New Mexico Geological Society Guidebook, 54th Field Conference, Geology of the Zuni Plateau, 2003, p. 419-424.

STRATIGRAPHY AND PALEONTOLOGY OF TRAPPED ROCK DRAW MASTODONT SITE, ZUNI, NEW MEXICO

PAUL G. DRAKOS[1], SPENCER G. LUCAS[2], GARY S. MORGAN[2] AND STEVEN L. RENEAU[3]
[1]Glorieta Geoscience Inc., PO Box 5727, Santa Fe, NM 87502; [2]New Mexico Museum of Natural History, 1801 Mountain Road NW, Albuquerque, NM 87104-1375; [3]Earth and Environmental Sciences Division, EES-9, MS D462, Los Alamos National Laboratory, Los Alamos, NM 87545

ABSTRACT.—A mastodont mandible was found within a 12.4-m-thick late Quaternary section exposed in an arroyo wall along Trapped Rock Draw, 2 km south of Zuni, NM. The Pleistocene stratigraphic section that contains the mandible suggests deposition in a low energy fluvial environment with small channels. The Pleistocene stratigraphic section is interpreted to represent a shallow, sandy, aggrading stream system. Stratigraphic relationships support the inference that the mastodont is a late Pleistocene-age fossil of *Mammut americanum*. *M. americanum* is rare in New Mexico and the southwestern United States, especially when compared to the numerous records of mammoths from this region. The Trapped Rock Draw mandible is the sixth record of *M. americanum* from New Mexico, and the first record from the Colorado Plateau in the northwestern part of the state. Invertebrate faunal analysis of samples collected from the stratigraphic section containing the mandible suggests that paleoenvironmental conditions at the time of the Trapped Rock Draw mastodont were characterized by complex ecosystems and a somewhat cooler and wetter climate than at present, with localized marshy conditions. Absolute age constraints are not currently available for the mastodont specimen, but charcoal samples collected from strata that overlie and underlie the mandible could provide an excellent temporal framework for the Trapped Rock Draw mastodont and the associated late Quaternary stratigraphic section.

INTRODUCTION

A mandible recently discovered near Zuni, NM provides an opportunity to examine a rare, very well preserved New Mexico mastodont fossil found in excellent stratigraphic context near the top of the Pleistocene section in an arroyo exposure. The invertebrate faunal assemblage collected from stratigraphic horizons above, below, and coincident with the horizon containing the mandible help constrain the paleoenvironmental setting around the time of burial of this specimen of *Mammut americanum*. The interpretation of the depositional setting, inferred from the description of the stratigraphic section, provides further data used to evaluate the paleoenvironmental setting.

The Trapped Rock Draw mastodont site is located approximately 1.5 mi (2 km) south of Zuni, NM (Fig. 1). The mastodont mandible was discovered in 2002 by a Zuni individual who was hiking in the arroyo and noticed the jaw eroding out of the arroyo wall. Zuni Pueblo notified the New Mexico Museum of Natural History (NMMNH). Personnel from NMMNH examined the mandible and identified the specimen. Zuni Pueblo allowed a subsequent site visit by Glorieta Geoscience, Inc. and Los Alamos National Laboratory personnel for completion of a detailed stratigraphic description, collection of samples for invertebrate analysis, and collection of charcoal for ^{14}C analysis. NMMNH personnel analyzed the invertebrate fauna for a temporal assessment of the local paleoecology. ^{14}C analyses have not been performed at the time of this writing.

SETTING

Trapped Rock Draw heads on the northern flank of Pie Mesa, and drains north to the Zuni River (Fig. 1). The mastodont site is located where the colluvial slopes from Pie Mesa meet the Zuni River valley floor, where Trapped Rock Draw is incised into a high Pleistocene terrace surface. Trapped Rock Draw is one of several drainages, including Prairie Dog Draw and Stinking Water Draw, which drain north to northeast from Pie Mesa toward the Zuni River or Galestina Canyon in the area west of Dowa Yolanne Mesa. Pie Mesa and Dowa Yolanne Mesa are composed of Jurassic Zuni Sandstone overlain unconformably by a relatively thin cap of Cretaceous Dakota Sandstone. The Zuni Sandstone is underlain by the Upper Triassic Wingate Sandstone and the Chinle Group, which underlie alluvium along the valley floor (Orr, 1987).

