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Recent archaeo-palaeontological findings from Barranca del Muerto site, Santiago Chazumba, Oaxaca, México

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ABSTRACT

This article presents the first results of an archaeo-palaeontological study which began in 2007 at the sites of Chazumba I and II in the Barranca del Muerto, located in the Sierra Madre del Sur (Santiago Chazumba, Oaxaca, Mexico). The excavation work is part of a larger international cooperation project titled "Biodiversity and Quaternary hunter-gatherer societies from Mexico", led by the Institut de Paleoeccologia Humana i Evolució Social (IPHES, Tarragona, Spain) and the Instituto Nacional de Antropología e Historia of Mexico. The main objective of the project is to study hunter-gatherer groups and their relationships with Pleistocene fauna and rock art.

To date, five excavation campaigns have been carried out (2007, 2008, 2010, 2013, 2014), which have primarily yielded faunal remains from the Late Pleistocene and from within a still undetermined period during the Rancholabrean Age (NALMA). The fauna is represented by megaherbivores (giant sloth, glyptodont and gomphotheres, among others) and mesoherbivores (deer, prong-horns, horses and even small mammals, reptiles and amphibians). Some lithic materials have been recovered in association with these remains and several fossils have been examined to determine the presence of cut marks. There is an AMS 14C date of 27,720–27,500 cal BP obtained from a charcoal sample from sediments on top of the bone layers. Further sample assays are warranted in order to confirm the antiquity of the archaeological assemblage.

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1. Introduction

The origin of the peopling of the Americas remains a subject of scientific controversy. However, all research addressing the American Pleistocene aims to contribute something new to the study of the human societies that inhabited the continent and to improve our understanding of the palaeoenvironmental setting and its

various species of fauna. In this case, we focus our attention on sites in Mexico (Arroyo-Cabrales et al. 2003, 2010).

There are an increasing archaeological evidence and a growing body of genetic data on early American human populations and, although still debatable, these point to the possibility of even more ancient migrations. For example, analyses conducted at Monte Verde II (Chile) and Tlapacoya I and Cedral (Mexico) have generated dates of more than 12,500 BP (Mirambell, 1967, 1978, 2012; Lorenzo and Mirambell, 1986; Dillehay and Mañosa, 2004; Acosta Ochoa, 2007).

In 2006, residents of Santiago Chazumba inadvertently discovered 35 Pleistocene megafauna remains, which led to a site inspection by specialists from the Instituto Nacional de Antropología

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e Historia (INAH) in Mexico City. The bones were at the depth of a ravine known as the Barranca del Muerto, and had fallen from the middle of one of the walls of the gully. The remains belonged to a proboscidean, apparently a mammoth (*Mammuthus columbi*). INAH researchers found that the wall and the skeletal remains were at risk due to steady erosion caused by torrential rains, which were undermining the foundation of the vertical section and resulting in a landslide of the palaeontological levels. The problematic location of the deposit required an urgent and necessary excavation in order to prevent the bones from continuing to plummet to the bottom of the canyon where they were being dragged and destroyed by the current during the rainy season.

Shortly thereafter, a team of archaeologists from the Institut de Paleoecologia Humana i Evolució Social (IPHES, Tarragona, Spain) visited the site and agreed with the palaeontologists and experts

from the INAH that the systematic excavation for the recovery of the remains of the proboscidean should be included within the project “Biodiversidad y sociedades cazadoras recolectoras del Cuaternario de México”, an international cooperation research project between Mexico and Spain, comprising the states of Oaxaca, Sonora and Baja California Sur, initially funded by the Agencia Española de Cooperación Internacional (AECI).

However, what at first was intended to be a rescue excavation of the remains of a mammoth, became the discovery of a large palaeontological deposit of great interest for understanding the Late Pleistocene in this area of Mexico (Cruz et al., 2009; Arroyo-Cabral et al., 2012a, b). The excavation, spanning an area of 30 m² at the Chazumba I site, revealed the palaeontological potential of the site starting from Level VII, located at a depth of 5 m and containing numerous fossils of different species. Associated

