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"Mycenaean" political domination of Knossos following the Late Minoan IB destructions on Crete: negative evidence from strontium isotope ratio analysis ($^{87}Sr/^{86}Sr$)

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ABSTRACT

Strontium isotope ratio analysis of human dental enamel and bone is applied to investigate a highly debated question of population movement and cultural discontinuity in Prehistoric Aegean Archaeology. The Late Minoan IB (ca. 1490/1470 BC) destructions on Crete are succeeded by cultural upheaval. The novel cultural features that appear at Knossos (Crete) in this period have forerunners in the Mainland. In Cretan context, the Linear B writing system, the funerary architecture and burial practices of the Mainland style are interpreted as evidence of an actual "Mycenaean" long-term settlement and political domination of Knossos. Human skeletal material from tombs that are associated with non-locals from the Mainland based upon the material culture is analysed to measure $^{87}Sr/^{86}Sr$. The results of the analysis show that all the examined individuals from the Knossos tombs were born locally.

1. Introduction

One of the widely debated questions in Bronze Age Aegean Archaeology concerns the Late Minoan IB (ca. 1490/1470 BC) destructions on the island of Crete and the subsequent cultural discontinuity (Fig. 1). Causative factors in the proposed interpretative models range from physical [(i.e. earthquakes, fires, the eruption of the Theran volcano and tsunamis) (e.g. Marinatos, 1939)] to anthropogenic [(i.e. inter-state warfare on Crete (e.g. Niemeier, 1983; Hallager, 1988), or "Mycenaean" invasion (e.g. Hood, 1985; Barber, 1987: 222; Doxey, 1987: 301; Driessen, 1990: 125; Popham, 1994: 93) or a combination of the two (e.g. Niemeier, 1985: 218; Hallager, 1988: 15; Warren, 1991: 36-37; Rehak and Younger, 2001: 441). More recent approaches, however, emphasise factors internal to Cretan society, social unrest and social competition as responsible for the generalised upheaval (e.g. Marinatos, 1993: 221; Driessen and Macdonald, 1997: 113; Driessen, 2002; Hamilakis, 2002)].

At present there is no doubt about the anthropogenic nature of the LMIB destructions on Crete; a thorough review of the archaeological evidence of this is provided by Driessen and Macdonald (1997). More precise information on the "nature" of these destructions is provided by the selective destruction of the operating administrative centres of the depleted sites. Settlements and buildings housing Linear A documents suffered severe damage, implying that aggression was directed towards a specific segment of the society (e.g. the ashlar Building B2 at Mochlos, the "mansion" at Myrtos Pyrgos). The hypothesis for a Knossian involvement into the widespread destructions, with or without the collaboration of the "Mycenaeans", is largely founded on the absence of LMIB destruction deposits from inside the palace at Knossos, at a time when several buildings and structures in the vicinity of the palace suffered damage (Hood, 1961, 1962; Driessen and Macdonald, 1997: 156). The hypothesis, however, that the palace was deliberately devoid of destructions has been seriously questioned in more recent years. Macdonald (2002) interpreted the absence of LMIB destruction deposits or dump sites from inside the palace and outside this respectively, as the result of a massive rebuilding of the palace during the LMIB. Additionally, assessments of the LMIB destructions on Crete have been recently modified by the lack of a consensus on whether the LMIB destructions are all contemporary or not. On the basis of material culture and archaeomagnetic evidence it is argued that these destructions do not represent a single horizon, but instead they

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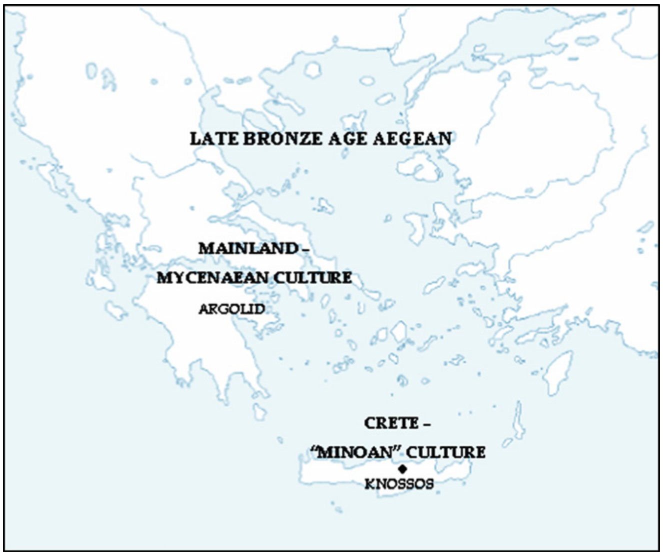

Fig. 1. Map of study area in the Aegean showing the Argolid region in the Mainland ("Mycenaean" culture) and Knossos on Crete ("Minoan" culture).

have taken place over one or two generations (Driessen and Macdonald, 1997: 106).

The "Mycenaean" identity of the invaders is postulated on the nature of the cultural upheaval that succeeds the LMIB destructions. The novel features that appear in the thematography of the representational arts, everyday utility artefacts, and principally in the writing and administration, domestic and funerary architecture, the sphere of religion, ritual and mortuary practices are similar to contemporary developments in the Mainland (Popham, 1994: 93–4; Rehak and Younger, 2001: 441). The recovery of Linear B tablets from Knossos is viewed as the confirmation of an actual "Mycenaean" presence there dating from the LMII (Driessen, 1990) or to the LMIIIA1-2 (Niemeier, 1982, 1985; Hallager, 1988; Catling, 1989: 7). Discrepancies in the dating of the Mycenaean presence at Knossos arise from the debate over the date of the final destruction of the palace and conflagration of the majority of the Linear B tablets. Niemeier (1985) based on the LMIIIB dating of the Linear B tablets at Knossos, placed the settlement of "Mycenaeans" at the site and associated changes in the character of the society, not earlier than the LMIIIA1 destruction of the palace.

The close similarities between the LMII–IIIA Knossian and Mainland cemeteries in terms not only of the ostentatious deposition of bronze items and the combination of pottery types in burial assemblages, but also in terms of tomb architecture and burial practices, are viewed as evidence for the settlement of "Mycenaeans" at Knossos (Sakellarakis, 1972: 415; Hood and Taylor, 1981: 11; Doxey, 1987: 303; Popham, 1994: 93–4; Alberti, 2004). "Warrior grave", "burials with bronzes" and the single-chamber tombs that occur for the first time in the Mainland (Popham et al., 1974: 255), have been excavated at sites mainly in Central Crete and their presence outside the Mainland has been associated with the settlement of Mainlanders (Popham et al., 1974; Driessen and Macdonald, 1984: 66; Doxey, 1987: 303; Driessen, 1990: 124–5). Sinclair Hood was the first to use the term "warrior graves" to describe the importance attributed to the bronze weapons in graves dating from the end of LMIB (Alberti, 2004: 129). It is argued, however, that the emphasis given on militarism, traditionally ascribed to the Mainlanders, in the early part of the Late Bronze Age, is more of a general trend in the Aegean rather than a novel feature in Cretan society following the LMIB destructions (Rehak and Younger, 2001: 441). Niemeier (1985: 226) very insightfully expresses his scepticism about equating discontinuities in burial customs to population invasion and argues that the "warrior graves" do not need to belong to "Mycenaeans". Moreover, even if this hypothesis is true, a "Mycenaean" presence does not necessarily imply Mycenaean conquest; clustering of these graves in rather small groups could be indicative of "a professional caste of foreigners" (Niemeier, 1985: 226).

Despite the critique that the theory for a LMIB "Mycenaean" invasion and political domination of Knossos has received in more recent years (Niemeier, 1985; Catling, 1989; Driessen and Macdonald, 1997: 113), the hypothesis for a "Mycenaean" involvement into the cultural upheaval on Crete from the LMII onwards (either immediately following the LMIB destructions or in the LMIIIA1-2) is still very influential in archaeological thinking and in models attempting to interpret the processes that brought about discontinuity in the Cretan Bronze Age culture history (Driessen and Macdonald, 1997: 112; Alberti, 2004: 136).

