THE STRUCTURE AND STRATIGRAPHY OF THE EARLY CRETACEOUS OF THE SOUTHERNMOST EAST POTRILLO MOUNTAINS, DONA ANA COUNTY, NEW MEXICO

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by

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THESIS

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ABSTRACT

The center of the East Potrillo Mountains, Dona Ana County, New Mexico (107° 00' long., 31° 52' lat.) are located approximately 20 mi (33 km) west of La Union, New Mexico and 30 mi (50 km) west-northwest of El Paso, Texas.

The units of the Early Cretaceous in the southern end of the range have been redefined on the basis of topographic and lithologic characteristics. The informal units are (from oldest to youngest): K1, K2, and K3. K1 is divided into nine bedded sequences which are grouped into three members. K1 contains five lithofacies: mudstone, fossiliferous or glauconitic, but not silty; arkosic sandstone; orthoconglomerate; siltstone-claystone-calcilutite; and stiltstone-claystone-calcilutite paraconglomerate. K2 is divided into ten members. The clastic lithofacies vary between pebbly sandstone, siltstone, and calcareous mudstone. The carbonate lithofacies include: mudstone, wackestone, packstone, boundstone and floatstone. K3 is divided into five members. Its lithofacies is restricted to organic-rich mudstone, glauconitic mudstone, and fossiliferous wackestone.

The K1 sequence indicates a rapid transgression over an irregular karsted Permian surface. Local relief was

infilled by submarine fans and fluidized flows. When the local relief was subdued, subtidal migrating dunes swept the shelf. Continuing transgression is recorded by glauconitic mudstones and channelized siltstones. An eustatic standstill separates K1 and K2.

K2 represents a shelf edge. Deposition occurred in shallow intertidal, marine water. The lower half of K2 thickens to the north infilling a lagoon. Coarse sandstones in this material delineate a shelf-break in the southernmost part of the range. The upper part of K2 was deposited on an intertidal shelf. Channel siltstones are most frequent in the southernmost part of the range. K3 deposition indicates an intertidal, shallow, marine shelf typical of Early Albian carbonate-clastic sequences.

Numerous, characteristic structural features are recorded in microfacies analysis best exemplified by compressional features such as micro- and macroscopic asymmetric folds which are crosscut by tensional en echelon gashes and boudinage. Lineated pseudospar infilled fractures are common, also.

Hydrothermal alteration is also characteristic of the range. Solution seams, solution rims, and horsetail seams were all recorded. Stratigraphic thicknesses may have been significantly reduced by solutioning activity. Stylolites are common.

The southern end of the range is essentially homoclinal. Pods of intrusive sill material increase recorded thicknesses and other strike and dip data. Emplacement of dike material develops small- to medium-scale structure in the country rock. These structural features may vary from compressional to tensional, but their overall trend follows the trend of the dike material. No evidence for thrusting was observed.

Jasperoid mineralization is extensive. Solution pathways follow dike and sill emplacement and statigraphic controls. Sulphide mineralogy has been oxidized and evidence of redeposition of metals is recorded. Hematite pseudomorphs of pyritohedrons and limonite mineralization are common.

Regional correlation is difficult; however, K2 and K3 seem to correlate to the west to the U-Bar Formation of the Big Hatchet Mountains. K1 might be syndepositional with the Hell-to-Finish Formation. To the east, the upper part of the Cuchillo Formation is lithologically grossly similar to K2 and K3. K1 may represent a correlation with the lower Cuchillo or Las Vigas (?) formations.

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Location

The East Potrillo Mountains are a north-northwest trending range composed of a sequence of Permian and Lower Cretaceous sediments that have undergone Laramide deformation, Tertiary intrusive activity, and Basin and Range faulting. They are surrounded by Quaternary alluvial pediments and Recent bolson eolian sands.

The range is located in Dona Ana County, New Mexico, approximately 20 mi (33 km) west of La Union, New Mexico, and 30 mi (50 km) west of El Paso, Texas. The range is approximately 7.1 mi (11.8 km) in length and 0.6 to 2 mi (1 to 3.3 km) in width. The highest elevation in the range is 5,359 ft (1,624 m) and the range rises over 1,200 ft (363.6 m) above the bolson floor. The range straddles the boundary between the Mount Riley and Noria 7.5' quadrangles of the USGS topographic series. These surveys are at a scale of 1:62,500 and are dated 1917 with a contour interval of 10 feet (3 m). The center of the range is approximately located at longitude 107° 00' and latitude 31° 52' and extends along the eastern border of T28S, R2W (see Fig. 1).

