PLUVIAL LAKE PALOMAS, NORTHWESTERN CHIHUAHUA, MEXICO AND PLEISTOCENE GEOLOGIC HISTORY OF SOUTH-CENTRAL NEW MEXICO

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Geologic study of the Lake Palomas basin is in its infancy. The writer first visited the area in the spring of 1964. During the past year and a half emphasis has been on general reconnaissance, mapping of abandoned shorelines, and geomorphological studies. This report lacks quantitative detail, but contains several geologic speculations based on legitimate geomorphic evidence which have a direct bearing on the Pleistocene geologic history of south-central New Mexico. Discovery of Lake Palomas and a high-water predecessor verifies the presence of an early Pleistocene pluvial lake surrounding the El Paso area, sheds new light on the mysterious La Mesa rounded gravels (Ruhe, 1962), and hopefully resolves the conflicting arguments on the age of the Rio Grande Valley.

Lake Palomas is named for the village of Palomas on the international border 35 miles south of Deming, New Mexico (fig. 1). Brand (1937) refers to Guzman, Santa Maria, and Tildio playas and the Franklin Bolson, and the term "Guzman Sink" is used by Martin (1963) for the northwestern part of the Palomas basin. The Lake Palomas basin is not a sink and is today marked by several separated playas such as Guzman and the Franklin Bolson or "El Barreal." Previous terminology is not only misleading but incorrect.

The Lake Palomas basin extends from about the Juarez-Chihuahua highway on the east to about 107°30′ W., and from the southern end of the Florida Mountains south to somewhat past Villa Ahumada (fig. 1). Access to the basin is best provided by the Juarez-Ascencion highway, which, although not paved, allows all-weather travel. The old "Pershing Highway" south of Palomas is also generally passable except at times during the rainy season (July-September). Innumerable trails branch from the main road but most are of the jeep type. Travel by car is best confined to the main roads but most roads between the isolated *ranchos* are passable with a pickup. No automobile service or gasoline is generally available outside of Palomas, Ascencion, Juarez, or V. Ahumada, and good drinking water is impossible to find. Investigators are advised to prepare for any eventuality.

EXTENT AND DEPTH

The extent of pluvial Lake Palomas is not fully known because of a paucity of good topographic control in Mexico, fringing sand deposits, and a total lack of subsurface control. Photogeologic maps, ground and air reconnaissance, and the sketchy topographic control available surprisingly do allow placement of several well-developed abandoned shorelines. At least three abandoned beaches of regional extent are recognized, a 4,100-foot level termed the La Mota from La Mota Rancho, a 4,070-foot level termed the Guzman from Guzman playa, and a 4,030-foot level named the Las Muertos from the Las Muertos Mountains. Innumerable weak lower level beaches (fig. 2) also exist, for instance, the Santa Maria at about 4,056 feet and the El Sancho at about 4,010 feet.

The La Mota beach is best exposed along the northeastern part of the basin, being more or less continuous from the vicinity of Columbus, New Mexico, south to past V. Ahumada, a distance of over 110 miles (fig. 3). The La Mota beach is difficult to place accurately along most of the western flank of the basin because of Recent alluvial deposits. The best approximation is the contact between Pleistocene lacustrine and alluvial sediments and the Tertiary alluvial debris.

The Lake Palomas basin is split by upthrust Cretaceous block mountains and Tertiary extrusives on the north and east sides of Santa Maria playa (fig. 1). The old western part of the lake is now marked by the Guzman-Sabinal playas, the central part by the Santa Maria playa (fig. 4), and the eastern part by "El Barreal" (fig. 1). Thus, during high water stages of Lake Palomas, two islands existed: Santa Maria and Union, about 250 and 100 square miles in area, respectively. During the high water stages Lake Palomas was about 130 miles long and in places 40 miles wide, definitely covering over 2,000 square miles and perhaps as much as 3,500 square miles. The low level El Sancho stage appears to have inundated at least 2,000 square miles.