The theory for a "Mycenaean" invasion and political domination of Knossos derives largely from a culture-historical interpretation of material culture history and the simplistic equation of certain material culture characteristics, archaeologically inferred practices and ideologies with certain people and the interpretation of cultural discontinuity at a site and inter-site stylistic and ideological transfers as evidence of population movement. Archaeological and other related research, however, has demonstrated the perception of population movement and residential change as the exclusive determinant of culture history to be highly problematic (Binford, 1965; Flannery, 1968; Renfrew, 1972; Bintliff, 1994). Stylistic transfers and discontinuity in material culture, although they signify interaction, fail to provide more accurate information concerning the nature of this interaction (Dickinson, 1994). Moreover, the production and consumption of distinctive styles of material culture may reflect rather complex conditions, such as socio-political competition, competitive emulation and the adoption of a foreign symbolic system by local leaders for the purposes of power justification (Schallin, 1993). Thereby, it is over-simplistic to infer population movement and biological history from material culture evidence alone.

When questions of population movement and cultural discontinuity are addressed, the analysis of the skeletal remains of the respective populations within a bioarchaeological research framework can contribute to a more complex reconstruction of population bio-cultural history and deepen our understanding of the cultural processes under which change, stylistic and ideological transfers occur. Despite the plethora of studies of the material culture in Crete postdating the LMIB destructions, there is a dearth of modern bioarchaeological studies that explore questions of population movement and biological interactions within the examined context in a systematic and scientifically sound mode. This paper derives largely from the author's doctoral research that investigated population bio-cultural history in the Bronze Age South Aegean using the results of morphological skeletal analysis supplemented by strontium isotope ratio ($^{87}Sr/^{86}Sr$) analysis. In this paper I will present and discuss the testing of the hypothesis for the presence of non-locals ("Mycenaeans") among those interred in the Sellopoulo and KSP (Knossos South of the Palace) chamber tombs and the Sellopoulo shaft grave at Knossos that postdate the LMIB destructions. Testing will use $^{87}Sr/^{86}Sr$ analysis results of human dental enamel and bone samples.

2. Materials

2.1. Archaeological context

In the district of Knossos (within a radius of less than 2 km from the palace), LMII–III tombs in the cemeteries at Sellopoulo, Ayios Ioannis, Isopata, Mavrospelio, Zafer Papoura, and the Hutchinson's

Tomb are described as "warrior graves" (Popham, 1994: 93; Alberti, 2004). Principally due to the predominant archaeological practices of the early 20th century in the Aegean and the inappropriate curation of the recovered skeletal material (Nafplioti, 2007: 87–8), strontium isotope ratio analysis was confined to samples from the Sellopoulo cemetery (the three chamber tombs and the shaft grave) and the KSP chamber tombs, from the area south of the Knossos palace. At present there is no record of where the Ayios Ioannis, Isopata, Zafer Papoura and the Hutchinson's Tomb human skeletal material is kept. Moreover, no teeth were present in the Mavrospelio skeletal collection that was recorded for the purposes of morphological skeletal analysis.

Sellopoulo chamber tombs 1 and 2 excavated in the 1950s were plundered. They belong to the single-chamber tomb (Mainland) type that is suggested to appear on Crete not earlier than LMII or at the end of LMIB (Alberti, 2004), and are dated to LMIIIA2 (Hood, 1957: 24–5). Unfortunately, to date, apart from a very brief report and a few illustrations of material recovered from their interior, Sellopoulo tombs 1 and 2 have not been published. Tombs 3 and 4 from the same cemetery were found partly plundered and intact, respectively. These are dated to the period immediately following the LMIB destructions (LMII–IIIA1) and are classified as "warrior graves" (Popham et al., 1974; Driessen and Macdonald, 1984; Alberti, 2004). The Sellopoulo shaft grave also dates to the LMIIIA1 period. Shaft graves that have no forerunners on Crete and the use of wooden coffins are considered "Mycenaean" cultural features introduced into the island possibly from the Argolid following the LMIB destructions (Driessen and Macdonald, 1984: 65; Doxey, 1987: 303).

Finally, skeletal material recovered from two out of the four KSP chamber tombs excavated in the area south of the palace was also sampled for $^{87}Sr/^{86}Sr$ analysis. According to the excavator, Sinclair Hood, Tomb I was probably a communal tomb used from the MM to LMIB times and then was cleared of burials in order to be reused in the LMII. Tomb IV from the same cemetery is a single-chamber tomb of the Mainland type and dates to the LMII–IIIA (Hood, pers. commun.).

2.2. Choice of samples

In order to investigate the hypothesis for the settlement of "Mycenaeans" at Knossos from the LMII onwards, I analysed samples from individuals interred into the Mainland type single-chamber tombs 1, 2 and 4 and the shaft grave in the Sellopoulo cemetery, and the KSP chamber tombs I and IV from the area south of the palace of Knossos. According to theories for a "Mycenaean" presence at Knossos from the LMII onwards based on the funerary architecture, artefacts associated with the interments and the burial practices, the examined burials from the Sellopoulo and KSP tombs should belong to non-locals, possibly from the Argolid (Hood, 1957, pers commun.; Driessen and Macdonald, 1984; Doxey, 1987: 301; Driessen, 1990: 125; Popham, 1994).

Choice of samples for $^{87}Sr/^{86}Sr$ analysis took into account archaeological information, but was further conditioned by the completeness of the skeletal collections available for analysis from the examined cemeteries and the active at the time Greek archaeological law for sampling from archaeological material. $^{87}Sr/^{86}Sr$ was measured for eight from the 14 adults recovered from the Sellopoulo chamber tombs (Minimum Number of Individuals for the adults was calculated using dental data). For two of the tested individuals (SEL1, VII and SEL1, III) $^{87}Sr/^{86}Sr$ was measured in both dental enamel and bone samples, whereas for the other six measurements were taken from enamel samples alone. Furthermore, $^{87}Sr/^{86}Sr$ was measured in dental enamel from all four adults from the KSP chamber tombs I and IV from which teeth were available, and the one adult in the Sellopoulo shaft grave.

Finally, $^{87}Sr/^{86}Sr$ was measured in samples from the Middle Minoan Ailias (Hood and Smyth, 1981) and the MMIII–LMI Upper and Lower Gypsades (Hood et al., 1958–1959; Catling, 1957) human skeletal collections also from the Knossos district. In the present paper, the results of $^{87}Sr/^{86}Sr$ analysis of samples from the Ailias and Gypsades interments are used for comparison with those from the Sellopoulo and KSP collections, since they predate the alleged "Mycenaean" migration and there is no associated hypothesis for a non-local origin of the respective populations based on material culture evidence. For one individual from the Gypsades collection (LGI, LAR) $^{87}Sr/^{86}Sr$ was measured in both dental enamel and bone, whereas for the other eight this was measured merely in enamel samples. Concerning the Ailias collection, $^{87}Sr/^{86}Sr$ was measured from enamel samples from eight individuals. Due to the poor preservation of the human bone and concomitant difficulty to isolate biogenic (vs. diagenetic) strontium (Bentley, 2006: 26), I decided not to measure $^{87}Sr/^{86}Sr$ in bone samples from the KSP and Ailias human collections.

3. Methods

3.1. Principles of strontium isotope ratio analysis

Strontium isotope ratio analysis has an ongoing, 20-year-long application to archaeological research into past populations' residential change and the mapping of their geographical movement.