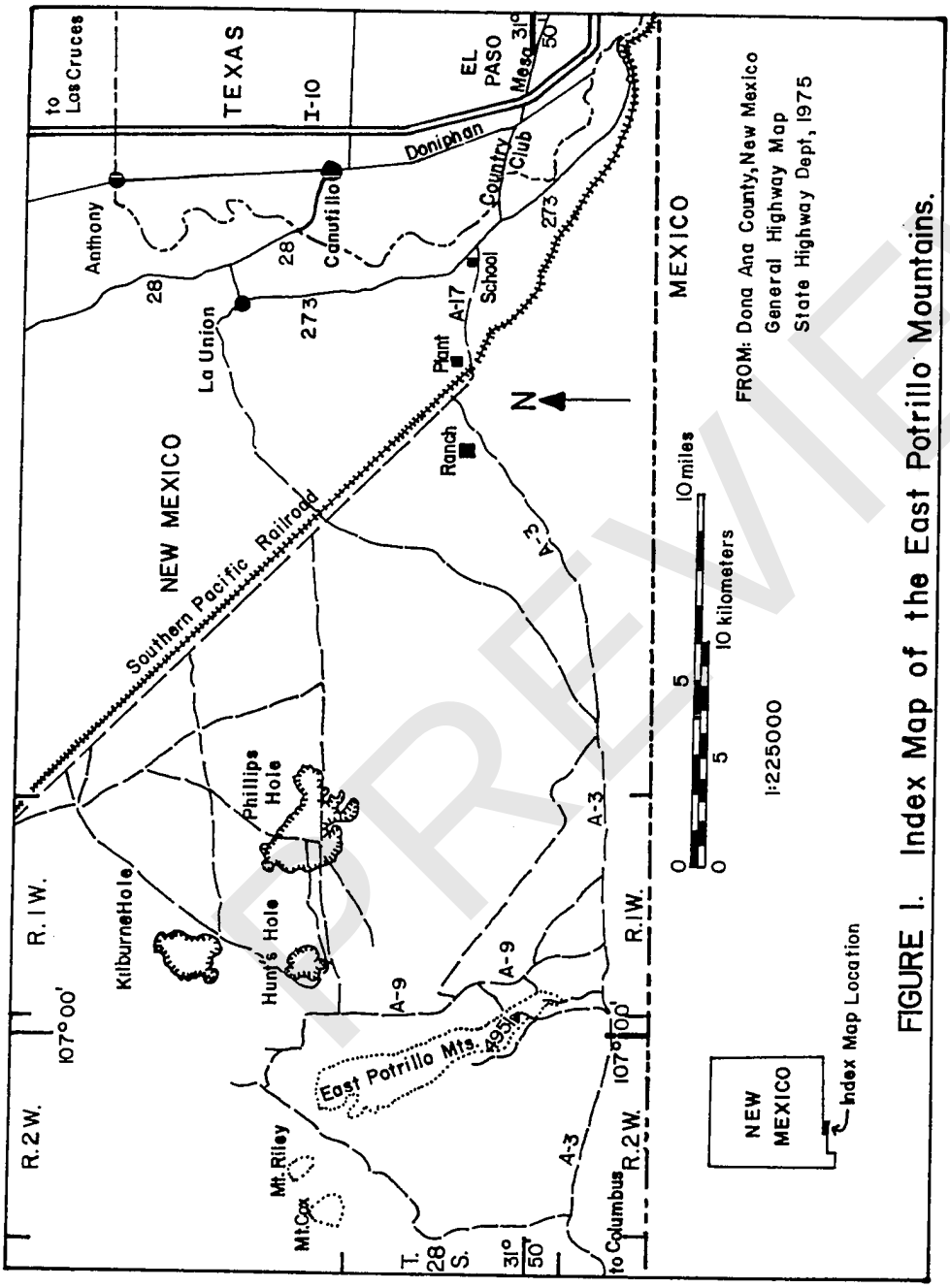

FIGURE 1. Index Map of the East Potrillo Mountains.

Accessibility

Directions for access from U.S. Interstate Highway 10 in El Paso, Texas are as follows:

1. Exit I-10 at the North Mesa Exit, northwest of central El Paso. Turn left on Mesa St. and travel west on Mesa St. to the intersection of Doniphan Blvd. and Mesa St.

