

# Earliest evidence for human-megafauna interaction in the Americas

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## RESUMEN

La extinción de la megafauna en el Pleistoceno tardío es un tema de gran interés académico que también implica asuntos éticos, debido a la propuesta del impacto humano entre sus posibles causas. Las evidencias de la interacción humanos-megafauna son escasas, especialmente en América del Sur, donde este tópico está vinculado al debate sobre la fecha del arribo humano. Aquí se presentan los resultados de dos dataciones radiocarbónicas del material hallado en un sitio en el Arroyo Vizcaíno, Uruguay. Uno de los restos corresponde a una costilla y el otro a una clavícula, ambas pertenecientes a un mamífero gigante extinguido, el perezoso terrestre pleistoceno *Lestodon*. La clavícula muestra marcas de origen humano. Los análisis dieron resultados consistentes, entre 28.000 y 29.000 años atrás, una edad mucho más antigua que la que predice el presente paradigma de poblamiento de las Américas y de las dataciones aceptadas actualmente, que se agrupan alrededor de los 12.000 años atrás.

**Palabras clave:** datación radiocarbónica, paleoindio, perezoso terrestre, Uruguay, Cuaternario.

## ABSTRACT

Megafaunal extinction in the late Pleistocene is a topic of great academic interest that also arouses ethical issues, due to the proposed impact of humans as its possible cause. Evidences on human-megafauna interaction are scarce, especially in South America, where this issue is entangled with the debate on the date of human arrival. Here we present the results of two radiocarbon datings of material found in a site in the Arroyo Vizcaíno, Uruguay. One of them was a rib and the other a clavicle, both belonging to an extinct giant mammal, the Pleistocene ground sloth *Lestodon*. The clavicle shows human-made marks. The analyses yielded consistent results, between 28 and 29 kybp, a much older age than predicted by the present paradigm of peopling of the Americas and from currently accepted datings, which cluster at about 12 kybp.

**Keywords:** radiocarbon dating, palaeoindian, ground sloth, Uruguay, Quaternary

## INTRODUCTION

The arrival of *Homo sapiens* in the New World at the end of the Pleistocene was followed by the continental extinction of a high number of large mammal species, belonging to the orders Proboscidea, Artiodactyla, Perissodactyla, Xenarthra, Liptoptera and Notoungulata. They disappeared in a few centuries, from Alaska to Tierra del Fuego (Barnosky *et al.*, 2004), with larger species having a stronger share of this extinction (Lessa and Fariña, 1996; Lessa *et al.*, 1997).

Apart from the influence of climatic change, some human induced causes have been proposed to explain the brevity and severity of this event: overkill by palaeoindians (*Blitzkrieg*), habitat modification by humans (*Sitzkrieg*) and extremely lethal diseases, perhaps also brought by humans, and combinations of some or all of them (Martin, 1984; Beck, 1996; MacPhee and Marx, 1997; Ferigolo, 1999).

Although recently the weight of the importance assigned to the human factor has grown (Barnosky *et al.*, 2004), evidences on human-megafauna interaction are scarce, especially in South America, where this issue is entangled with the debate on the date of human arrival (Miotti *et al.*, 2003). Here we present the results of two radiocarbon datings of material found in a site in the Arroyo Vizcaíno, Uruguay, that strongly modify our current view of this issue. One of the remains was a rib and the other a clavicle, both belonging to an extinct giant mammal, the

