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Linking environmental changes with human occupations between 900 and 400 ka in Western Europe

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ABSTRACT

Human occupation in Europe strongly fluctuated over the Quaternary. Archaeological records suggest an intermittent human occupation in Western Europe between 900 and 500 ka, especially in the north of Europe at latitude higher than 45°N. On the opposite, southern Europe, more stable from a palaeoenvironmental point of view, was occupied continuously. This period is followed by a more widespread and dense occupation over the last 450 ka. In parallel, the last 900 ka are characterized by global climatic oscillations and display shifts between glacial/drier and interglacial/wetter periods that modulate the general repartition of fauna and flora. The pacing of these climatic periods is well recorded in numerous palaeoclimatic archives that provide global as well as regional information concerning past climatic and environmental changes. A transition is observed from 1.25 Ma until up to 450 ka (Mid-Pleistocene Revolution) with a change of the dominant periodicity of climate cycles from 41ka to 100 ka in the absence of substantial change in orbital forcing. After 450 ka, the amplitude between glacials and interglacials increases. The change in periodicity since 450 ka corresponds to a change in the density of human occupations as well as the Acheulean technoculture expansion in Europe. There is a general perception that these climatic and environmental oscillations have played a role in human occupation and his morphological evolution. For instance, temperate environments might have favored permanent occupations or occupations over larger territories with long periods dominated by dry meadows and steppes and followed by the expansion of broadleaf deciduous and confireous forests. Testing this hypothesis for the period encompassing 900 to 500 ka is a challenge because of the lack of a common chronological framework between climatic/environmental archives and sites of human occupation, but also because archaeological records are only snapshots of cultural and morphological changes of hominins.

1. Introduction

The link between hominin occupations and environmental conditions from the earliest evidence of occupations until 400 ka is still under debate (Carbonell et al., 2010; Martinón-Torres et al., 2011a; Mosquera et al., 2013; Rodríguez et al., 2011, 2015; Voinchet et al., 2015). It has been suggested that climatic and environmental changes over the period encompassing 900 to 400 ka have an impact on the continuity of occupation by small hominin groups. Some regional studies put forward an important role of the climatic changes (Rodríguez et al., 2011; Preece and Parfitt, 2012), while others just observe the lack of hominin occupations in some areas without any climatic-based reasons (Despriée et al., 2011). Considering a geographical delimitation at around 45°N, a widespread hypothesis is that Northern Europe would have been occupied predominantly during favourable climatic periods (Carrión et al., 2011; MacDonald et al., 2012). In contrast, Southern Europe would have been occupied more continuously due to moderate climatic variations over time (Almogi-Labin, 2011; Cuenca-Bescós et al., 2011; Rodriguez et al.,

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2011; Abbate and Sagri, 2012; Muttoni et al., 2015; Orain et al., 2013b).

Over the last few decades, new data from both Northern and Southern Europe established the earliest appearances of assemblages with bifacial tools in Europe between 900 and 500 ka, providing evidence for the onset of new behaviours, including handaxe-making on a core-and-flake substrate. In addition, recent discoveries in Spain, France and England enriched our vision of human colonization in both the southern and the northern parts of the continent. They reveal that the onset of the bifacial technology happened well before 500 ka, i.e. in parallel to occupations without bifaces and to new behavioural strategies for raw materials supply and land-use patterns. The bifacial technology would thus have been sporadic before 500 ka, before becoming widespread after the glacial episode of Marine Isotope Stage (MIS) 12. While handaxes appeared in Africa as early as 1.8 Ma ago, this tradition appeared later on the European continent limited to Western and Southern Europe (de la Torre, 2011; Lepre et al., 2011; Beyene et al., 2013). Bifacial technology is observed in some well dated open-air and cave sites along a geographical belt from Southern and North-Western Europe to the South Caucasus. There is no trace of bifacial technology in Central Europe, Russia or Central Asia until 250 ka.

The 1 Ma-500 ka period of time also raises questions concerning the relationship between various groups of hominins and the onset of these new behaviours, including bifacial or Acheulean technology (Moncel et al., 2013; Vallverdú et al., 2014). The few hominin fossils dated from this period (Gran Dolina TD6, Mauer, Boxgrove, Notarchirico) are attributed to either *Homo antecessor* or *Homo heidelbergensis*, and the diversity of anatomical features suggests possible hominin intra- or inter-diversity in Europe due to longitudinal migrations of new hominin groups from Asia and/or speciation events in Africa or Eurasia prior to 600 ka (Bermúdez de Castro et al., 2011; Dennell et al., 2011; Martinón-Torres et al., 2011a, b; Stringer, 1996, 2012; Vincenzo et al., 2015).