MASTODONT SITE STRATIGRAPHY

The Trapped Rock Draw mastodont site is part of a 12.4-m-thick section of Pleistocene and Holocene sediments exposed in the arroyo wall. At the mastodont locality, the arroyo is incised into an inset surface that is approximately 7 m below the elevation of a higher Pleistocene terrace surface graded to a broad Zuni River terrace. The exposure includes a topographic high of Pleistocene deposits surrounded by channel deposits of inferred Holocene age. The exposure consists of a 6.6 m thick, relatively fine-grained Pleistocene section of parallel-bedded (bedding is one-to-four-mm thick) to non-stratified (bioturbated) fine-grained sand with thin (15 cm thick), medium sand lenses, unconformably overlain by a coarser, 5.8 m thick section of fine-to-medium grained cross-bedded sand with gravel lenses, in turn overlain by nonstratified fine sand (Figs. 2-3). The upper, 5.8 m thick section is of inferred Holocene age.

The Pleistocene stratigraphic section suggests deposition in a low-energy fluvial environment with small channels, likely representing a shallow, sandy, aggrading, braided stream system. The overlying Holocene section is a gravelly channel-fill deposit. The mastodont mandible is located within and rests at the base of a channel sand deposit, 5.1 to 5.3 m above the arroyo floor, and is approximately 1.5 m below the contact between the lower Pleistocene deposits and the unconformably overlying channel fill deposit of inferred Holocene age (Figs. 2-3). The underlying fine-grained sand unit is deformed under part of the mandible, suggesting the sand was saturated when the mandible came to rest. The channel-fill deposit containing the mandible is buried by massive, fine-grained sand with scattered pebbles up to 5 cm