Analysis is based on the properties of strontium. Strontium isotope ^{87}Sr comprises c. 7.04% of total strontium and is the product of the radioactive decay of rubidium isotope ^{87}Rb, which has a half-life of approximately 4.7×10^{10} years. In nature, strontium occurs in the form of three additional stable isotopes, ^{88}Sr (c. 82.53%), ^{86}Sr (c. 9.87%) and ^{84}Sr (c. 0.56%), none of which is radiogenic (Faure, 1986). Variation in ^{87}Sr abundances in the Earth's crust are expressed as $^{87}Sr/^{86}Sr$ ratios and the ratio depends on the relative abundance of rubidium and strontium and the age of the rocks. This principle was employed initially by geologists to the determination of the age of various geological formations (Faure and Powell, 1972; Faure, 1986).

Strontium in bedrock passes into soil and groundwater and into the food chain. Therefore, strontium isotope ratios in rock, groundwater, soil, plants and animals reflect local geology (Graustein, 1989). Although other factors, such as atmospheric deposition and in modern context fertilisers, can contribute to the strontium composition of local soils this largely reflects mineral weathering (Bentley, 2006: 14). Since $^{87}Sr/^{86}Sr$ in soil reflects local geology and passes to human skeletal tissues through consumed food and water, analysis of dental and osseous tissue from the same individual should show a very similar $^{87}Sr/^{86}Sr$ to that measured in the local geological material, if that individual was born, raised and spent at least the last 7 to 10 years of his/her life in the local area (Steele and Bramblett, 1988).

One major advantage of the analysis of strontium stems from the fact that strontium isotope composition in not fractionated by biological processes, due to the very small relative mass differences between ^{87}Sr and ^{86}Sr (Graustein, 1989). Therefore, despite the variation in local levels of elemental strontium in plant and animal tissue, the isotope composition is the same for both and reflects the isotope composition of the local geology that is assumed to pass to the skeleton of the human population through food and water resources (Price et al., 2002).

Strontium isotope ratio analysis in studies of population movements uses human tissues formed at different ontogenetic stages (Price et al., 1994, 2000). Bone undergoes continuous replacement of its inorganic phase and measurements of bone strontium reflect the last years of the life of the individual. The half-life for turnover in cortical bone is approximately 23.1 years (Parfitt, 1983). On the other hand, dental enamel, a cell-free tissue, forms during childhood and does not remodel thereafter (Hillson, 2002: 148). Since Sr in dental enamel is taken up during early childhood and the Sr content of the bones represents the Sr uptake of the last 7–10 years prior to death, significant differences between ratios in the two tissues indicate that the examined individual spent his/her childhood in a location geologically and isotopically different to his/her residence prior to death.

3.2. The geological context

The effectiveness of $^{87}Sr/^{86}Sr$ analysis to track population movement relies on the variation in the Sr isotopic composition in the local geology (Graustein, 1989). Thereby, differences between the geological composition of the Argolid in the Mainland and Knossos on Central Crete will allow $^{87}Sr/^{86}Sr$ analysis to detect any change of residence for individuals between the two regions.

The geological history of the Aegean is complex as a result of high tectonic activity (Higgins and Higgins, 1996: 17). The Argolid is more geologically varied than Central Crete. The first is crossed by the Pindos and the Parnassos tectonic zones, and at its easternmost part by the Sub-Pelagonian Zone (Fig. 2). Isopic zones are groups of widespread rocks that share a common history (Higgins and Higgins, 1996: 17).

Mycenae in the Argolid, where the non-locals in the Sellopoulo and KSP cemeteries at Knossos are suggested to have originated from, was built on a knoll that consists of Late Triassic to Middle Jurassic limestones (Fig. 3). The latter also underlie the hills to north and south of the site and the mountain range to the east. The greatest portion of the valley between the hills and the ridge that runs southwards from west of the citadel is formed by marls and conglomerates deposited during the Late Pliocene to Pleistocene. The spring that supplied the site with water is located 200m east of the citadel. The spring is fed by water that falls on Mt Ayios Elias, descends to the valley bottom through Pleistocene marls and reaches the surface through ancient scree deposits from the hill.

Knossos in Central Crete is crossed by the Gavrovo zone (Fig. 2) and is located in the fertile lowlands of Kairatos, a small stream that rises from springs near Archanes, less than 5km to the south (Fig. 4) (Higgins and Higgins, 1996: 203). The site is mainly underlain by Neogene sedimentary rocks that to the west of Kairatos, where the Palace of Knossos is situated, comprise soft marly limestones (known locally as kouskouras). Mt Profetes Elias (Ailias) situated in less than 1 km distance to the north-east from the Palace, is underlain by Neogene white limestones for its greatest portion. On the northern slopes of Mt Profetes Elias crops out Cretaceous limestone of grey to dark grey colour. Moreover, in less than 1 km distance to the south of the Palace, the hill of Gypsades partly consists of gypsum. The latter formed when the Mediterranean dried up about 6 million years ago.

Thereby, as $^{87}Sr/^{86}Sr$ in rock minerals is a function of the relative abundances of rubidium and strontium and the age of the rocks (Bentley, 2006: 137), differences between the sites of Knossos and Mycenae in terms of local geology (i.e. time of rock crystallisation and types and chemical composition of rocks (for variation in the $^{87}Sr/^{86}Sr$ of marine limestones through time see Elderfield, 1986) are expected to distinguish between individuals born and raised in the two sites based on $^{87}Sr/^{86}Sr$ measured in dental enamel (Steele and Bramblett, 1988). Unfortunately, to date the only $^{87}Sr/^{86}Sr$ data available on the geology of Greece concerns igneous rocks from the Central Cyclades (Pe-Piper and Piper, 2002), and it is of no direct use in the present study.

3.3. Distinction between locals vs. non-locals at Knossos

Due to the present research being the first strontium isotope ratio study of human skeletal remains in the Aegean, and the absence of any published $^{87}Sr/^{86}Sr$ data on the geology of the two

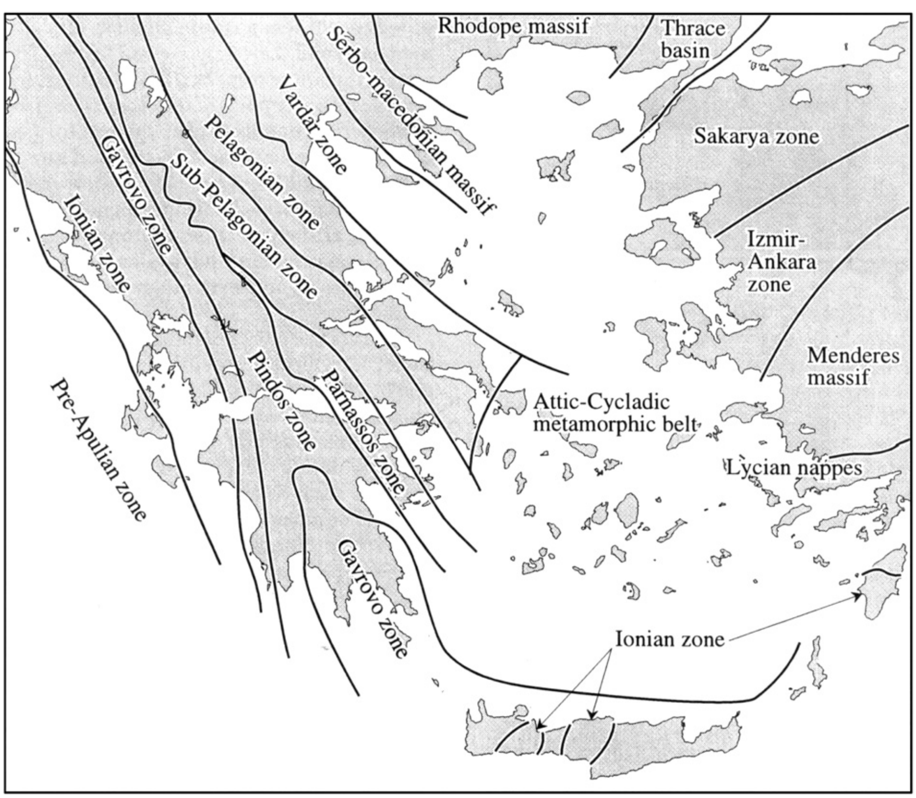

Fig. 2. Isopic zones and massifs of the Aegean region. After Higgins and Higgins (1996: figure 2.2).

