GEOLOGIC AND PALEONTOLOGIC INVESTIGATION OF THE CIMARRON NATIONAL GRASSLAND, MORTON COUNTY, KANSAS

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ABSTRACT--A geologic and paleontologic survey was completed on parts of the Cimarron National Grassland in Morton County, extreme southwestern Kansas. Six geologic units were mapped: 1) ?Triassic Dockum Group; 2) Miocene Ogallala Group; 3) undifferentiated Ogallala Group and Quaternary sediments; 4) Quaternary loess; 5) Quaternary dune sands; and 6) Quaternary alluvium. The geologic contacts often were inferred because of the extensive soil cover. Fossils were found only in the Ogallala Group. These were recovered from the Fullerton Gravel Pit and include the horse *Protohippus*, the dog *Osteoborus*, and the camels *Megatylopus*? and *Hemiauchenia*. These taxa co-occurred during the early Hemphillian Land Mammal Age, and are the first vertebrate fossils reported from Morton County, Kansas. Only two other reported Miocene fossil assemblages are located in the southwestern quarter of Kansas; therefore, this fauna represents a significant addition to our knowledge of Kansas Tertiary paleontology.

INTRODUCTION

Drought conditions during the 1930's and the prevailing farming practices of that time caused decimation of land on the Great Plains. Winds swept across the landscape, picked up a great amount of topsoil, stripped the land of its value, and caused the era to become popularly known as the "Dust Bowl." In 1938, the United States government began purchasing land in southwestern Kansas from local farmers in order to provide economic relief. In 1960, the federally owned lands were renamed the Cimarron National Grassland. Today, the grassland in extreme southwestern Kansas contains 108,175 acres within Morton and Stevens counties. The area is managed for wildlife, water conservation, livestock grazing, recreation, and mineral production.

In an on-going effort to characterize the resources of the grassland, the United States Department of Agriculture's (USDA) Forest Service and Fort Hays State University (FHSU) entered into a mutually beneficial agreement in 1994 to explore the paleontologic resources on parts of Cimarron National Grassland in Morton County. This agreement called for the production of a surficial geologic map in both hard copy and digital formats, collection and curation of fossil specimens, and assessment of the fossil resources. The study area consisted of all lands of the Cimarron National Grassland within the Midway Southeast and Elkhart North 7.5 minute topographic quadrangles.

PREVIOUS WORK

McLaughlin (1942) constructed the initial geologic map of Morton County and investigated the area with regard to ground water resources. He did not mention fossils from Morton County. Smith (1938, 1940) provided a regional geologic study for all of southwestern Kansas. Hibbard, a paleontologist from the University of Michigan, worked extensively in southwestern Kansas (e.g., Hibbard, 1938, 1940, 1941a, b, 1944a, b; Frye and Hibbard, 1941); however, his work primarily dealt with the Plio-Pleistocene sections of Meade County. In 1995, Donna Porter organized a Friends of the Pleistocene field trip in the area (Porter, 1995). Porter's work in the area involves dune development in southwestern Kansas.

METHODS

After additional background research, a team from the Department of Geosciences and the Sternberg Museum of Natural History at FHSU traveled to the study area to map the geology. Due to the extensive vegetation and low relief, the contacts very often had to be inferred and are represented on our map by dashed lines (Fig. 1). Few fossils were found during the mapping stage. Machine operators at the Fullerton Gravel Pit found the majority of the fossils and donated them for this study. Without their generosity, very little would be known about the fossil vertebrates in the county.

After completion of fieldwork, the data were placed digitally into a Geographic Information System (GIS). Besides the geological and paleontological data collected through fieldwork, other pre-existing digital data layers were compiled including roads, public land survey system, railroad, pipelines, soil types, streams, contours, land use/land cover, Cimarron National Grassland boundary, and digital orthophoto quadrangles. These data are now available for use by Forest Service personnel to better manage the resources on the grassland.

RESULTS

Six geologic units were mapped in the study area: 1) ?Triassic Dockum Group; 2) Miocene Ogallala Group; 3) undifferentiated Ogallala Group and Quaternary sediments; 4) Quaternary loess; 5) Quaternary dune sands; and 6) Quaternary alluvium. The geologic contacts often had to be inferred because of the extensive soil cover over most of the study area. Fossils were found only in the Ogallala Group.