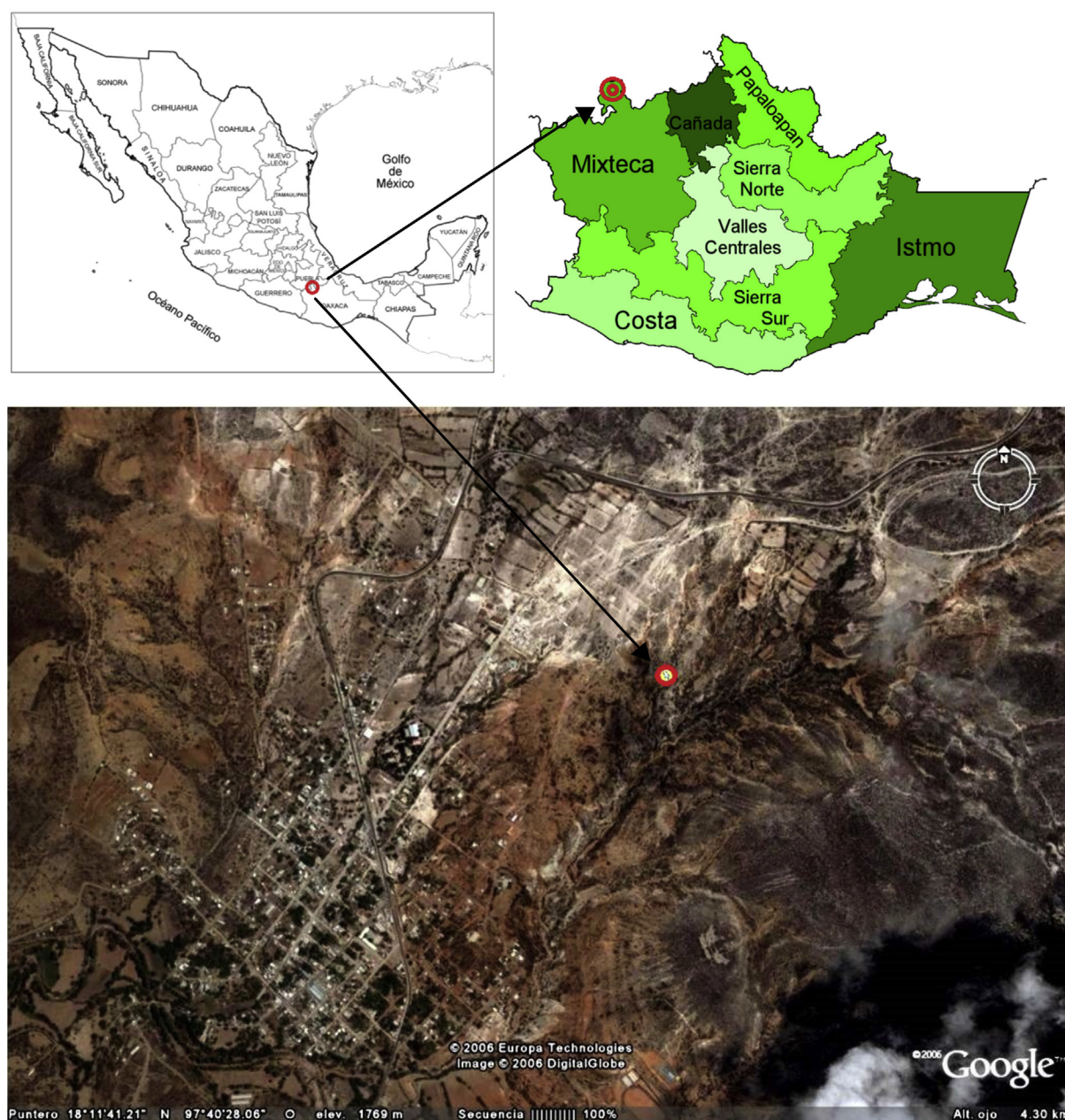


Fig. 1. Location of Barranca del Muerto site (Santiago Chazumba, Oaxaca, México).

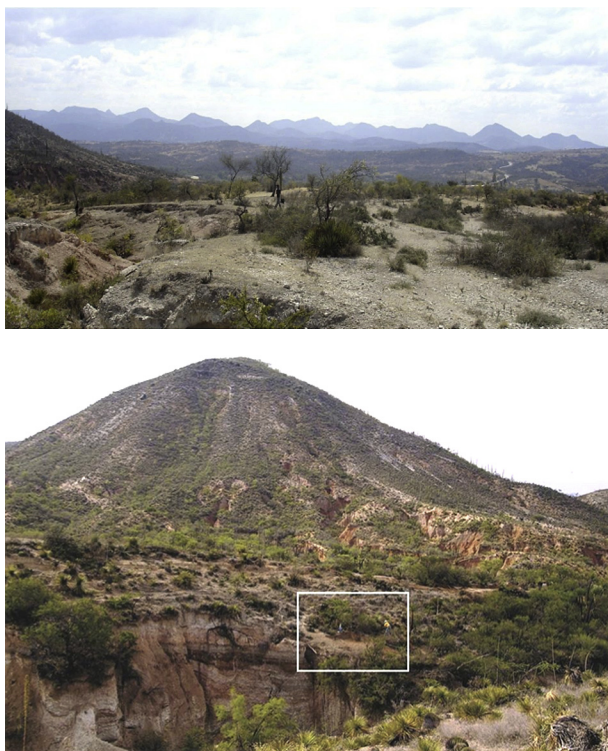


Fig. 2. View of the Sierra Madre del Sur (top) and Cerro Yacuzá (bottom) with Barranca del Muerto site. The box indicates the excavation area of the Pleistocene deposit of Chazumba I.

with the faunal remains there were some lithic fragments, perhaps indicative of expeditious industry. However, on the same hillside, outside of the stratigraphic context, various retouched lithic pieces were recovered that could have come from either the palaeontological levels or from the surface level ravaged by erosion. These artefacts were documented along with several chips and small pieces of pre-Hispanic pottery.

In addition to the need to rescue the bones, we were also interested in finding any possible evidence of human activity related to the fauna. Furthermore, the discovery of another collapse containing megafauna remains in a nearby natural cut (Chazumba II) forced us to continue the excavations to recover the fossils that were exposed in the pit of the creek and above the channel stream (2007, 2008, 2010, 2013, 2014)

The excavation work has led not only to the recovery of a large megafauna assemblage, but also to the documentation of the stratigraphy of Chazumba and to the discovery of new evidence regarding the palaeoenvironmental conditions in the region (Arroyo-Cabrales et al. 2013). No other controlled excavations of Pleistocene sites have ever been undertaken in the Mixteca Baja region. However, the existence of isolated palaeontological findings has been reported in different nearby towns including San Pedro and San Pablo Tequixtepec, south of Santiago Chazumba, and in San Miguel Tequixtepec, in the Coixtlahuaca Valley in the Mixteca Alta (Pérez-Crespo et al. 2007). Notably, *Glyptotherium* remains have been recovered in the region of San Juan Raya (Puebla), about 20 km north of Santiago Chazumba and were studied by José R. Ortega Ramírez (a geologist at INAH) and Alfonso Valiente (an ecologist at the Institute of Ecology, UNAM), who dated the bones to 19,310 BP (Medina Sánchez, 2009).



Fig. 3. Barranca del Muerto. Excavations in the sites of Chazumba I (top) and Chazumba II (bottom).

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Fig. 5. Wall landslide at Chazumba I, on the canyon bottom.

The palaeontological findings at the Barranca del Muerto are currently the most significant of the Mixteca Baja. The site was discovered by coincidence when two young brothers from Santiago Chazumba, Daniel and Ivan Cervantes, were roaming a dry creek bed in the gully and came upon some large bones. The boys subsequently transported them to the local town hall. In the same place, they observed the presence of other remains about 5 m up on a vertical wall, where, it was later learned, all the bone material came from.

The bones were classified as belonging to *Mammuthus columbi*, and consisted of two humeri, one coxal ilium tuberosity of the pelvis, a phalanx, several fragments of ribs and a kneecap, all exhibiting the effects of drying and requiring urgent consolidation. The finding was reported to the INAH authorities and excavations were planned in co-direction with the IPHES to salvage the materials in keeping with the following objectives: 1) to retrieve osteological material of Pleistocene fauna; 2) to reinforce the skeletal material recovered; 3) to determine the existence of any human activity, related or not, to the palaeontological remains; and 4) to understand the taphonomy of the materials and the origin of the deposit.