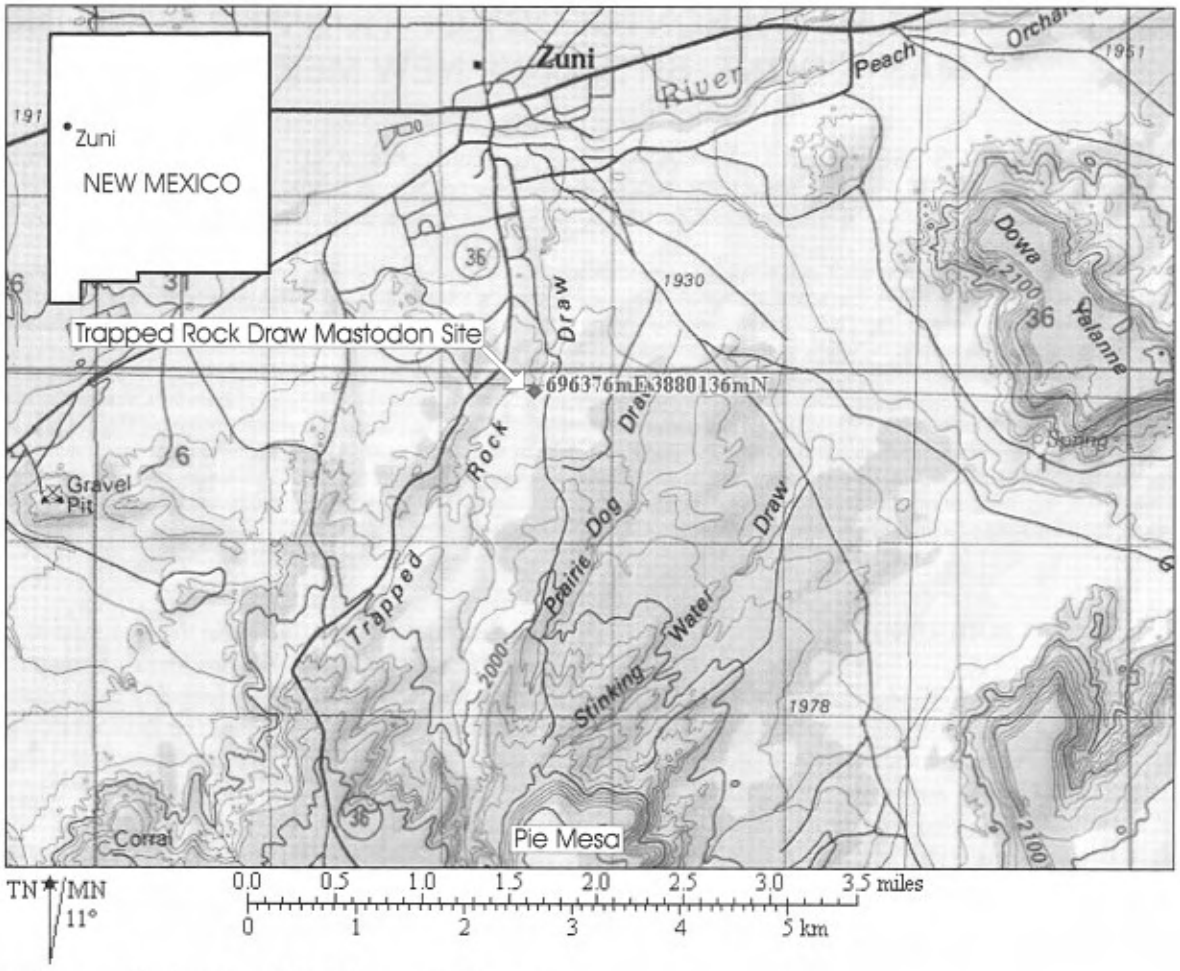

FIGURE 1. Location map showing Trapped Rock Draw mastodont site.

in diameter, interpreted to represent colluvial deposition adjacent to a stream bank.

Buried soils were not observed in the section. This observation is consistent with a depositional environment characterized by an aggrading braided fluvial system. Sediments underlying the mandible include carbonate-cemented layers 1 to 3 cm thick that likely represent precipitation from ground water rather than a pedogenic accumulation of carbonate. The absence of buried soils suggests relatively continuous deposition during the period represented in the section. The position of the mandible near the top of the Pleistocene section suggests a late Pleistocene age for the fossil, but erosion during the Holocene likely removed an unknown thickness of Pleistocene sediment. Secondary iron oxide staining observed in deposits in the Pleistocene section (Figs. 2-3) is indicative of periodic high water tables.

Other research in the area suggests that up to 8 m of Holocene alluvium was deposited since 7.4 ka, interrupted by multiple episodes of incision and arroyo formation (Wells, 1988). Hall (1990) reports rapid accumulation of sand and gravel after 4.5-3 ka, followed by subsequent incision. Although the timing of the culmination of aggradation at this location could fit the chronology described by Hall (1990), this cannot be confirmed without independent age constraints.

Samples were collected from several mollusk-bearing strata and analyzed by NMMNH personnel. Results of these analyses are discussed below. The invertebrate faunal analysis suggests that the Pleistocene deposition occurred along a riparian corridor of grass and deciduous forest, with localized marshy conditions during the time of the Trapped Rock Draw mastodont. Samples collected from the overlying section of inferred Holocene age indicate a change to a more xeric environment.

FAUNAL ASSEMBLAGE AND PALEOECOLOGY

Mammut americanum (Kerr)

Much of the lower jaw of the mastodont in Trapped Rock Draw remains in the field at the time of this writing. Nevertheless, we were able to examine and study the partial left dentary, which includes part of m2 and a complete m3 (Fig. 4). This specimen is currently housed in the collections of the Zuni Cultural Resource Enterprise (ZCRE) in Black Rock, New Mexico, and will eventually be displayed in a museum at Zuni Pueblo.

