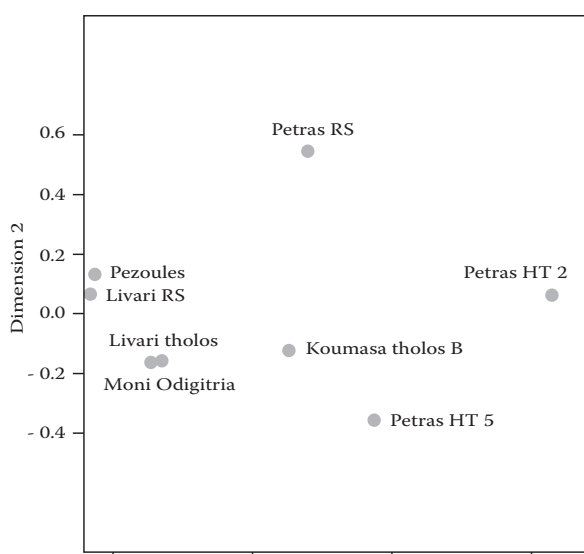
<sup>34</sup> Freeman & Tukey 1950.

## Results and Discussion

The obtained MMD values and their corresponding p-values calculated using permutations are given in Table 3 while the MDS plot that visualizes them is given in Table 4. The biodistances visualized through the MDS plot reveal three principal patterns: 1) there is an overall proximity among Pezoules, the Livari-Skiadi Rock Shelter, the Livari-Skiadi Tholos and the Moni Odigitria Tholoi, though the Livari-Skiadi Tholos appears notably closer to the Moni Odigitria Tholoi than to the Livari-Skiadi Rock Shelter; 2) Koumasa lies on its own despite its prominent presence in the cultural networks of the time, while it is striking that it does not appear particularly close to Moni Odigitria despite their geographic proximity; 3) all assemblages from Kephala-Petras are distant both from the remaining Minoan sites as well as from each other.

In respect to the Livari-Skiadi assemblages, it can be seen that they lie rather close to each other but not as close as would be expected considering their geographic proximity, being located only meters apart, and their contemporary use from the Early





**Table 4.** Multidimensional Scaling plot based on MMD distances.

Minoan IB to Early Minoan IIB. This greater than expected biodistance between the two Livari-Skiadi assemblages was also noted in the paper by Triantaphyllou and her colleagues. The extra ~100 years during which the Rock Shelter was still in use while the tholos had been abandoned is unlikely to be responsible for the observed biodistance between the two sites, since genetic divergence normally takes many generations in order to manifest. In contrast, the proximity between the Moni Odigitria assemblages and the Livari-Skiadi Tholos tomb is striking, as is the proximity between the Livari-Skiadi Rock Shelter and the Pezoules assemblages. These results appear to support at a preliminary level archaeological evidence that suggests a change in the contact networks in which Livari engaged between the EM I–IIA and EM IIB. More specifically, archaeological evidence suggests that until the EM IIA Livari was in close contact with the Mesara region; however, from the EM IIB Livari distanced itself from Mesara and engaged more intensively in contacts with the Mirabello area and broader eastern Crete.<sup>35</sup> As such,

<sup>35</sup> Papadatos pers. comm.

