Mammoth bone quarrying on the late Wisconsinan North American grasslands

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SUMMARY: During the late Wisconsinan, the vast North American grasslands stretched from the Basin of Mexico through the Great Plains and eastward. Mammoth are one of the available resources within this expansive setting. Mammoth bone as a production resource involves high-speed impact using a percussion method of a focused and quick blow that causes combined tensions that result in a helical fracture in fresh long bones. 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. Procurement for technological pursuits throughout the time period is through hunting and scavenging found fresh carcasses.

1. Introduction

During the late Pleistocene, the North American grasslands stretched from the Basin of Mexico through the Great Plains and eastward (Fig. 1). The extent of these grasslands and the resources they contained are significant aspects in examining the late Pleistocene peopling of the landscape and evidence for early occupations. Research addressed here is centered on mammoth remains from the southern grasslands. The time span is a ca. 7000 year period from ca. 18,000 to 11,000 BP, encompassing seven localities spanning the Southern Plains and Mexican Plains.

2. Mammoth Localities

While a number of mammoth localities occur throughout the Great Plains during the Wisconsinan (Graham & Lundelius, 1994), those from the late Wisconsinan associated with early peoples are limited. That limitation is further reduced by restricting the localities to those site collections meeting the research criteria. Seven mammoth localites have been selected based on the following criteria: 1) presence of cultural modification to the mammoth bone in the form of bone technology; 2) available appropriate radiocarbon ages; and 3) confirmation of cultural modification to bone through review of the collection by the author.

Fracture-based bone technology is being investigated. Mammoth bone as a production resource is a significant aspect of carcass utilization. High-speed impact using a percussion method of a focused and quick blow causes combined tensions that result in a helical fracture in fresh long bones. Fresh bone breakage by people has an impact point that is a circular depressed area (an inverted cone) caused by localized compression failure. Ring cracks, crushed bones, and cone flakes (technological flakes coming from the interior of the impact zone) result from impact. Fracture fronts expand out from the impact zone in a radial patten until they merge, intersect, are deflected, or energy is dissipated. Radial diaphyseal (shaft) segments are produced through fracture and intersecting fracture fronts (Johnson, 1985, 1991). 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

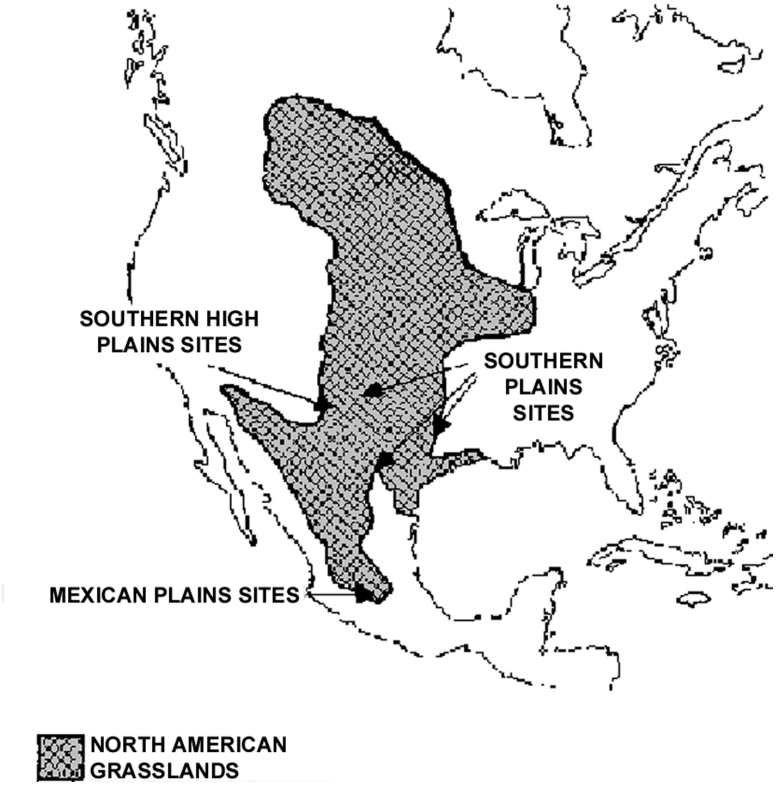

Fig.1 - North American grasslands with general location of mammoth bone quarry sites on the Southern Plains and Mexican Plains.

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.

2.1 Southern Plains

Six localities on the Southern Plains represent a more central part of the vast grasslands (Fig. 1). These localities are positioned within a non-glacial landscape that was formed through depositional and erosional processes from aggrading and downcutting and dissolution and aeolian activities. They are located along streams or at the edge of paleo-lake basins.

Lubbock Lake Landmark is located in an entrenched meander of Yellowhouse Draw at a place where springs have flowed since at least the Late Pleistocene (Johnson 1987). The particular late Pleistocene occupation of interest is on top of a gravel bar and is dated ca. 11,100 yr BP (wood) (Johnson 1987). Helically-fractured mammoth long bones, radial diaphyseal segments, debris with intersecting fracture fronts, and cone flakes indicate bone quarrying occurring along a point bar. A cortical bone flake with a remnant platform points to core production and use as one of the purposes of bone quarrying (Johnson 1985).

The Sand Creek Mammoth (Johnson *et al.* 1994) is in lacustrine sediments from a paleo-lake basin, dated ca. 13,450 yr BP (organic sediments). Human influence is in terms of dynamic impact fracturing features and debris. A number of cone flakes from the impact zone and debris with intersecting fracture fronts and helical surfaces indicate breakage of fresh long

bones by people. The cone flakes are consistent with those found at Lubbock Lake. A number of smaller cone flakes from small ring cracks were found in place overlapping each other. Bone quarrying was occurring with the Sand Creek mammoth carcass, the specific purpose of which is unknown.