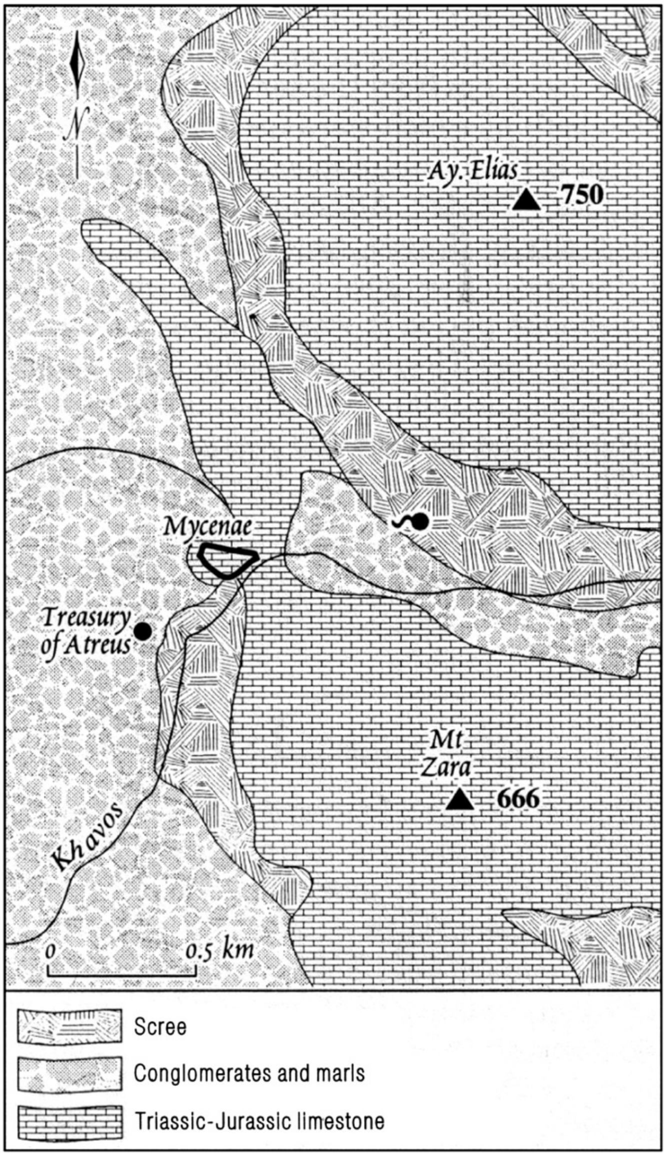

Fig. 3. Geological map of Mycenae in the Argolid. After Higgins and Higgins (1996: figure 5.5).

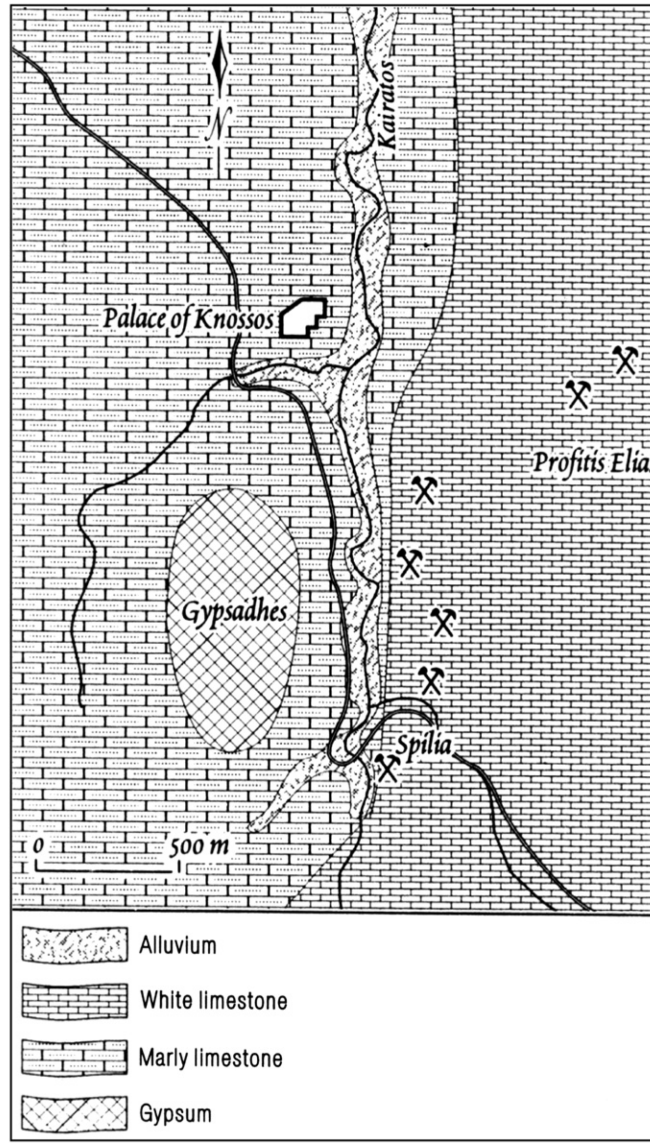

Fig. 4. Geological map of Knossos in Central Crete. After Higgins and Higgins (1996: figure 16.4).

regions under investigation (i.e. Knossos on Crete and Mycenae in the Argolid), I used regional animal samples to characterise the local biologically available $^{87}Sr/^{86}Sr$ and distinguish between locals and non-locals at Knossos. Following Price et al. (2002), I measured the local biologically available strontium isotope ratios determined from archaeological and modern animal tissues (i.e. dental enamel and shell), and calculated the range of the mean local biologically available strontium isotope ratio $\pm$ 2 standard deviations (Price et al., 2002), in order to provide an objective means of distinction between locals and non-locals.

The local biologically available $^{87}Sr/^{86}Sr$ is not simply equated to values measured for bedrock geology at the studied area (Faure, 1986; Price et al., 2002), since the range of $^{87}Sr/^{86}Sr$ values for the local soils results from the differential weathering of the various minerals within the rocks, mixing of various sources of sediment within the soil, the groundwater, if it incorporates deeper older waters (Jorgensen et al., 1999). In this research, the local biologically available strontium isotope signature was determined from dental enamel samples from archaeological animal species (smaller and larger ones) that are assumed to have lived locally. Strontium isotope ratio was measured in three pigs [because the amino acid requirements and diets of the pigs are similar to that of humans (Van der Merwe et al., 2003; Bentley, 2006: 23)], one sheep/goat and one cow. Animal skeletal tissues provide an average of the biologically available $^{87}Sr/^{86}Sr$ of the local feeding territories they occupied in life, and dental enamel in particular, is resistant to post-depositional contamination (i.e. diagenesis) (Bentley, 2006: 21). Additionally, in order to sample both archaeological and modern animals from across the postulated food catchment area of the Knossos Bronze Age population, $^{87}Sr/^{86}Sr$ was also measured in samples from modern snail shells. Acknowledging for sample contamination from pollutants and/or soil fertilisers (Price et al., 2002: 122–9; Bentley, 2006), the modern snails were collected from areas of wild vegetation, with no sign of human cultivation in the immediate vicinity, and from a radius of 2 km around the site.

Despite the potential narrowing of the range of the local biologically available $^{87}Sr/^{86}Sr$ due to the post-depositional contamination of bone from local ground waters (Bentley et al., 2004: 366; Bentley, 2006: 26), $^{87}Sr/^{86}Sr$ was measured in bone samples from three Sellopoulo and Gypsades individuals (as in Price et al., 1994, 2002: 131; Ezzo et al., 1997), because the $^{87}Sr/^{86}Sr$ in human bone reflects the long-term assimilation of the locally available $^{87}Sr/^{86}Sr$ through the consumption of the food and water available in the catchment area of the examined human population (Price et al., 2000, 2002). In order to control for the distorting effect of the presence of recent immigrants in the examined population samples whose bones may not have completely calibrated to local geology, human bone strontium isotope ratios were cross-validated by ratios measured in dental enamel from archaeological animals and in modern snail shells from the area of investigation.