The studies now underway will assess climatic changes during the Late Pleistocene reflected in the past and present faunal composition. However, our final conclusions must await the results of the studies of the osteological materials, their final identification, as well as the pollen, lithic and new radiometric analyses.

2. Barranca del Muerto and its Pleistocene deposits

2.1. Location and characteristics

La Barranca del Muerto is a tributary of the Manzanera River, located in the Sierra Madre del Sur, in northwest Oaxaca. It belongs to the municipality of Santiago Chazumba (elevation 1700 m)

within the Mixteca Baja region and the subregion called Tequixtepec-Chazumba, at the north end of the district of Huajuapán de León. Its meandering northeast–southeast path begins northeast of the municipal seat of Santiago Chazumba and crosses the base of Cerro Prieto or Yacuzá. Its coordinates are: 18° 11'N, 97° 41'W (Figs. 1 and 2).

The Mixteca Baja region is characterized by hills, valleys and gullies covered in xerophytic vegetation and tropical deciduous forest. A dry, semi-desert climate and heavy erosion caused by torrential waters in times of rains create significant flows that break down the soil, causing cracks and gullies such as the Barranca del Muerto, along which run the intermittent streams that are currently destroying the Pleistocene deposits (Fig. 2).

2.2. Area of study

The area of study is located in the vicinity of the town and very close to the expansion of the urban area, which is a serious problem for the preservation of the Pleistocene deposits. The geology of the area is characterized by different types of materials, metamorphic, sedimentary and igneous, which are distributed according to elevation: sandstones and conglomerates in the valleys; basalt, andesite and volcanic breccia in the surrounding valleys; and limestone materials in the mountains to the north of Santiago Chazumba.

Several points containing remains of Pleistocene fauna have been located throughout the Barranca del Muerto and neighbouring areas. However, the two most significant fossiliferous deposits are located in a side ravine of the Barranca del Muerto.

The Chazumba I site, located at 18°11'44"N, 97°40'15"W at an elevation of 1774 m, is a wall measuring about 12 m in height which defines the left margin of one of the gullies most affected by fluvial erosion. The site is located in an area where the channel leads through a conduit, causing torrential water to crash against the wall deposit (Figs. 3–5) (Table 1).

Table 1

Archaeo-palaeontological materials recovered in Chazumba I (up to 2013 archaeological campaign).

Chazumba I	2007	2008	2010	2013	Total
Faunal remains	190	88	72	227	577
Charcoal samples		5	7	22	34
Sediment samples	28	1	7	2	38
Pollen samples		2	20	20	42
Lithic remains in stratigraphic context	11	7	16	60	94
Lithic remains in surface (without stratigraphic context)	30	23	27	14	94
Ceramic remains in surface	5	10			15
Total	264	136	149	345	894

Some palaeontological materials in Chazumba I, in particular, fragments of the long bones of megamammals, initially surfaced in a cut in the wall between 5 and 6 m above ground level. In this zone of the gully, it is possible to observe the different horizontally stratified and sometimes sinuous layers, indicating ancient erosion processes and the existence of palaeochannels, which may have undermined and partially destroyed the surface of the palaeontological deposits. These layers are typically composed of fine clay sediments, sometimes with clasts, gypsum crystal “desert roses”, and sand and gravel of river and swamp origin (Fig. 5).

The Chazumba II site was detected during the 2010 season, 17 m north of the previously mentioned site in the same stream. As is the first deposit, it is a vertical slit which defines the left side of a gully (Figs. 3 and 4) (Table 2). Thus the water impacts and erodes the base while at the same time precipitating from the top of the platform in a cascade, creating a channel which runs vertically along the deposit. Between 2009 and 2010, rainfall broke off part of the wall and large blocks with sediment and the remains of a glyptodont collapsed to the bottom of the stream bed. The site is therefore divided into two zones: the wall, and the landslides that have accumulated on bottom of the gully (Fig. 6).

Table 2

Archaeo-palaeontological materials recovered in Chazumba II (up to 2013 archaeological campaign).

Chazumba II	2010	2013	Total
Paleontological remains	288	161	449
Charcoal samples	4	5	9
Sediment samples	24	6	30
Pollen samples		10	10
Lithic remains in stratigraphic context	21	10	31
Total	337	192	529

3. Methodology and laboratory studies

The approach to the excavation at Chazumba I was conditioned by the characteristics of the wall, which is vertical and poses the risk of collapse. To this end, a 5×6 m (30 m^2) grid was established from the edge of the creek and a platform of earth was constructed to contain the wall of the deposit and excavate it, in stepped form and from the outside, where sediments crack and move, fracturing the bone material and dropping it to the ground below.

Each 1×1 m square was designated with initials and each unit (bone, lithic raw material, snail, charcoal or sediment samples, etc.) was registered and tagged with its corresponding coordinates (X, Y, Z) to obtain the spatial and stratigraphic record (Fig. 4). Most of the bones were consolidated *in situ* with polyvinyl acetate diluted in water and, depending on the nature and size of each one, wrapped in aluminium foil, bubble wrap and individual bags or packed in polyurethane moulds for transport. In some cases, the remains were recovered with adhering sediment and excavated in the Archaeozoological Laboratory of the Subdirección de Laboratorios y Apoyo Académico at INAH. An exhaustive photographic record of the excavation process was also taken and maps were drawn up showing the levels and sections of the stratigraphy and the location of the materials within it at a 1:5 scale in order to determine the deposition processes that had taken place and to undertake a taphonomic study.



Fig. 6. Wall landslide at Chazumba II.

For practical purposes, level 0 and the grid were moved to 5.10 cm in depth, where the palaeontological deposit was found (Level VIIa.1). All the sediment removed during the excavation process was screened using ½ inch sieves, and the remaining material was transported to the Subdirección de Laboratorios y Apoyo Académico at INAH in Mexico City for washing and sieving for microvertebrate remains.