2. Proceed straight (west) on Country Club Road (Mesa is renamed this, west of Doniphan) to New Mexico Highway 273 immediately before the entrance to Santa Teresa Country Club.

3. Turn right (north) on 273 for 0.8 mi (1.3 km).

4. Make a left turn (west) before Santa Teresa Middle School onto County Road A17.

5. Continue down A17 in a generally westwardly direction until reaching the Southern Pacific Railroad tracks. One must turn left prior to the Enersteel Plant.

6. Cross the railroad tracks and immediately turn right.

7. Continue about 0.9 mi (1.5 km) and turn left on County Road A3 through the 5R Ranch.

8. County Road A3 roughly parallels the abandoned Southern Pacific Railroad grade and reaches the Department of Interior's sign for Kilburne Hole at the junction of A9 after 15.3 mi (25.5 km)(see Fig. 1).

9. It is approximately 6 mi (10 km) from the junction to the quarry.

Location

The East Potrillo Mountains are public domain administered by the Bureau of Land Management. The study area of this report is the southern portion of this range below the approximate latitude 31° 49'. The southern, eastern, and western borders of this study area are bounded by Quaternary alluvial pediment or Recent bolson sand. The northern boundary is determined by the boundary of the aerial photograph. The area is approximately 1.7 sq mi (4.2 sq km) and has over a thousand feet (303 m) of relief in places.

Accessibility

The area is accessible by any one of four dirt roads from Dona Ana County Road A3 which connects El Paso, Texas and Columbus, New Mexico. From Dona Ana County Road A3, turn north prior to (or east of) the range onto County Road A9, marked by a sign to Kilburne Hole. Along this road, exiting to the left, are two dirt roads, in good condition, that approach the base of the range. The first goes to abandoned glory holes and the second to an abandoned quarry. Along A3, another dirt road makes a southerly approach to the range about 3 mi (5 km) past (west) of A9. A fourth dirt road makes an approach from the west. Look

for a wire gate about 0.5 mi (0.8 km) beyond where A3 combines with the abandoned railroad grade. Once through this gate, turn right and then left prior to the next gate. Follow the fence line until the road splits. The right fork goes to a low saddle in the range and the left fork continues on along the west side of the range.

Purpose and Objectives

Little detailed stratigraphic work has been done on the Lower Cretaceous strata in the East Potrillo Mountains compared to strata in the Franklin Mountains, the Sierra de Juarez, or Cerro de Cristo Rey. The only comprehensive stratigraphic work was done by Bowers in 1960. His work, however, consisted largely of mapping based on aerial photography and reconnaissance. A recent aerial photographic survey was carried out by the USGS in April, 1980, possibly to aid in the updating of their topographic survey of the area. This recent aerial survey was at a considerably larger scale (1:16,800) than was that with which Bowers worked (1:32,500).

This project was chosen because of the recently available aerial survey and the lack of detailed work in the area. The southern part of the range was chosen as the study area because of its suitability for stratigraphic studies. The determining factors were the area's high

accessibility and paucity of structure in comparison to the remainder of the range.

The objectives of this study are:

1. To initiate detailed mapping of the mountains at a large scale (1:7,140 for this study)(base is about 2x enlargements of the 1980 aerial photographic survey).

2. To initiate detailed stratigraphic work in the Lower Cretaceous strata. The studies will be especially useful in later structural analyses in the range.

3. To augment the knowledge of the regional relationships of the Lower Cretaceous of south-central New Mexico. Specific knowledge in the study area will potentially be extremely useful for overthrust model evaluations.

4. To determine the modes of deposition and the depositional environments of the different lithofacies of the Lower Cretaceous strata in the East Potrillo Mountains.

5. To establish basic lithostratigraphic criteria for recognition of the Lower Cretaceous strata in outcrop.

Methods

The methods of study utilized by this author included:

1. Initial field reconnaissance to locate the most suitable area for a stratigraphic section which should be

devoid of unnecessary structural and stratigraphic complications.

2. Construction of a preliminary stratigraphic column (measured from the Permian-Lower Cretaceous contact in the second arroyo south of the marble quarry updip to Restless Peak)(see Pl. I). Collection of the section with necessary measurements, sampling, and descriptions (see Pl. II).