?Triassic Dockum Group

The oldest rocks within the study area present the greatest enigma as to their age and correlation. These rocks are exposed at the base of a well-known geologic landmark called Point of Rocks (SE 1/4 Sec. 12, T. 34 S., R. 43 W.). This bluff was a landmark for travelers along the Cimarron Cutoff of the Santa Fe Trail, and wagon paths can still be seen in the area. This area was also important to travelers because of the nearby Middle Spring, a valued water supply in the arid region.

Point of Rocks is capped with a resistant Ogallala calcrete, which disconformably overlies a 12 m section of unfossiliferous buff, yellow, brown, and white sandstone, red to maroon siltstone, and red shale, which has been called ?Triassic Dockum Group. This assignment is based on correlation with lithologically similar redbeds in Oklahoma. A brief review of the history and rationale for this correlation is offered here.

In an early work, Gould (1900:135) referred "Point of Rocks, in Morton county, a line of bluffs on Bear creek, in Stanton county, and several exposures between these, on the North Fork of the Cimarron" to the Cretaceous Dakota. Subsequently, Gould and Lonsdale (1926) examined outcrops in Texas County, Oklahoma, south of Point of Rocks. In that county, they identified three exposures of redbeds: 1) along Beaver Creek in the southeastern part of Texas County near Palodura Creek (T. 1 N., R. 18 and 19 E.); 2) beds west of Guymon near the old Red Point post office (near NW 1/4 Sec. 25, T. 3 N., R. 13 E.); and 3) rocks along Tepee Creek farther to the west (T. 3 N., R. 12 E). Gould and Lonsdale believed the first two redbed localities represented the Permian Cloud Chief Formation. They suggested that the third site at Red Point could be Triassic, stating that some work "suggests that these beds are not of Permian age" (Gould and Lonsdale, 1926:25). However, they end their discussion by saying "the Texas and Cimarron County red beds do not