The excavation work began at the Chazumba II site during the 2010 season. The area was delimited with a 12 × 12 m grid to include the various different points of this site: wall, channel landslides and debris accumulated in the channel. Much of the material was out of context. However, the coordinates were recorded in order to transfer this data to the stratigraphy of the wall. To rescue the faunal remains exposed on the wall and in the high area of the canal, including a jaw and the proximal end of two incisors or tusks of a gomphothere, overlapping scaffolding was installed from the bottom of the creek bed to a height of 6.50 m to allow the digging to be done from the top.

The sampling and analyses for the study were carried out by a large team of researchers: Jaime Urrutia-Fucugauchi (Institute of Geophysics, UNAM), paleomagnetic dating; Antonio Flores (Soil Chemistry Laboratory, INAH), soil surveys; Jose R. Ortega Ramírez (Geophysical Laboratory, INAH), paleoenvironments and sedimentology; Ramón Viñas, AMS 14C dating; Joaquín Arroyo, study and analysis of bone material; Iran Rivera (Laboratory of Palynology, ENAH) and Francesc Burjacs (Laboratory of palaeoclimate, IPHES),

pollen studies; Xosé P. Rodríguez and Ramón Viñas (IPHES), lithic analyses; and Itzel Eudave (URV), cut marks study.

3.1. Excavation units

At Chazumba I, the palaeontological deposits begin at level VIIa, located at a depth of approximately 5.30 m from the surface. The excavation area measures 30 m², and only the northern squares at the edge of the wall (A and B: 2, 3, 4, 5, 6) have been excavated, although with some cracks and collapse problems. The remaining squares have just begun to be excavated or remain intact (Fig. 5). During the last season (2014) the base of the deposit in squares A and B was reached at a depth of 9.50 m, indicating a thickness of 4 m for this part of the palaeontological deposit.

The Chazumba II site required a top opening in order to remove the remains from above. To date, the work has been limited to the rescue of the materials accumulated inside the landslides and those in the wall in danger of collapse (Fig. 6).

3.2. Chazumba I stratigraphy

The complete stratigraphic column is 9 m thick and is divided into four squares, parts A and B, the characteristics of which are presented below (Fig. 7):

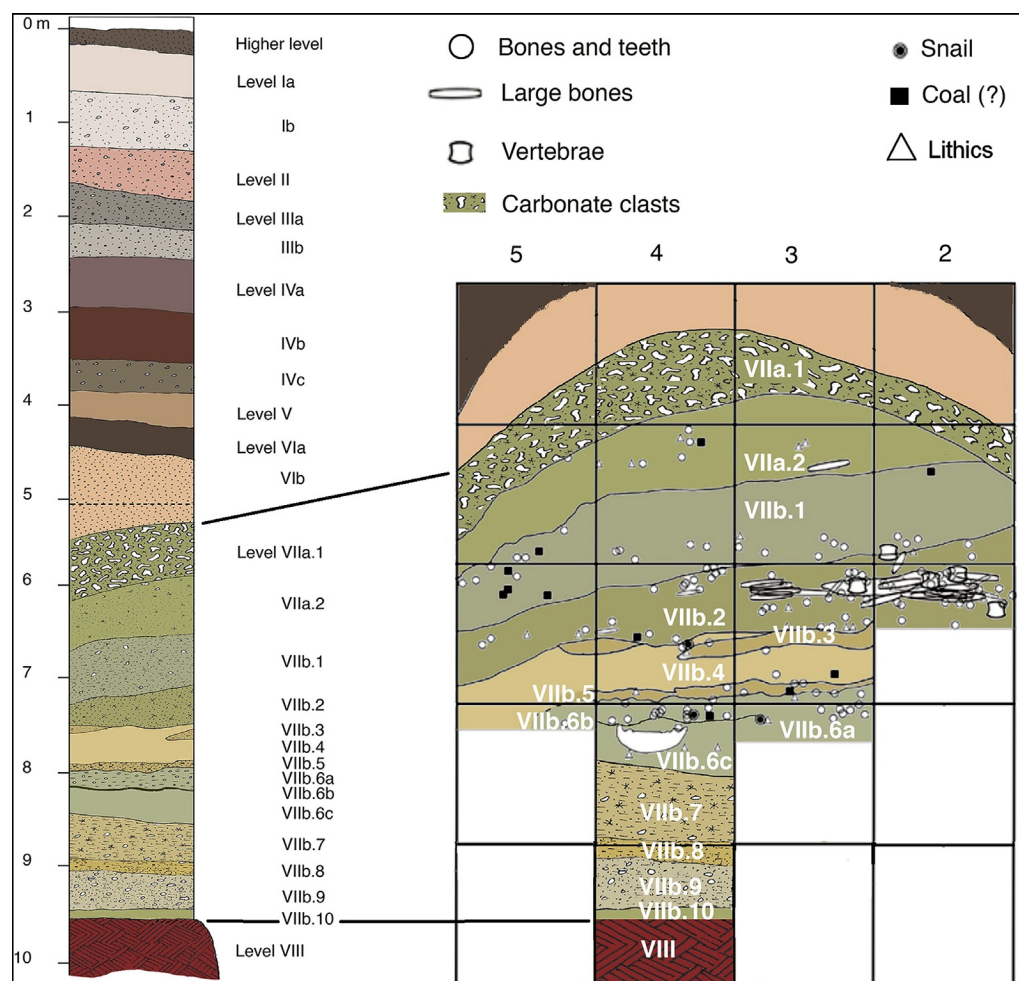


Fig. 7. Stratigraphic sequence of Chazumba I. Left: Stratigraphic Column (square A/B: 4) (thickness: 10 m). Right: the palaeontological levels start at VIIa.1 fossil level (5.30 m deep), and reach the VIIb.10 level (9.50 m deep) (square A/B: 2–5).

