

New pieces



of the puzzle

Teeth from a deer found alongside human bones inside a cave in the state of Piauí suggest that humans were present in the region more than 20,000 years ago

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External view of Toca do Serrote das Moendas in São Raimundo Nonato



Two teeth from a large deer discovered at a prehistoric site in the vicinity of the Serra da Capivara National Park in São Raimundo Nonato, southern Piauí State, will likely add fuel to the debate regarding the date of modern man's arrival in the Americas. Two different laboratories independently dated these giant mammal remains, which were discovered at a depth of slightly over half a meter in the same geological layer of Toca do Serrote das Moendas in which human bones were recovered. One tooth was analyzed at the Department of Physics of the Riberão Preto Faculty of Philosophy, Science, Languages and Literature, which is part of the University of São Paulo (FFCLRP/USP); the other tooth was examined at the Department of Chemistry of Williams College in Massachusetts. The results of both tests indicate similar results: 29,000 years in the first case and 24,000 in the second. At the Baixada Santista campus of the Federal University of São Paulo (Unifesp), a



third group ascertained the age of the concretion, that is, a compact layer rich in carbonates capping the sediments, in which the animal teeth and human skeleton fragments were discovered. As expected, the latter test confirmed that the concretion layer was younger than the layer that contained the animal remains: the soil sample was 21,000 years old. Equipment purchased with FAPESP funding was used in the two dating measurements performed in Brazil.

Based on the results of these three tests, the researchers believe that they have gathered indirect evidence of human presence at least 20,000 years ago in what is today the semi-arid northeast region of Brazil, which is well before the date that traditional archeology posits for the peopling of the Americas. “The three dates line up,” says physicist Oswaldo Baffa, coordinator of the Ribeirão Preto/USP group and one of the study’s authors. “To mitigate any possible criticism, we were careful to have the samples analyzed at three different places, where they worked blind, without knowing exactly what they were analyzing.” The classic view, as advocated by US groups, posits that the first *Homo sapiens* arrived on the continent approximately 13,000 years ago by crossing the Bering Strait, which separates Asia from Alaska. The conclusions derived from the tests on the material collected in the semi-arid Northeast cave were published in an article in the *Journal of Human Evolution* in December 2014. “There was no collagen that could be used to directly date the human bones from the cave using carbon 14,” says archeologist Niède Guidon, another author of the paper and president of the Museum of the American Man Foundation (Fumdhm). “But the results of the dating of



Marsh deer: animal depicted in the region’s rock paintings

Niède Guidon believes that *Homo sapiens* may have reached Piauí by sea

the deer teeth and the concretion layer, obtained by three different laboratories, point to very ancient human occupation of the region.” Fumdhm manages the park in conjunction with the Chico Mendes Institute for Biodiversity Conservation (ICMBio), a government agency within the Ministry of the Environment.

Guidon and her collaborators have been conducting research in the vicinity of the park—a UNESCO World Heritage site—since the 1970s, particularly in the fields of archeology and paleontology. Her team has catalogued 1,400 prehistoric sites in the Capivara Mountains, which has the largest concentration in the Americas; 900 of these sites have rock paintings created thousands of

years ago. In addition to human figures, the drawings on the rocks depict animals, including marsh deer (*Blastocerus dichotomus*), which is the species whose teeth were found at Toca do Serrote das Moendas. Although there are numerous sites in the semi-arid state of Piauí, those sites have never provided human remains that could be carbon dated, which is the method that is generally employed to ascertain the age of organic matter (i.e., bones, shells, wood, coal, fabric) from as long ago as 50,000 years and in some cases even 100,000. Collagen, the organic portion of the bones that is indispensable to this dating technique, is a protein that is rarely preserved in the skeletons discovered in this region.

Because it was impossible to determine the age of the bones discovered at what are potentially the oldest of the Capivara Mountains sites, Guidon has almost always endeavored to establish an acceptable timeline for the environment in which human bone fragments have been unearthed and for the artifacts and remains that may have been produced by human hands. Over the past three decades, she has dated the remains of stone hearths and artifacts attributed to *H. sapiens*, along with ubiquitous rock paintings, a mark of human presence. Her results, which are still questioned by a significant portion of the scientific community, suggest a human presence in the region between 30,000 and 100,000 years ago; the hypothesis is that man arrived this early by way of an Atlantic sea route. The new study at Toca do Serrote das Moendas, a site located approximately five kilometers from the park, has afforded the archeologist additional data, based on other dating techniques, which can be applied to the controversial puzzle regarding when man first set foot in the Brazilian Northeast and, accordingly, in the Americas.

This prehistoric site generates new potential for analysis. The sizeable cave, which measures 35 meters by 23 meters at its greatest width, has supplied the remains of paleofauna, stone artifacts, ceramic fragments, and portions of three human skeletons, two of children and one of an adult. The two teeth of the marsh deer lay side by side, 35 centimeters away from the fragments of the adult skeleton and located at the same depth. This sce-



Human bones were found 35 cm away from two deer teeth (below) in the same geological layer



nario is an indication—although not irrefutable proof—that man and animal may have co-existed during the same era.

Electron spin resonance (ESR)—also known as electron paramagnetic resonance spectroscopy—was used to date the teeth. The technique measures the amount of ionizing radiation incident on a sample using the spin concentration prompted by energy deposited in the material. “In principle, the older a tooth, the greater the dose deposited in it,” says physicist Angela Kinoshita of Sacred Heart University (USC) in Bauru, São Paulo, and a post-doctoral researcher at the USP Department of Physics in Ribeirão Preto, who examined one of the teeth using the technique. When dating a sample, in addition to recording the level of radiation stored in the tooth’s enamel and dentine, scientists must consider the specific conditions at the site in which the material being analyzed was discovered (i.e., local levels of radiation emitted by elements such as uranium, thorium, and potassium) as well as cosmic radiation.

A different technique was used to date the carbonate-rich concretion layer that practically sealed off the sediment stratum in which the teeth and human remains

were found: optically stimulated luminescence (OSL). This method measures levels of this type of light in the quartz crystals of a geological layer. “Theoretically, the more intense the OSL signal, the older the sample,” explains Sonia Tatumi, the Unifesp physicist who analyzed two samples from the concretion layer at Toca do Serrote das Moendas. “Quartz absorbs blue light and emits OSL in the ultraviolet region,” she says. The data derived from a sample taken from the most central portion of the concretion were inconclusive. However, examination of a more external piece of the layer provided the results that appear in the scientific article: an age of 21,000 years, with a degree of accuracy of nearly 94%, according to Tatumi. ■

Project

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Scientific article

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