Blackwater Draw Locality No. 1 (the Clovis site; Hester 1972) is in a paleo-lake basin that drains into Blackwater Draw. At one of the mammoth localities within the site (dated ca. 11000 yr BP), a humerus and diaphyseal segment were mapped but now are missing. Their representation and adjacent positions suggest a helically-fractured humerus (similar breakage pattern to the humerus at Lubbock Lake) and its associated large humeral diaphyseal segment (Johnson & Holliday 1997). If correct, then bone quarrying was occurring with this carcass. The large diaphyseal segment would appear similar to one at Lubbock Lake that has been interpreted as a blank from which mammoth bone foreshafts and wrenches would have been made (Johnson 1985: 203). Mammoth bone foreshafts were recovered in another part of the paleobasin (Hester 1972: 117).

Cooperton (Anderson 1974) is located along the edge of a small tributary creek. Radiocarbon dates range from 17,575 to 20,400 yr BP (bone and tooth) with large sigmas, indicating a late glacial maximum age. The right scapula and both humeri were helically-fractured. The humeri were broken in the same manner as that at Lubbock Lake (mid-diaphysis above the supracondyloid crest) and some of the diaphyseal segments could be refitted. Although the specific purpose is unknown, bone quarrying was occurring with this carcass (Anderson 1975: 171; Johnson 1991).

Duewall-Newberry (Steele & Carlson 1989) is located along the Brazos River. Both humeri and the right femur were helically-fractured, exhibiting excellent dynamic loading points, cone flakes, and flake scars (Steele & Carlson 1989: 424-225, Figs. 15 and 16). The elements were broken in the same manner as those at Lubbock Lake. Large diaphyseal segments and cortical flakes indicated bone quarry operations for the production of both blanks and cores (Johnson 1985, 1991).

Bonfire Shelter (Bement 1986) is at the southern end of the Southern Plains, in a rockshelter along Mile Canyon, a tributary of the Rio Grande. Limited mammoth remains were recovered around small limestone blocks in Stratum H-1 (dated ca. 12,400 yr BP [diffuse charcoal]) and Stratum E (bracketed between dates of ca. 12,400 - 10,200 yr BP) (Bement 1986). A tibial diaphyseal segment from Stratum H-1 and a long-bone diaphyseal segment from Stratum 1E are helically-fractured. These elements indicate limited bone quarrying occurring, probably for the production of diaphyseal blanks (Johnson 1985, 1991).

2.2 Mexican Plains

The grassland corridor from northern México to the Basin of México is termed the Mexican Plains. At the southern end of the grasslands, Tocuila is located in the Basin of México (Fig. 1). The locality is in a mud flow at what was an edge of Lake Texcoco. Remains of at least seven mammoth are in a deposit with several radiocarbon dates (charcoal, seeds, and bone) that average ca. 11,188 yr BP (Morett *et al.* 1998; Arroyo-Cabrales *et al.*, in press).

A triangular-shaped femoral radial segment exhibits a helical fracture at the apex, crushing and small flake removal along the opposite edge, and a series of large facets along the cortical surface. Another specimen 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. These specimens are interpreted as a bone core and a cortical bone flake. The cortical flake conjoins with the central flake scar on the bone core. The Tocuila and Lubbock Lake cortical flakes are morphologically similar and share the same features. The same relationship exists for the large cone flakes from Tocuila, Lubbock Lake, and Sand Creek. 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 (Johnson *et al.* 2001).

3. Discussion

The localities span the ca. 7000 to 8000 year time period from the last glacial maximum to terminal Pleistocene. This time range assumes that available radiocarbon ages for the localities are valid, but those from Cooperton (Anderson 1974) are most suspect. However, comparable dates are available from similar sites in the Central Plains (Holen 1994, 1996, 1999; May & Holen 1993) that underscore the plausibility of people and mammoth procurement at this early time on the North American grasslands.

Bone quarrying is a type of specialized site. The earliest evidence of mammoth procurement appears to be for the purpose of bone quarrying. Evidence of meat acqusition activities at Cooperton is lacking. Activity at La Sena in the Northern Plains at the same time appears oriented only towards bone quarrying (Holen 1994, 1999; May & Holen 1993). Mammoth procurement for bone quarrying is not a subsistence activity but rather a technological one aimed at securing raw material shaped into transportable, useable form. The activity is akin to that at a lithic outcrop and for a similar purpose. This type of mammoth procurement appears in two modes, either as a concordant activity occurring in concert with the butchering of a mammoth or as an independent activity. Bone quarrying is a specialized activity that requires fresh mammoth bone. Mammoth bone quarrying is a North American grasslands-wide technological activity with a great time depth. It is dependent on the cortical thickness of mammoth limb bones and drops from the grasslands hunter-gatherer technological repertoire as mammoth become extinct.

4. Conclusion

For Late Wisconsinan grasslands peoples, mammoth procurement apparently has two main purposes that could be accomplished in two ways. A mammoth carcass represented meat-related subsistence and raw material economy. Based on the database and available literature, it would appear mammoth did not become a food item until ca. 13,000 years ago; prior to that, mammoth limb bones are quarried for raw material, without direct evidence on the bones for butchery in meat acquisition.

People are on the North American grasslands prior to the terminal Pleistocene and had developed strategies to obtain some of the resources represented by a mammoth carcass. Mammoth procurement for whatever purpose using any strategy, however, comes to an end as mammoth become extinct. That part of the late Wisconsinan repertoire and lifestyle is abandoned and a cultural response of transformation or replacement of strategies ensued.

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