

## The Sima de los Huesos origin of hominin accumulation. The state of the art.

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The Sima de los Huesos (SH) site represents one of the most intriguing human fossil accumulations for the abundance of hominin remains recovered to date (7000 fossils), their chronology (430 ka) and their extraordinary location deep inside a karstic environment. Since systematic excavations began in 1984, numerous hypotheses to explain how the skeletal remains arrived at the site have been proposed, including the hypothesis of an anthropic origin, favored by the excavation team [1]. A long-term research project is currently in progress addressing the biostratigraphic and the fossil-diagenetic phases. The present study provides an overview of our current state of knowledge regarding the origin of the hominin accumulation. We are now in a position to rule out conclusively several scenarios proposed as possible agents for the hominin accumulation at the site. 1) The sedimentological features of the hominin-fossil-bearing level (LU6), indicate low-energy depositional processes and no traction transport from outside the karst system [2]. The human fossils were not transported to the site from a remote place. Furthermore, the only possible access to the SH chamber was a 14m vertical conduit (shaft). This circumstance excludes any hypothesis that implies an accessible exit from the site. 2) Carnivore tooth marks have been documented on the SH hominins [3]. These tooth marks, only present in a very low proportion of the assemblage, do not involve bone fracturing typical of carnivore dens. The results of the taphonomic analyses indicate that carnivore modification of the SH assemblage is compatible with bear activity, although limited intervention of lions, while less probable, remains possible. Neither lions nor bears accumulate bones in their dens (and no carnivore accumulates exclusively humans). Carnivore access and modifications, then, occurred exclusively in the context of scavenging of hominins previously accumulated at SH by other causes. 3) Forensic and taphonomic analyses of cranial fractures has shown that at least some of the hominin individuals likely were already dead before they were deposited at the site, ruling out accidental causes [4,5]. Given these circumstances, the intentional accumulation of bodies by other hominins remains as the only possible explanation for this extraordinary deposit of human fossils. The analysis of the spatial distribution of hominin fossils within the site has revealed that the bones are not found in their original position, but are generally mixed together in the sedimentary matrix of the main chamber. For this reason, many of the usual criteria for identifying mortuary behavior are not applicable here. Different agents have modified the original position of the skeletal remains. 1) Within the SH site itself, the presence of a sloped ramp of sediments at the base of the shaft, has facilitated the secondary deposition of fossil remains at the lowest point of the cavity. Hominin fossils are found throughout the site, from the bottom of the shaft to the distal wall of the chamber some 13m away, with a maximum accumulation after the sloped ramp in the horizontal, lower part of the site. 2) The erosive event associated with the deposit of LU7 and the subsidence in the central zone of the site [2] probably modified the structure of the hominin-bearing level LU6. 3) The carnivore scavenging activities must have affected the original position of some of the remains. 4) Finally, repeated entry to the site during historic times by inexperienced diggers in search of bear fossils resulted in moving tons of sediments. At present, the SH site has been only partially excavated, and it is estimated that more than the half of the extension of the deposit remains unexcavated. Under these circumstances, as a cautionary note, we maintain that any attempt to solve the site by dealing exclusively with one factor, such as the relative abundance of skeletal elements, is likely to lead to unreliable interpretations.

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