Measurements (in mm) of the teeth are: m2 width = 82, m3 length = 178, m3 width = 93 and depth of ramus under the m2/m3 juncture = 165. The m3 has four lophids and a talonid (tubercle),

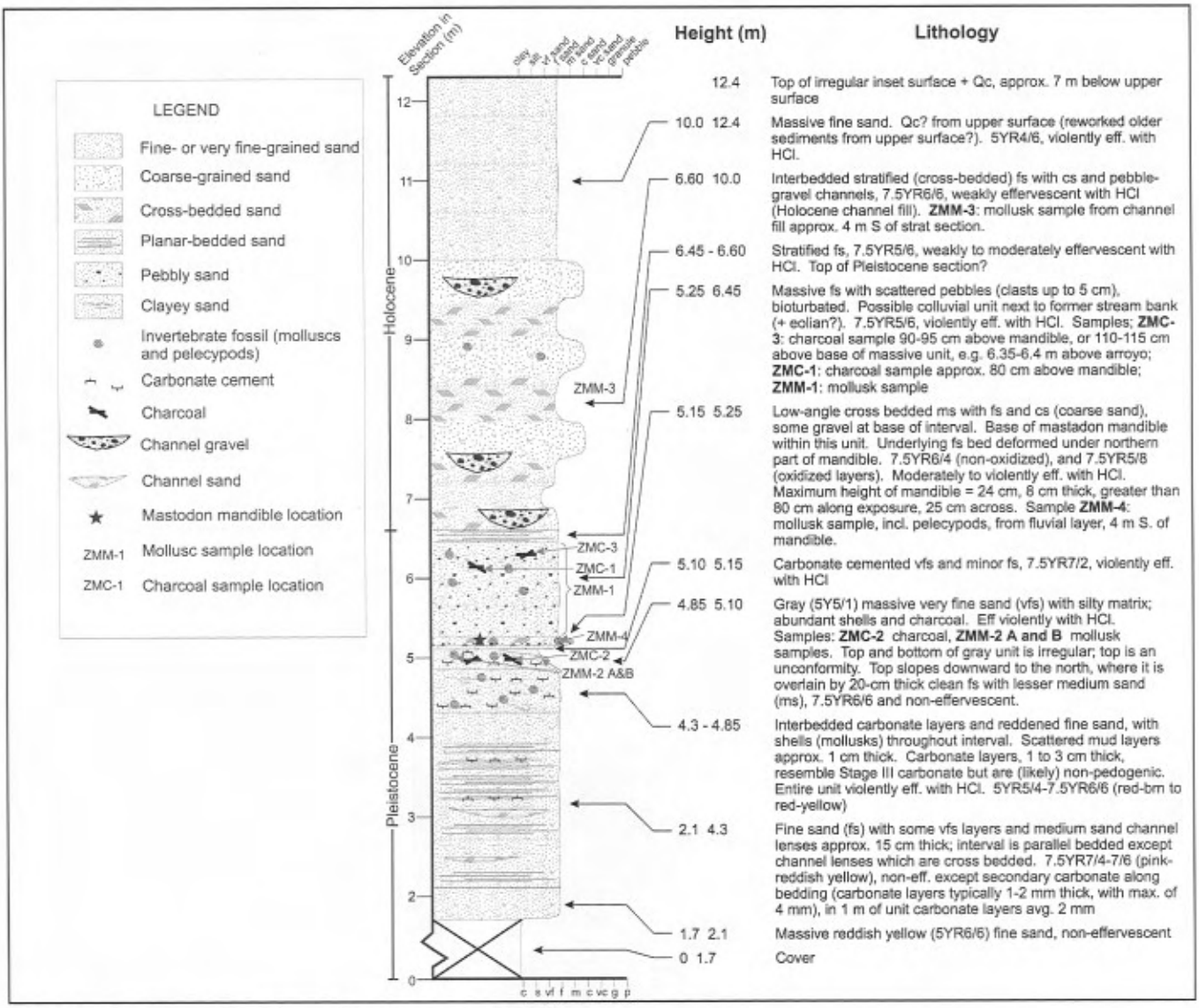

FIGURE 2. Stratigraphic section at Trapped Rock Draw mastodont site.

ptychodont enamel and is well worn. Each lophid on m3 consists of two cuspids separated by a median sulcus. There are no median pillars, pretrite or posttrite cuspids, and the talonid is a small, transverse lophid. The size and morphology of the Trapped Rock Draw mastodont jaw closely match other specimens of *Mammut americanum* from New Mexico, especially a left dentary with m2-m3 (NMMNH P-25098) from a gravel pit near Lemitar in Socorro County (Lucas and Morgan, 1997, figs. 1A-B).

