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Introduction

Late Glacial to Early Holocene socio-ecological responses to climatic instability within the Mediterranean basin

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1. Introduction

The period spanning the Late Glacial and the Early Holocene (≈19–8.2 ka) witnessed a dramatic sequence of climate and palaeoenvironmental changes (Rasmussen et al., 2014). Interestingly, some of the most significant transformations ever documented in human Prehistory took place during this period such as the intensification of hunter-gatherer economic systems, the domestication process of wild plants and animals, and the spread of farming across Eurasia. Understanding the role of climate and environmental dynamics on long-term cultural and economic trajectories, as well as specific human responses to episodes of rapid climate change, still remains as one of the main challenges of archaeological research (Kintigh et al., 2014).

The Mediterranean region, in this sense, provides a unique opportunity to investigate these issues because of its very rich biodiversity, its vulnerability to climatic change and, overall, its long history of human-environmental interactions. This special issue of Quaternary Science Reviews compiles a selection of papers which were presented in the MEDINES International Conference. The conference was entitled *Late Glacial to Early Holocene socio-ecological responses to climatic instability within the Mediterranean basin*, and took place in Tarragona (Spain) during February 3rd–5th 2016. The main focus of the MEDINES meeting was to bring together international scholars to generate new knowledge on the effects of climatic instability on human resilience, within the Mediterranean basin, from the Late Upper Palaeolithic to the Neolithic period. The selected papers discuss patterns of past climate change, local and regional environmental responses to climatic deterioration, and the effects climate has had on past population dynamics and human resilience. The understanding of past climate change patterns, local and regional responses to climate deterioration and its effects on prehistoric communities requires new integrative efforts and research strategies, considering different geographic and temporal scales (Izdebski et al., 2016).

The research articles published in this special issue represent a new generation of works, from case studies analysing multi-proxy evidence on key sites, to regional studies based on the meta-analysis of palaeoenvironmental and archaeological data sets. Methodologically, it encompasses analysis of pollen and charcoal data sets, the geomorphological and geo-archaeological study of sedimentary records, analysis of large mammals, micro-mammals and amphibian assemblages, and cutting edge chronological approaches such as tephro-chronology, radiocarbon Bayesian modelling and radiocarbon palaeodemographic modelling.

2. The focus of this special issue and summary of papers

Understanding human responses to the variable impacts of Late Pleistocene and Early Holocene environmental changes requires robust chronological frameworks. That is the subject of the two first papers of the MEDINES' special issue (Blockley et al., 2017; Bergadà et al., 2017). The paper authored by Blockley and colleagues focuses on the radiocarbon chronology of Grotta of Romito (Calabria, Italy), a key Upper Palaeolithic site containing occupational evidence and bio-archaeological assemblages dated between the Last Glacial Maximum and the Early Holocene. This case study exemplifies the potential of using Bayesian chronological approaches to integrate multiple lines of palaeoenvironmental and archaeological evidence at intra-site level. In addition, a significant contribution of this

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article is the first characterization and dating of the tephra layer ROM-D30. Interestingly, the new Bayesian-constrained chronology for this tephra layer indicates a slightly older chronology (15,792–15,318 cal BP) than the widespread Neapolitan yellow tuff. The correlation between archaeological and palaeoenvironmental data shows significant increase in occupational intensity during the GI-1 warming, in comparison to the pattern of occupation documented for the Last Glacial Maximum (LGM) and the onset of the deglaciation.

The need of detailed stratigraphic frameworks for understanding regional effects and the timing of climate change on natural and human systems justifies the contribution of Bergadà et al. (2017). This work is focused on the stratigraphic and sedimentary analyses of the karstic records of Can Sadurní and la Guineu caves, in the coastal ranges of NE Iberia. This study case describes the succession of detrital and anthropogenic episodes spanning 13–6 ka, covering both the Younger Dryas (YD) and the 8.2 ka cal BP event. The authors present a two-phase model, in which phase 1 (c.12.7–7.4 ka) witnessed a succession of Epipalaeolithic and Mesolithic occupations showing stratigraphic discontinuities. In contrast, the second phase (s.7.4–6 ka) recorded Early and Middle Neolithic occupations in a more humid context, favoring the formation of continuous records with an increase of anthropogenic sedimentation related with the pastoral use of the caves.

A second set of articles discusses long-term human responses to the Late Glacial and the last glacial-interglacial transition from a regional perspective (Roberts et al., 2017; Barton et al., 2017; Alday et al., 2017). The paper of Roberts and colleagues reconstructs the demographic responses to the last glacial-interglacial transition (ca.16–9 ka) in Southwest Asia, a period that witnessed the domestication process of wild plants and animals. After a historical review of the role of climate change in the transition to agriculture, this work synthetises a large body of regional palaeoclimate and palaeoecological data - from stable isotope analyses on lake and speleothem records to pollen sequences and macro-charcoal data sets - to infer long-term palaeo-hydrological and vegetational changes. On the other hand, using Summed Probability Distributions (SPDs) of calibrated archaeological radiocarbon dates, the authors reconstruct long-term demographic changes in three different regional units: South-Central Anatolia, Northern Levant/Upper Mesopotamia and Southern Levant. Interestingly, this paper identifies a subregional variability on demographic trajectories, suggesting a major influence of pre-existing socio-ecological continuity in the observed patterns. Thus, whereas the Southern Levant acted as human refuge during the YD, allowing rapid adaptation of human communities to the Early Holocene warming during the PPNA, other subregions such as South-Central Anatolia suffered low population levels during the cold episodes of the Heinrich Event 1 and the YD, showing a delayed demographic response.