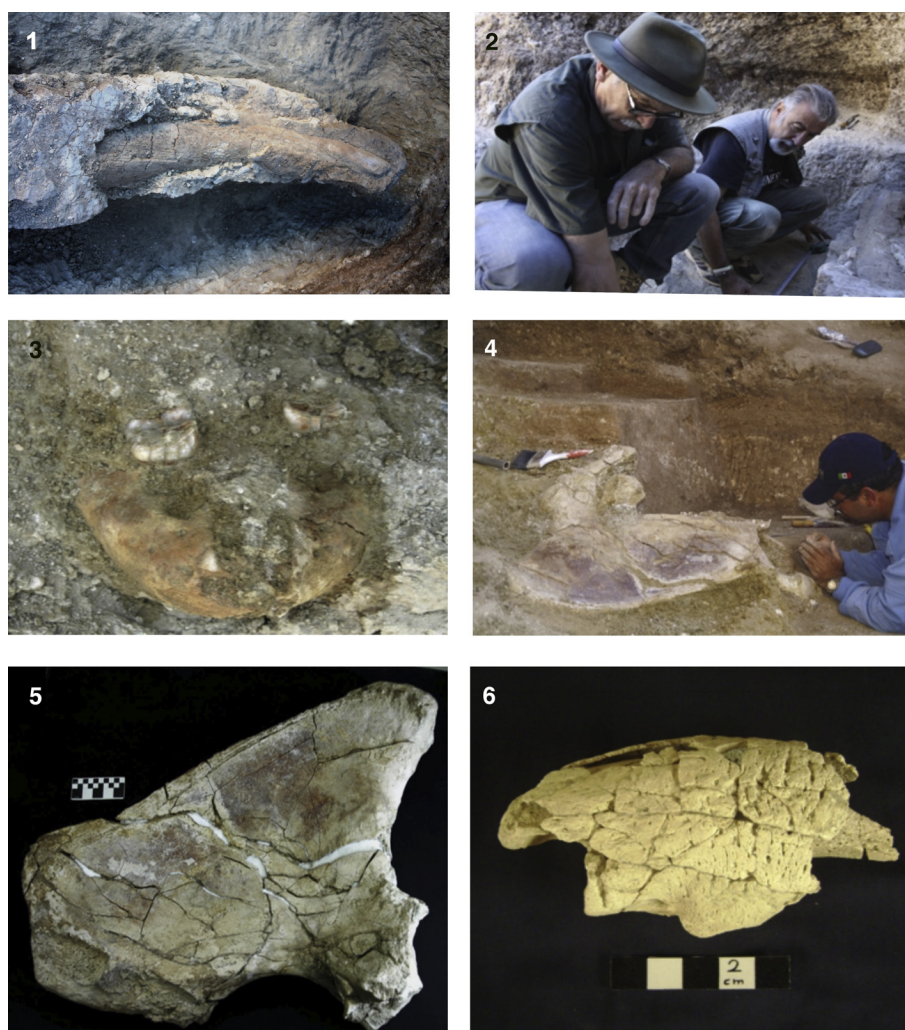


Fig. 8. Remains of megafauna from Chazumba deposits: 1–2) Gomphotherium tusks (Chazumba II); 3) Gomphotherium mandible (Chazumba I); 4–5 “Xenarthran” pelvis (Chazumba I); 6 Giant ground sloth claw *Eremotherium* (Chazumba I).

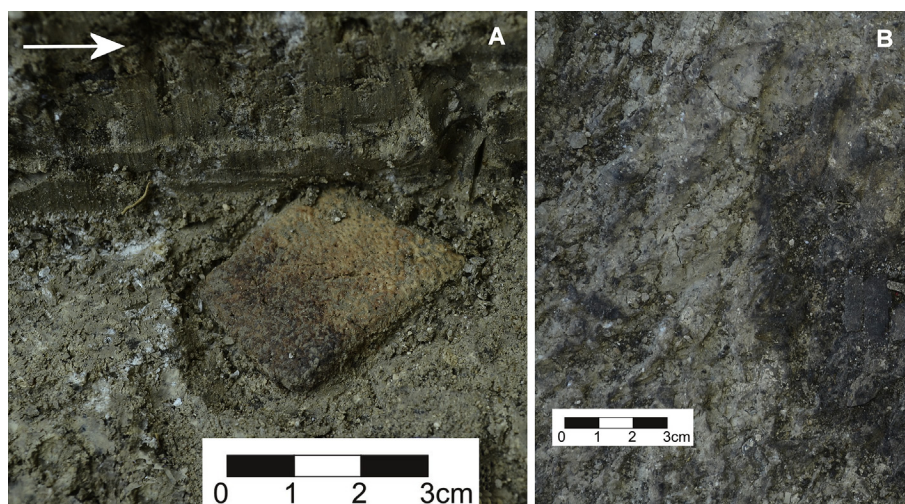


Fig. 9. Remains of pampatherium (*Pampatherium mexicanum*) found in Chazumba II during the 2014 archaeological excavation (A), and location of the charcoal sample that has been dated (B). In figure A an arrow indicates the location of the sample above the remains of pampatherium.

Stratigraphic observations showed that the palaeontological deposit was formed by silts, clays, sands and gravels of fluvial origin, indicating the existence of springs, lakes and wetlands with shallow waters that were quickly desiccated and periodically re-established (abundant presence of gypsum crystals or “desert roses”). Additionally, as a working hypothesis, we propose that the same river erosion remodelled the surface of the palaeontological deposit, providing the numerous nodules or carbonate clasts (between 3 and 10 cm in diameter) that are abundant in the upper half of Level VIIa. This process culminated in the mogote morphology of the site (Fig. 7).

4. Results

Each new campaign has accomplished the rescue of a large number of fossils and expanded the list of new species recovered in the area, underscoring the abundance of large mammals, notably including gomphothere (Proboscidea, Gomphotheriidae, *Cuvieronius* sp.) and four taxa from the superorder Xenarthra: one mylodon (*Paramylodon harlani*), a giant ground sloth (*Ereomotherium laurillardi*), a glyptodont (*Glyptotherium* sp.) (Fig. 8), and a pampatherium (*Pampatherium mexicanum*) (Fig. 9) (Table 3).

resources, but in the general context of an arid or semi-arid region. This may have attracted several species of fauna, both from the arid region and from the nearby area, to this water resource rich site.