Mammut americanum is rare in New Mexico and the southwestern United States, especially when compared to the numerous records of mammoths from this region (Lucas and Effinger, 1991; Lucas and Morgan, 1997). The Trapped Rock Draw mandible is the sixth record of *M. americanum* from New Mexico, and the first record from the Colorado Plateau in the northwestern part of the state. Of the four previously published records of the American mastodont from New Mexico (Lucas and Morgan, 1997), two are in the Sandia Mountains (Sandia Cave and Tree Spring) and two are in the middle Rio Grande Valley (Los Lunas and Lemitar). A fifth record, an isolated left m3 from near Piñon in Otero County in southeastern New Mexico, has not been previously reported.

Invertebrate Fauna

The invertebrate community in the stratigraphic section containing the mastodont mandible was examined to provide a comparative temporal assessment of the local paleoecology. Sediment samples of approximately one pint each were collected from the upper four of five mollusk-bearing strata (Figs. 2-3). Samples were screen-washed at NMMNH and sorted to the lowest identifiable taxon. Vouchers of all taxa were deposited in the paleontology collection at NMMNH.

Shells recovered from the sediment samples represent 13 species of terrestrial pulmonate gastropods and a single species each of freshwater gastropod, bivalve, and ostracod (Table 1). All taxa recovered appear to be extant species, and stratigraphic relationships in the exposed strata suggest a late Quaternary age for these

