



## Site formation and chronology of the new Paleolithic site Sima de Las Palomas de Teba, southern Spain



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### ABSTRACT

The newly identified Paleolithic site Sima de Las Palomas de Teba hosts an almost seven-m-thick sediment profile investigated here to elucidate the rock shelter's chronostratigraphy and formation processes. At its base, the sediment sequence contains rich archeological deposits recording intensive occupation by Neanderthals. Luminescence provides a *terminus ante quem* of  $39.4 \pm 2.6$  ka or  $44.9 \pm 4.1$  ka (OSL) and  $51.4 \pm 8.4$  ka (TL). This occupation ended with a rockfall event followed by accumulation of archeologically sterile sediments. These were covered by sediments containing few Middle Paleolithic artifacts, which either indicate ephemeral occupation by Neanderthals or reworking as suggested by micromorphological features. Above this unit, scattered lithic artifacts of undiagnostic character may represent undefined Paleolithic occupations. Sediment burial ages between about  $23.0 \pm 1.5$  ka (OSL) and  $40.5 \pm 3.4$  ka (pIRIR) provide an Upper Paleolithic chronology for sediments deposited above the rockfall. Finally, a dung-bearing Holocene layer in the uppermost part of the sequence contains a fragment of a human mandible dated to  $4032 \pm 39$  <sup>14</sup>C yr BP. Overall, the sequence represents an important new site for studying the end of Neanderthal occupation in southern Spain.

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### Introduction

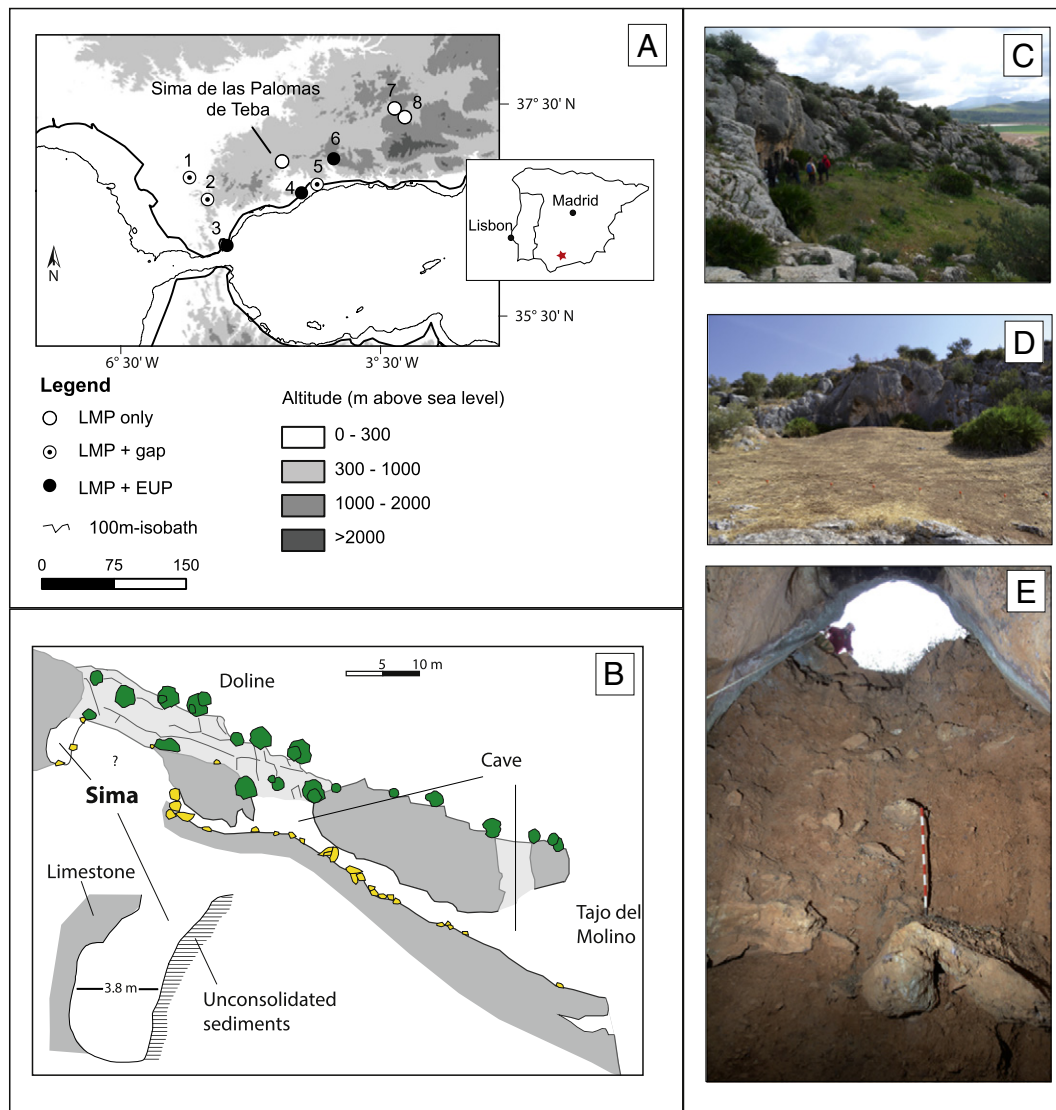
Iberia has a rich Middle Paleolithic record of 70 cave and rock shelter sites documenting occupation by Neanderthals. Most of these sites appear to reflect discontinuity of human occupation after Neanderthals, because the archeological sequences contain Mousterian levels only or do not include Protoaurignacian or Aurignacian assemblages, which are attributed to early anatomically modern humans (AMHs) in Iberia. Less than one-third (28) of the sites contain layers of both Neanderthals

