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# Geoarchaeology of the Mediterranean islands: From "lost worlds" to vibrant places

From the 30th June to 2nd July 2015, the first international colloquium held in France on the geoarchaeology of the Mediterranean islands took place in Cargese (Corsica). This scientific event was attended by around 100 scientists from 14 countries (75% of the participants came from France, Greece and Italy) and was jointly organised by the Centre Européen de Recherche et d'Enseignement des Géosciences de l'Environnement (CEREGE, AMU–UMR 7330 CNRS–IRD–Collège de France, Aix-en-Provence, France), the Laboratory of Physical Geography of Meudon (UMR 8591 CNRS), the French Ministry of Culture and Heritage (*Direction Générale des Affaires Culturelles de Corse*[1]) and the Swiss School of Archaeology in Greece. This colloquium was strongly supported by the University of Marseille (France), the MISTRALS–PALEOMEX INEE working group on climate change and related anthropogenic landscapes and the ECCOREV Federation (Aix-en-Provence, France). The meeting hosted 7 thematic sessions and comprised 35 oral presentations, in English or French, and 20 poster presentations. Following the International Colloquium on Mediterranean Geoarchaeology that took place in Egypt during September 2010 (Ghilardi and Tristant, 2012a, 2012b), it was decided to focus on the Mediterranean islands since geoarchaeological literature on these environments was scarce, in turn suggesting an under-researched theme, especially, in relation to complex human-landscape interactions, despite their geostrategical significance. Within the actual debate and discussion about future climate change (global warming) and its impacts on both human and natural ecosystems, this meeting provided an opportunity to publicise case studies that highlighted long term human/landscape interactions and by analogy, better evaluate the resilience of both landscapes and human societies to change.

## 1. Scientific background

The exact number of the Mediterranean islands remains unknown despite numerous digital survey methods (LIDAR, satellite imagery and aerial photos) that could help to identify any emergent landmass. Some research, however, indicates that probably 10,000 islands and islets (half of them being located in the Aegean Sea) can be identified (Renou, 2012), and amongst them only 200 are bigger than 5 $km^2$ and no more than 300 are inhabited by humans. Both the geomorphology and the human occupation history of the Mediterranean islands are complex, a result from their long-term evolution.

The shape and irregular (chaotic) relief of the Mediterranean islands demonstrate important tectonic histories since a large number are directly situated overlying the contact between the major African and Eurasian tectonic plates and the smaller plates such as the Anatolian, Aegean, Apulian and Iberic, that are associated with them (Mckenzie, 1972). The evolution of the islands is driven by seismic and volcanic activity and the main active volcanoes of the Mediterranean Sea are in fact forming islands: Etna in Sicily, the Pontine (Ponza, etc.) and Aeolian Islands (Vulcano, Stromoboli, etc.), Santorini, Milos, Nisyros and Aegina (the Aegean arc in the Aegean Sea). Despite the natural hazards linked with the tectonic activity, which is an integral part of the histories of the great ancient Mediterranean civilizations, human populations have settled many of these rocky monadnocks. Most of them are small (9 of have an area >1000 $km^2$ and amongst them only 2 have an area of ca. 25,000 $km^2$). Early settlers benefited from the rich fertile areas offered by these lands since the Neolithic. In addition to the underlying tectonic processes which have directly affected their morphology, the shape and relief of these islands have been affected by Quaternary sea-level oscillations, influencing the position of the shoreline and creating both erosional and depositional landforms. Indeed, the multiple glaciations over the Quaternary and the related marine transgressions and regressions have contributed to the increased size of the islands in the present day. During the last glacial period (110–13 ka BP) where the sea level was between 120 m and 130 m below present day limits (Lambeck and Purcell, 2005; Lambeck et al., 2014) "mega islands" were formed; for example in the Cycladic Plateau, Naxos, Paros, Antiparos, Mykonos and Delos coalesced (Lykousis, 2009) and Corsica and Sardinia merged forming an island covering an area of ca. 47,000 $km^2$ (Ghilardi et al., 2016).

Ecological trajectories and human colonization of the Mediterranean islands have been largely influenced by the multiple Quaternary glaciations and their associated paleosea-levels, impeding of facilitating migration and movement. In addition, since the Late-Glacial period, rapid climatic changes (RCC) have affected the whole Mediterranean and may have modified environmental dynamics and geomorphological processes (Mayewski et al., 2004). Amongst the RCC, the 8.2, 4.2 and 3.2 ka BP events are probably the most well-documented, even if palaeoclimatic and archaeological evidence is lacking from the Mediterranean islands. In the present overview paper, big issues are addressed to the resilience of human groups since the Palaeolithic.

