GEOLOGY AND GEOGRAPHY

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Geology of Sabine Lake and Vicinity, Louisiana and Texas

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Location

Sabine Lake, a lake estuary (11), is situated in the extreme southeastern corner of Texas and the southwestern corner of Louisiana, in a portion of the North-Central Gulf Coastal Plain. The northern boundary of the lake is approximately at lat. 29° 59′ N.; the southern at lat. 29° 45′ N.; the eastern at long. 93° 45′ W.; the western at long. 93° 57′ W.

General Geology

Structurally, the Gulf Coastal Plain is a homocline with gulfward dipping strata disturbed locally by normal faulting, folding, and salt dome uplifts. The age of the geomorphic and stratigraphic features of the province with which this study is concerned is Late Pleistocene and Recent.

Significant geological contributions about southeast Texas have been made by Bernard (2) and about southwest and central Louisiana by Fisk (3), Holland and others (9), Howe and others (10), and Welch (16).

In Louisiana, four Pleistocene terraces have been recognized by Fisk (3). These terraces, representing deltaic deposits coastwise and equivalent fluviatile deposits up the valleys, are designated, from youngest·to oldest, Prairie, Montgomery, Bentley, and Williana. Bernard (2) extended the correlation of these terraces (formations) from Louisiana into southeast Texas and applied the same formational names. He considered that part of the Prairie formation of Louisiana flanking the Gulf equivalent to the Beaumont clay of Texas.

In addition, Bernard (2) recognized in southeast Texas a surface between the Pleistocene Prairie terrace and the modern flood-plains of the Neches and Sabine rivers which he designated Deweyville. The youngest surface recognized is the modern-day floodplains with their equivalent coastwise marsh, bay, and associated deposits. The modern surfaces are Late Recent in age, with the Deweyville considered of questionable Early Recent age.

Surface Geology

The Late Quaternary geology of the study area consists of the Pleistocene deltaic plain of the Neches and Sabine rivers in the northern

1. Acknowledgments are made to Shell Development Company for its financial grant toward this project and to the Gulf Coast Association of Geological Societies for permission to publish Figures 1 and 2.

part and the Pleistocene deltaic plain of the Trinity River in the western part (see fig. 1). These deltaic deposits, with interbedded marine and lagoonal facies, form an extensive coastwise plain (1),

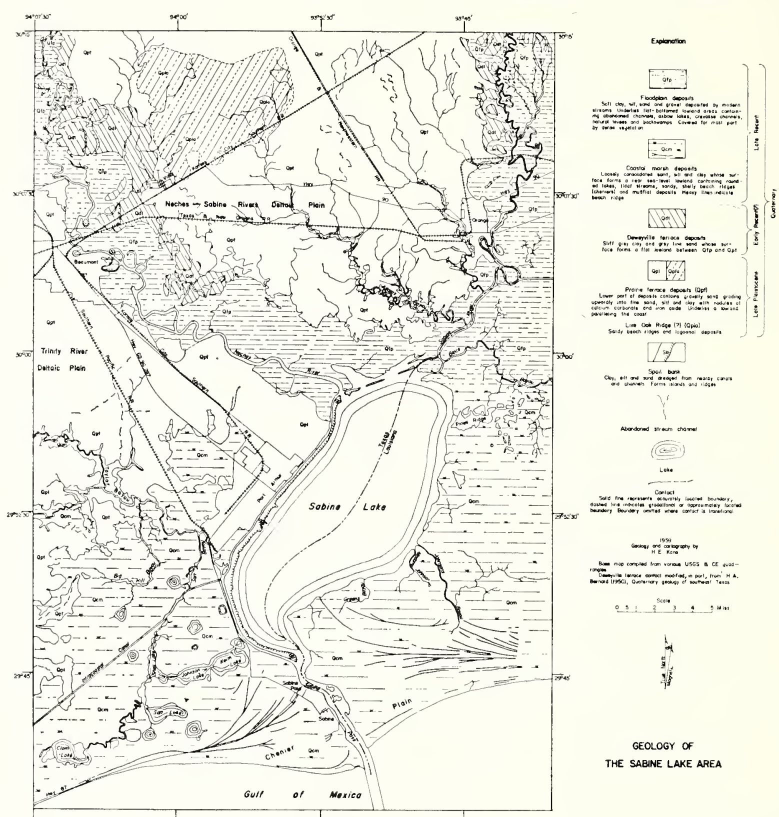

FIG. 1

Figure 1

which has been designated the Prairie terrace and which can be traced into fluviatile equivalents up the valleys. Remnants of this terrace representing dissected stream divides occur in Louisiana near Black Bayou. Other remnants and ridge extensions of the terrace occur in the western part of the area.