and early AMHs. Considering that in 14 of these sites the corresponding levels are separated by archeologically sterile layers or sedimentary discontinuities (Mallol et al., 2012), it appears likely that records of discontinuity in human occupation are much more numerous than those documenting continuity.

In southern Spain, several cave and rock shelter sequences document occupation by Neanderthals (Fig. 1). The caves of Carigüela (Fernández et al., 2007), Horá (Vega Toscano, 1988), Higueral de Sierra Valleja (Jennings et al., 2009) and Higueral de Motillas (Giles Pacheco et al., 1998), as well as the rock shelter Complejo del Humo (Ramos et al., 2005; Jennings, 2006; Fig. 1A) were abandoned after Neanderthal occupation and not used by early AMHs. In contrast, Gorham's cave (Pettitt and Bailey, 2000; Finlayson et al., 2006), El Bajondillo (Cortés Sánchez et al., 2008) and the Boqueta de Zafarraya (Barroso and DeLumley, 2006), were occupied by AMHs during the Early Upper Paleolithic as well (Schmidt et al., 2012 and references cited therein). However, the cultural attribution of presumably early Upper Paleolithic levels is still under discussion (Peña, de la and Vega Toscano, 2013;

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**Figure 1.** A. Location map with caves and rock shelters documenting occupation of Neanderthals in southern Spain. 1) Higueral de Sierra Valleja, 2) Higueral de Motillas, 3) Gorham's cave, 4) El Bajondillo, 5) Complejo del Humo, 6) Boqueta de Zafarraya, 7) Carigüela, 8) Horá. Altitudinal zones based on Aster data. B. Cross-section through the karst complex of Las Palomas de Teba showing the approximate geometry of the Sima and the main cavities. The southern wall of the Sima consists of unconsolidated sediments (cf. panel E). C. The Sima is located in the limestone rim of the doline. Overhanging boulders are remnants of the former rock shelter roof. Persons are standing in front of the small entrance to the Sima on the heap of artifact-rich sediments excavated at unknown times. View from west, January 2015. D. The cleared surface of the doline with the heap in front of the Sima. View from south. E. The profile before cleaning and construction of the scaffolding. The large boulders underneath the scale (1 m) were cut before cleaning the central part of the profile. The boulders cover sediment units 9 and 10 (Fig. 2).

Marreiros and Bicho, 2013) and it appears very likely that dispersion of AMH into the south of the Iberian Peninsula was retarded.

Dating the Late Neanderthals in southern Iberia is a matter of recent dispute. Radiocarbon dating at Gorham's cave (Finlayson et al., 2006), Boquete de Zafarraya (Hublin et al., 1995) or Carigüela (Fernández et al., 2007) apparently suggests a late survival in the South until about 28  $^{14}\text{C}$  ka BP, equivalent to about 32 cal ka BP. More recent dating efforts demonstrate that these and other previous radiocarbon dates probably underestimated the time of Late Neanderthals in Iberia, which according to new estimates disappeared at the latest around 38 cal ka BP, but probably earlier (Maroto et al., 2012; Kehl et al., 2013a; Michel et al., 2013; Wood et al., 2013; Higham et al., 2014). Causes of age underestimation may relate to poor preservation of bone or contamination with modern  $^{14}\text{C}$  in charcoal. Wood et al. (2013) found that C/N ratios indicated appropriate collagen preservation in just two out of ten Middle and early Upper Paleolithic sites of southern and central Iberia, stressing the poor suitability of bone for

radiocarbon dating in that area. Systematic underestimation of radiocarbon dating on bone in Iberia was also observed by Jöris et al. (2003). Further problems arise from inappropriate definition of archaeological context or poor diagnostic value of lithic assemblages of dated layers (e.g., Zilhão, 2006).

Given the uncertainties in radiocarbon dating, independent age control using other radiometric or dosimetric methods is needed. Recently, thermoluminescence (TL) and optically stimulated luminescence (OSL) have been used to date the sediment context of Late Neanderthal occupations at El Salt. Levels VIII to V middle, including the uppermost Mousterian assemblages, were dated to 43 to 54 ka, if error margins are included (Galván et al., 2014). U-series dating on three bone samples from the uppermost Mousterian layer at Gruta de Oliveira, Level 8, yielded between 34 and 40 ka (Hoffmann et al., 2013). These dates apparently corroborate radiocarbon dates on two pieces of burnt bone from the same level yielding about 38 cal ka BP (Angelucci and Zilhão, 2009). Although there is doubt that dating burned bone produces

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