Emory (1857) reported Santa Maria and Guzman playas joining in wet years but Brand (1937) thought this impossible. Field evidence indicates that both

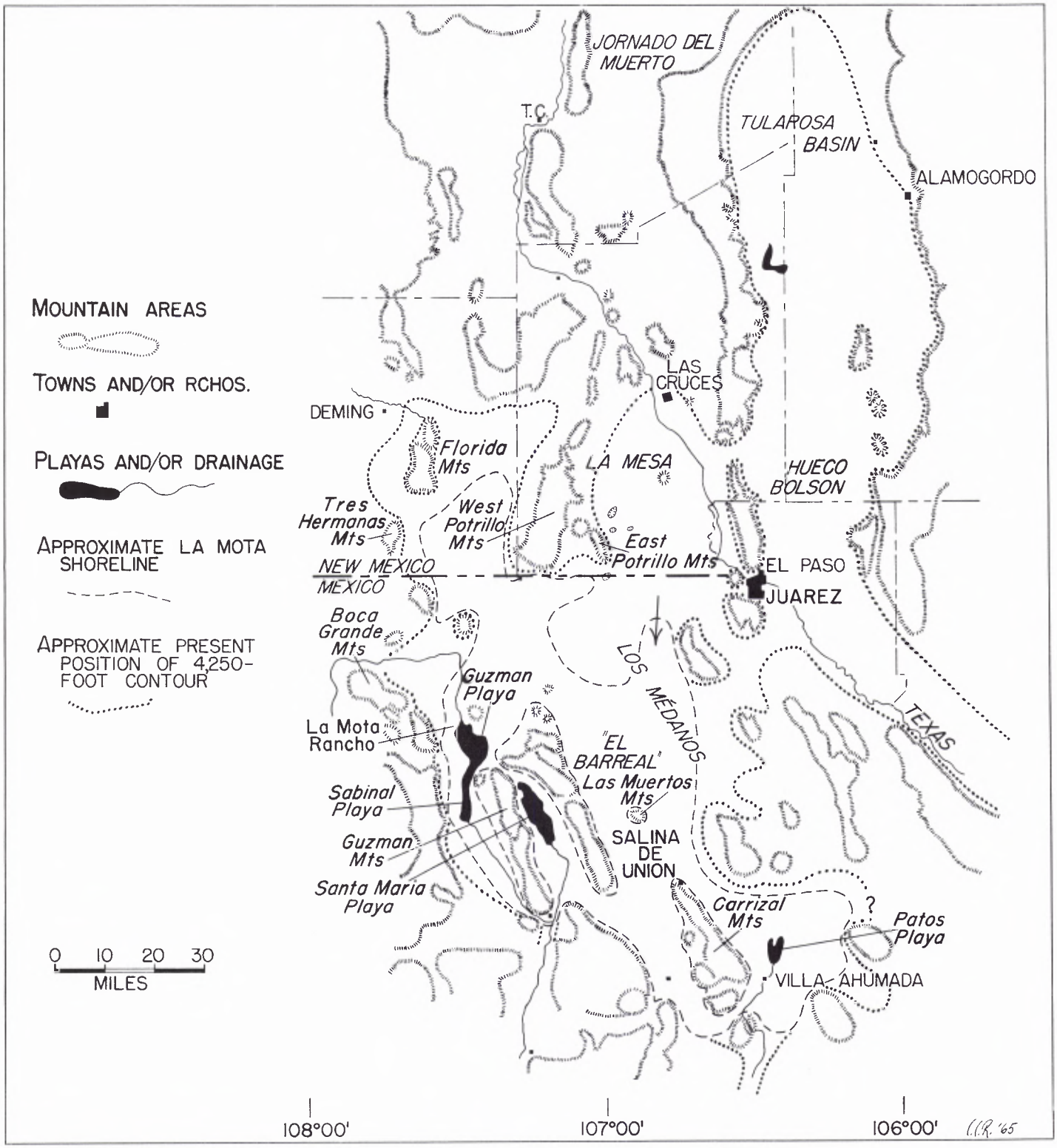

FIGURE 1

Index map of south-central New Mexico and northwestern Chihuahua, Mexico. The south-pointing arrow 20 miles west of El Paso and immediately south of the international border marks the suspected ancestral Rio Grande influent to the Lake Palomas basin. The present position of the 4,250-foot contour marks the approximate *minimum* extent of ancient Lake Cabeza de Vaca.