The article of Barton and colleagues analyses human responses to environmental changes from the Last Glacial Maximum through to the Early Holocene in the Western Mediterranean. Through geographic down-scaling of paleo-climate models and the meta-analysis of archaeological data sets, the authors reconstruct sub-regional variability in palaeoenvironmental conditions along different climatic phases (LGM, Late Pleniglacial, End Glacial and Initial Holocene) to discuss, then, human responses in terms of land use strategies, hunting practices and demographic shifts. The authors suggest that human populations were able to adapt to the spatial and temporal ecological uncertainty during the Late Pleniglacial and the End Glacial to a certain threshold, after which rapid climate change could have had dramatic demographic consequences.

Finally, the paper authored by Alday et al. (2017) discusses the issues concerning the analysis and interpretation of SPDs of calibrated radiocarbon dates to reconstruct palaeo-demographic dynamics. By using a regional case study focused on the Ebro valley, this piece of work evaluates both the palaeoenvironmental evidence and the radiocarbon record from the Late Magdalenian to the Early Neolithic (ca. 15–6 ka). The authors advise that caution is needed when interpreting the palaeodemographic significance of the SPDs curves, particularly when considering the presence of Early Holocene sedimentary hiatuses in rock-shelter sites, the differential preservation of open-air sites and research biases towards specific time periods or sub-regions.

Following on from the regional case studies, the next series of papers (Jones, 2018; Rufà and Vaquero, 2018) discuss the impacts of the Late Glacial-Holocene transition on human foraging strategies analysing faunal assemblages from different perspectives. The article of Emily E. Jones focuses on the statistical analysis (cluster analysis and non-metric multi-dimensional scaling) of Upper Palaeolithic archaeofaunas within the Mediterranean bioclimatic region of Iberia. As far as large mammals are concerned, this study concludes a strong compositional similarity in faunal assemblages in spite of the Last Glacial Maximum to the Early Holocene climatic and palaeoenvironmental changes.

The paper of Rufà and Vaquero (2018) is mainly based on the materials of the Molí del Salt rock shelter, located in Vimbodí (Tarragona, NE Iberia), containing both Late Upper Magdalenian and Early Mesolithic occupations. On the basis of the faunal spectrum represented in the Molí del Salt and its comparison with other zooarchaeological assemblages from NE Iberia, which are overwhelmingly dominated by leporids compared to ungulate species observed, the authors suggest a continuity pattern on foraging strategies during the Pleistocene-Holocene transition.

The paper of Berto and colleagues (2017) revolves around the study of small mammal assemblages from the Late Epigravettian site of Riparo Tagliente (Southern Alps, Italy), recording the transition between the stadial GS2-1a and the interstadial GI-1. A comparative analysis involving micro-mammal assemblages from Italy and southern Europe indicates an increase in temperature during the first half of the GI-1 interstadial (Bölling/Alleröd) in a vegetal landscape in which woodlands were replacing open grasslands. As forests recovered prehistoric foragers appear to have responded to the GI-1 warming and forest recover by expanding the altitudinal gradient of their settlement pattern, up to 1700 masl.

The research article of Bisbal-Chinesta and Blain (2017) is based on the meta-analysis of a new bio-archaeological proxy, the amphibian and herpetofaunal remains, to reconstruct palaeobiogeographic changes in Iberia between the Late Pleistocene and the Holocene. For the Late Pleistocene (MIS3), the authors differentiate two biotic regions: the Center and Southern Iberian Peninsula on one hand, with thermophilous species of arid Mediterranean climate, and the Atlantic/Cantabrian and NE Iberia on the other hand, dominated by hygrophilous and eurosiberian species of temperate and humid climate. After the LGM, herpetofaunal assemblages in north and southern Iberia were dominated by thermophilic species, whereas the Early Holocene witnessed the entrance of new species from eastern Mediterranean refuge to reach northern Iberia.

The three last papers of the MEDINES' special issue focus on the palaeoenvironmental context of the Mesolithic-Neolithic transition in three different Western Mediterranean regions (Battentier et al., 2017; Revelles et al., 2017; Jones et al., 2018). The work of Battentier and colleagues, synthetises 41 palaeoenvironmental records from both natural deposits and archaeological contexts between the Rhone River and the Northern Apennines, analysing pollen and anthracological data to reconstruct the vegetal landscape between 8450 and 7350 cal BP. Interestingly, in this area the altitudinal

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