it is possible that the proximity between the Livari-Skiadi Tholos and Moni Odigitria indicates gene flow between these two parts of the island, potentially through the relocation of a group from Mesara to Livari-Skiadi via maritime networks by the EM IB period. This human mobility is culturally supported by the presence of a tholos tomb in eastern Crete, at a large distance from the Mesara region where this architectural type is primarily found. In light of our evidence it may be possible that the tholos is a cultural trait imported along with human groups. On the other hand, the proximity between the Livari Rock Shelter and Pezoules may be suggestive of the new eastward direction of the Livari contact networks from the EM IIB period onward. However, it must be stressed that the Pezoules dental sample was particularly small, so any conclusion regarding its biodistance from other Cretan assemblages is tenuous. A factor that could have promoted extensive interactions between Livari-Skiadi and other Cretan communities is the marginal and fragile local natural environment, which must have necessitated the formation of networks for survival. As mentioned in the paper by Triantaphyllou and her colleagues, human mobility need not have engaged numerous individuals since the assemblages under study must have consisted of merely a few tens of individuals, based on survey data, settlement information, the reconstruction of demographic patterns based on the minimum number of individuals determined from skeletal remains and Whitelaw's seminal work on the paleodemography of prehistoric Crete.<sup>36</sup> Triantaphyllou and her colleagues provide a summary table (Table 2) which highlights the small numbers of skeletons deposited per century in recently examined cemeteries on the island, supporting the nuclear family as the basic social unit in Early Bronze Age Crete. As such, even the appearance of a few newcomers would have affected the genetic structure of existing groups. In any case, further research em-

<sup>36</sup> Bintliff 1977; Whitelaw 2007; 2012; 2015.

playing biomolecular and chemical analyses should ideally be conducted before final conclusions are drawn, especially since the sample sizes for the bio-distance analysis from Moni Odigitria, Pezoules and the Livari tholos were not particularly large.

Koumasa Tholos B does not appear to be particularly close to any single assemblage. The assemblages closer to Koumasa are the Kephala-Petras House Tomb 5, the Livari-Skiadi Tholos and Moni Odigitria. The relative proximity between Koumasa and House Tomb 5 from Kephala-Petras might be supported by the active North-South axis of product and raw materials exchange within Crete. Indeed, archaeological evidence suggests that in the Mesara and the Asterousia areas *Cycladica* was not directly imported from the Cyclades, rather North Cretan sites played an active role in the transportation and exchange of raw materials, artifacts and technological skills and ideas of Cycladic origin.<sup>37</sup> However, further research is required in order to elucidate the extent of contact between these sites, especially given the distance between Koumasa, Kephala-Petras House Tomb 2 and the Kephala-Petras Rock Shelter. In contrast, the biodistance between Koumasa and Moni Odigitria is small compared to the overall Minoan assemblage under study, but much larger than anticipated considering the geographic proximity between these two sites and their temporal overlap. It appears that the cultural similarities between these two sites were the result of cultural rather than demic diffusion but, once again, further research is required before factors potentially limiting gene flow between these Mesara assemblages can be identified.

The location of the Kephala-Petras assemblages on the MDS plot is rather surprising. Not only is the distance between these assemblages and other Cretan groups large, but also the distances among the Kephala-Petras assemblages themselves are substantial. The distance between Kephala-Petras and

other largely contemporary assemblages, in particular Livari-Skiadi, had been previously noted by Triantaphyllou and her colleagues.<sup>38</sup> However, in contrast to the results of the aforementioned publication, where the biodistance between the Kephala-Petras Rock Shelter and House Tomb 2 appeared very small, in our current study the genetic heterogeneity among the groups buried at the Kephala-Petras cemeteries seems prominent. This discrepancy can be attributed to the largest dataset of Cretan assemblages that is analysed in the current paper, also including one more assemblage from Kephala-Petras (House Tomb 5). It must be stressed that the biodistances calculated from nonmetric traits are relative to each other, rather than absolute values. As a result, when new samples are imported into the analyses, the relative biodistance of each assemblage from the others is modified. Normally such changes are rather small; however, in our case, the small sample size of the material from House Tomb 2 likely rendered it sensitive to changes in the overall dataset genetic heterogeneity. As such, even the current results regarding House Tomb 2 should be treated with caution. Nevertheless, the biodistance between the two house tomb assemblages, which exhibited large sample sizes, attests to the heterogeneity of the population buried at Kephala-Petras.