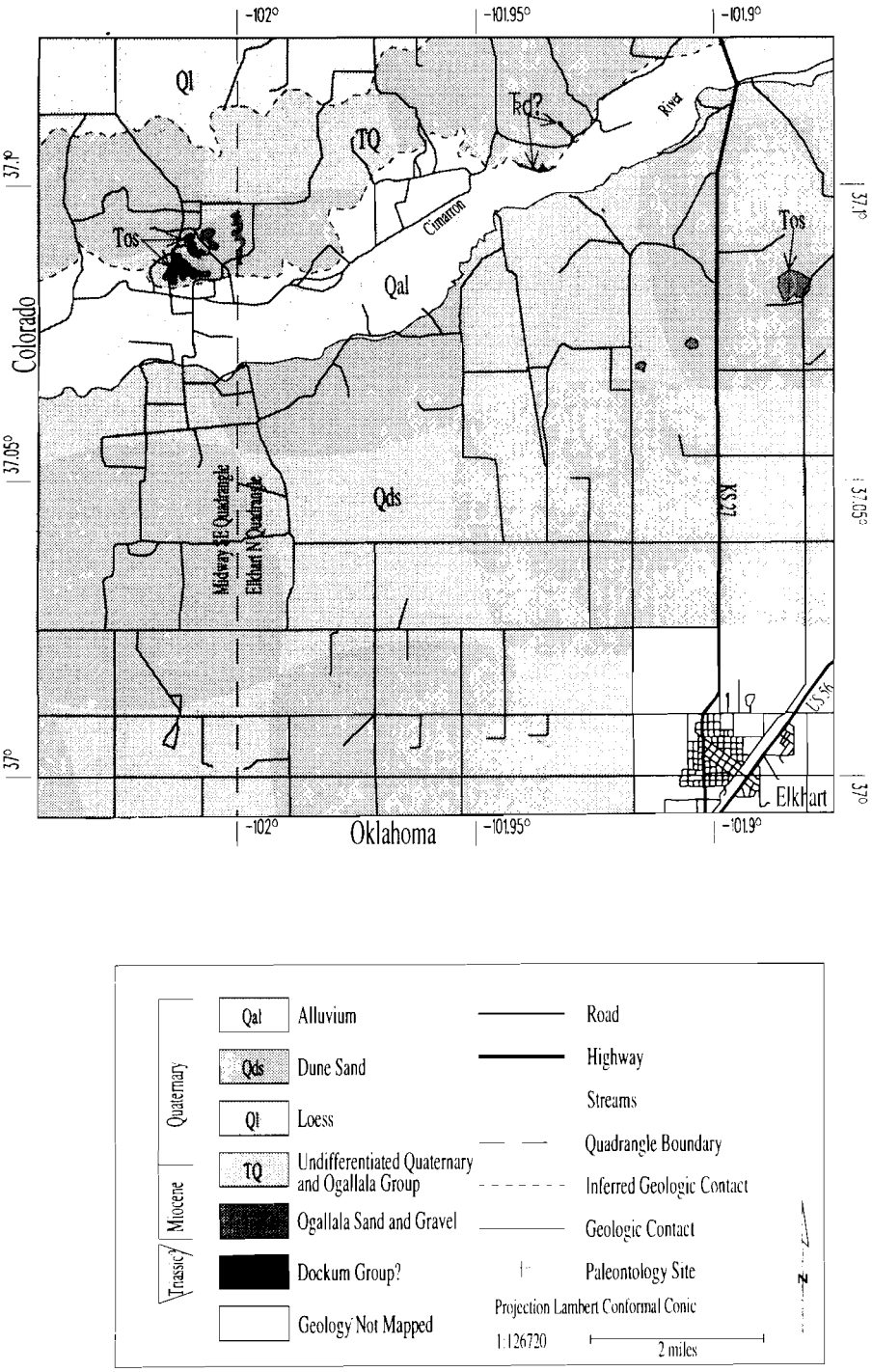

FIGURE 1 - Geologic map of the study area in Morton County, Kansas, extreme southwestern Kansas.

resemble the Texas Triassic rocks and do have the facies of the Oklahoma and Kansas Permian red beds" (Gould and Lonsdale, 1926:26).

Schoff (1939) reviewed the geology of Texas County, Oklahoma, discussed the same three redbed outcrops, and limited the Permian Cloud Chief Formation to the first area, along Beaver Creek. Schoff considered the other two outcrops to be Mesozoic in age, and he tentatively referred to them as Triassic and Jurassic, respectively. This new assertion was based primarily on an unpublished report of Lower Cretaceous invertebrate fossils being found in a sandstone bed at the Red Point locality in 1925, suggesting to Schoff that between the Permian Cloud Chief and the Lower Cretaceous fossil beds there would be Triassic and Jurassic beds. However, on his map of the area, he refers to both of these outcrops as Triassic(?) "because of the incomplete field data, and the tentative character of the conclusions, and because some of the outcrops are too small to be shown individually" (Schoff, 1939:49).

The Kansas Geological Survey first mapped the Point of Rocks, Kansas, redbeds as Triassic on the state map of 1937 (Merriam, 1963). McLaughlin stated that the redbeds at Point of Rocks are similar to those in the Red Point area in Oklahoma which "Schoff (1939: 49-51) and others have called Triassic(?)" (McLaughlin, 1942:71). However, as stated above, Schoff suggested that those rocks could be either Triassic or Jurassic and had evidence of Cretaceous invertebrates.

These rocks have been questionably assigned to the Triassic in several more recent publications (Moore et al., 1944, 1951; Merriam, 1963), and Buchanan and McCauley (1987) placed them in the Jurassic. But in no case was any additional evidence presented to support the assignment. Unfortunately, the present study did not uncover any evidence that would help to resolve this issue. However, we plan continued study seeking positive evidence for the age of this unit. Such evidence might come in the form of microfossils, especially pollen. In the confirmed Dockum sequence of Texas, Dunay and Traverse (1971) have found spores and pollen. However, the red clay and sand do not present an optimum environment for the preservation of pollen.