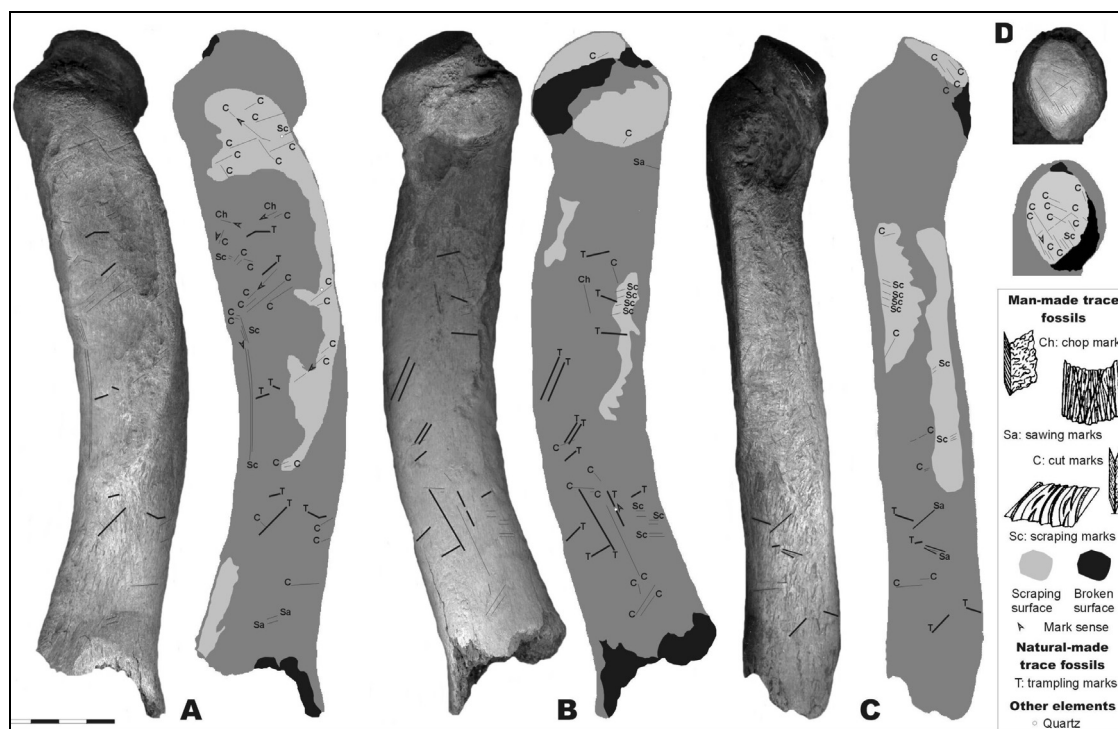
Pleistocene ground sloth *Lestodon*. The clavicle shows human-made marks, extensively described in Arribas *et al.* (2001).

## STUDIED SITE

The site containing the clavicle, the rib and many other remains of typical members of the Pleistocene South American megafauna (some individuals of *Lestodon* and three genera of glyptodonts: *Glyptodon*, *Doedicurus* and *Panochthus*) was found in the Arroyo Vizcaíno, near the town of Sauce, Departamento de Canelones, Uruguay (latitude: 34°35' S, longitude: 56°03' W). This fossil material was recovered from the sediments in the riverbed during a very severe drought in January 1997. These sediments were assigned to the late Pleistocene Sopas-Dolores Formation (Panario and Gutiérrez, 1999), typically composed of reddish brown (5 YR 5/4) deposits of reworked loess, with tectosilicate grains. From the geomorphological perspective, the site is a place where the stream becomes deeper, forming a natural pond on a substrate of Cretaceous sediments (Mercedes Formation).

## METHODS

Although it lacks the sternal end, the clavicle is in good condition, with the outer bone layer well preserved on all surfaces (Fig. 1). It must have undergone only a very slight aeolic polishing. The 87 marks observed on the anterior surface, posterior surface, dorsal border and on the acromial articular surface preserved are very clear



**Figure 1.** Clavicle of *Lestodon* (A: anterior surface, B: posterior surface, C: dorsal border, D: acromial end) showing cut marks (C), chop marks (Ch), sawing marks (Sa), and trampling marks (T) at macro and mesoscale, with scraped surfaces (Sc), associated microstriae and broken surfaces (scale bar length in cm). Taken from Arribas *et al.* (2001). Diagram of cut mark sections in the figure modified after Noe-Nygaard (1989).

(Arribas *et al.*, 2001). Apart from the naturally-made trampling marks (Lyman, 1994), all the four types of possible human-made marks (Noe-Nygaard, 1989) have been identified: chop, sawing, scraping and incisions or true cut marks (Fig. 2). They are especially associated with muscular attachment areas (Arribas *et al.*, 2001), suggesting they were made while accessing the scapulohumeral joint or the muscles under the scapula, possible places for dismembering the forelimb.

A sample was taken from the broken end of the clavicle. After dissolving the mineral fraction in cold 0.1N HCl, collagen was washed in cold 1.0M NaOH to remove secondary organics and then dried, measured for  $^{13}\text{C}/^{12}\text{C}$  and dated by accelerator mass spectrometry (AMS) in Beta Analytic Inc., Miami, FL, USA. This sample, identified as A° Vizcaíno 2, yielded a measured age of  $29\,050 \pm 290$  BP ( $\delta^{13}\text{C} = -18.8$  ‰;  $29\,150 \pm 290$  BP conventional radiocarbon age; Beta 206660). Another sample was taken from an accompanying rib (A° Vizcaíno 1), also assigned to *Lestodon*. The condition of this other bone is also very good and it was treated in the same way.