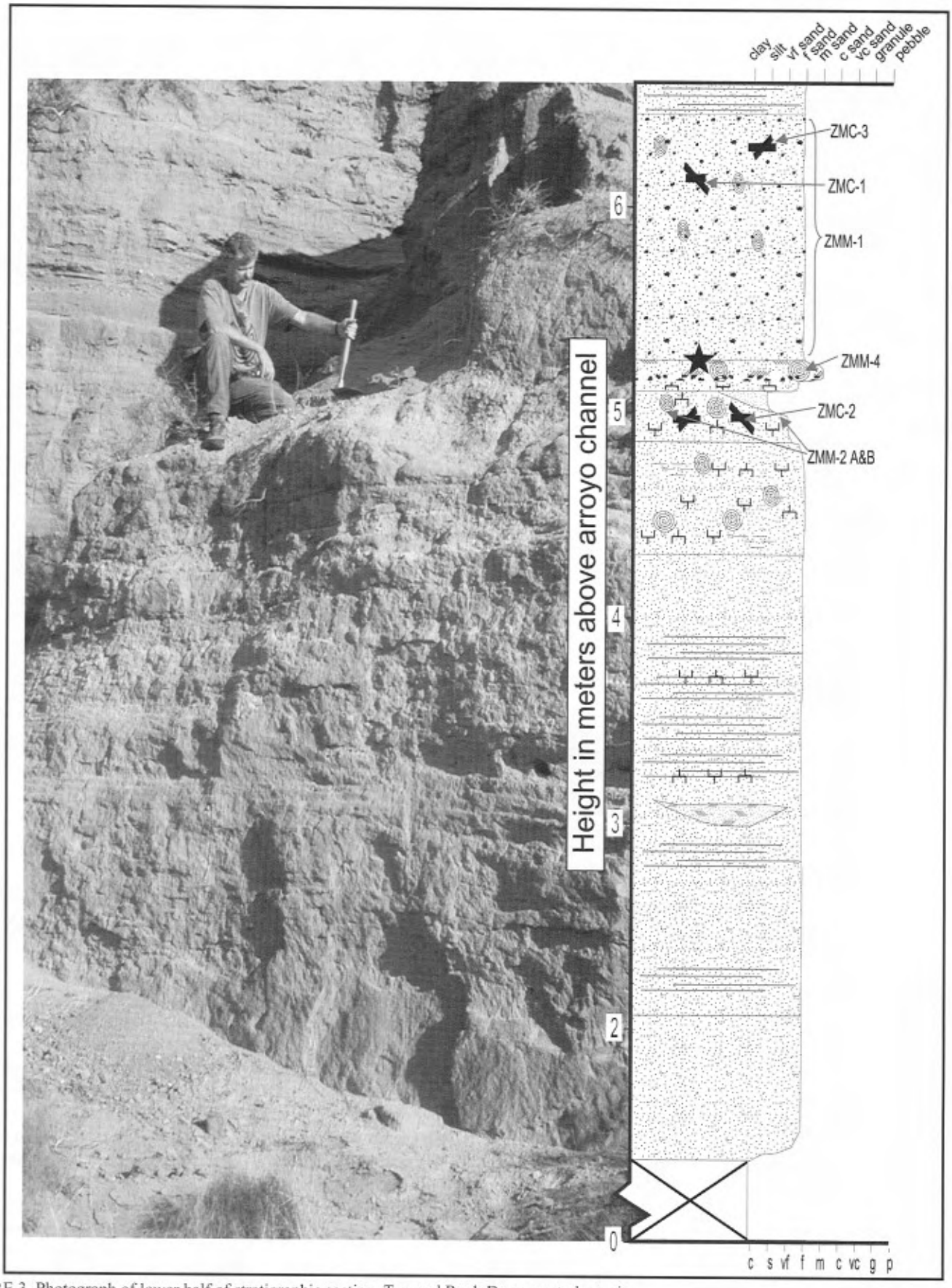

FIGURE 3. Photograph of lower half of stratigraphic section, Trapped Rock Draw mastodont site.

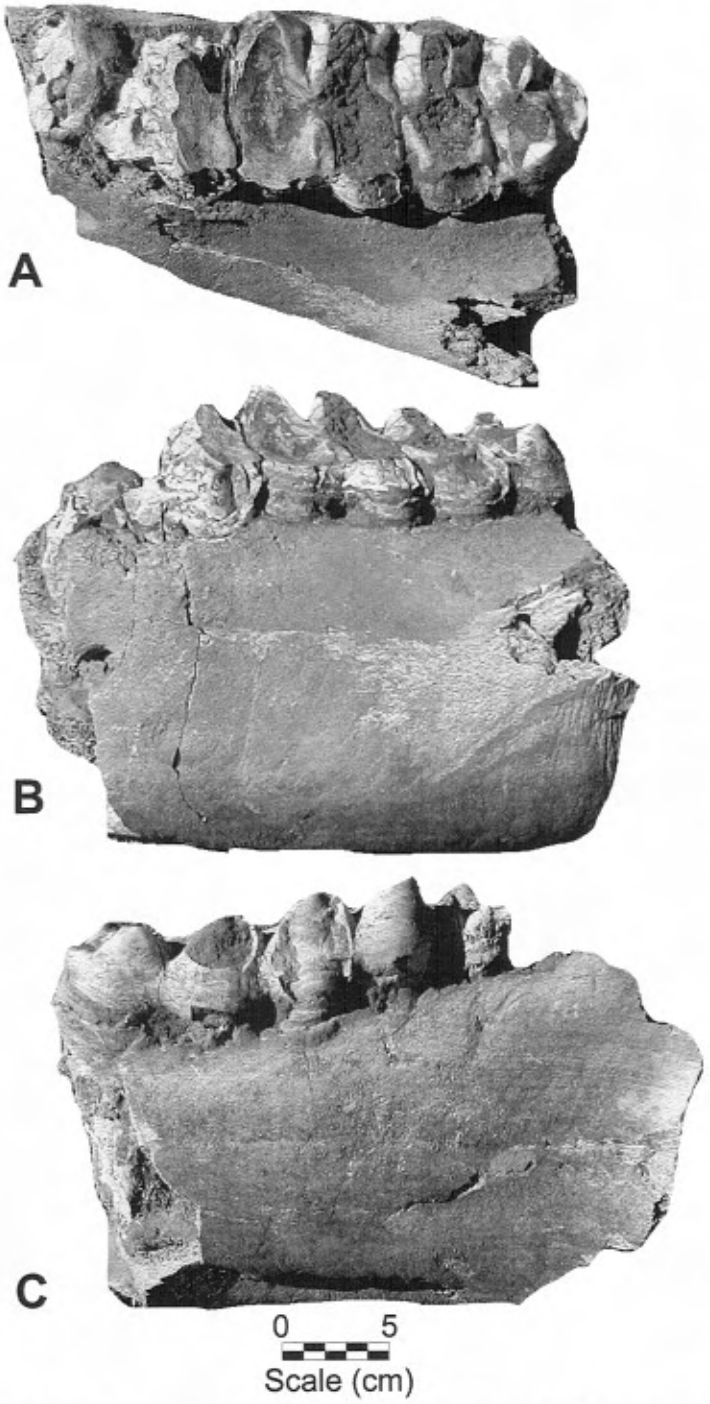

FIGURE 4. *Mammut americanum* from Trapped Rock Draw, incomplete left dentary with m2-3 in occlusal (A), labial (B), and lingual (C) views.

