

Molar macrowear analysis to unveil dietary habits in Sima de los Huesos population

Laura Martín-Francés^{1,2}, Luca Fiorenza², María Hernaiz-García², José María Bermúdez de Castro^{1,3}, Juan Luis Arsuaga⁴, María Martínón-Torres^{1,3}

1 - CENIEH (National Research Center on Human Evolution), Burgos, Spain · 2 - Monash Biomedicine Discovery Institute, Department of Anatomy and Developmental Biology, Monash University, Melbourne, Australia · 3 - University College London Anthropology, London, UK · 4 - Centro Mixto UCM-ISCIII de Evolución y Comportamiento Humanos, Madrid, Spain

The importance of determining hominin diet lies in its relationship with the morphological evolution of the masticatory apparatus. According to isotopic reports, the early Neanderthals from Atapuerca-Sima de los Huesos (SH) site, dated to 448 ± 15 ka [1], probably relied on a rich-protein diet [2], as previously suggested for Neanderthals. In addition, the microwear analysis of the posterior dentition of SH suggested that this population also exploited other resources such as plant foods [3]. By analysing the occlusal macrowear in maxillary molars, this study explores the dietary ecology of this Middle Pleistocene population that likely lived during the MIS 12, one of the coldest periods recorded globally, that in the Iberian Peninsula caused a significant increment in semi-desert vegetation [1]. We employed the Occlusal Fingerprint Analysis (OFA) method [4], a digital approach that allows to reconstruct the individual masticatory behaviour through the analysis of occlusal wear facets. We examined seven maxillary first molars characterised by a moderate degree of tooth wear.

The SH group is characterised by a macrowear pattern with large buccal phase I facets (41%), followed by lingual phase I (29%) and phase II (28%) facets. This pattern is similar to those of Neanderthals who inhabited temperate forests. The comparative analysis (One-way PERMANOVA, N permutation=9999, $p=0.0001$), further confirms this result, showing significant differences with Eurasian Pleistocene groups from Mediterranean and steppe/coniferous forest areas, but not with Neanderthals from deciduous woodlands.

The results of this preliminary study suggest that the SH population exploited both animal and plant foods. The presence of larger buccal phase I facets in maxillary molars, as those displayed by the SH group, is associated with a diet dominated by animal proteins [5]. Moreover, the high proportion of lingual phase I facets indicates an increase in transverse mandibular movements, generally associated with the consumption of hard and abrasive foods, including roots, seeds, gums, and other plant materials [5]. Consequently, the large lingual phase I facets displayed by the SH group would indicate that this population exploited plant material as well. It is possible that the SH population relied on the consumption of underground storage organs, which are available year-round and are rich in carbohydrates.

Our result is in agreement with the previous reports on isotopic [2] and tooth microwear analyses [3] that suggested that SH mainly relied on a diet rich in animal foods but also exploited hard and poorly processed plant resources, such as tubers, stems and seeds.

This research is funded by the Horizon Program-Marie Skłodowska-Curie Actions of the EU Ninth programme (2021-2027) under the HORIZON-MSCA-2021-PF-01-Project: 101060482 and MCIN/AEI/ 10.13039/501100011033 and "ERDF A way of making Europe" Grant PID2021-122355NB-C33 & -C31. LMF receives funding from the EU Program-Marie Skłodowska-Curie Actions. M-MT has received support from the Leakey Foundation through the personal support of Gordon Getty (2013) and Dub Crook (2014-2022). The authors gratefully thank the curators and institutions which allowed us to study comparative and fossil specimens: Almut Hoffmann (Museum für Vor- und Frühgeschichte, Berlin, Germany), Maria Teschler Nicola (Naturhistorisches Museum Wien, Vienna, Austria), Marta Dočkalová (Moravské Zemské Muzeum, Anthropos Institute, Brno, Czech Republic), Bence Viola (Department of Anthropology, University of Vienna, Austria), Yoel Rak (Department of Anatomy and Anthropology, University of Tel Aviv, Israel), Fabio Parenti (Istituto Italiano di Paleontologia Umana, Rome, Italy), Chris Stringer and Rob Kruszynski (Natural History Museum of London, England), National Museum of Wales (Cardiff, Wales), Angiolo del Lucchese (Museo Preistorico dei Balzi Rossi, Ventimiglia, Italy), and Erik Trinkaus (Department of Physical Anthropology at Washington University in Saint Louis, USA).

References: [1] Demuro, M., Arnold, L.J., Aranburu, A., Sala, N., Arsuaga, J.-L., 2019. New bracketing luminescence ages constrain the Sima de los Huesos hominin fossils (Atapuerca, Spain) to MIS 12. *Journal of Human Evolution*. 131, 76–95. [2] García, N., Arsuaga, J.L., 2011. The Sima de los Huesos (Burgos, northern Spain): palaeoenvironment and habitats of *Homo heidelbergensis* during the Middle Pleistocene. *Quaternary Science Reviews*. 30, 1413–1419. [3] Pérez-Pérez, A., Lozano, M., Romero, A., Martínez, L.M., Galbany, J., Pinilla, B., Estebanaranz-Sánchez, F., Bermúdez de Castro, J.M., Carbonell, E., Arsuaga, J.L., 2017. The diet of the first Europeans from Atapuerca. *Scientific Reports*. 7, 43319. [4] Kullmer, O., Benazzi, S., Fiorenza, L., Schulz, D., Baco, S., Winzen, O., 2009. Technical note: Occlusal fingerprint analysis: Quantification of tooth wear pattern. *American Journal of Physical Anthropology*. 139, 600–605. [5] Fiorenza, L., 2015. Reconstructing diet and behaviour of Neanderthals from Central Italy through dental macrowear analysis. *Journal of Anthropological Sciences (Rivista di antropologia)*. 3, 119–133.