PaleoAmerica

A journal of early human migration and dispersal

ISSN: 2055-5563 (Print) 2055-5571 (Online) Journal homepage: http://www.tandfonline.com/loi/ypal20

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To cite this article: Eric Boëda, Christophe Griggo & Christelle Lahaye (2017): The Cerutti Mastodon Site: Archaeological or Paleontological?, PaleoAmerica, DOI: 10.1080/20555563.2017.1338006

To link to this article: http://dx.doi.org/10.1080/20555563.2017.1338006

Published online: 22 Jun 2017.

PALEOAMERICA, 2017
https://doi.org/10.1080/20555563.2017.1338006

Center for the Study of the First Americans
Texas A&M University

Routledge
Taylor & Francis Group

PERSPECTIVE

The Cerutti Mastodon Site: Archaeological or Paleontological?

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ABSTRACT
The newly reported California discovery of mastodon remains possibly altered by humans more than 130 ka is unprecedented and potentially transformational. It calls for a concerted effort in North and South America to investigate other such ancient contexts that substantially predate the commonly accepted late-glacial timing of the first peopling of the New World.

KEYWORDS
Cerutti Mastodon site; taphonomy; early peopling of the Americas

The publication of the ensemble of research carried out at the Californian site of Cerutti causes a real earthquake in research on the first settlement of the Americas. Before considering this general theme further, however, we first review the specifics of the very carefully documented article recently reported in *Nature* (Holen et al. 2017). The demonstration relies on the plurality of research domains: geomorphology, taphonomy, archaeozoology, technology, dating, and experimentation. The first question concerns the geomorphological and taphonomic aspects of the site – whether natural causes could have been responsible for this accumulation of bones and lithics. In the case of the lithics, the description of the sediments and their inferred modes of deposition suggest that the energy of moving water was not sufficient to deposit these materials. As for the bones, possibly some of the remains of animals were carried by water current, but the presence and condition of fractured elements, coming only from the most robust animal – a mastodon – cannot be explained solely by their placement by water. These data are completely contradictory and suggest human action. But if placement and breakage did not occur during sedimentation, could there still be post-depositional disturbances to explain these phenomena? The microstratigraphy found during the excavations indicates that this was not the case. Nothing, then, naturally explains the presence of these elements and their transformations.

Let us now examine the signs of transformations present on each of the two materials: lithic and bone. First, in the case of lithic material, the incongruity of the large stones in such sediment is already, in itself, a strong argument of the human origin of some manuports. However, what should be kept in mind is the presence of traces of impacts – crushing/depression – arranged in circumscribed foci on once convex surfaces. If it is desired to control the transmission of energy in an impact, it must be done by the encounter of two convex surfaces or a convex surface with a flat surface. This detail, however simple it may be, is fundamental, for nature has no "efficiency" concern and the location of the shocks would be random. Thus, the choice of a specific volume and the use of technically operative impact surfaces are in favor of intentional repeated shocks, indicative of percussion activity using hammer and anvil.

In the case of the bone material, several points need to be made. The first, which is an indirect argument, is that only the long bones of the mastodon are fractured, while bones of horses and wolves are intact. The second and by far the most demonstrative observation concerns the technical analysis of the bones that demonstrates the occurrence of flaking negatives. These are familiar to us, and in many cases we have considered them to unambiguously represent the work of human voluntary action. But before going any further, let us consider the type of fracture observed. The elimination of an animal cause and/or process of post-depositional alterations is obviously paramount. No trace of carnivorous action responsible for fracturing is attested, nor indeed of post-fracturing alterations. This means that we must exclude any animal intervention before the burial of the remains. In view of the presence of such a mass of meat, it is often difficult to admit that carnivores would not benefit from this energy supply, but we have many archaeological examples where this is the case. So, what is observable elsewhere may very well be the case here, too. Let us now analyze the technical features

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of the fractured bones. For this the lead author Boëda compared his opinion with that of a zooarchaeological colleague, co-author Griggo. The richness and precision of the documentation presented by Holen et al. (2017) really allow us to have all the information necessary for establishing a diagnosis. Impact features are those of percussion on fresh bones that burst the diaphyseal body of the long bones, allowing access to the marrow. The presence of diagnostic and unique bone fragments of the fracturing of thick mammalian diaphyseal bodies confirms the link between the various fractured elements.

