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PLEISTOCENE ROCKS IN EL PASO AND HUDSPETH COUNTIES, TEXAS ADJACENT TO INTERSTATE HIGHWAY 10

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INTRODUCTION

Pleistocene rocks are exposed in the Rio Grande Valley in El Paso and Hudspeth Counties. Interstate Highway 10 follows the Rio Grande Valley paralleling the river from the northern border of El Paso County to the Quitman Mountains in Hudspeth County. From the New Mexico–Texas state line to El Paso, the highway lies in the Mesilla Bolson. From El Paso to the Quitman Mountains, the highway passes through the Hueco Bolson.

Pleistocene rocks crop out locally adjacent to Interstate 10. Near the Quitman Mountains the river and highway diverge. The highway veers to the north of the Quitmans and the Rio Grande passes through a narrow gap south of the mountains at which point it enters the Red Light Bolson.

Four formations have been described in the three bolsons. The Fort Hancock and Camp Rice formations occur in the Mesilla and Hueco bolsons. The Bramblett and Love formations are restricted to the Red Light Bolson. The deposits are poorly consolidated and are of fluvial and lacustrine origin. The Fort Hancock is older than the Camp Rice Formation, and the Bramblett Formation is older than the Love Formation. Lithologically the Bramblett is very similar to the Fort Hancock and the Camp Rice resembles the Love Formation. Most of the strata are essentially horizontal. The Fort Hancock and the Camp Rice formations are included in the Santa Fe Group (Kottlowski and LeMone, 1969).

STRATIGRAPHY

Fort Hancock Formation

The Fort Hancock Formation (Strain, 1966) is named for the small town of Fort Hancock in Hudspeth County. The type section is approximately 11 km up stream from the point where I-10 crosses the Madden Arroyo in Hudspeth County. The type section is composed of alternating horizontal layers of claystone, siltstone and silty claystone 23.37 m thick. In the southeastern part of the Hueco Bolson, gypsum occurs as interbedded laminae or is disseminated as selenite throughout the formation. The formation crops out along the Rio Grande Valley and its tributaries in the Hueco and Mesilla bolsons. Maximum exposed thickness is about 243 m, but no single exposure reveals more than 24 m.

The total thickness of the Fort Hancock is unknown because its base is not exposed, but a well drilled for water at Fort Hancock penetrated 1,067 m of "Fort Hancock-like" strata (oral communication, A. J. Wafer, 1958).

Fossils indicate that the upper part of the Fort Hancock is early Pleistocene, probably Nebraskan, but the lower unexposed part may be Pliocene or older.

At the time of deposition of the Fort Hancock, the Hueco Bolson was essentially a closed basin with internal drainage. The Mesilla Bolson was open to the south to areas in northern Chihuahua so that at maximum flood stage, water spread into Mexico and eastward around the Juarez Mountains into the Hueco Bolson. The sedimentary particles composing the Fort Hancock came from the weathering of rocks in the mountains bordering the bolsons and at times of maximum flooding, from sources far to the northwest. The "Ancestral Rio Grande" which transported the sediment to the Mesilla and Hueco bolsons had its origin in the mountains of New Mexico and southwestern Colorado (Kottlowski, 1958).

Camp Rice Formation

The Camp Rice Formation takes its name from the Camp Rice Arroyo near Fort Hancock in Hudspeth County (Strain, 1966). It is composed of clayey silt, sand, gravel and discontinuous lenses of volcanic ash. It was deposited in a fluvial environment and has a wide range in grain size which generally distinguishes it from the Fort Hancock Formation. Owing to the wide range in grain size, three reference sections are established in addition to the type section which is in the Campo Grande Arroyo about 8 km north of McNary, Texas (Strain, 1966). The thickness of the type section is 26.91 m, but most sections are thinner.

Caliche, related to the present climatic cycle, forms the capping stratum of the formation. This indurated caliche layer may be as much as 2 m thick and probably began forming prior to the present cycle of erosion.

