Mammoth bone technology at Tocuila in the Basin of Mexico

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SUMMARY: Tocuila is located along a paleoshore of Lake Texcoco within the Basin of Mexico that is part of the vast late Pleistocene Mexican Plains. Fractured bone represents human activity engaged in bone quarrying efforts to produce cores and flakes for future use. Fracturing is through high-speed impact using a percussion method of a focused and quick blow, causing combined tensions that result in a helical fracture in fresh long bones. A long bone segment has been shaped further into a bone core exhibiting prepared platforms. A series of overlapping flakes struck from this core have remnants of the prepared platforms. The great thickness of compact bone is appropriate to making these large cortical flakes. The bone technology seen at Tocuila is typical of a larger North American late Pleistocene tradition. This tradition represents an economic-technological use of mammoth resources rather than a subsistence one.

1. Introduction

The late Pleistocene (120,000 - 11,000 years BP) was a complex period of climatic shifts, changing faunal and floral communities, and impacted landscapes representing now extinct ecosystems. Changes in the biotas were initiated by global changes in climate that resulted in deglaciation in North America. Localized fluctuations on a regional and microgeographic basis also were involved (Nilsson 1983; Porter 1983). Therefore, the building blocks essential for understanding the Pleistocene and its biogeography must start with individual localities.

At the southern end of the North American grasslands, Tocuila (Morett *et al.* 1998a, b) is located in the Basin of Mexico within a volcanic area that was active during the late Pleistocene and is still active today. The locality is situated in a mudflow at the edge of Lake Texcoco, one of several shallow paleo-lakes within the main basin (Fig. 1). Remains of at least seven mammoths, ranging in age from young to adult, have been uncovered, along with a few bones from ungulates, rabbits and aquatic animals (Morett *et al.* 1998a, b; Corona-M. & Arroyo-Cabrales 1997). A number of radiocarbon dates (charcoal, seeds, and bone) from samples taken throughout the mud flow unit provide an average age of ca. 11,188 BP (Morett *et al.* 1998a; Arroyo-Cabrales *et al.* in press).

The main unit (ca. 1,7 m thick) containing the mammoth bones is stratified in a lahar (a mudflow caused by volcanic activity). Lahars form when heavy rains or melted snows wash loose volcanic debris down from higher to lower ground, usually flowing down a stream channel. Above this unit are deposits derived from smaller lahars. Volcanic ashes overlying lacustrine clays are stratified below the mam-

moth-bearing unit (Morett *et al.* 1998a). The lahar had flowed through and filled the channel of a late Pleistocene stream cut prior to the deposition of the unit containing the mammoth remains (Arroyo-Cabrales *et al.*, in press).

2. Results and Discussion

The presence of humans is indicated by dynamic impact fracturing features on mammoth long bone segments and fracture debris. The assemblage is small but significant. A triangular-shaped femoral radial segment (TOC-1-281) exhibits a helical fracture at the apex, crushing and small flake removal along the opposite edge (i.e., the "base" of the triangle), and a series of large facets along the cortical surface below the crushed and small flake removal area (Fig. 2). This specimen is interpreted as a bone core with a prepared platform and scars from the removal of a number of large cortical flakes. Another specimen (TOC-1-534) has a number of facets on the cortical surface, an area of crushed bone and small flake removal at the top of the faceted area, and an undulating surface on the reverse side with a large diffuse bulge. This specimen is interpreted as a cortical bone flake with remnant platform preparation. The cortical flake conjoins with the central flake scar on the bone core.

The Tocuila cortical flakes are similar morphologically and share the same features as