Associated with the Prairie terrace, in the northern part of Orange County, near Mauriceville, Texas, are sandy beach accretions and associated lagoonal deposits, referred to as the Live Oak Ridge (?) or Ingleside shoreline (13). These deposits, rising approximately ten feet above the surrounding Prairie terrace level, result from a Late Pleistocene stand of the Gulf of Mexico. Subsequently, this shoreline was bypassed by the regional drainage as deltas were built seaward. According to

Price, this shoreline can be traced in discontinuous segments from Matagorda County, Texas, to Calcasieu Parish, Louisiana.[2] Henry (8) posits a possible correlation with the Pamlico shoreline of Florida, which occurs at a 25-foot elevation.

South of the Pleistocene outcrop is the Recent coastal marsh; equivalent fluviatile deposits extend up the valleys of the Neches and Sabine rivers. The fluviatile deposits of the two rivers include the Deweyville terrace and the modern floodplains. The coastal marsh toward the Gulf margin includes the chenier plain (14), consisting of abandoned sandy and shelly beach ridges and associated mudflat and marsh deposits.

Subsurface Geology

The sedimentary material of the oxidized Pleistocene lying beneath the Recent fluviatile and marsh deposits is a stiff, vari-colored clay, bluish-gray, red, brown, yellow, or tan, sometimes containing concentrations of lime or iron nodules. In a few cases, the uppermost material of the oxidized zone consists of whitish, very fine sand or silt. The Pleistocene clays were usually very difficult to penetrate with a probe or auger.

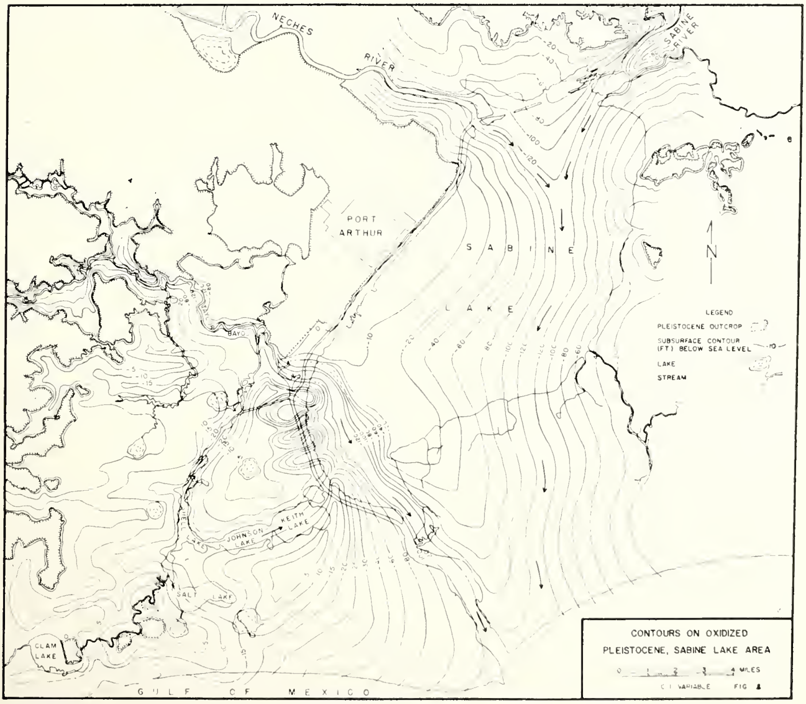

Figure 2

2. In personal correspondence, dated September 24, 1949, with Bernard (1950).

In contrast, the Recent sediments consisted of grayish or blackish soft clays and silts with grayish or whitish compact sands. The clays were penetrated very easily by auger; the thick sands resisted penetration. In some logs and borings in Taylor Bayou and Sabine Pass, great thicknesses of sand were encountered in the basal section of the Recent sediments.

Subsurface contours on top of the oxidized Pleistocene reveal the confluence of the Neches and Sabine rivers at the north end of the lake (see fig. 2). The valley of the combined streams is entrenched to a minimum depth of 120 feet. The axis of the valley trends generally north-south through the eastern part of Sabine Lake, then through the western portion of Cameron Parish, Louisiana, approximately four miles west of Johnsons Bayou. The western side of the valley merges with the Pleistocene outcrop flanking Sabine Lake on the west. The Pleistocene stream divides in Louisiana indicate that tributary streams entered the valley from the east, probably giving an embayed appearance to this part of the valley wall. The same interpretation might apply to the western wall, but substantiating evidence is lacking.

A narrow stream divide projects southwardly from the main Pleistocene outcrop on the western side of the entrenched valley of the Neches and Sabine rivers, separating it from the entrenched valley of Sabine Pass.