samples. Fluvial processes probably were the primary depositional mechanisms responsible for the death assemblages of these taxa. However, some shells appear to have been scorched, as indicated by gray discoloration, or had ash adhering to their surfaces. Common charcoal fragments associated with these specimens suggest possible mortality from fire and deposition without passive redistribution.

Small sample sizes (e.g., see Table 1: compare taxa recovered from the same stratum in samples ZMM-2A and -2B), limited width of the stratigraphic exposure examined, and the lack of specimens from the lowest mollusk-bearing stratum, may have contributed to a rather incomplete list of invertebrates. Furthermore, the small sample sizes make paleoecological inferences from the mollusc assemblage tentative and subject to later revision. However, available information on species-specific habitat preferences (e.g., Pilsbry, 1939, 1940, 1946, 1948; Hubricht, 1985; Metcalf and Smartt, 1998; M. Gordon, unpublished) reflect generally cooler, more mesic environments relative to present climatic conditions. Charcoal fragments may indicate that these environments were subjected to periodic fires, despite the cooler and more mesic climate. Strata represented by samples ZMM-2 (gray massive fine-grained sand underlying the mastodont mandible) and ZMM-1 (possible colluvial unit next to stream bank: Figs. 2-3) apparently indicate cool, mesic periods with a mixed riparian corridor of grass and deciduous forest. Surrounding non-riparian vegetation probably was probably dominated by open stands of mixed conifer and deciduous forest. The presence of aquatic taxa and *Oxyloma* in ZMM-4 (fluvial deposit with mastodont mandible) suggests that the intervening stratum may have been deposited during a somewhat cooler and wetter period with localized marshy conditions. The fauna of ZMM-3, collected from the uppermost mollusk-bearing stratum (inferred Holocene-age stratified fine-grained sand with coarse-grained sand and gravel channel deposits: Figs. 2-3), appears to reflect an increasingly xeric environment. Climatic conditions still supported an aquatic fauna, possibly in a cienega environment, and riparian zones with grass and woody, deciduous stands; however, the surrounding areas appear to have succeeded to predominantly piñon-juniper woodland communities.

CONCLUSIONS

The Trapped Rock Draw mastodont mandible occurs within a 12.4-m-thick exposure including a 6.6-m-thick Pleistocene section interpreted to represent deposition in a shallow, sandy, aggrading, braided stream system. The Pleistocene deposits are overlain by a gravelly channel-fill deposit of inferred Holocene age. The Holocene stream channel eroded an unknown thickness of the underlying Pleistocene deposit. The mandible occurs approximately 1.5 m below the top of the Pleistocene section. Based on stratigraphic relationships and the absence of buried soils, it is inferred that the mastodont is a late Pleistocene-age fossil. The Trapped Rock Draw mandible is the sixth record of *Mammut americanum* from New Mexico, and the first record from the Colorado Plateau in the northwestern part of the state.

Invertebrate faunal analysis suggests that paleoenvironmental conditions at the time of the Trapped Rock Draw mastodont were somewhat cooler and wetter than at present, with localized marshy conditions. ^{14}C analysis of charcoal samples collected from overlying and underlying strata have the potential to provide well-constrained age estimates for the Trapped Rock Draw mastodont , and would provide a better temporal framework for paleoenvironmental interpretations.

ACKNOWLEDGMENTS

The authors thank Zuni Pueblo for allowing access to the site, and for allowing collection of samples for faunal analysis. Danny Katzman and Dr. Stephen Hall provided helpful review comments. Jim Riesterer drafted the figures, and Cathy Ratcliff of Glorieta Geoscience, Inc. provided a final edit. Thanks to Dan Simplicio, Zuni Pueblo Tribal Council, for showing Drakos and Reneau the site.