Finally, the biologically available $^{87}Sr/^{86}Sr$ at Mycenae was characterised using shell samples from four modern snails collected from non-cultivated areas; one from inside the acropolis of Mycenae, two from the area surrounding the fortifications ($\leq$500 m), and the last at 2 km south-west of the acropolis.

3.4. Procedure

3.4.1. Dental enamel and bone sampling

For the purposes of $^{87}Sr/^{86}Sr$ analysis, enamel and cortical bone were removed from the first molar (M1) and the femur (anterior mid-shaft region), respectively. The M1 was sampled because its crown is formed during early childhood [(i.e. crown development is completed by the fifth year of life of the individual (Ubelaker, 1989)]. In all cases, enamel was extracted from the buccal, lingual, mesial and/or distal surfaces of the tooth crown and in particular, from the superior half/third of the crown that is formed earlier in the life of the individual than its inferior portion. Sampling from the superior portion of the tooth crown was possible in all cases, as dental attrition was not severe for the teeth analysed. The cortical bone from the femoral shaft region remodels more slowly compared with trabecular bone (Parfitt, 1983; Hill, 1998). In three individuals for whom these elements were not available for sampling, the femur was substituted with the tibia (individual SELI, III), due to the very similar turnover rates for the two elements (Hill, 1998). The first molar (M1) was substituted with the second molar (M2) (individual LGI, F) or the fourth premolar (PM4) (individual LGI, F5), because their crowns are formed within roughly the same period of life of the individual (Ubelaker, 1989). A description and provenance of the analysed human samples are provided in Table 1.

Table 1
Strontium isotope ratio analysis: description of human samples analysed

Geographical region	Skeletal collection	Individual	Element
Knossos, Central Crete	Ailias	AIL 1	Tooth (M1)
	Ailias	AIL 2	Tooth (M1)
	Ailias	AIL 6	Tooth (M1)
	Ailias	AIL 15	Tooth (M1)
	Ailias	AIL 90	Tooth (M1)
	Ailias	AIL 98	Tooth (M1)
	Ailias	AIL 102	Tooth (M1)
	Ailias	AIL 103	Tooth (M1)
	Upper Gypsades	GYPXVIII, II	Tooth (M1)
	Upper Gypsades	GYPXVIII, III	Tooth (M1)
	Upper Gypsades	GYPXVIII, III	Tooth (M1)
	Upper Gypsades	GYPXVIII,VI	Tooth (M1)
	Upper Gypsades	GYPXVIII,VII	Tooth (M1)
	Lower Gypsades	LGI, F	Tooth (M2)
	Lower Gypsades	LGI, F5	Tooth (PM4)
	Lower Gypsades	LGI, E6	Tooth (M1)
	Lower Gypsades	LGI, Larnax	Tooth (M1)
	Lower Gypsades	LGI, Larnax	Bone (femur)
	Sellopoulo	SEL1, II	Tooth (M1)
	Sellopoulo	SEL1, IV	Tooth (M1)
	Sellopoulo	SEL1, IV	Tooth (M1)
	Sellopoulo	SEL1, III NE	Tooth (M1)
	Sellopoulo	SEL2, N.BOTHROS	Tooth (M1)
	Sellopoulo	SEL4, 3	Tooth (M1)
	Sellopoulo	SEL1, VII	Tooth (M1)
	Sellopoulo	SEL1, VII	Bone (femur)
	Sellopoulo	SEL1, III	Tooth (M1)
	Sellopoulo	SEL1, III	Bone (tibia)
	Sellopoulo	SEL/58	Tooth (M1)
	Knossos	KSP I, I	Tooth (M1)
	Knossos	KSP I, III	Tooth (M1)
	Knossos	KSP IV, I	Tooth (M1)
	Knossos	KSP B26	Tooth (M1)

3.4.2. Sample preparation and measurement of $^{87}Sr/^{86}Sr$

Preparation and analysis of samples for the measurement of $^{87}Sr/^{86}Sr$ was undertaken by the author in the National Oceanography Centre in Southampton. In order to remove surface contamination, all teeth, bone and snail shell specimens were placed in an ultrasonic bath for 30 min. The bath was interrupted every 10 min to allow for the specimens to be mechanically cleaned using a toothbrush and ultra pure water (resistivity of 18.2 Ω). Specimens were dried overnight in an oven (60 °C).

Enamel samples of at least 20 mg were extracted from each tooth using a scalpel. Any adhering dentine was thoroughly removed mechanically from enamel samples using a Dremel tool. This practice was preferred to placing samples dentine side down in concentrated hydrochloric acid for 15 min and heated for a further 5 min in order to dissolve as much dentine as possible, because in one case (as part of the author's doctoral research), unwanted dissolution of a small portion of the enamel was observed. The same minimum amount (20 mg) of bone powder was extracted from the inner cortical area of the selected specimens, in order to control for surface contamination. Using a Dremel tool specimens were bisected and the inner cortical bone was drilled out and collected as fine powder on glassine paper. For the same purpose, the external layer of shell samples (>20 mg) was abraded. Enamel, bone and shell samples were placed in the ultrasonic bath for a further 20 min and rinsed using ultra pure water. In order to remove diagenetic strontium, samples were leached in 2 ml of 5% acetic acid overnight. Samples were then rinsed four times and dried in an oven (60 °C). All leachates were retained in order to check for diagenesis, in case odd values were measured for any of the tested samples.

Strontium columns were prepared by filling small Teflon columns up to the neck with cleaned Sr resin. The columns were cleaned with H_2O and 3 M HNO_3. Bone and enamel samples were digested on a hotplate in 3 M HNO_3 and 6 M HNO_3 respectively, and loaded as solutions of 3 M HNO_3 onto the resin. The matrix and everything except Sr and Rb was eluted with 2.5 ml 3 M HNO_3. Finally, the Sr was released by passing through 1.5 ml of ultra pure water. The collected Sr was dried down on the hotplate and the Sr fractions were loaded onto a single tantalum filament with Ta-activator. The strontium isotope ratio of the samples was measured (to the 6th decimal digit) by a thermal ionisation mass spectrometer.

With regard to diagenesis or post-depositional contamination of archaeological skeletal material, it is acknowledged that both mechanical and acid cleaning of samples may not be sufficient to remove all diagenetic strontium, particularly from archaeological bones whose biogenic strontium has been overwhelmed of even replaced by groundwater strontium after the burial of the skeleton (Price, 1989; Tuross et al., 1989; Price et al., 1992; Hedges, 2002; Hoppe et al., 2003; Bentley et al., 2004; Bentley, 2006).

A good indication of the degree of contamination present in samples analysed is provided by measurement of uranium and/or the rare earth elements in samples, as in Kohn et al. (1999) and Price et al. (2002). In this research, the three human bone samples analysed were not tested for post-depositional contamination as any possible contamination would come from local groundwater solutions. Thereby it would preclude the possibility that any of the non-locals ratios would be heavily contaminated (Bentley, 2006: 164; Grupe et al., 1997: 520). It is possible, however, that local strontium contamination may reduce the standard deviation of $^{87}Sr/^{86}Sr$ values for the bones and thus narrow the range of local biological available $^{87}Sr/^{86}Sr$ determined from them (i.e. bone samples). This, however, is not a major problem in this study that uses ratios measured in archaeological and modern animal samples (mean $^{87}Sr/^{86}Sr \pm 2$ standard deviations) in order to distinguish between locals and non-locals at Knossos (following Price et al., 2002), and the mean archaeological human bone ratio as a complementary baseline. Moreover, in this study, the possibility that some contamination of shell samples by local $^{87}Sr/^{86}Sr$ may remain following mechanical and chemical cleaning of the specimens that would narrow the range of the local biologically available $^{87}Sr/^{86}Sr$ determined from snails, is treated by broadening the sampling area so as to collect snails from a radius of 2 km around the two sites under investigation (Price et al., 2002).