FIGURE 2

Abandoned low level shorelines of pluvial Lake Palomas, north end of Guzman playa (31°18′ N., 107°28′ W.). Notice four levels.

FIGURE 3

Aerial photograph of the Bonneville-Lahontan aged La Mota beach along northeastern flank of Lake Palomas basin (31°35′ N., 107°15′ W.). Notice regional extension of beach in background. Good exposure of lacustrine strata and wave-cut terraces in this locality.

were wrong. The Guzman and Santa Maria playas are at elevations of about 4,000 and 3,960 feet respectively,* the divide on the Guzman-Santa Maria trail rising only to about 4,050 feet. This effectively prevents joining of the playas during even the wettest years. However, both the Guzman and the La Mota Lake levels must have joined the playas during pluvial times. Figure 5 shows the faint trace of the Guzman beach cut on the hard basalt rim on the north side of the Guzman-Santa Maria divide.

The maximum thickness of lacustrine strata in the Lake Palomas basin is unknown. The Chihuahuan Desert is a flat plain broken by long narrow NNW-SSE aligned mountain ranges of mainly folded Cretaceous strata and igneous intrusive and extrusive rocks. Between the ranges are long, narrow, and generally interconnected *bolsones*. The Chihuahuan *bolsones*, like La Mesa to the north, may be filled with many thousands of feet of unconsolidated debris and, as study of their northwestward trends in Arizona

FIGURE 4

Aerial photograph of Santa Maria playa, spring 1964 (31°9′ N., 107°18′ W.).

FIGURE 5

North side of the Guzman-Santa Maria divide (31°10′ N., 107°20′ W.) showing the faint trace of the la Mota beach (arrows), pluvial Lake Palomas.

* Both playas have an average slope of about 3 feet per mile.

shows, (Melton, 1965), perhaps with exaggerated thicknesses of lacustrine strata.

Depth of Lake Palomas, at least above most of the present playas, was apparently never very great. The La Mota beach is now only about 100 feet above Guzman playa and only 140 feet above Santa Maria playa. The deepest part of Lake Palomas was probably in the Salinas de Union area (fig. 1) where the La Mota beach is about 410 feet above the playa (elevation of Salinas de Union from Ciudad Juarez 13R-I, 1958).

AGE AND REGIONAL IMPLICATIONS

Although no exact chronology has been established for Lake Palomas, certain gross assumptions, based on related pluvial lake studies (Morrison, 1964; Broecker and Kaufman, 1965) and observed features, can be made. The highest youngest abandoned shoreline, the La Mota, is considered to be of Bonneville-Lahontan age (about 60,000 years B.P.), and the other lower shorelines perhaps to be reflective of late Wisconsin high stands (Broecker and Kaufman, 1965). Evidence for a very old, early Pleistocene lake about 150 feet above the La Mota beach, generally in the form of escarpments and wave-notched mountain spurs, sporadically occurs throughout the Lake Palomas basin. An irregular remnant escarpment between Arena and the Potrillo Maar (Reeves and De Hon, 1965) and several truncated mountain spurs in the "El Barreal" area are thought to mark this old lake level.

Topographic maps show that a 4,250-foot lake level in the Lake Palomas basin would even now inundate vast areas of southern New Mexico (fig. 1). La Mesa, the Tularosa and Hueco basins, perhaps the southern Jornada del Muerto, and the Rio Grande Valley as far south as the Quitman Mountains must have been inundated by the early Pleistocene lake waters. This area, combined with the larger area flooded in Chihuahua, means that the early Pleistocene lake surrounding the El Paso area covered about 9,000-10,000 square miles.