Miocene Ogallala

The Ogallala Group is comprised of late Tertiary sediments and rocks that crop out across parts of Texas, Oklahoma, Kansas, Colorado, New Mexico, Nebraska, South Dakota and Wyoming. Vertebrate fossils have been collected throughout the region. Sediments were spread across this vast area by fluvial systems running generally west to east. The sediment is a mixture of clay, silt, sand, and gravel, with localized cement of opal or calcium carbonate. In northern areas of the distribution, the clastics are often derived from the Front Range in Colorado and have a silicic composition. In southern regions, the clastics are often derived from basaltic sources in New Mexico. Additional clastics are often derived from local bedrock. Because of its complex depositional regime across such a large area, individual beds are rarely traceable over long distances. In many places, a veneer of younger silt, sand, and gravel further complicates the physical stratigraphy, making it difficult or impossible to differentiate the older beds from the younger.

In Kansas, the Ogallala Group can be readily identified by the presence of resistant calcrete beds and generally fine-grained sediments. It is now known that the calcrete beds are not useful for defining the top of the Ogallala (Diffendal, 1982) as was once thought (Frye et al., 1956).

The age of the Ogallala Group has also been revised. Older literature refers to the Ogallala Group in Kansas as Pliocene (e.g., Frye et al., 1956). However, with the acceptance of the Miocene/Pliocene boundary at 5 ma, placement in the late Miocene is necessitated. Based on biostratigraphy the Ogallala Group in Kansas ranges in age from early Clarendonian (~12 ma) (e.g., Gretna, Hamburg, and Keller local faunas) to the late Hemphillian (~6 ma) (e.g., Edson, Lost, and Rhinoceros Hill local faunas).

Fullerton Gravel Pit--The sediment at the Fullerton Gravel Pit is fluvial in origin and contains thinly bedded to cross-bedded fine to

TABLE 1 - Faunal list from the Fullerton Gravel Pit, Morton County, Kansas. Specimens are listed at the lowest taxonomic level that they were identified to. All specimens are housed at the Sternberg Museum of Natural History, Hays, Kansas.

CLASS	ORDER	FAMILY	GENUS	SPECIMEN # FHSM VP
Reptilia	Chelonia			13315, 13350, 13562, 13397
Mammalia				13307, 13308, 13309, 13310, 13311, 13312, 13314, 13407, 13408, 13409, 13410, 13411, 13412, 13413, 13571, 13572
Mammalia	Perissodactyla	Equidae		13294, 13295, 13296, 13297, 13416, 13417, 13563, 13564, 13565
Mammalia	Perissodactyla	Equidae	*Protohippus*	13292, 13293, 13345
Mammalia	Artiodactyla			13304, 13321
Mammalia	Artiodactyla	Camelidae		13298, 13299, 13302, 13305, 13317, 13318, 13319, 13320, 13346, 13347, 13348, 13349, 13399, 13400, 13406, 13414, 13415, 13569
Mammalia	Artiodactyla	Camelidae	*Megatylopus*	13300, 13570
Mammalia	Artiodactyla	Camelidae	*Hemiauchenia*	13301, 13303, 13398, 13401, 13402, 13403, 13404, 13405, 13567, 13568
Mammalia	Artiodactyla	Cervidae		13306
Mammalia	Carnivora	Canidae		13316
Mammalia	Carnivora	Canidae	*Osteoborus*	13344
Mammalia	Proboscidea			13313, 13566

coarse-grained sands with well-rounded cobbles of calcrete, sandstone, and igneous rocks up to 20 cm in diameter.

It has been stated many times by past workers that in southwestern Kansas it is very difficult to distinguish Ogallala sand and gravel from younger sediments (Smith, 1938; McLaughlin, 1942). It has been the general opinion, however, that Ogallala sediment is finer-grained than sediments deposited in younger and presumably more competent fluvial systems. McLaughlin (1942:83) specifically mentioned the Fullerton Pit by legal locality and stated that "these gravels are probably post-Ogallala in age." Frye et al. (1956:50-51) stated "The earliest post-Ogallala sediments of the central Great Plains are coarser than those of the upper Ogallala, and Pleistocene materials subsequently transported eastward from the Rocky Mountains to western Kansas are considerably coarser than any of the Ogallala materials."