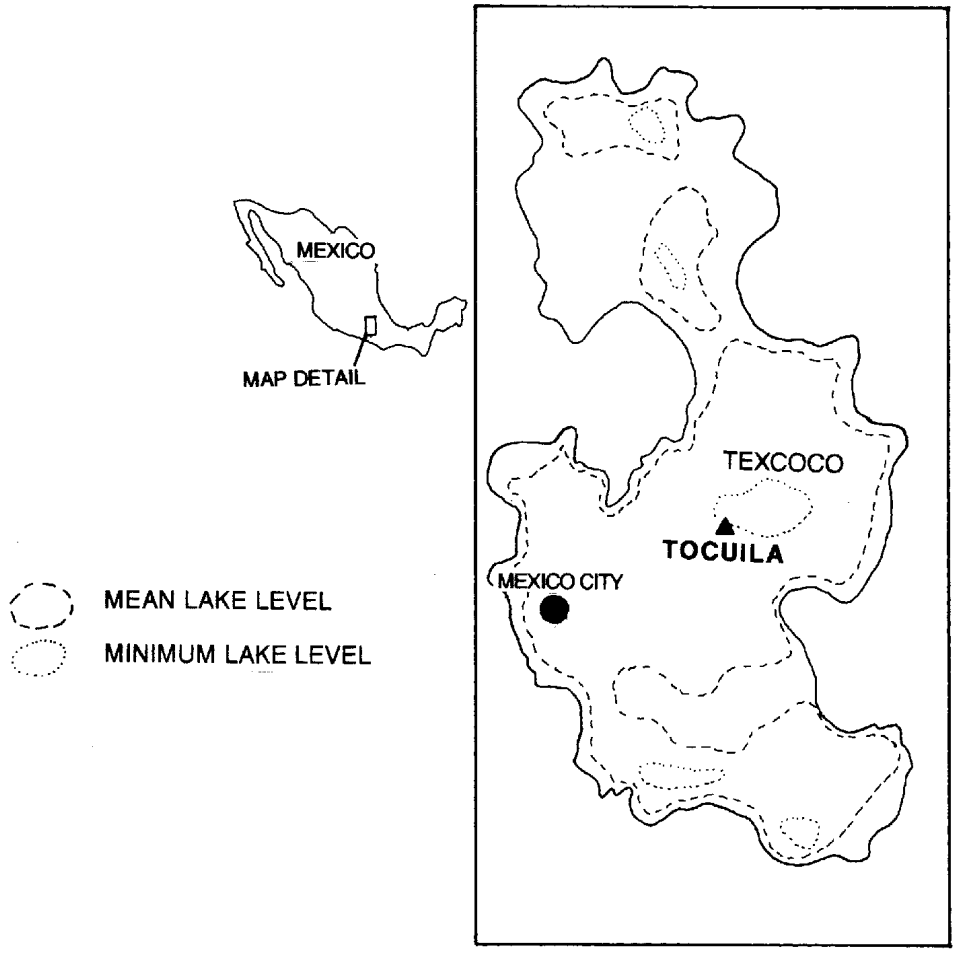

Fig.1 - Location of Tocuila in the Basin of Mexico.

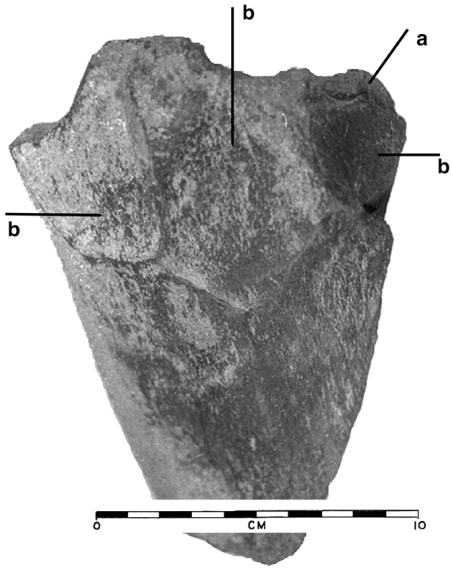

Fig.2 - Bone core from Tocuila, exhibiting edge crushing and small flaking from platform preparation (arrow a) and large flake scars (arrow b) from removal of large cortical flakes.

those from other North American grasslands mammoth sites (i.e., Lubbock Lake [Johnson in review], Lange-Ferguson [Hannus 1989, 1997], Duewall-Newberry [Steele and Carlson 1989], Owl Cave [Miller 1989]), and the experimentally-generated ones from Ginsberg (Stanford *et al.* 1981). The same relationship exists for the large cone flakes from Tocuila and other North American grasslands mammoth sites (i.e., Lubbock Lake [Johnson 1985], Sand Creek [Johnson *et al.* 1994], and Duewall-Newberry [Steele & Carlson 1989]). While human involvement with mammoth at Tocuila is limited, it is focused on bone breakage and interpreted as bone quarrying to produce cores for transport elsewhere.

Mammoth bone quarrying is a fracture-based bone technology, producing tool blanks and cores (Johnson 1985). Mammoth procurement for bone quarrying is a technological activity aimed at securing raw material shaped into transportable, useable forms (Johnson 1985; Hannus 1989; Miller 1989). Breakage is purposeful to cause segmentation and selected segments used in production endeavors. This bone quarrying is focused on the use of proboscidean bone as a resource for the production of cores and blanks in the same manner as stone is fractured from its quarry source to yield segments suitable to fashion cores and blanks. The great thickness of compact bone is appropriate to making large cortical flakes. Bone cores exhibit prepared platforms and flakes struck from those cores have remnants of their prepared platform.

3. Conclusion

Mammoth bone quarrying is a North American grasslands-wide technological activity with a great time depth (Johnson in review). It is dependent on the cortical thickness of mammoth limb bones and was dropped from the grasslands hunter-gatherer technological repertoire when mammoth become extinct.

The mode of accumulation of the remains of the Tocuila mammoths still is unclear, as information pertaining to the age, gender, and carcass condition of these animals is currently not available. Other than their deposition in the same unit, the relationship between the mammoth remains and the bone core and the flakes has not been defined. A mudflow is a cata-

strophic event. Due to the disarticulated nature of the remains, it appears that the mudflow did not kill the mammoths and other animals present in the fauna in the flow deposit. Whether the mammoth remains previously had been deposited in the channel (either as the result of attritional accumulation or a catastrophic event) and subsequently were covered by the mud flow or whether the mammoth remains were transported into the channel with the mud flow currently is being debated (Morett *et al.*, 1998a; Arroyo-Cabrales *et al.*, 1999, 2000; Siebe *et. al.* 1999).

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