Fossils (Strain, 1966) indicate that the age of the lower part of the Camp Rice is early Pleistocene, possibly Nebraskan, and the upper part is middle Pleistocene, probably late Kansan. Volcanic ash found in the lower part of the formation is type "B" Pearlette which accumulated 2 million years ago (oral communication, J. W. Hawley, 1980).

The source of the rock fragments was both in the surrounding mountains and far up stream. Pebbles of igneous rocks can be traced to sources in the Franklin Mountains in Texas, the Organ and Doña Ana mountains in New Mexico, and possibly sources adjacent to the "Ancestral Rio Grande" farther north. Hawley (1978) considers the basal Camp Rice river deposits in the El Paso area to be transitional southeastward in the Hueco Bolson with upper Fort Hancock playa-lake beds.

Bramblett Formation

The Bramblett Formation (Akersten, 1970) crops out in the Red Light Bolson east of the Quitman Mountains and south of I-10 near Sierra Blanca in Hudspeth County. The formation is named for the John D. Bramblett Ranch where the type section is exposed. Thickness of the exposed section is about 85 m, but the total thickness is unknown because the base of the formation is not exposed. Clay, silt, sand and gravel constitute the formation. Most beds are lenticular and are of short lateral extent.

According to Akersten (1970), the source of the rock fragments making up the Bramblett Formation was the surrounding mountains. He believes that the formation was laid down in a closed basin during an arid interval in the early Pleistocene, probably the Nebraskan Age.

Fossils recovered from the Bramblett demonstrate that mammals belonging to the Pleistocene part of the North American

Blancan mammalian age occur in the Red Light local fauna (Akersten, 1970).

The contact with the overlying Love Formation is gradational. The top of the uppermost green clay in the Bramblett was arbitrarily chosen as the top of the Bramblett Formation.

Love Formation

The Love Formation is named for the Love Triangulation Station in the Red Light Bolson, Hudspeth County, Texas. The type section is on the Bramblett Ranch (Akersten, 1970). A reddish silty clay and gravel facies and a silt, sand and gravel facies make up the Love Formation. The formation was deposited in a basin containing a through-flowing axial stream. The thickness of the Love Formation is approximately 61 m.

Akersten believes that the Love Formation is similar in age to the Camp Rice Formation in the Hueco Bolson which Strain (1966) considered to be Aftonian and Kansan. Recent work has established the age of the volcanic ash in the lower part of the Camp Rice as 2 millions years before the present (Hawley, 1978). This suggests the age is late Nebraskan or possibly early first interglacial.

STRUCTURE

Normal faults generally bound the bolsons. Structural deformation began in the area at least by Miocene time (Richardson, 1909; Bryan, 1938; King, 1935; Sayre and Livingston, 1945). Major faults occur along the mountain front bordering the bolsons. Adjacent to the Franklin Mountains there are high-angle faults with displacements of several thousands of meters (Lovejoy, 1976). Akersten (1970) recorded normal faults bordering the Red Light Bolson.

Faults with throws of only a few meters occur in the basin fill and mostly parallel the axes of the basins. They can seldom be traced for more than a kilometer. In most, the downthrown side is toward the axis of the basin (Albritton and Smith, 1965; Strain, 1966; Akersten, 1970). Albritton and Smith suggest that they may be inherited from older faults in the bedrock beneath the fill. Strain (1966) believes that the small normal faults may result from the compaction of clay and silt in the basin with the most compaction taking place toward the axis of the bolson where the thickness is greatest.

BOLSONS

The Mesilla, Hueco and Red Light bolsons formed principally as a result of faulting. The three bolsons were originally isolated basins with internal drainage (Bryan, 1938; Kottlowski, 1958; Albritton and Smith, 1965; Strain, 1966; Akersten, 1970). Only the surrounding mountains supplied sediment to aggrade the basin floors. Deposits were typical of closed basins with internal drainage (Wright, 1946). Coarse rock fragments collected in alluvial fans at the base of the mountains. Owing to selective transport, successively finer materials were carried toward the center of the basins where silt and clay accumulated in intermittent lakes and playas. The strata which formed in each basin were similar to a striking degree in grain size and color. The color of the older basin fills suggests that climatic conditions were the same throughout the region. The fossil turtle *Geochelone,* cotton rats and burrowing rodents such as gophers and ground squirrels, which thrive in warm climates with dry sandy soils, indicate that the climate was probably warm and at least semi-arid during the deposition of the Fort Hancock and Bramblett formations. Certainly the ground did not freeze in the winter because freezing leads to the death of burrowing terrestrial turtles (oral communication, C. W. Hibbard, 1958). A further suggestion of aridity of a periodic nature is seen in the thin interbedded gypsum layers in the Fort Hancock in the extreme southeastern part of the Hueco Bolson.