On the other hand, dental enamel is generally accepted to be resistant to diagenesis (e.g. Kohn et al., 1999; Hillson, 2002; Price et al., 2002: Bentley et al., 2004: 366; Bentley, 2006: 158; Tafuri et al., 2006: 392). Enamel is much less susceptible to post-depositional chemical and physical modifications compared with bone and dentine, because it is denser, harder and more inert than the latter. This results from the fact that phosphate crystals in the enamel are relatively large (>1 μm), and the structure is compact with less porosity compared with bone or dentine (Kohn et al., 1999; Bentley, 2006).

4. Results

Are the results of $^{87}Sr/^{86}Sr$ analysis of dental enamel samples from Bronze Age Knossos skeletal collections consistent with the hypothesis that following the LMIB destructions on Crete or the LMIIIA1-2 destruction of the palace of Knossos, “Mycenaeans” settled and politically dominated the site? According to the theory tested, settlement involved high status individuals and their warrior aristocracy who upon death were interred in the so-called “warrior graves”, or tombs of Mainland architecture, or are associated with the “burials with bronzes” dating from the LMII onwards (e.g. Hood, 1985; Barber, 1987: 222; Doxey, 1987: 301; Driessen, 1990: 125; Popham, 1994: 93). According to other researchers (e.g. Niemeier, 1985; Hallager, 1988), however, the “Mycenaeans” arrived and settled at Knossos later, following the LMIIIA1–2 destruction of the palace.

In order to confirm this hypothesis, because the bedrock geology of Knossos is different to that of the Argolid (Higgins and Higgins, 1996), on the one hand, strontium isotope ratios measured in the enamel of individuals from the Sellopoulo and KSP cemeteries that postdate the suggested migration should be different from the local at Knossos biologically available strontium isotope ratio. On the other hand, the measured ratios should fit within the reconstructed range of the mean local at Mycenae (Argolid) biologically available strontium isotope ratio ± 2 standard deviations. Finally, these values should be different from ratios measured in enamel samples from the Ailias and Gypsades individuals, also from Knossos, for whom a non-local origin has not been suggested in studies of the material culture. If, however, the tested hypothesis is false, the $^{87}Sr/^{86}Sr$ values for the Sellopoulo and KSP individuals will fall within the range of the mean local at Knossos biologically available strontium isotope ratio ± 2 standard deviations.

Strontium isotope ratio was measured for 30 individuals from the district of Knossos dating from the Middle Minoan to Late Minoan III times. The results are given in tabular form and are graphically represented in Table 2 and Fig. 5, respectively. In the graph the samples are arranged in the same (chronological) order as in Table 2 and are grouped by location of the burials: Ailias and Gypsades population samples date to the Middle Minoan and the MMIII–LMI period, respectively. The Sellopoulo and KSP population samples date to the LMII–III period. Black bars represent dental enamel samples and white bars represent bone samples.

The horizontal bands mark the range of the mean local biologically available strontium isotope ratio (determined from archaeological and modern animal, and archaeological human bone samples) ± 2 standard deviations. These three confidence limits (horizontal bands) are used here to distinguish between locals and non-locals in the district of Knossos. The mean $^{87}Sr/^{86}Sr$ measured in dental enamel samples from five archaeological animals (three pigs, one sheep/goat and one cow) from the district of Knossos is 0.708927 ± 0.000223, and the range for ± 2 s.d. is 0.708481–0.709373 (Table 3). The confidence limit (at the mean ± 2 s.d.) based on enamel values from archaeological animals (in grey colour) is wider than that based on modern snail shell (hatched lines, oriented to the right) and archaeological human bone values (hatched lines, oriented to the left). The mean $^{87}Sr/^{86}Sr$ measured in shell samples from four modern snails was calculated as 0.708985 ± 0.000031 and the range for ± 2 s.d. is 0.708923–0.709047. Narrower is the range of the mean strontium isotope ratio $(0.709022 \pm 0.000022) \pm 2$ s.d. measured from the three human bone samples. This is calculated as 0.708978–0.709066. Confidence limits based on human bone and snail shell values are very similar and slightly narrower for bone than shells, as in Bentley et al. (2004: 370). In the graph (Fig. 5), all three horizontal bands showing confidence limits for the distinction between locals and non-locals overlap at 0.708978–0.709047. In this study, non-locals are identified using the animal dental enamel criterion for reasons outlined earlier in the methodology section.

Table 2
Strontium isotope ratio values for Knossos individuals, dental enamel and bone

Individual	Element analysed	Strontium isotope ratio (value)
AIL 1	M1	0.709212
AIL 2	M1	0.708970
AIL 6	M1	0.709000
AIL 15	M1	0.709042
AIL 90	M1	0.709014
AIL 98	M1	0.709227
AIL 102	M1	0.708999
AIL 103	M1	0.709050
GYPXVIII, II	M1	0.709021
GYPXVIII, III	M1	0.709053
GYPXVIII, III	M1	0.709029
GYPXVIII,VI	M1	0.709058
GYPXVIII,VII	M1	0.709025
LGI, F	M2	0.708997
LGI, F5	PM4	0.709035
LGI, E6	M1	0.709085
LGI, Larnax	M1	0.709033
LGI, Larnax	Femur	0.709022
SEL1, II	M1	0.709062
SEL1, IV	M1	0.708604
SEL1, IV	M1	0.708984
SEL1, III NE	M1	0.708934
SEL2, N.BOTHROS	M1	0.709016
SEL4, 3	M1	0.708943
SEL1, VII	M1	0.708933
SEL1, VII	Femur	0.709000
SEL1, III	M1	0.708967
SEL1, III	Tibia	0.709044
SEL/58	M1	0.709128
KSP I, I	M1	0.708963
KSP I, III	M1	0.708910
KSP IV, I	M1	0.708478
KSP B26	M1	0.709037

Key: M1 = 1st Molar; M2 = 2nd Molar; PM4 = 4th Premolar.

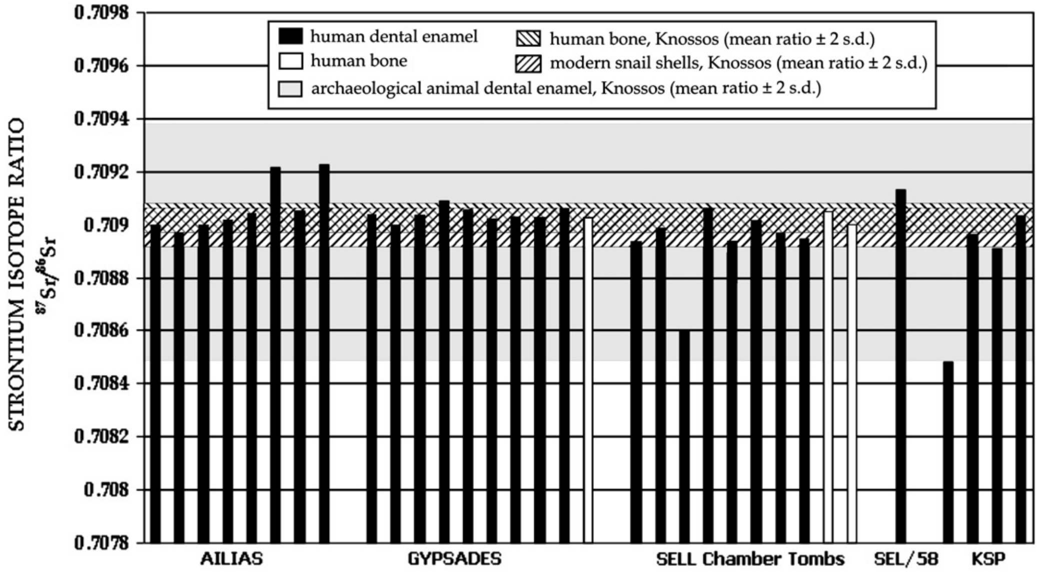

Fig. 5. Strontium isotope ratios measured in dental enamel and bones from Knossos individuals.