The valley of Sabine Pass, with steep and highly embayed walls as indicated by a portion of its western valley wall, is entrenched to a minimum depth of 120 feet. This valley, which trends southeast, represents the southern continuation of the present Taylor Bayou valley. The trend of the valley suggests that it might be tributary to the main entrenched valley of the combined Neches and Sabine rivers. Presently, the valley of Sabine Pass functions as the tidal outlet of Sabine Lake.

Subsurface ridges extend from the Pleistocene outcrop on the extreme western side of the study area toward the Shell Lake-Clam Lake drainage system. Some Pleistocene outliers also occur. This area is separated from two main subsurface "hills" by the valleys of Shell, Johnson, and Keith Lakes, and Salt Bayou, all of which flow around the flanks of the northernmost of these "hills." The lakes drain into Sabine Pass, and Salt Bayou flows into Taylor Bayou.

Fisk (4), using information based on sparse subsurface control, depicted a possible position of the Sabine River trench several miles east of Johnsons Bayou with the top of the Pleistocene (Prairie) at a minimum depth of 124 feet below sea level at the shoreline. He also showed a Sabine or Neches river trench in the area of Sabine Pass with the top of the Pleistocene at a minimum depth of 220 feet below sea level at the shoreline. Later, Fisk and McFarlan (6) mapped a Sabine trench which bifurcated approximately 30 miles offshore in the Gulf of Mexico, with the right fork located in almost the same geographic position as his previous Sabine trench. He defined a second trench as the Neches trench, with part of it passing through the mouth of Sabine Pass and then through the western extension of Cameron Parish, Louisiana, between Blue Buck Point and Johnsons Bayou, across Sabine

Lake to connect with the mouth of the Neches River. He delineated both trenches with the 100-foot contour, postulating a possibly greater depth of entrenchment.

Historical Development of Late Quaternary Geology

The terraces and later deposits can be ascribed to alternate valley-cutting and filling resulting from fluctuations of sea level. These fluctuations were caused by the waxing and waning of the continental ice sheets during the Quaternary period. During the waxing stage of the glacial sheets, sea level was lowered, stream gradients were increased, and the streams cut vigorously into the underlying deposits; this was the valley-cutting stage. Also during this interval, streams were capable of transporting coarser-grained materials. As the ice sheet melted (interglacial stage), sea level rose, causing a diminution of stream gradient and consequent valley-filling. Coarse sediments grading upward into fine-grained sediments were deposited during this stage. The general sequence of the fluviatile deposits is:

Top substratum—fine sands, silts, and clays;

Basal substratum—gravels and coarse sands.

This depositional sequence grades coastwise into a thicker deltaic sequence where, generally, clays and silts are more common and overlie gravelly sands.

Upon completion of each cut-and-fill cycle, the coastwise portions of the depositional surfaces subsided, and the resulting isostatic adjustment uplifted and steepened the interior sections to preserve them in their present-day position and sequence. The oldest surface, Williana (exposed beyond the limits of the study area), occurs at a higher elevation and has a steeper gradient than the next younger surface, and so on, with the Prairie and Recent surfaces generally showing the least amount of deformation, or none at all.

Approximately 25,000 years ago (12), with the retreat of Late Wisconsin ice, sea level began to rise, marking the beginning of the Recent epoch. Sea level continued to rise, with a probable minor fluctuation in the early Recent (Mankato (?) glacial substage), until about 5,000 years ago[3] when the sea reached its present level. Apparently, no major changes in sea level have occurred in the last 5,000 years (12).

With the last advance of the sea, the coasts and associated stream valleys were drowned to form bays as well as estuaries such as Sabine Lake. The rise in sea level decreased stream gradients and caused alluviation of the valleys.

Since the maximum inland stand of the Gulf which is marked approximately by the cheniers farthest inland, the coastal region around Sabine Pass has generally been built out into the Gulf of Mexico. The record of progradation is interpreted from the features of the chenier plain, such as the stranded sand and shell ridges along the marsh and mudflat deposits separating the ridges (see fig. 1). Howe and others

3. The 5,000-year estimate for the beginning of the stillstand of the Gulf of Mexico is questioned by Gould and McFarlan (1959).

(10), Fisk (4, 5), and Van Lopik (15) offer excellent descriptions and interpretations of the cheniers along the Louisiana coast.

Alluviation from the rivers has resulted in the filling of the entrenched valley of the Neches and Sabine rivers. This valley-filling and the prograding of the shoreline have closed the southern segment of the valley and have formed the modern Sabine Lake with its tidal outlet, Sabine Pass.

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