Regarding the interpretation of this heterogeneity at Kephala-Petras, given the small temporal distance between the three assemblages and their highly concurrent use, the large biodistances cannot be effectively explained based on chronological factors. One possibility would be that Kephala-Petras population groups had developed intermarriage networks with communities outside the island, with which they had already developed cultural exchange networks. Appealing though this scenario may be, it is not supported by limited strontium isotopic data analysis performed by Triantaphyllou and her colleagues; the analysis showed that around twelve

37 Papadatos 2007a;

38 Triantaphyllou *et al.* 2015, table 6.

individuals sampled from the Kephala-Petras Rock Shelter and House Tomb 2 were locals.<sup>39</sup> Further research encompassing more house tomb assemblages from the cemeteries at Petras, as well as more extensive isotopic analyses, is required in order to reach more reliable conclusions regarding the degree of heterogeneity of the Petras assemblage and its possible attribution to gene flow between Petras and non-Cretan populations.

Finally, the large biodistance of all the Kephala-Petras assemblages from the remaining sites of the island is quite remarkable, especially if one takes into account the participation of Kephala-Petras in the cultural networks of the time. Triantaphyllou and her colleagues proposed as a possible explanation for this phenomenon the fact that Kephala-Petras, due to its location on a fertile plain, was able to be self-sufficient, thus not under pressure to develop intermarriage networks in Crete to ensure its survival at times of hardship. In light of our new findings this interpretation appears rather unlikely since it would imply greater homogeneity within Petras. Once again, further research is required encompassing material from more house tombs in Petras, in

order to gain a better understanding of this site *per se*, and also a more extensive comparative database from the rest of Crete and the broader southern Aegean to explore gene flow patterns between Petras and other communities more thoroughly.

In summary, our results suggest an interesting pattern of biodistances in Prepalatial and Protopalatial Crete. As such, they corroborate and offer a broader context to our earlier study; however, they also reveal an unexpected degree of heterogeneity within the Kephala-Petras population groups, which needs to be further explored by examining material from the other excavated house tombs in the cemetery. It is our aim to expand our research in the direction of studying more material from Kephala-Petras, the rest of Crete and the broader southern Aegean, as well as expanding the use of chemical and biomolecular analyses in the future, so that the nature and character of the contact networks established in Crete and the southern Aegean in the 3<sup>rd</sup>–early 2<sup>nd</sup> millennia BC may be explored with higher resolution and accuracy.

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39 Triantaphyllou *et al.* 2015, fig. 2.

## Discussion

- Relaki:** Thank you for this exceptional paper! I am not sure whether you have an answer to what I am going to ask you – I understand there are limitations due to the unavailability of the material – but I observed that your comparisons were between Petras and tholos tombs. Maybe you should check material from other cemeteries with house tombs?
- Nikita:** Are you thinking of a particular site?
- Relaki:** No, but I believe that if we look outside Crete, at the Cyclades for example, the first results are negative.
- Nikita:** Yes, there is undoubtedly need for that.
- Relaki:** Of course, and as the key point of your paper is the combination of biological and cultural similarities, there are many cultural parallels with house tombs in Eastern Crete.
- Nikita:** The question is whether the material is available for study. Ideally I would like to have material for which the macroscopic study has been completed, in order to see the meaning of our conclusions.
- Relaki:** Yes, I know, it is something to consider for the future.
- Nikita:** Thank you very much.
- Vavouranakis:** If I am allowed to comment on this – since as we just saw, a group of people arrived at Mesorrachi, stayed there and did not move to the fertile plain of Siteia, although this seems to us the most obvious thing to do, maybe we need to reconsider what was obvious or expected for them. This needs more reconsideration, especially for those periods when social aspects such as economy, society and identity were very much interwoven.
- Relaki:** I agree completely, but you are on the safe side, if you examine the obvious before you exclude it. This was the meaning of my comment.
- Kyparissi:** On the table you showed with the number of teeth from every site what impressed me was that the largest sample comes from the Petras Rock Shelter, and it is even larger than the one from House Tomb 5, which, as we saw, had many burials. Were there more mandibles, more skulls in the Rock Shelter or is it a random choice?