Numerous discussions and debates exist concerning the timing (Broodbank, 2006) and nature of the human colonization of the Mediterranean islands (Cherry, 1990; Simmons, 2012; Cherry and Leppard, 2014): did direct routes exist from one island to another, within the context of constantly changing sea levels, or did the transfer of populations occur most of the time from the Eastern and Southern mainland (Howitt-Marshall and Runnels, 2016)? Some limited evidence of sea crossings have been found with lithic material indicating possible human "visitation" at the end of the Late Glacial period and early

[1] DRAC Corsica is based in Ajaccio.

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Holocene. However, until now, archaeological surveys and excavations have not found significant evidence earlier than the Mesolithic: Lower and Middle-Palaeolithic occupation sites on Mediterranean islands are scarce (Kozlowski, 2005), though most of them are probably submerged as a result of sea-level rise or buried by thick Holocene deposits and remain undiscovered. Only a few sites that date from the Upper Palaeolithic (Mesolithic, ca. 9000–8500 BP) have been clearly identified (Fig. 1): Kythnos and Naxos in the Cycladic Archipelago (Sampson et al., 2002; Sampson, 2016; Carter et al., 2014), Lemnos (Efstratiou et al., 2014), Gioura and Ikaria in the Sporades (Sampson, 2001; Sampson et al., 2012), Kerkyra, Kephallonia and Zakynthos in the Ionian Islands (Ferentinos et al., 2012), Chalki in the Dodecanese islands (Sampson et al., 2016), in Corsica (de Lanfranchi, 1998; Cesari et al., 2014), in Sardinia (Sondaar et al., 1995), in Sicily (D'Amore et al., 2010; Mannino et al., 2011), in Brač (Adriatic Sea, Croatia), in Cyprus (Simmons, 1988) and potentially in Crete (Strasser et al., 2011; Runnels et al., 2014). Questions about the original settling ("anthropization") of the Mediterranean islands remain a matter of fascination and debate (Cherry, 1990; Phoca-Cosmetatou, 2011; Cherry and Leppard, 2014), with some authors considering that major technological improvements in the navigation at the beginning of the Holocene (Kozlowski, 2005; Simmons, 2014), allowed human groups to inhabit these lands. It is probable that the first "human" colonization must not be restricted simply to the Mesolithic period since several glacial/interglacial cycles have occurred over the last 2.6 million years and natural landbridges may have facilitated the incursion of *Homo sapiens* (or earlier hominins) into what are now the Mediterranean islands, especially near the contemporary mainland. Much more work needs to be done in the future to investigate traces of early occupation (Lower and Middle Pleistocene) and future research must elucidate the character and spatial extent of the actual – and submerged – Mediterranean islands from past Quaternary glacial/interglacial cycles. Particular attention has to be paid to fluvial terrace archives that could contain lithic artefacts, as well as underwater geoarchaeological surveys. The periods of human occupation following the Mesolithic are much better documented, in particular for the Neolithic period, where a clear orientation East/West in the spread of cultures is attested to (Fig. 1). The first significant signs of anthropogenic activity on the landscape are related to the development of Neolithic agricultural practices such as cereal cultivation and animal domestication (Louboutin, 1990; Walsh, 2014; Guilaine, 2015). The latter periods (e.g. Chalcolithic, Bronze Age, Greek-Roman times and later) are well-represented on all the Mediterranean islands. The Bronze Age is characterized by the rapid growth of populations and new socio-political models. It is also a rich period in terms of local development of an insular Bronze Age culture called the Talayotic in the Balearic Islands, the Torrean in Corsica, Nuragic in Sardinia, Minoan in Crete, Helladic in Euboea, Cycladic in the Cyclades Archipelago and so forth. It is not only a major archaeological period, when connections between the islands themselves were numerous, but it is also significant in terms of environmental impacts. In Corsica and Sardinia, this period is characterized by the development of a hierarchical society and the building of fortified structures such as *Nuraghe* (Sardinia, Fig. 2A), *Naviform* buildings (Balearic Islands, Fig. 2B) and *Castelli* (Corsica, Fig. 2C). Megaliths (menhir statues, Fig. 2D) also date from this period and are found in Corsica where they probably indicate a particular environmental feature linked to the supply of freshwater. In Crete, the Minoan Realm was notable for its Palaces (Fig. 2E) and harbours that controlled part of the Eastern Mediterranean.

