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Terrasses de la Riera dels Canyars (Gavà, Barcelona): the landscape of Heinrich Stadial 4 north of the "Ebro frontier" and implications for modern human dispersal into Iberia

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ABSTRACT

Terrasses de la Riera dels Canyars is an Upper Pleistocene fluvial deposit containing the remains of large mammals, principally accumulated in the framework of hyena denning in the area, as well as a few artifacts. Radiocarbon-dated to ~39.6 ka cal BP, the time of Heinrich Stadial (HS) 4, this site enables us to reconstruct the environmental conditions then prevalent in the NE of the Iberian Peninsula. The concentration in a single locus of finds generated by different agents relates to a flash-flood event, the rapidity of which, combined with the absence of archaeological, ecological or paleontological incongruities in the composition of the assemblage, warrants an assumption of broad contemporaneity for its contents. The ecofactual evidence (fauna, pollen, charcoal, phytoliths) indicates a steppe-dominated environment for the coastal areas between the Pyrenees and the Ebro delta; the dominant elements are cold- and dry-adapted species but a Mediterranean component is present, implying a less rigorous climate than farther north in Europe. The artifacts are clearly Upper Paleolithic, and assignment to the modern human-associated Aurignacian technocomplex is supported by the radiocarbon dates and the typology of a bilaterally retouched blade. This evidence is consistent with the notion that anatomical modernity spread across Europe over open landscape niches. Available pollen data from deep sea cores indicate that, during some of the interstadials of Marine Isotope Stage (MIS) 3, a significant vegetation gradient existed at 40°N, broadly coincident with the "Ebro frontier:" temperate and warm temperate trees expanded significantly to the south, while steppe-tundra landscapes remained dominant to the north, a contrast best seen during Greenland Interstadial (GI) 8. Such an environmental boundary must have implied a durable barrier to diffusion and migration during interstadials. Under the cold and arid conditions of HS4, the site of Canyars shows that the Eurasian steppe-tundra extended as far south as the Llobregat delta; however, the environmental reconstructions available for the lower Ebro valley and adjacent mountains of the Iberian Range farther south suggest that they formed at this time a belt of

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semi-desert or steppe-desert landscapes, thus maintaining the boundary effect despite the climatic reversal. The persistence of such a boundary through HS4 and the interstadials that bracket it must have played a role in the delayed arrival of the Aurignacian (and modern humans) to southern and western Iberia, which continued to be settled by Middle Paleolithic Neanderthals well beyond 40 ka cal BP.

1. Introduction

The emergence of early modern Europeans and the fate of the Neanderthals are major topics in human evolution research and this is especially so in the Iberian Peninsula because, south of the Ebro basin (the "Ebro frontier"), Neanderthals seem to have persisted longer than elsewhere in Western Europe (Vega Toscano, 1990; Villaverde and Fumanal, 1990; Zilhão, 1993, 2000, 2009). In the framework of arguments and observations made in marine and ice cores dated to MIS3 (e.g., Huber et al., 2006), both the role of climate change in this persistence and the duration of the pattern have been the subject of much debate (d'Errico and Sánchez-Goñi, 2003; Jöris et al., 2003; Finlayson, 2004, 2009; Finlayson et al., 2006, 2008; Zilhão, 2006, 2009; Zilhão and Pettitt, 2006; Jiménez-Espejo et al., 2007; Sepulchre et al., 2007; Zilhão et al., 2010a, 2010b). Models that question the reality of the geographic segregation underlying the "Ebro frontier" model have also been proposed (Baena et al., 2005, 2012; Vaquero, 2006; Martínez-Moreno et al., 2010); with variants, such alternative models revolve around the notion of a long-term coexistence between Neanderthals and modern humans in Iberia as a whole, both north and south of the Ebro, permitted by the mosaic nature, at both the inter and intra-regional levels, of the peninsular landscapes of the time.

Twenty years on, it is clear that additional high resolution archaeological and radiocarbon data are required to advance the discussion of these issues. For the northern areas in particular, progress along these lines has already contributed considerable clarification (e.g., Mallol et al., 2010; Mora et al., 2011; Camps and Higham, 2012; Maroto et al., 2012). For instance, the very young dates obtained for the uppermost Middle Palaeolithic levels of the Cueva Esquilleu, in Cantabria, can now be understood in the framework of the geological study of the site, which showed that those levels were severely affected by post-depositional disturbance, namely cryoturbation. Where Catalonia is concerned, the apparent late persistence of the Mousterian at sites such as Cova dels Ermitons has been shown to be an artefact of incomplete decontamination of the radiocarbon samples used in support of the argument, while recent dating work at the rock-shelters of L'Arbreda and Abric Romaní confirmed that the chronological interface between the Protoaurignacian (assumed to be modern human-related) and the preceding Neanderthal-associated industries lies at ~36.5 ^{14}C (~41.5 cal) ka BP (as in adjacent France, and as previously proposed on the basis of continent-wide chrono-stratigraphic patterns; Zilhão and d'Errico, 1999, 2003; Zilhão, 2006; Zilhão et al., 2007).