## RESULTS

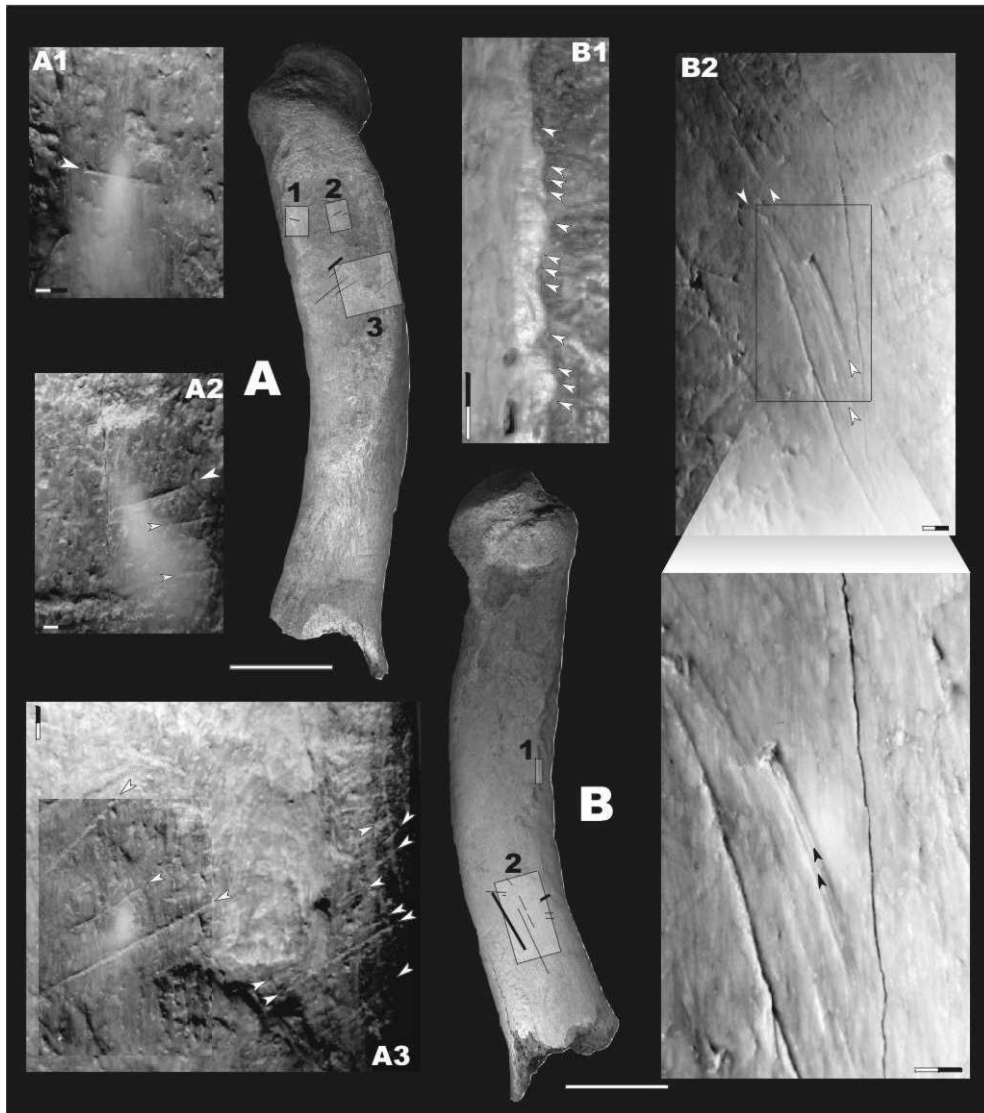
The sample taken from the marked clavicle, identified as A° Vizcaíno 2, yielded a measured age of  $29\,050 \pm 290$  BP ( $\delta^{13}\text{C} = -18.8$  ‰;  $29\,150 \pm 290$  BP conventional

radiocarbon age; Beta 206660). The other sample, taken from an accompanying rib (A° Vizcaíno 1) yielded a similar age of  $28\,200 \pm 230$  BP ( $\delta^{13}\text{C} = -18.6$  ‰;  $28\,300 \pm 230$  BP conventional radiocarbon age; Beta 204256).