- Nikita:** Sevi Triantaphyllou is the most appropriate person to answer this question. The data I analyse are strictly from teeth, irrespective of whether they were associated with a maxilla/mandible or were loose. Since we are dealing with secondary burials, the bones were mingled, and I cannot say whether there were more skulls in the Rock Shelter. However, I should clarify a point regarding our methodology: in order to be able to see if a nonmetric trait is present or not, we need well-preserved teeth. It is possible that in House Tomb 5 there were more teeth (and I repeat Sotiria Kiorpe and Sevi Triantaphyllou can answer this), but they are not preserved well enough. Furthermore, to avoid studying the same individual twice, our practice is to study only one side of the dental arcade, right or left; in this case we studied the right side. So the number of teeth you see is actually half of the number that was present in every sample.
- Triantaphyllou:** We need to consider the long duration of use of the rock shelters, both at Livari and at Petras. Hence the larger number of individuals. As far as House Tomb 5 is concerned, this is really a big issue, as we mentioned in our papers there was a large number of teeth that were not connected to the mandibles.
- Kyriatzi:** If I can add something to what Sevi Triantaphyllou just pointed out, what about the internal homogeneity (or lack of it) in every one of your groups? In the graphs you showed, each site was represented by a dot. Is there a difference within each group, i.e., are there groups that are more homogeneous than others?
- Nikita:** This is something we have not examined, as these groups are so mingled. The macroscopic analysis of these remains has not indicated any clusters within each assemblage that would form the basis of a separate examination of sub-groups. This finding, in addition to the fact that the statistical analyses we employ require large sample sizes in order to produce valid and meaningful results, led us to treat each assemblage as a unit.
- Triantaphyllou:** I suspect, correct me if I am wrong, that in order to try to find statistically internal patterns in the various populations you must start by examining some constants, which we do not have.
- Nikita:** Exactly.
- Triantaphyllou:** The first constant would be the sex, and as you said, we cannot use that because the teeth are disconnected from the mandibles, so sexing is not possible.
- Nikita:** Right. Besides sex, it would be interesting to explore patterns between different chronological phases since we have such a large time span in the use of certain burial sites, for example in the case of the Rock Shelter, but determining which teeth belong to each phase is a big issue, as I understand.
- Tsipopoulou:** This is exactly what I wanted to point out: the time span of use of the Rock Shelter is much longer than that of the two house tombs you studied (House Tomb 2 and House Tomb 5); it starts in EM IB and continues until MM IB/IIA, ca. 600 years. Would it be possible in this case to trace a genetic mutation? Are five or six centuries enough time for that?
- Nikita:** In theory, yes, but in practice it depends on the mutation rate of specific genes.

**Tsipopoulou:**

Let me make another point: there were 90 skulls preserved in the Rock Shelter, and the stratigraphy was inverted, meaning that later deposits were excavated underneath earlier ones; this is why we believe that the Rock Shelter was filled on one occasion. Sevi Triantaphyllou conducted a very meticulous study of the skeletal material and she found that bones belonging to the same individual were found in different layers. This was a very significant conclusion of her study. So, things are more complex than in a house tomb, which was probably used by a certain social group, which we can define as a nuclear family, an extended family, a clan etc., a social unit in any case. In the Rock Shelter the situation is not clear and becomes more complicated if the large chronological span is taken into consideration; it was in use for much longer than the excavated house tombs. Still, I would like to remind you that part of the deposits excavated in House Tomb 2 are contemporary with those of House Tomb 5 (EM III/MMIA).