South of the Ebro, on the other hand, the persistence pattern remains consistent. Recent radiocarbon and U-series dating supports an age ≤40 ka cal BP for the uppermost levels of the Middle Paleolithic sequences from Sima de las Palomas and Cueva Antón, Murcia, and Gruta da Oliveira, Portugal (Walker et al., 2008; Zilhão et al., 2010b; Hoffmann et al., in press). And wherever an Aurignacian assemblage has been found in long stratigraphic successions spanning the Middle to Upper Palaeolithic transition, its affinities lie invariably with the Aurignacian II (a.k.a. "Evolved Aurignacian") or the Aurignacian III/IV (a.k.a. "Late Aurignacian"). This is the case at Cova Beneito, Alicante (Domènech, 2001), Cueva Bajondillo, Málaga (Cortés-Sánchez et al., 2011), and Pego do Diabo, Portugal (Zilhão et al., 2010b), where reliably associated dates are no earlier than ~37 ka cal BP. Whether a sedimentation hiatus is present or not, the Protoaurignacian and the Aurignacian I are always lacking, and, where the latter is concerned, its index fossil, the split-based bone point, has never been seen in these regions, not even as isolated finds devoid of stratigraphic context. Some have even questioned the Aurignacian status of the assemblages above, arguing that the earliest Upper Paleolithic of these regions is the Gravettian and suggesting that Neanderthals could have persisted in Gibraltar up until the LGM (Last Glacial Maximum) (Finlayson et al., 2006; Jiménez-Espejo et al., 2007).

Palaeoenvironmental conditions have played a prominent role in explanations of this Neanderthal persistence pattern. The "Ebro frontier" model proposed that this river's drainage divided regions to the north, which, except perhaps during less cold interstadials, would have been part of the Eurasian steppe-tundra, from those to the south, where tree cover would always have been significant and, during warmer interstadials, perhaps extensive. d'Errico and Sánchez-Goñi (2003) and Sepulchre et al. (2007), in turn, emphasized the impact of extreme aridity during HS4 (i.e., the Greenland stadial during which occurred the shorter episode of iceberg discharge known as Heinrich Event 4; cf. Sánchez Goñi and Harrison, 2010). During this cold event, semi-desert landscapes would have developed in central and southeastern Iberia, thus hindering the southward dispersal of Aurignacian moderns and creating a refugium for Neanderthals in the south and west. Others (e.g., Finlayson, 2004) suggested that the mosaic woodlands of the latter regions were less favorable for the subsistence economy of modern humans and that these would have settled them only after they were vacated by the Neanderthals. This abandonment would have been caused by the rapidity and amplitude of the period's climate oscillations—the hypothesis being that the world of the Neanderthals changed faster than they could cope with, eventually leading them to extinction.

Our model of site formation process at Terrasses de la Riera dels Canyars (henceforth, Canyars) indicates that the finds made here can be treated as a closed context from a paleoenvironmental perspective. Under this assumption, and because it is dated to the HS4 stadial, Canyars is the only continental site north of the "Ebro frontier" where paleoenvironmental reconstructions for this period can proceed unhampered by concerns related to the possibility of post-depositional disturbance. The site thus provides an opportunity to assess the impact of HS4 on the regional landmass and to fine tune the climate models that have been used to assess the issue.

2. General setting

Canyars (41°17′46″N, 01°58′47″E) is located in the Garraf Massif, near Gavà, 20 km south of Barcelona (Fig. 1). The Garraf Massif is part of the *Serralades Costaneres Catalanes* (Catalan Coastal Range), a low-relief mountain chain (<600 m high) composed of Jurassic and Cretaceous limestone and dolomite (Esteban and Julià, 1973) overlaying Triassic deposits. This massif features one of the most important karstic systems of NE Iberia. With an area of ~500 km^2 (Solé, 1964; Salas, 1987), it contains several Lower and Middle