Another important aspect of the Holen et al. (2017) report is a life-sized experiment, the aim of which was to reproduce not the tools by means of actions but instead to reproduce an activity to achieve a goal: obtaining the marrow from diaphyses of a large mammal – an elephant. It does not matter if the gestures are not exactly the same, as long as the activity uses the same volumes and masses as the archaeological artifacts. It would indeed be illusory to attempt to reproduce the exact gestures because the original actors are no longer there to tell us how to do it. Thus, it is not so much the spectacular side of the experimentation that interests us but the protocol and the observations of the consequences of the actions on the different materials, in other words the traces. These traces can be universals, and it is these universals that are sought during experiments, because they alone will have an analogous diagnostic value. Our own observations, as well as those of many other experimenters, confirm what is given to us to read. This brings us to the third observation: the combination of these three categories of materials bearing different traces, with different meanings, to make a system – an anvil, hammer, and fractured diaphysis.

Once we have examined the appropriateness of the anthropogenic nature of the artifacts and the fact that we are confronted with a place of fracturing activity, it is obviously necessary to examine the chronological data which are crucial because they suggest that Cerutti is the oldest known site in the Americas. For this purpose, the lead author sought the advice of a specialist in the methods used (optically stimulated luminescence (OSL) and uranium-thorium (U-Th) dating), coauthor Lahaye. Indeed, without collagen the radiocarbon dates were immediately excluded from the methodological pool of dating. Instead, both dating methods used in this work converged on Pleistocene ages of the site. Quartz grains studied with OSL were too close to or beyond the limit of the method, so that only minimum ages could be deduced. They show the sediment surrounding the fossils of the Cerutti Mastodon site were not exposed to natural light for at least 60–70 ka. It can be deduced, if all the depositional and post-depositional phenomena are well understood, that the fossils enclosed in the site's sediments are older than 60–70 ka. U-Th measurements on bones also can only be considered as minimum ages of bones' burial. The results of analyses of different bones are consistent, giving an age of ca. 130.7 ± 9.4 ka. Combining OSL and U-Th results, in a well understood stratigraphic context, leads to the conclusion that the Cerutti mastodon dates to around 130 ka.

The resolution of the methods used does not allow a very precise chronological result (130.7 ± 9.4 ka), thus situating the site at the interface between the end of the latest glacial (MIS 6), which is interpreted to have been a cold phase like the last glacial maximum and the beginning of the rapid warming which marked the beginning of the latest interglacial (MIS 5e). This chronological position makes it difficult to discuss the origins of this group of individuals and the process of their dispersal. For, assuming that they were newcomers, depending on the date taken into account, on the one hand they could have existed at the maximum extent of the glaciers blocking the land passage between Alaska and the Great Plains of North America, with the lowering of sea level more than 100 meters and the creation of a land bridge between Asia and North America. On the other hand, the alternative situation would have been characterized by a rise in sea level, which may have led to the closing of the land bridge but at the same time the opening of a corridor after the disappearance of glaciers, with the formation of large lakes as consequences. So, when in time are we situated, exactly? The fauna is not sufficiently informative to make us lean to one alternative or the other. Nonetheless, the coastal seaway remained a permanent solution whatever the climates.

Perhaps, however, these were not newcomers but instead descendants of generations already present in the Americas. But let us guard ourselves during this time of scientific upheaval to give priority to just those facts which alone have heuristic value. All the scenarios that we envisage must remain heuristic scenarios and not a paradigm, as we had with "Clovis first". Keep in mind that the facts once verified remain paramount. We experienced this ourselves in Piauí in South America, where our successive and repeated discoveries in the same geographical area testified not to the presence of a "Robinson Crusoe" but to a large perennial population that existed for at least 5000 years between 35 and 40 ka (Boëda et al. 2016). This means that scientific research, finally rid of traditional ideological locks, can focus on the expansion of prospecting, taking into account the geomorphological changes of the Pleistocene. We have to look for the sites, in the places

where they are likely to be, under water or under many meters of sediment.

We are left finally with one last problem: the creators of the Cerutti feature. Holen et al. (2017) provide a realistic picture of the situation in Asia. We have a fairly broad choice of candidates – late *Homo erectus*, Neanderthal, archaic *Homo sapiens*, or even Denisovan. In the absence of hominin remains, some researchers will consider these candidates' respective cognitive aspects when making a taxonomic attribution. For our part, having experience across Asia from north to south, we would be suspicious of any specific biological/cultural fit. We are dealing with technical worlds quite different from our Western and African references. From experience, let us guard against prejudice and remain open to all possibilities.

To conclude, I endorse the last sentence of Holen et al.'s (2017) article by extending it to all of America: this discovery calls for further archaeological investigation of the North and South American strata of early-late Pleistocene age.

Acknowledgment

We thank our colleague Ramos for his comments.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Christelle Lahaye is an Associate Professor in archaeometry at Bordeaux Montaigne University, in France. She is a specialist of paleodosimetric dating, especially luminescence-based dating techniques.

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