3. Aerial geologic mapping (Pl. I) at a large scale (1:7,140) from aerial photographs (USGS series GS-VERK, 1-8, 4-28-80).

4. Additional detailed stratigraphic analyses including more descriptions, measurements, and interpretations of deposition.

5. Qualitative and quantitative thin-section analysis of 107 samples.

6. Measurement of an additional two sections to indicate lateral correlation problems and internal facies changes (see Pl. III).

Mapping was done from a USGS aerial photograph base (about 2x enlargement, scale 1:7,140). The scale was determined using a Brunton compass and a steel tape. Field equipment included a 35 mm camera, handpick, acid bottle, Jacob's staff, Brunton compass, and hand lens. The USGS topographic survey maps of the Mount Riley and Noria 7.5' quadrangles (1917)(scale 1:62,500) were considered too

inaccurate as a base for mapping and too small a scale for field orientation.

Physiography

This range is included as part of the Basin and Range Province of North America as described by Gilbert (1928). Basin and Range uplift occurred during the Cenozoic, after Laramide activity and Tertiary intrusions. The range rises above the "La Mesa surface" as described by Lee in 1907. The La Mesa surface is Quaternary bolson fill deposited throughout the Pleistocene as an alluvial plain throughout New Mexico, West Texas, and northern Mexico (Strain, 1966).

The East Potrillo Mountains are surrounded by Quaternary pediment and Recent bolson sands. On the east side of the range, the Robledo fault is indicated by an erosional fault scarp which places calichified pediment fanglomerate against Recent bolson sands. The mountains have, on the west side, several isolated blocks of outcrop protruding the pediment. Arroyos basically trend east-west except where structure has dictated other patterns.

Climate, Fauna, Flora

The East Potrillo Mountains are within the Chihuahuan Desert and Biotic Province. Summer daytime temperatures are above 100°F (38°C). The average daytime

winter temperatures are from 55° to 69°F (13° to 16°C). The average mean annual temperature is 63°F (17°C) and the mean maximum temperature is 77.5°F (25.3°C). Average annual precipitation is 8.6 inches (215 mm) and evaporation averages 97 inches per year (242 cm/yr). The dominant wind direction for seven months of the year is west-southwest with an average velocity of 5.9 mi/hr (9.5 km/hr). High winds in March and April have velocities that exceed 45 mi/hr (72 km/hr)(Gile et al., 1970).

The life zone fits within the Creosote-Cottontail-Yucca Faciation of the Chihuahuan Biotic Province. Flora within this zone consists of grasses such as fluff grass, burro grass, bush muhly, and black grama. Bushes such as ocotillo, Brickellia, and saltbush are included. Trees consist of cottonwood, desert willow, and oak. Plants include Mormon tea and cacti. The plants that this author has noted most often are broad and narrow leaf yuccas, prickly pear, strawberry cactus, cholla, and Mormon tea. The most common trees are junipers on the heights and mesquite at lower elevations. Commonly observed bushes include creosote, ocotillo, and catclaw.

The most commonly observed vertebrate fauna are horned and other assorted lizards, and jackrabbits. Rattlesnakes are encountered very frequently. Coyotes are common. There are multitudinous small birds and occasional

owls. A single deer was observed in the winter and deer tracks were encountered in the winter snow.

Previous Work

W. T. Lee visited the East Potrillo Mountains in 1904 and collected some fossils from the north end of the range (Lee, 1907). Darton (1928) mentioned Lee's fossil collection and commented on it. Dunham (1935) gave a general account of the geology of Dona Ana County along with notes on the geology of the East Potrillo Mountains which included a reference to gold mining by John Graham around 1900 from a quartzite bed on the east side of the range.

W. E. Bowers (1960) wrote a master's thesis on the geology of the East Potrillo Mountains. His thesis stressed aerial photography (p. 3). He mapped the area at a scale of 1:35,400, measured three stratigraphic sections, studied sixteen rock sample thin sections, and informally named the Lower Cretaceous units.

Kottlowski (1963) synthesized the regional Mesozoic stratigraphy. He mentioned the Pure No. 1 Federal "H" completed in 1962, and suggested similarities between the strata in the East Potrillo Mountains and the Cretaceous strata in the Tres Hermanas Mountains.

Donald Lokke (1964) identified Orbitolina gracilis Douglass from samples collected in the East Potrillo Mountains. He collected from an 800 ft (242 m) carbonate