## DISCUSSION

In these cases, when a much unexpected age is obtained, the possibility of contamination must be properly discussed. We claim that it can be safely discarded, based on the following arguments. Percentage carbon from combustion is considered to be an evidence of good quality of the sample when a percentage higher than 10% is found. For our samples, Beta-206660 yielded 11% and Beta-204256 yielded 33% carbon from the combusted collagen, both above the minimum required, although with a disparity likely due to differences in preservation in the material and pre-treatment consequences. This should be taken as evidence against the presence of contamination. Had contamination accounted for differences in the carbon content of the collagen, it is reasonable to state the two dates would have been completely different, as would have the  $^{13}\text{C}/^{12}\text{C}$  and  $^{15}\text{N}/^{14}\text{N}$  ratios (see below).

Moreover, purity of collagen in both samples was assessed by visual observation of the collagen, combined with the value obtained for the  $^{13}\text{C}/^{12}\text{C}$  and  $^{15}\text{N}/^{14}\text{N}$  ratios. In the case of these samples, the collagen appeared



**Figure 2.** Microphotographs of the observed cut marks (A: anterior face, B: posterior face). Chop marks on the anterior surface (A1 and A2) that have left two equally sized, convergent signs perpendicular to the main axis of the bone with cut marks associated, following the same direction. A3: set of parallel cut marks preserving the alignment at both sides of a depression, located in a muscle attachment surface. B1: part of a scraping surface, rendering these areas mechanically abraded, associated with a muscle attachment, with tens of parallel microstriae oblique to the main axis of the bone. B2: set of cut marks which left two consecutive, perfectly aligned cuts, probably due to a jump of the cutting edge, with visible inner microstriae. Bone scale in cm, microphotograph scale in mm. Taken from Arribas *et al.* (2001).

normal at visual observation throughout the pre-treatments. Furthermore, the  $^{13}\text{C}/^{12}\text{C}$  ratios were very typical of bone and the same (-18.6 and -18.8 ‰), and  $^{15}\text{N}/^{14}\text{N}$  ratios were also the same (+10.7 for Beta 206660 and +10.3 ‰ for Beta 204256). It is important to note that the two samples were analysed at completely separate times, 3 months apart from each other. Given this, with collagen visually looking good in both cases, the  $^{13}\text{C}/^{12}\text{C}$  and  $^{15}\text{N}/^{14}\text{N}$  ratios being in good agreement with each other, and the two dates being statistically identical (three different lines of congruent evidence in spite of the extracted collagen has had completely different carbon contents), dating accuracy should be regarded as reliable and therefore the possibility of

contamination can be safely ruled out. In other words, for the dates not to be accurate, the analysed material would have to be entirely contamination with  $^{13}\text{C}$  and  $^{15}\text{N}$  ratios similar to a 28 ky-old bone, which of course is far from likely.

Those results imply a very much earlier human presence than usually accepted both in South America and in North America (Barnosky *et al.*, 2004; see also Dillehay, 1999, 2000). Most dates of earliest evidence of peopling cluster at about 12 000 BP (Miotti *et al.*, 2003; Barnosky *et al.*, 2004). However, a recent proposal of ancient coexistence of humans and megafauna comes from Santa Elina, a rock shelter in central Brazil (Vialou, 2003). In its Unit

III, numerous bones of the extinct ground sloth *Glossotherium* dated by U-Th as  $27\,000 \pm 2\,000$  BP were found contiguous to lithic material, although further studies are needed to rule out a stratigraphic artefact. Those bones show no evidence of butchering.

The results discussed here suggests as a first attempt of colonisation before the climate became too harsh for human thriving as it approached the last glacial maximum (Markgraf, 2001; Lambeck *et al.*, 2002). In this view, that early population, living as far South as the present territory of Uruguay, may have gone extinct or moved to tropical latitudes. A second wave of immigrants must have taken the land only when the climate started to ameliorate in the last few millennia of the Pleistocene, once the glacial maximum was over.

Another consequence of these results has to do with the proposal of the *Blitzkrieg* or rapid overhunt as the cause of extinction of the megafauna (Martin and Klein, 1984). That early population had interaction with the species of the megafauna, either as hunters or carrion-eaters, but obviously did not drive them quickly to extinction. If the human impact was the decisive force in that extinction, it must have been so through the action of that possible later wave of colonisers, who might have taken advantage of the improved climatic conditions that must have favoured the growth of their populations.

Moreover, it can be speculated that perhaps the route of human migration through the Americas might have not been as simple as previously suggested (Martin and Klein, 1984; Barnosky *et al.*, 2004), with Behringia and Alaska as the starting point of a straightforward southbound journey. The possibility exists that early inhabitants may have colonised and even re-colonised North and South America travelling from each other more than once.

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