A radiocarbon date of $23,420 \pm 90$ BP (27,720–27,500 cal BP, 2σ CI, Beta-399509) was recently obtained from a charcoal sample recovered from sediments on top of the bone layers of Chazumba II (Fig. 9). These sediments have been provisionally correlated with level VIIa of Chazumba I. This age provides a timeframe for the deposits at Chazumba and led us to propose a correlation with the nearby site of San Juan Raya (Puebla), with a *Glyptotherium* dated to 19,310 BP and with some older dates (around 25,000 BP) for the lower levels. The records of tortoises in the Chazumba deposits, including the genera *Kinosternon* and *Gopherus*, point to a dry and semi-arid climate that developed in the stage prior to 22,500 BP, as shown by pollen studies conducted in the nearby Tehuacan-Cuicatlán Valley in Puebla, which show a higher rainfall and cooler environment during the period between 22,500 and 5000 BP (Cruz et al., 2009).

In 2008, the two sediment samples collected in square B2 of Level VII at Chazumba I, analysed by F. Burjachs at the IPHES, provided one grass pollen or shrub belonging to the genus *Artemisia*; one trileta

Upper level	Clay rich in organic matter, 30 cm thick (brown), some jasper and chert flakes and small pieces of rounded pre-Hispanic pottery recovered outside of the grid
Level Ia	Fine silt textured, 50 cm thick (whitish), from an archaeological-palaeontological perspective, all levels are sterile from this level until the start of level VIIa.1
Level Ib	Silt and sand with small pebbles, 50 cm thick (whitish)
Level II	Silt with sand and small pebbles, 0–50 cm thick (pink)
Level III	Silt with sand and small pebbles, 30–40 cm thick (gray)
Level III b	Silt with sand and small pebbles, 30 cm thick (light gray)
Level IVa	Compact clays, 50–60 cm (reddish)
Level IVb	Silt and compact clay, 50–60 cm thick (reddish-brown)
Level IVc	Silt and clay with small pebbles, 30 cm thick (gray)
Level V	Silt of irregular thickness (beige)
Level VIa	Compacted clay, 30 cm thick (brown)
Level VIb	Silt and sand, 100 cm thick (pink)
Level VIIa	Clayey silt with sand, gravel, quartz, schist, gypsum crystals and “desert roses”, compact and hard with a high concentration of whitish, rounded carbonate clasts (light gray-green), irregular thickness, at this level the palaeontological deposit starts with the appearance of rodents, medium and small mammal ribs and unidentified bone fragments and ends with the appearance of Level VIII
Level VIIb.1	Silt clayey, sand, gravel, quartz, schist (similar to above) but with meagre clasts and less compacted (greenish gray and yellowish gray-green) lime, 20–50 cm thick, sticky texture; these features are present throughout the entire sequence of the fossil deposit
Level VIIb.2	Compact clayey silt with presence of gypsum crystals “desert roses” and small sand intrusions of 45 cm thick (light greenish gray), undulating
Level VIIb.3	Sand and gravel, with small quartzite pebbles and schist boulders, 10 cm thick (light ochre), disjointed lenticular pockets
Level VIIb.4	Compact clayey silt, 38 cm thick (yellow ochre)
Level VIIb.5	Sands with little gravel and gypsum crystal “desert roses”, 10 cm, irregular thickness and undulated (light ochre)
Level VIIb.6a	Clayey silt with small pieces of gravel and rolled stones, 20 cm thick (light gray greenish), slightly undulated morphology
Level VIIb.6b	Clayey silt, 2 cm thick (dark greenish gray), forms a slightly darker undulated line
Level VIIb.6c	Clayey silt, 30 cm thick (greenish light gray), a gomphothere jaw was uncovered here, occupying several different layers of VIIb.6
Level VIIb.7	Clay with gravel, quartzite, schist, and gypsum crystals, about 50 cm of irregular thickness (two shades: yellow ochre (left) and brown ochre-orange (right))
Level VIIb.8	Fine sand and gravel about 15 cm thick, elongated “denticular” and irregular pockets, (orange–brown), extends to the west
Level VIIb.9	Silt, about 30 cm thick, small intrusions of sand, gravel and small white pebbles, with a calcareous or carbonate appearance (gray-ochre)
Level VIIb.10	Silt without gravel or round stones, between 5 and 10 cm thick, “sticky” texture (gray greenish), indicates the beginning or bottom of the palaeontological deposit in A and B: 4 squares (9.50 m deep)
Level VIII	Compact clay stratum (reddish), apparently sterile

The fauna discovered at these sites indicate the existence of both a warm and humid microclimate close to the sites, which favoured the development of a tropical deciduous forest, and a dry grassland regional setting, with savannahs and temperate forest. In addition to the medium-sized mammals, most of the large mammals also suggest a warm, humid area, while some turtles and woodrat (*Neotoma* sp.) are most commonly located in dry scrub areas, and the Mexican vole (*Microtus* cf. *mexicanus*) is known to inhabit both grassland and temperate forest. Therefore, the specific location of Chazumba offered abundant

spore from a fern, *Botrychium* type; a genus of algae cyanoficea *Gloeotrichia*; fungal hyphae and *Polyporisorites* type; and ‘303’ and protist types (very abundant). Although this information does not allow for an interpretation of the vegetation at the site, this first analysis does reveal a constant humid environment.

One noteworthy finding comes from the preliminary study of the cut marks, initiated by Itzel N. Eudave and supported by Ursula Thun at the University of Ferrara (Italy), on an initial selection of eight bones from the Chazumba I excavation. The study resulted in the identification and classification of a carnivore mark, several