The mean $^{87}Sr/^{86}Sr$ measured in enamel samples from the Ailias ($N = 8$) and Gypsades individuals ($N = 9$) was calculated as 0.709064 ± 0.000099 and 0.709037 ± 0.000025, respectively. The range of strontium isotope ratio values is between 0.708970–0.709227 for the Ailias and 0.708997–0.709085 for the Gypsades collection, respectively. Both ranges fall within the confidence limit for characterising the indigenous Knossos population based on archaeological animal enamel values (0.708481–0.709373).

Concerning the population sample from the Sellopoulo chamber tombs ($N = 8$) and shaft grave ($N = 1$), the mean strontium isotope ratio measured in dental samples was calculated as 0.708947 ± 0.000147. Intra-group variation for the Sellopoulo skeletal collection (s.d. $= 0.000147$) is higher compared with the earlier collections from Gypsades (s.d. $= 0.000025$) and Ailias (s.d. $= 0.000099$), also from the Knossos district, as a result of the comparatively low value measured in the enamel of individual SELI, IV from chamber tomb 1 (0.708604 ± 0.000013). Ratios for the other eight Sellopoulo individuals fall within (seven cases) or slightly above (one case) the range of the local at Knossos biologically available strontium as determined from human bone and modern snail shells (0.708923–0.709066). Moreover, the range of $^{87}Sr/^{86}Sr$ values for the Sellopoulo individuals that is between 0.708604 and 0.709128 falls within the confidence limit for the distinction between locals and non-locals at Knossos based on animal enamel ratios (0.708481–0.709373).

The mean $^{87}Sr/^{86}Sr$ measured in enamel samples from the KSP collection ($N = 4$) was calculated as 0.708847 ± 0.000251 and the range of ratio values is between 0.708478 and 0.709037. Intra-group variation (s.d. $= 0.000251$) is higher compared with the Sellopoulo collection. It is the ratio measured for individual KSP IV, I from tomb IV that causes the intra-group variation of the examined collection to increase (s.d. $= 0.000251$). Ratios measured in the enamel of the other three KSP individuals fall within (two cases) or slightly lower (one case) than the confidence limit based on human bone and snail shells from Knossos. Using the animal enamel criterion (confidence limit at mean strontium isotope ratio $\pm$ 2 s.d. $= 0.708481$–0.709373), however, none of the tested KSP individuals was identified as non-local at Knossos.

Additional negative evidence for the presence of Mycenaeans among the Sellopoulo and KSP individuals derives from the local at Mycenae biologically available strontium. This was determined from modern snail shell samples ($N = 4$) collected from a radius of 2 km around the prehistoric acropolis. The mean $^{87}Sr/^{86}Sr$ was calculated as 0.708267 ± 0.000043 and the range for 2 s.d. is 0.708181–0.708353. Thus, the local biologically available $^{87}Sr/^{86}Sr$ at Knossos (confidence limit based on animal enamel is 0.708481–0.709373) and Mycenae is different, as expected from the different geology of the two sites (Higgins and Higgins, 1996). Strontium isotope ratios for all tested individuals from Knossos (0.708478–0.709227) fall clearly above the confidence limit for the distinction between locals and non-locals at Mycenae (Fig. 6).

It should be noted that the local at Mycenae biologically available strontium was determined from modern snail shells alone. Although the intra-group variation of the Mycenae snails is low (s.d. $= 0.000043$), it is higher compared with the snails from Knossos (s.d. $= 0.000031$). The possibility that the local biologically available strontium isotope ratios at Mycenae determined from modern snails may be too local, due to their limited home ranges (Price et al., 2002: 125), and/or contamination through fertilisers (Bentley, 2006: 158), is acknowledged. In order to control for the artificial narrowing of the local range of biologically available strontium isotope ratios, the snails were selected from a broad area with concern to sample from different geological regions in the site, and avoid any cultivation-related contamination of the samples.

Table 3
Strontium isotope ratio values for samples used to determine the biologically available strontium isotope ratio at Knossos and Mycenae: archaeological animal dental enamel and modern snail shell

Individual	Element analysed	Strontium isotope ratio (value)
LGI/57 (P)	M1	0.709092
LGI/57 (S/G)	M1	0.708534
LGI/57 (P)	M1	0.709024
LGI/57 (C)	M2	0.708992
SEL1/58 (P)	M1	0.708995
KN1 SN	Shell	0.708991
KN2 SN	Shell	0.709026
KN3 SN	Shell	0.708974
KN4 SN	Shell	0.708952
MYC1 SN	Shell	0.708262
MYC2 SN	Shell	0.708254
MYC3 SN	Shell	0.708226
MYC4 SN	Shell	0.708328

Key: M1 = 1st Molar; M2 = 2nd Molar; P = Pig; S/G = Sheep/goat; C = Cow.

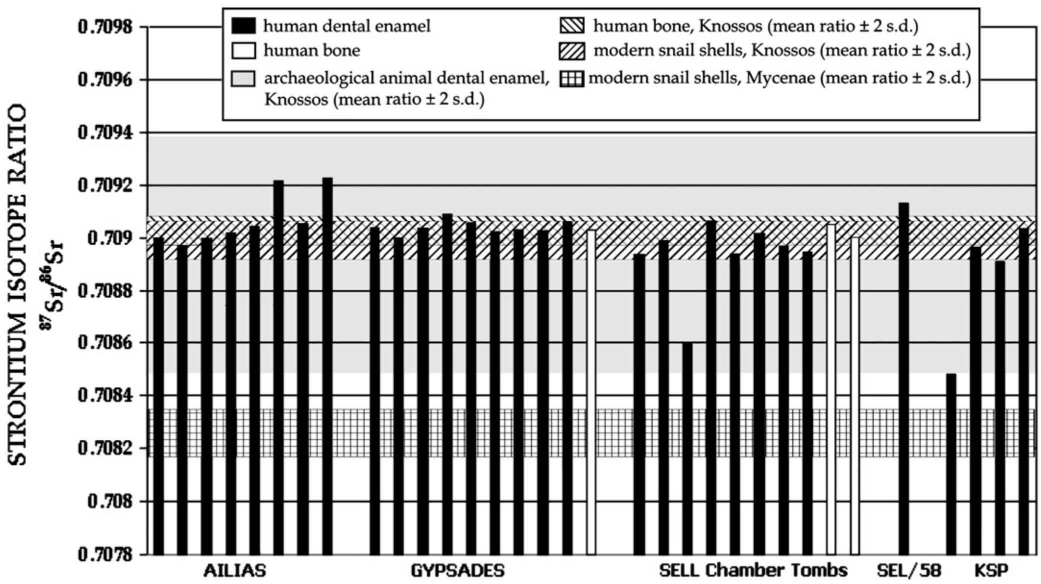

Fig. 6. Strontium isotope ratios measured in dental enamel and bones from Knossos individuals.

Distinction between locals and non-locals at Knossos was made using the animal dental enamel criterion. The confidence limits based on animal enamel from Knossos are broader than for snails or human bone from this site. As the local at Mycenae range of biologically available strontium was not determined from animal enamel, it cannot be excluded that the local at Mycenae range of $^{87}Sr/^{86}Sr$ determined from animal enamel may overlap (to some extent, at least) with that of Knossos. Therefore, in order to allow comparability of data on the biologically available strontium from Knossos and Mycenae, the modern snail shell criterion is used to distinguish between locals and non-locals at Knossos and to explore the presence of Mycenaeans between the individuals analysed. All humans from Knossos fall above the confidence limit for the local at Mycenae biologically available strontium (0.708181–0.708353). Twenty-three out of the 30 (77%) individuals analysed fall within the confidence limit for characterising the local at Knossos population based on snail shells (0.708923–0.709047). From the rest, two ratios (0.709212 and 0.709227) fall above it, two (0.708604 and 0.708478) bellow it, and three (0.709058, 0.709128 and 0.708910) very close to its higher and lower values. Thus, out of the thirty individuals from Knossos, it is only individuals SEL1, IV (0.708604) and KSP IV, I (0.708478), whose ratios fall between the confidence limits for the biologically available strontium at Knossos and Mycenae and closer to the latter (Fig. 6), who cannot be determined as locals either at Knossos or Mycenae, based on the snail shell criterion.