This paper aims to place the main archaeological sites dated back to 1 Ma (early evidence of bifacial technology), 700 ka (onset of innovation in core technology for instance) and around 500 ka (before the glacial period MIS 12 considered to be a break in the hominin settlement) within the global climatic and local environmental frameworks to present a critical review of the current state of knowledge on the potential impact of climate on the distribution of earliest European hominin occupations. In the first section, we concentrate on available archaeological data, dating constraints and *in-situ* environmental proxies on several European sites that would help to establish the link between local environment and hominin occupations. Focusing on Mediterranean and northern temperate areas, the types of lithic series (with or without bifaces) are thus compared with the available climatic and environmental data. An overview of the glacial-interglacial cycles over the last million years is presented in the following two sections to introduce the main global climate changes over this long period as well as the associated regional vegetation responses. We finally discuss the limitations of a direct comparison between archaeological and climatic records. These limitations result from inherent biases due to archaeological deposits, dating methods uncertainties, quantitative interpretation of analysed proxies and/or degree of preservation of records. Keeping these limitations in mind, we present an attempt to discuss hominin occupations/cultures vs global climatic and environmental records.

2. Early hominin occupations in Europe: available archaeological data

The archaeological data available are variable in quality and in quantity depending on the area. We decided to select some sites from particular areas of Europe (Fig. 1). These sites provide short or long sequences with well-dated levels of occupations as well as multiple proxies for paleoenvironmental reconstructions: plant remains, mammals and micro-mammals, types (i.e. alluvial, lacustrine, volcanic) and dynamic of deposits. These sites are dated by various methods with variable margins of error (biostratigraphy, radiometric methods, chronostratigraphy) presented in Table 1. Some of the sites show small series of artefacts and provide limited data for our purpose. However, we decided to keep them since they have recorded useful paleoenvironmental information. For the following discussion, we separate our sites within two large geographical areas with delimitation at 45°N (limit of the current Mediterranean climate): (1) the great European northern plain and small basins and (2) the plains and valleys from the south of Europe.

2.1. South Great-Britain

At Happisburgh Site 3, the human occupation is dated to the end of either MIS 21 (866–814 ka) or MIS 25 (970–936 ka). An assemblage of 78 flint cores, flakes and flake-tools has been excavated from fluvial gravels, laminated estuarine sands and silts of the ancestral River Thames and Bytham River (Cromer Forest-bed Formation CF-bF) (Parfitt et al., 2010).

The environment and climate during the period of human occupation can be reconstructed with combination of plant remains, foraminifera, marine molluscs, barnacles, beetles and vertebrates. Most of the artefacts are associated with *Pinus* and *Picea* pollen, conifer wood and pine-cones, indicating regional conifer-dominated forest. Local grassland is indicated by the range of grazers (*Equus suessenbornensis*, Bovidae *and Microtus* spp.) and indirectly by preserved pollen from hyaena coprolite. Mammals include *Mammuthus* cf. *meridionalis*, *Equus suessenbornensis* and at least two species of *Mimomys*. The mean summer temperatures are estimated to lie between 16 °C and 18 °C and mean winter temperatures between 0 °C and −3 °C based on the conifer-dominated woodland similar to what exists in southern Scandinavia today.

At Pakefield, a maximum age is indicated by palaeomagnetic data (normal polarity) as possibly the early part of the Brunhes Chron. The hominin presence can be dated to MIS 17 (about 680 ka) at the very youngest or to the later part of MIS 19 (about 750 ka). 32 flakes in local flint came from four different contexts within an interglacial infill of a channel incised into Early Pleistocene marine sediments (Parfitt et al., 2005).

Macro-remains (*Trapa natans, Salvinia natans* and *Corema album*), beetles (*Cybister lateralimarginalis, Oxytelus opacus* and *Valgus hemipterus*) and the presence of *Hippopotamus* indicate warmer summers (between 18 °C and 23 °C) and mild winters. *Mammuthus trogontherii, Stephanorhinus hundsheimensis, Megaloceros savini, M. dawkinsi, Bison* cf. *schoetensacki*, and carnivores (*Homotherium* sp., *Panthera leo, Canis lupus* and *Crocuta crocuta*) compose the faunal assemblage. Pollen analysis indicates an interglacial with broadleaf woodland including coexisting *Carpinus*. *Mimomys savini* and *M.* aff. *pusillus*.

The sites of Brandon Fields, Maidscross Hill and Warren Hill yielded evidence of a bifacial technology. Flint bifaces indicate both tools produced by some deep removals and thinner tools produced by a series of removals and final working of the cutting edges and the tip. Recent geological fieldwork has suggested that the sediments with archaeological findings lie on the 2nd terrace of the Bytham (Bridgland et al., 2006). The age of this terrace possibly dates back to MIS 15 (Ashton et al., 2011; Preece and Parfitt, 2012). New ESR-U series investigations confirm the age of MIS 15–14 for the earliest bifaces in Great-Britain (Voinchet et al., 2015) but the environment of occupations cannot be reconstructed. Microfaunal

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