Within this scientific research context where little was known about landscape evolution, settlement patterns and human-environment interactions on the Mediterranean islands, archaeologists, geographers, paleoecologists, historians, anthropologists, geologists and geophysicists joined together at the GEOMEDISLANDS colloquium as part of a multidisciplinary network to study the complex relationships between landscape and environmental change and human adaptation and resilience.

## 2. Summary of contributions

This special issue is composed of 11 research articles from the colloquium. It augments and is augmented by a second volume published as part of the CNRS Editions, which comprises a further 25 papers (Ghilardi et al., 2016). The geographical areas discussed here (Fig. 3) are Corsica — France (4 articles), Naxos, Modi and Crete — Aegean Greece (3 articles), Balearic Islands — Spain (2 articles), Paleo Islands of Western Turkey (1

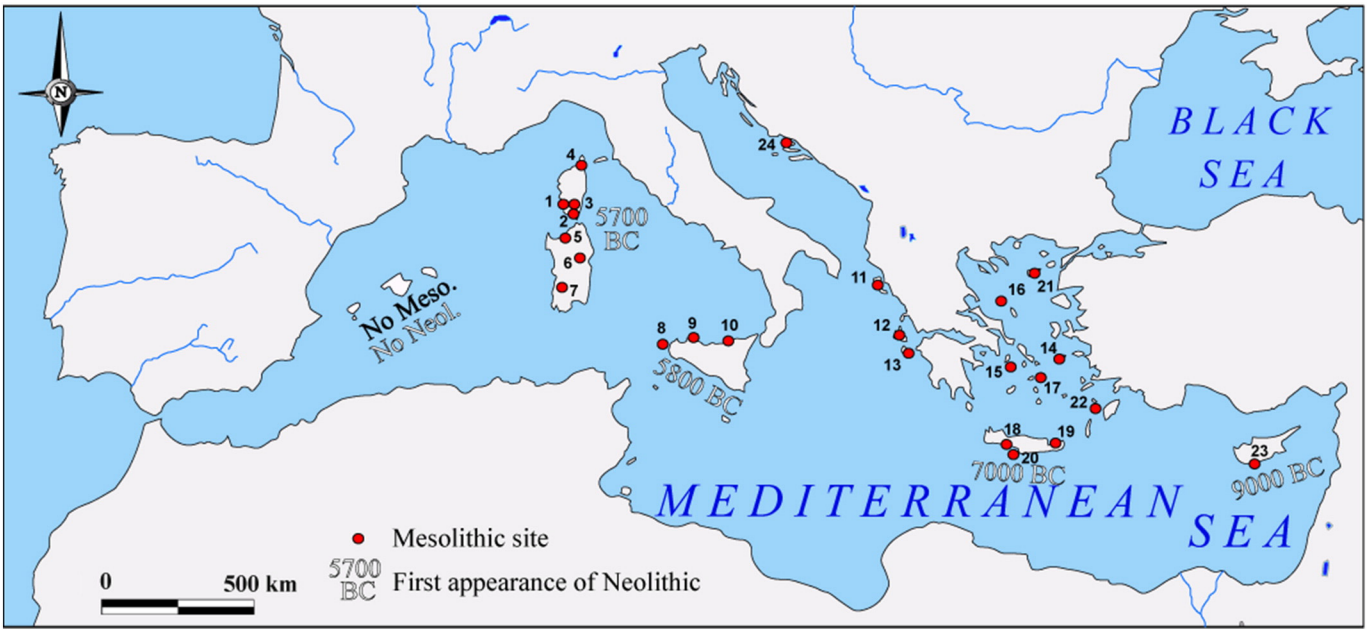


**Fig. 1.** Location map of Mesolithic sites and the dates of Neolithic appearance in the Mediterranean Islands. 1: Campu Stefanu; 2: Bonifacio group (Monte Leone-Longone-Araguina-Senola); 3: Curacchiaghju (Levie); 4: Cape Corsica group (Grittulu Tuffo-Pietracorbara-Torre d'Aquila-Strette); 5: Porto Leccio; 6: Corbeddu; 7: Arbus (S'Omu e S'Orku); 8: Favigna isl. (Grotta d'Oriente); 9: Addaura Caves; 10: Grotta di San Teodoro; 11: Kerkyra (Sidari); 12: Kephallonia; 13: Zakynthos; 14: Ikaria (Kerame); 15: Kythnos (Maroulas); 16: Gioura; 17: Naxos (Stélida); 18: Plakia; 19: Moxlos; 20: Gavdos; 21: Lemnos; 21: Chalki; 23: Akrotiri-Aetokremnos; and 24: Brač.

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