Is it possible, however, that the range for the biologically available strontium at Mycenae, determined from animal dental enamel, would be broad enough to overlap with that of Knossos and thus inhibit distinction between individuals born at Knossos or Mycenae? Leaving out questionable individuals SEL1, IV and KSP IV, should the local at Mycenae $^{87}Sr/^{86}Sr$ range based on animal enamel be broad enough as to allow even the lowest ratio (0.708910) measured in one of the tested individuals to fall within its limits, the highest limit (0.708910) of this range would be 0.000643 higher than the mean ratio measured from snail shells (0.708267). This difference would be almost two times higher (0.000388) compared with that between the highest limit of the Knossos local range of $^{87}Sr/^{86}Sr$ determined from animal enamel (0.709373) and the mean ratio measured from snail shells (0.708985) from this site. Thereby, unless the intra-site variation in strontium isotope ratios for Mycenae is considerably higher than Knossos (which is not expected from the available information on the geology of the two sites), it is rather improbable that there would be a significant overlap of the two ranges so as to suggest an origin from Mycenae for the twenty-eight individuals tested.

Finally, with regard to the two questionable individuals (SEL1, IV and KSP IV, I) it is interesting to note the ratio (0.708534) measured in the dental enamel of a sheep/goat from Lower Gypsades (Knossos). This was used as a control sample to help characterise the local $^{87}Sr/^{86}Sr$ range at Knossos and its ratio is very close to the values (0.708604 and 0.708478) for the two individuals.

To sum up, strontium isotope ratio analysis suggests that all individuals tested from the Sellopoulo and KSP cemeteries are locals at Knossos based on the animal enamel criterion. Moreover, ratios measured in these individuals are similar to ratios measured in earlier population samples from this site, i.e. the Ailias and Gypsades samples. Finally, none of the thirty individuals from Knossos analysed could have been born and raised at Mycenae in the Argolid, based on the local at Mycenae biologically available strontium characterised from snail shell samples. Thereby, the results of the present analysis are not consistent with the hypothesis for the presence of non-locals at Knossos from the LMII onwards. Thus, with concern for the paucity of data on the local at Mycenae biologically available $^{87}Sr/^{86}Sr$, the examined hypothesis can be rejected.

5. Discussion and conclusions

Strontium isotope ratio analysis was applied to individuals associated with "warrior graves", "burials with bronzes" and tombs of Mainland architecture at Knossos dating from the LMII onwards, in order to test the hypothesis for a "Mycenaean" invasion and political domination of Knossos either at the end of LMIB or in the LMIIIA1-2. With concern for the low size of the analysed samples, particularly for the period immediately following the LMIB destructions, and the paucity of data on the local at Mycenae biologically available strontium, based upon the strontium isotope ratio results presented above the hypothesis can be rejected. The strength of this conclusion derives from the fact that $^{87}Sr/^{86}Sr$ analysis demonstrated one of the constituent elements of the tested hypothesis to be malfunctioning. The "warrior burials",

"burials with bronzes" and the single-chamber tombs (tombs of Mainland architecture) are not necessarily associated with Mainlanders. In fact, none of the examined individuals from these LMII–IIIA1 and LMIIIA2 tombs was non-local at Knossos that would be expected based upon the tested theory.

Moreover, according to the theory for a "Mycenaean" political domination of Knossos following the LMIB destructions on Crete, the identity of the invaders is postulated on the "nature" of cultural discontinuity, i.e. the novel cultural features on Crete have parallels in contemporary developments in the Mainland. However, the "abrupt" nature of innovations in funerary architecture, burial assemblages and associated ideologies together with other novel material culture features and practices dated to the period immediately succeeding the LMIB destructions and assigned a common aetiology (i.e. a "Mycenaean" political domination of Knossos), is largely exaggerated by archaeological bias. The question is this: How can there be a valid argument for a major rupture in funerary tradition at the end of LMIB, when so little is known about the burials during the LMI period? The archaeological picture is further obscured by plundering of a very high portion of tombs at Knossos (Alberti, 2004: 131). Discontinuity in the burial practices of the Late Bronze Age Cretan society becomes less clear-cut when considering the finds from excavations in Poros (Herakleion) (5 km from Knossos) (Lembessi, 1967). There, a transitional architectural type between the Cretan multi-chamber, cave-like tomb and the single-chamber tomb that is attributed to the Mainland invaders (Doxey, 1987; Popham, 1994; Alberti, 2004), predates the LMIB destructions (Lembessi, 1967). In this line of reasoning, Niemeier (1985: 226) and Kilian-Dirlmeier (1985) argued for the local origin of both the "warrior graves" and the single-chamber tombs with dromos. With regard to the last, it is interesting to note that the single-chamber tomb as opposed to the Cretan multi-chamber tomb did not go out of use following the destruction of the palace and the end of the alleged "Mycenaean" political domination of Knossos. Likewise, the Linear B writing system that is suggested to have been introduced by the "Mycenaean" ruling elite, survived its demise. Finally, concerning the anthropogenic origin of the LMIB destructions the absence of refuge sites on Crete dating to this period is more consistent with the hypothesis that the enemy was internal, rather than external to Cretan context (Driessen and Macdonald, 1997: 113).

By showing that the people buried in the Sellopoulo and KSP cemeteries are locals based upon the results of the strontium isotope ratio analysis, it has been demonstrated that the introduction of novel cultural features on Crete in this period need not have resulted from the actual settlement of the people ("Mycenaeans") suggested to be the first to create them. On the other hand, the results presented above are compatible with more recent archaeological theories for the LMIB destructions on Crete and subsequent cultural upheaval that emphasise factors internal to Cretan society, social competition and unrest (Marinatos, 1993; Driessen and Macdonald, 1997).

What appears to be targeted destruction of administrative centres and elite symbols in the depleted Cretan sites most probably conveys information about the identity and the motives of those who caused them. In this line of reasoning, Rehak and Younger (2001) attribute the destructions to the revolution of the lower class against the ruling elite and their authority. In the context of social unrest and competition, the author agrees with Driessen (2002) and Hamilakis (2002) who argue for a horizontal rather than vertical hierarchical organisation of the pre-LMIB Cretan societies and factional competition, respectively. The LMIB destructions and cultural discontinuity on Crete could be the result of social unrest triggered perhaps by the psychological and economic consequences of the pre-eruption LMIA earthquake and the actual volcanic eruption of Thera (Driessen and Macdonald, 1997: 112), and/or the consequences of the intensification of the power of Knossos over the entire island (Manning, 1994). The new leaders who were successful in the social competition, affiliated to some extent with the "Mycenaeans" or not, adopted a new ("Mycenaean" in origin) symbolic system in order to justify the political change and legitimise their power (Schallin, 1993). This system, however, was already known to the Cretans through inter-regional contacts that date back to the Early Bronze Age. These contacts that were responsible for stylistic and ideological interactions between the two regions, in the LMIA could have taken the form of "Mycenaean" aid in agricultural products to a depleted Crete from the earthquake and the eruption of the Theran volcano (Driessen and Macdonald, 1997: 114).

A more comprehensive reconstruction of Cretan socio-political context dating from the LMIB onwards is expected to be achieved through more systematic analysis of both the material culture and biological history of the Mainland and Knossos populations from the end of the Middle Bronze Age onwards.

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