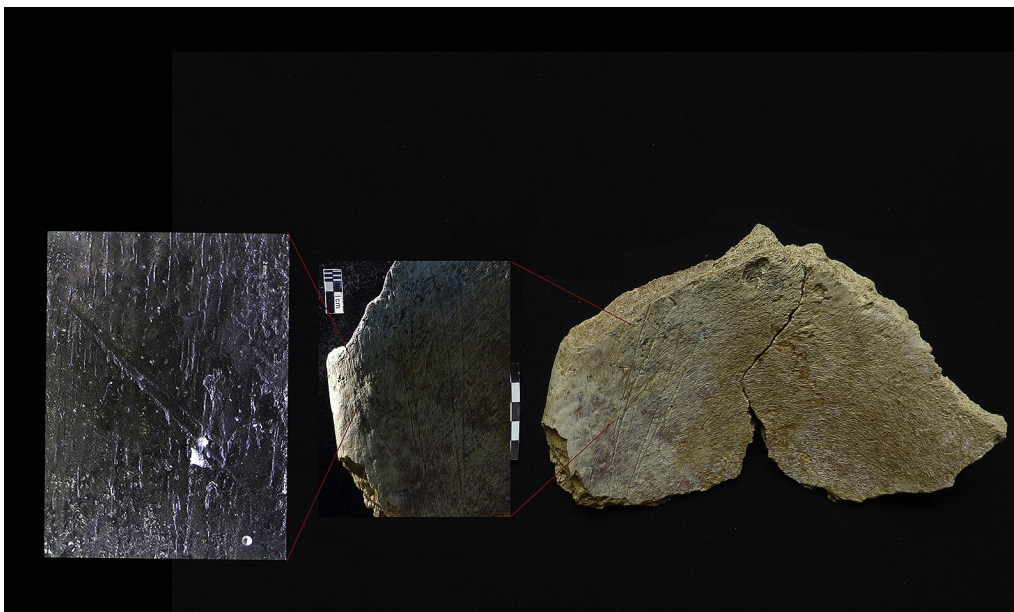


Fig. 10. Cut marks: “Xenarthran” scapula, number 42-1, Level VII. These fragments were found with several natural and some anthropic marks.

trampling marks, some roots (root-etching), and one anthropic cut mark. This last mark was discovered on fragments of a scapula, possibly from a giant ground sloth (numbers 42-1 and 42-2, in the square A-2, Level VIIb 1, $Z = 7.15$ m), exhibiting loss of the periosteum by taphonomic agents such as weathering and fluvial erosion. The examination by reflective light and transmitted microscope, as well as electron and stereo microscope helped to identify a cut mark on the 42-1 fragment (Figs. 10 and 11). The mark is defined by a V-shaped cross-section with a stretch mark parallel to the main mark and the presence of Hercynian cones, features that indicate cut marks (Eudave-Eusebio, 2012) (Fig. 11). Other marks are visible on the same piece, although they are not as clear. However, this first indication of a possible relationship between humans and

Pleistocene fauna may be significant. The presence of lithics, albeit minimal, with an expeditious appearance emphasizes the need for a traceology study.

In general, the lithics recovered at Chazumba consist mainly of small-format pieces, knapped mainly using flint and jasper (Fig. 12). The only large format objects have been interpreted as hammers or anvils. Some pieces have partial patina and other artefacts have concretion remains. Flakes and fragments were among the pieces recovered. We have only identified two cores (one of which is a fragment of a core) and few retouched flakes. Therefore, we can say that the *chaîne opératoire* for the production of tools is incomplete. This is also confirmed by the very low number of flakes with cortex remains (belonging to the early stages of the core exploitation

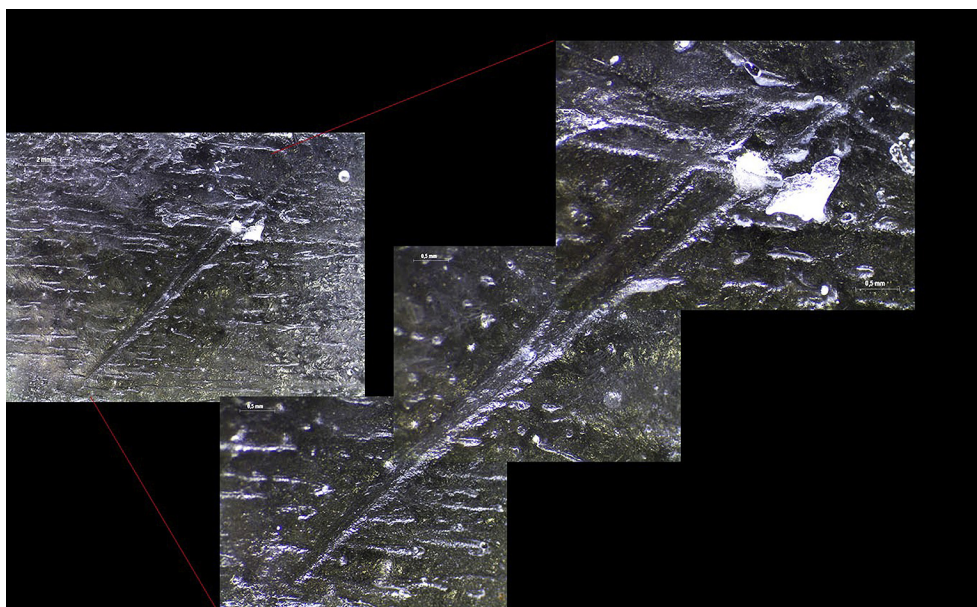


Fig. 11. Cut marks view through a stereoscopic optical microscope (30x) (left), and a scanning electron microscope (SEM) (231x) (right). In these images, we can see the diagnostic morphology of the cut marks, defined by a V-shaped cross-section, parallel to the main hercynian cone with groove.



Fig. 12. Lithic materials located in Chazumba I, in the surface slope (top) and in the excavation, with stratigraphic context (bottom).

process). Among the retouched flakes, no morphotype acts as a clear cultural marker. There is a predominance of retouched pieces with a dihedral configuration edges, with a straight or slightly convex morphology. We have also identified pointed morphologies to configure a distal trihedral.

5. Discussion and conclusions

The Chazumba sites have yielded several Late Pleistocene fossils, but are also extremely vulnerable, which is why the continuity of the excavation and the rescue of the material at the site are essential.

The five excavation campaigns in Chazumba I and II have shown the existence of Rancholabrean fauna of neotropical affinity, judging by the presence of various xenarthros as *Eremotherium*, *Paramylodon* and *Glyptotherium*. However, the presence of such elements from a tropical deciduous forest with a warm and humid climate contrasts with the presence of the *Microtus* cf. *mexicanus* vole and the desert tortoise *Gopherus*, which belong to drier climates with grasslands, savannas, desert scrub and temperate forests, indicating various types of paleoenvironments.

If confirmed, the association of lithic artefacts of an expeditious nature with extinct fauna dating to 27,720–27,500 cal BP may be of particular interest, as a cut mark detected on one of the bones of *Eremotherium* seems to show human intervention. This age puts Chazumba at the centre of the debate about the timing of the first human settlement of the Americas. The paradigm that postulates that Clovis Paleo-Indians were the first settlers of the Americas is brought into question by the publication of new data concerning human occupations at sites dated to more than 11,500 years ago

Table 3

List of faunal species discovered in the Pleistocene deposits of Chazumba I and Chazumba II.