**Nikita:**

Let me clarify another point on biodistance analysis. The genetic material of a person or a group of people can change over time due to various factors; it is important for us to realize that and accept the limitations of our studies. The first factor is natural selection, i.e., certain traits that give an advantage to the individual and ensure survival will increase in frequency in the future generations, while traits that are maladaptive and harmful tend to disappear. This rule does not strictly apply to the dental non metric traits, however, because they are neutral – they do not offer any advantage or disadvantage. Consequently, I doubt that natural selection plays a major role in determining the frequency of nonmetric traits. The other factor is called genetic drift and expresses the random changes that occur in our genome, because in nature not everything happens according to a plan. Therefore, the frequency of certain genes changes from generation to generation due to random factors as well. Genetic drift must have influenced these traits that are neutral, as I said, but by definition genetic drift is random and has no particular direction. I believe that in the material under study natural selection and genetic drift are not sufficient to explain the observed patterns. Instead, my suggestion is that at Petras a group, small or large, came or left, and this changed the local genotype.

**Wright:**

This was such a fascinating talk. I am not sure I understood everything you said, but about your last comment, you mentioned marriage. Between Livari and Moni Odigitria one might say that there is some strong marital pattern. We do not know for sure but we might think that this is more matrilineal than patrilineal. However, since you don't have enough evidence from other communities as you have not been able to test enough data for other populations in the Petras region, we cannot show what was happening there. This issue of the role of marital networks is a very serious one as bioarchaeology is leading us away from the tyranny of the boundaries of material culture and leads us to talk in better informed ways about people. But at the same time, looking at your dental analyses we are looking at things that are part of a genetic process over hundreds of years, right?



- Nikita:** Yes, this is a very good point. In general, when we find genetic proximity between two groups, this can indicate two things: 1. These groups shared a common ancestor in their recent history – in the case of the Livari tholos tomb and Moni Odigitria, maybe the individuals in Livari originated in Mesara, so they had a common ancestor with the individuals from the Moni Odigitria assemblage; or, 2. an alternative explanation is what Professor Wright just mentioned, that these groups do not share a common ancestor in their very recent history, but instead they developed very extensive gene flow between them, probably due to marriage, and as a result, their genetic affinity was formed in their more recent history. This is why ideally we should combine the macroscopic results with strontium analysis. This combination of analyses could clarify whether these people came from Mesara, for instance. In addition, analysis of ancient DNA could show when the groups diverged. So, we could see when the common ancestor was present.
- Philippa-Touchais:** When Yiannis Papadatos gave a lecture a few months ago at the British School he pointed out the fact that these coastal sites in South Crete communicated through the sea. This could be a factor, as Petras, situated on the north coast, belonged to a different network.
- Nikita:** Yes, this is a very important point. In the context of my post-doctoral research I explore biodistances across the Aegean from the Early Neolithic until the Early Iron Age. To understand how important the role of natural barriers and corridors is in human mobility, I am collaborating with a colleague from East Anglia University in order to calculate pairwise geographic distances in GIS using least-cost path analysis.
- Tsipopoulou:** As far as we know, the occupation at Petras started in the Final Neolithic. The close relations with the south-southeastern Aegean may suggest that a group of people moved from that area and was established on the Kephala hill. Before them there might have been an indigenous population already living there, but we have no evidence for that. Consequently, we are clearly dealing with a population movement to Petras. Also it is interesting to speculate about what happened to the people of Hagia Photia after the cemetery stopped being used. I do not believe that they suddenly disappeared. They might have moved to Petras, that was a better place, and become assimilated into the local population. They already had close relations with the inhabitants of Petras, as is evidenced also by the finds in the Rock Shelter, the Kampos group pottery and the Cycladic figurines. These Cycladic people, even after they moved to Petras, probably maintained their relations with their metropolis, so this fact might offer us another key for the understanding of the situation at Petras.
- Nikita:** Ideally we would like to study the material from the Hagia Photia cemetery. For the moment it is not available, as it is under study, but we hope that in the next two to three years we will be able to access it, particularly since Hagia Photia is a key site for the understanding of the area.