The idea of an ancient lake in the La Mesa-Tularosa-Hueco areas is not new. Lee (1907) and Burrows (1910) both thought, mainly from physiographic evidence, that gigantic lakes once covered much of northwestern Chihuahua and southern New Mexico. Recently Ruhe (1962) and Strain (personal communication, May, 1965), on the basis of rounded and flat-pebble gravels, even-bedded sands and clays, and general topography, have proposed a Quaternary lake in the El Paso area. Strain suggests the name Cabeza de Vaca after the early Spanish explorer.

Everyone working in southern New Mexico seemingly sooner or later joins in the debate over the age of the Rio Grande Valley (Lee, 1907; Dunham, 1935; Bryan, 1938; Kottlowski, 1953, 1958; Ruhe, 1962). The writer is no exception, primarily because he feels that the significance of the presence of lakes de Vaca and Palomas in relation to the age of the Rio Grande Valley is not altogether obvious. The characteristic rounded gravels of La Mesa are of Kansan to medial Illinoisian age (Hibbard, 1958; Strain, 1959). If they and underlying even-bedded clays, silts, and sands represent lacustrine strata deposited by Lake Cabeza de Vaca, no through-flowing pre-Kansan Rio Grande existed in the La Mesa or Tularosa-Hueco areas as suggested by Lee (1907) and Bryan (1938). This evidence was also presented by Ruhe (1962: 1964).

Strain (personal communication, May, 1965) believes the Rio Grande originally cut through Fillmore Pass and the Hueco Bolson, and abandoned its channel in middle Pleistocene (post-medial Illinoisian?) time for its present course. Kottlowski (1958) suspects meandering of the ancestral Rio Grande across La Mesa south into Chihuahua before capture by headward erosion of a lower Rio Grande in mid-Pleistocene time. The lowest part of the northeastern flank of the Lake Palomas basin exists as a trough which may represent either an ancient Rio Grande influent or a lake-fed effluent to an early Rio Grande Valley. This low trough extends north to La Mesa between El Paso and the East Potrillo Mountains (fig. 1) and, from present physiographic evidence, is considered a post-medial Illinoisian influent to the Lake Palomas basin. The Rio Grande (after abandoning its course through Fillmore Pass?) flowed west of the Franklin Mountains into the Lake Palomas basin, perhaps as long ago as late Illinoisian time or as recently as early Wisconsin.

The abandoned ancient Rio Grande influent to the Lake Palomas basin, the present Mesilla Valley, and the fact that the Bonneville-Lahontan La Mota shore is not as high as old Lake Cabeza de Vaca, indicate that northwestern Chihuahua lost the Rio Grande's flow probably in a manner not unlike that described by Kottlowski (1958), after medial Illinoisan time but before Bonneville-Lahontan time. This gives a maximum of about 320,000 years and a minimum of about 60,000 years (Ericson, Ewing, and Wollen, 1964) to entrench the Rio Grande. If we consider 400 feet of entrenchment, a minimum cumulative rate of 0.015 inches per year or a maximum cumulative rate of 0.08 inches per year occurred. The maximum is not excessive considering the sediments incised. Because of the paired Tortugas, Picacho, and Fort Selden terraces along the Rio Grande (Ruhe, 1962, 1964), the late Illinoisan age seem most likely.

Because of the absence of parallel abandoned shorelines, a general southerly slope to the La Mesa gravels, the mineralogy of the La Mesa gravels, many of which would tend to form beach-appearing pebbles regardless of environment, and incorrect relative elevations in northwestern Chihuahua, many investigators think it unlikely that early Pleistocene pluvial lakes inundated the *bolsones* immediately surrounding El Paso and joined with the pluvial lakes in Chihuahua. It is significant that both Strain (personal communication, May, 1965) and the writer (often working nearly 100 miles apart) find complementary evidence for Lake Cabeza de Vaca.

Study of the Lake Palomas basin will continue with emphasis placed on shoreline chronology, lacustrine exposures, relation to ancestral drainage, and the ancient Cabeza de Vaca level. Studies of interrelations between Lakes Cabeza de Vaca and Palomas will help to clarify the Pleistocene history of south-central New Mexico.

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