Deposits which accumulated in the Mesilla Bolson near El Paso and northward toward Las Cruces, New Mexico, were somewhat coarser than those farther out in the basin (Lovejoy, 1976). The "Ancestral Rio Grande" debouched from the rather narrow valley north of Las Cruces into the Mesilla Bolson and built a delta-like deposit in the large sedimentary basin which extended into Mexico. At the onset of flooding during fluvial cycles, flood plain deposits spread widely over the bolson floors. In periods of maximum flooding the waters of the Hueco and Mesilla bolsons coalesced to form Lake Cabeza de Vaca which spread into northern Chihuahua, New Mexico and Texas (Strain, 1966).

In the early Pleistocene, probably during the Kansan glacial age, the Rio Grande, meandering over a wide aggradational plain in the Mesilla Bolson, changed its course to pass through Fillmore Pass between the Franklin and Organ mountains and entered the Hueco Bolson. The river traversed the Hueco Bolson to a point south of the Quitman Mountains where for a time it may have found an outlet to the south into Mexico (Kottlowski, 1938; Albritton and Smith, 1965; Strain, 1971). Eventually however, the river entered the Red Light Bolson and then the Presidio Bolson where it joined the Rio Conchos. In the middle Pleistocene the Rio Grande changed its course, most likely due to faulting, from Fillmore Pass to the west side of the Franklin Mountains through Paso del Norte in the course it follows today (Lovejoy, 1976; Hawley, 1978).

A pluvial environment provided the increased stream flow to deposit the Camp Rice and Love formations (Kottlowski, 1958; Albritton and Smith, 1965; Strain, 1966; Akersten, 1970). Deposits of this kind are characteristic of basins with through-flowing streams (Wright, 1946).

The increase in rainfall probably produced more plant growth to support a larger fauna than had existed during the deposition of the Fort Hancock and Bramblett formations. This is indicated by a greater number of fossil species and individual bones found in the Love and Camp Rice formations.

GEOMORPHIC SURFACES

Constructional sedimentary processes of the floor of the Mesilla Bolson ceased in the middle Pleistocene with the final depositional stages of the Camp Rice Formation before the river began to entrench itself in the older basin fill. During the middle and late Quaternary several major episodes of river activity, associated with glaciation in the headwaters region in the Rocky Mountains, resulted in the development of distinct geomorphic features (Kottlowski, 1958; Ruhe, 1962, 1964; Hawley, 1978).

Ruhe (1962) described La Mesa surface as the modified Mesilla Bolson floor. He also described the Tortugas, Picacho and Fort Selden geomorphic surfaces near Las Cruces. Kottlowski (1958) described the Kern Place, Gold Hill and lower terraces in the El Paso area. Smith and Albritton (1965) described the Miser, Madden, Giles, Ramon and Balluco gravel bodies deposited on both pediments and terraces in the southeastern part of the Hueco Bolson.

Hawley (1978) correlates the Tortugas–Kern Place surfaces, the Picacho–Gold Hill surfaces, and the Fort Selden surface–El Paso area lower terraces. The same paper (p. 238, column M) gives a generalized correlation of the gravels and terraces described by Smith and Albritton in the southeastern part of the Hueco Bolson.

Most of the terraces discussed above are visible along I-10 from

Las Cruces to the Quitman Mountains. They are especially well developed between the Franklin Mountains and the highway.

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Black-footed ferret, *Mustela nigripes*.

Hairy tridens plant and spikelet, *Erioneuron pilosum*.