- Philaniotou:** First, I would like to congratulate you, this was a very interesting paper, and since you mentioned Kouphonisi and Tsikniades, I would like to say that it was very good that you started this study, because the macroscopic study of this material is still in progress. However, the sample was so small that I think if any relations resulted from your study it would be purely accidental.
- Nikita:** No, I do not agree with that. You see, in statistical analysis when we trace a significant phenomenon, as was the case for the biodistance between Tsikniades and most other south Aegean sites, this cannot be attributed to the small sample size. Of course, the remaining issue is the extent to which the small group of individuals that we studied is representative of the entire population of Naxos.
- Philaniotou:** Furthermore, there is a difference between the two sites. Tsikniades was a cemetery with primary burials while Kouphonisi-Potamia was a secondary deposit; there were no bones there of primary burials and this difference is probably significant. On the other hand, of course, cultural relations between Kouphonisi and the Siteia bay area are certain, as suggested by the pottery. In any case more studies will be necessary before we will be able to understand the situation fully.
- Nikita:** I agree that we need to study more and if you know of any other site in the Cyclades that could be included in the study, I would be very happy to know about it. It is true that the samples are very small, Potamia particularly has a very small sample, but the Tsikniades sample is what I would call small but ‘acceptable’.
- Philaniotou:** But Tsikniades are far away from the south Aegean networks we are talking about.
- Nikita:** You are right. The issue of how isolated individual assemblages were is an important one. I would assume that since the Cyclades represent a rather marginalized natural environment, the Cycladic population must have been in regular contact with each other to ensure their survival. Also, if endogamy was predominant, mutations would have accumulated in these small communities after a few generations, which is deleterious. Therefore, from indirect evidence I suspect that Cycladic communities must have developed marital networks, but of course this is something that requires proper study.
- Philaniotou:** They must have, but if we examine the modern situation, the Cyclades are what the poet Odysseas Elytis wrote “*αυτός ο κόσμος ο μικρός, ο μέγας*”. Every island is a microcosm, with its own traditions and sometimes with different dialects, for example the Kouphonisians do not speak like the Parians, or the Tenians. Of course, in antiquity the situation might have been different.

### *Greek abstract*

#### **Μετακινήσεις πληθυσμών και πολιτισμικές ταυτότητες στην Προανακτορική κεντρική και ανατολική Κρήτη**

Η προανακτορική και πρώιμη πρωτοανακτορική περίοδος στην Κρήτη χαρακτηρίζονται από εκτενή δίκτυα επαφών που εκτείνονται σε ολόκληρο το νησί αλλά και στο ευρύτερο νότιο Αιγαίο. Παρότι τα δίκτυα αυτά

έχουν αναγνωριστεί με βάση διάφορες πτυχές του υλικού πολιτισμού, όπως η κεραμική, τα μεταλλικά αντικείμενα και άλλα, οι γνώσεις μας αναφορικά με τον πιθανό ρόλο πληθυσμιακών μετακινήσεων σε αυτά παραμένουν ελλιπείς. Το παρόν κεφάλαιο εξετάζει την κινητικότητα πληθυσμιακών ομάδων στην κεντρική και ανατολική Κρήτη κατά την Προανακτορική και πρώιμη Πρωτοανακτορική περίοδο προκειμένου να προσδιορίσει τον βαθμό γονιδιακής ροής μεταξύ των κοινοτήτων της εποχής. Τα αποτελέσματα αποκαλύπτουν μια ενδιαφέρουσα εικόνα βιοαποστάσεων μεταξύ αυτών των κοινοτήτων, η οποία μπορεί να αποδίδεται σε δίκτυα επιγαμίας ή στη μετακίνηση ομάδων για άλλους λόγους. Στις περισσότερες περιπτώσεις φαίνεται πως οι πολιτισμικές ομοιότητες συνοδεύονταν και από ανθρώπινη κινητικότητα, ωστόσο εντοπίστηκαν και σημαντικές εξαιρέσεις. Περαιτέρω έρευνα απαιτείται ώστε να διερευνηθεί πιο αναλυτικά το ζήτημα της γονιδιακής ροής στην προϊστορική Κρήτη και ο ρόλος της στη διαμόρφωση και διατήρηση των δικτύων πολιτισμικής επαφής.