It is not true, however, that Ogallala sediment is finer than post-Ogallala sediment. The fossil vertebrates recovered from the Fullerton Gravel Pit are consistent with vertebrates found at other Hemphillian sites across the state (see biostratigraphy section). It seems unlikely that the fossils were re-worked into younger sediment. It would be unlikely to have such a concentration of Hemphillian-aged material in a reworked site and no younger taxa are present in the fauna which would be expected with reworking. Thus it is likely that the deposit is of the same age as the fossils and the coarse grain size at the Fullerton Gravel Pit clearly shows that Ogallala fluvial systems could be just as competent, if not more so, then their younger counterparts. Grain size alone does not indicate the age of sediments in southwestern Kansas.

Systematic Paleontology--A complete list of specimens from the Fullerton Gravel Pit is presented in Table 1, but the specimens identified to genus are reviewed below. All specimens are in the collections of the Sternberg Museum of Natural History, Hays, Kansas.

Class Mammalia
Order Perissodactyla
Family Equidae
Genus *Protohippus*

Specimens - VP-13292 right maxillary with P3-M3; VP-13293 right m3; VP-13345 distal end of left humerus.

Order Artiodactyla
Family Camelidae

An unusual feature about the Fullerton fauna is the number of camel specimens that have come from the locality. The exact taphonomic filter working to preserve camels is not known, but camels continue to be recovered with greater frequency then other identifiable mammal remains.

Genus *Megatylopus*?

Specimen - VP-13300 1st phalange; VP-13570 cervical vertebra centrum.

Genus *Hemiauchenia*

Specimens - VP-13301 1st phalange; VP-13303 partial right metatarsal; VP-13398 partial distal end of radius; VP-13400 proximal end of left metacarpal; VP-13401 proximal end of left metacarpal; VP-13402 partial right metatarsal; VP-13403 proximal end of right metatarsal; VP-13404 proximal end of left metatarsal; VP-13405 partial metapodial; VP-13567 partial distal metapodial; VP-13568 partial proximal metapodial.

Order Carnivora
Family Canidae
Genus *Osteoborus*

Specimen - VP-13344 posterior end of left dentary with m2.

Biostratigraphy--The horse *Protohippus* ranged from the late Hemingfordian to the end of the late early Hemphillian about 6 ma (MacFadden, 1998). The camels *Megatylopus*? and *Hemiauchenia* ranged from late Barstovian into the Blancan (Honey et al., 1998), and the dog *Osteoborus* ranged through the Hemphillian (Munthe, 1998). All these taxa co-occur during the early Hemphillian (8.8-6.0 ma), thus suggesting this age for the fauna at the Fullerton Gravel Pit.

Quaternary Deposits

Quaternary deposits dominate the surface area within the study area. Dune sand prevails in the southern portion and loess in the north. No fossils were found in either of these two units, but these sediment types are known to occasionally yield fossils. Frye and Leonard (1951) presented a listing of many loess sites across the western two thirds of Kansas that produce mollusks. Likewise, our team recovered *Bison* remains from loess just outside the study area.

Dune sands are extensively deposited on the south side of the Cimarron River (Fig. 1). Most of the dunes have a vegetative cover, but their characteristic dune shape is very evident. The age of the dunes varies throughout the southwestern quarter of the state (Smith, 1938). According to Smith (1940), the dunes in the area could be contemporaneous with the loess deposits, but in at least a few cases are younger, as the sand occasionally overlies the loess. Lastly, Quaternary alluvium covers the meandering river valley of the Cimarron River.

DISCUSSION

Future work on the enigmatic Mesozoic rocks in the Point of Rocks area may yield clues as to their ages and stratigraphic correlations. The Fullerton Gravel Pit local fauna is the first fossil vertebrate fauna from Morton County and adds significantly to only two other Miocene localities in the entire southwestern quarter of Kansas. The local fauna seems to be typical of other Hemphillian assemblages, with the exception that camels are highly concentrated. This concentration may be real or artificial. To date, no fossil seeds have been found in the Ogallala Group of Morton County, although they are prevalent elsewhere in the state. This absence is likely due to the coarse-grained nature of the sediments, which would not preserve the fragile reproductive structures.

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