Class	Order	Family	Species
Amphibia			
	Caudata		
Reptilia			
	Tetudines		
		Podocnemididae	<i>Podocnemis</i> sp.
		Testudinidae	<i>Gopherus</i> sp.
		Kinosternidae	<i>Kinosternon</i> aff. <i>K. hirtipes</i> / <i>K. integrum</i>
Birds			
	Passeriformes		
Mammalia			
	Cingulata		
		Pampatheriidae	<i>Pampatherium mexicanum</i>
		Glyptodontidae	<i>Glyptotherium</i> sp.
	Pilosa		
		Megalonychidae	<i>Eremotherium</i> cf. <i>laurillardi</i>
		Mylodontidae	<i>Paramylodon harlani</i>
	Rodentia		
		Cricetidae	<i>Microtus</i> cf. <i>mexicanus</i> <i>Neotoma</i> cf. <i>mexicana</i>
	Proboscidea		
		Elephantidae	<i>Mammuthus columbi</i>
		Gomphotheriidae	<i>Cuvieronius</i> sp.

(continued on next page)

Table 3 (continued)

Class	Order	Family	Species
	Perissodactyla		
		Equidae	
			<i>Equus</i> sp.
	Artiodactyla		
		Cervidae or	
		Antilocapridae	

(13,500 cal BP) (Goebel et al., 2008). In United States, the sites of Schaefer (14.2 ka cal BP) and Hebior (14.8 ka cal BP) (both in Wisconsin), yielded lithic implements associated with the remains of two mammoths (Joyce, 2006). Also in the US, at the Manis site (Washington) a bone projectile point was embedded in a rib of a mastodon dated to 13.8 ka cal BP (Waters et al., 2011a). The Debra L. Friedkin site (Texas) contains a lithic assemblage dated to between 13.2 and 15.5 ka cal BP (Waters et al., 2011b). In the Meadowcroft rockshelter (Pennsylvania) the minimum age for the presence of human populations is 14–12.55 ka cal BP, although the average of the six deepest dates unequivocally associated with archaeological remains is 17,500–16,750 cal BP (Adovasio and Pedler, 2004). The excavation of Paisley Caves (Oregon) has provided artefacts and human coprolites dated to 14.3 ka cal BP (Gilbert et al., 2008), although some researchers have questioned this evidence (Fiedel, 2014). In Page Ladson (Florida), lithic tools and faunal remains have been recovered dating to 14.4 ka cal BP (Webb, 2006). Human intervention on the bone assemblage from Blue Fish Cave II (Yukon Territory, Canada), dated at ca. 23–25 ka, has not yet definitively proven, though it has been suggested based on evidence at the site (Bourgeon, 2015). The association between two lithic artefacts and faunal remains dated to 17 ka cal BP at the Wenas Creek site (Washington) also requires further investigation (Lubinski et al., 2014a, 2014b).

In Tlapacoya I (Basin of Mexico), Lorenzo and Mirambell (1986) published the discovery of faunal remains in association with hearths and artefacts. In the Alpha trench, charcoal samples were dated to 24 ± 4 ka BP and 21.7 ± 0.5 ka BP, while in Beta trench a layer including a quartz artefact was dated to 22 ± 2.6 ka BP. In Tlapacoya II, a obsidian blade was discovered beneath a wooden trunk dated to $23,150 \pm 950$ BP. However, the existence of human occupations more than 20,000 years ago in Tlapacoya is controversial. According to Gonzalez et al. (2015), the new archaeological projects under way in Tlapacoya do not support the existence of human occupations as old as those advocated by Lorenzo and Mirambell (1986). Gonzalez et al. (2015) question the existence of lithic artefacts and the “hearths” of the original excavations, which are interpreted as “simply local angular pebble-gravel, scree, and burnt vegetation” (Gonzalez et al., 2015: 17).

In South America, the most controversial pre-Clovis site that exhibits the best pre-Clovis evidence is Monte Verde (Chile), dated to 14.6 ka cal BP (Dillehay and Mañosa, 2004). The existence of lithic artefacts and hearths dating to more than 30 ka in Boqueirão da Pedra Furada site (Brazil) has been questioned repeatedly (Guidon and Delibrias, 1986; Meltzer et al., 1994; Guidon et al., 1996). However, new sites in Brazil have been documented with human occupations dating to the end of the Late Pleistocene. Faunal remains, lithic tools and human fossils have been found in the Cave of Toca do Serrote das Moedas (Sao Raimundo Nonato, Piauí). Although the human fossils have not been directly dated, ESR and OSL ages ranging between 29 ± 3 to 21 ± 3 ka have been obtained for the archaeological assemblage (Kinoshita et al., 2014). In the same area, the Toca da Tira Peia rockshelter has yielded OSL ages of $20,000 \pm 1500$ for level C7, and $15,100 \pm 1200$ for level C6, both

containing lithic artefacts (Lahaye et al., 2013). Close to Boqueirão da Pedra Furada, the open-air site of Vale da Pedra Furada produced new evidence of human occupation prior to 20,000 cal BP (by a combination of ^{14}C and OSL ages). Artefacts from Layers C6 and C7 are dated to around 22,000 BP (Boëda et al., 2014).

Although controversy surrounds all the sites with human occupations dating to more than 13,500 cal BP, it is increasingly difficult to reject the possibility of a human settlement in the Americas prior to the Clovis Paleo-Indians. It is logical for a certain degree of scepticism and a critical reaction to arise when new ages are published that significantly push back the timing of the settlement of the Americas. However, as references to sites dated to more than 13,500 cal BP sites increase, it becomes more difficult to deny the existence of a pre-Clovis settlement. In this context, Chazumba provides new data that must be added to those already mentioned, and opens the window to a possible human presence in North America more than 25 ka ago. However, these data must also be taken with caution, as Chazumba has provided only one radiocarbon date so far. The results of the identification and analyses of the osteological materials, as well as the analyses of cut marks and use wear on the artefacts and new radiometric dating must be complete before any conclusions can be drawn.

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