REFERENCES

Hall, S.A., 1990, Holocene fluvial environments at Zuni, New Mexico: Geological Society of America Abstracts with Programs, v. 22, no. 7, p. A310-A311.

Hubricht, L., 1985. The distribution of native land mollusks of the eastern United States: Fieldiana, Zoology, new series, v. 24, p. 1-191.

Lucas, S. G. and Effinger, J. E., 1991, *Mammuthus* from Lincoln County and a review of the mammoths from the Pleistocene of New Mexico: New Mexico Geological Society, Guidebook 42, p. 277-282.

Lucas, S. G. and Morgan, G. S., 1997, The American mastodont (*Mammut americanum*) in New Mexico: Southwestern Naturalist, v. 42, p. 312-317.

Metcalf, A.L. and Smartt, R. M., 1998, Land snails of New Mexico: New Mexico Museum of Natural History and Science, Bulletin 10, p. 1-145.

Orr, B.R., 1987, Water resources of the Zuni tribal lands, McKinley and Cibola Counties, New Mexico: U.S. Geological Survey, Water-Supply Paper 2227, 76 p.

Pilsbry, H.A., 1939. Land Mollusca of North America (north of Mexico), v. 1, part 1: The Academy of Natural Sciences of Philadelphia, Monographs, no. 3, v. 1, part 1, p. 1-574.

Pilsbry H.A., 1940. Land Mollusca of North America (north of Mexico), v. 1, pt. 2: The Academy of Natural Sciences of Philadelphia, Monographs, no. 3, v. 1, part 2, p. 575-994.

Pilsbry, H.A., 1946. Land Mollusca of North America (north of Mexico), v. 2, pt. 1: The Academy of Natural Sciences of Philadelphia, Monographs, no. 3, v. 2, part 1, p. 1-520.

Pilsbry, H.A., 1948. Land Mollusca of North America (north of Mexico), v. 2, pt. 2: The Academy of Natural Sciences of Philadelphia, Monographs, no. 3, v. 2, part 2, p. 521-1113.

Wells, S.G., 1988, Holocene and historic arroyo evolution in the Zuni River watershed, western New Mexico: Geological Society of America Abstracts with Programs, v. 20, no. 7, p. A361.

TABLE 1. Invertebrate fossils associated with proboscidean remains in Trapped Rock Draw, Zuni Pueblo, New Mexico

TAXON	STRATIGRAPHIC LAYER				
	LOWEST		—>		HIGHEST
SAMPLE (ZMM-#):	2A	2B	4	1	3
Mollusca					
Gastropoda					
Pulmonata					
Stylommatophora (terrestrial pulmonates)					
Pupillidae					
Pupilla cf. *P. muscorum* (Linneaus 1758) complex[1]		X			
Pupoides albilabris (Adams 1841)				X	X
Pupoides hordaceus (Gabb 1866)					X
Vertigo cf. *V. modesta* (Say 1824) complex		X	X	X	
Vallonidae					
Vallonia cyclophorella, (Sterki 1892)		X		X	
Punctidae					
Punctum cf. *P. californicum*, (Pilsbry 1898), complex			X		
Helicodiscidae					
Helicodiscus singleyanus (Pilsbry 1889)		X		X	
Succineidae					
Catinella sp.	X	X			X
Oxyloma sp.			X		
Succinea grosvenori, (Lea 1864)				X	X
Zonitidae					
Glyphalinia cf. *G. paucilirata* (Morelet 1851) complex			X		X
Hawaiia neomexicana (Cockerell and Pilsbry 1900)			X		
Limacidae					
Deroceras sp.		X			
Basommatophora (aquatic pulmonates)					
Lymnaeidae					
Stagnicola caperata (Say 1829)		X			X
Bivalvia					
Sphaeriidae (aquatic)					
Pisidium casertanum (Poli 1791)			X		
Crustacea					
Ostracoda (aquatic)			X		

[1] The reference of particular taxa to species groups does not imply an inability to accurately classify these snails but indicates the need for systematic revision that is beyond the scope of this manuscript.