

Geology of the Elizabeth 7.5-Minute Quadrangle, LA

Louisiana Geological Survey

Introduction, Location, and Geologic Setting

The Elizabeth quadrangle (Figure 1) lies in an area south of the subsurface lower Cretaceous shelf edge (Toledo Bend flexure) and north of the northern edge of the Gulf Coast salt and growth-fault basin. It is near the southern edge of the coast-parallel outcrop belt of terraced Pleistocene strata of the Intermediate allogroup, in this area comprising three subunits: the Lissie, Elizabeth, and Oakdale alloformations (Figure 2). The Elizabeth alloformation, named for the town of Elizabeth, is of limited extent and mostly lies within the quadrangle of the same name. Although southwestern Louisiana is an area where supposed terrace escarpments (Fisk, 1939, 1948) subsequently have been interpreted as fault-line scarps (Heinrich, 1988, 2000), the Elizabeth as previously mapped at 1:100,000 scale lacks any obvious suggestion of a potential structural basis. These Pleistocene units are covered by Sicily Island Loess (Miller et al., 1985, their figures 2–3), which becomes thicker than 1 m nearer the Mississippi River flood plain beginning ~14 km to the east (Miller, 1983; Figure 2, stipple pattern).

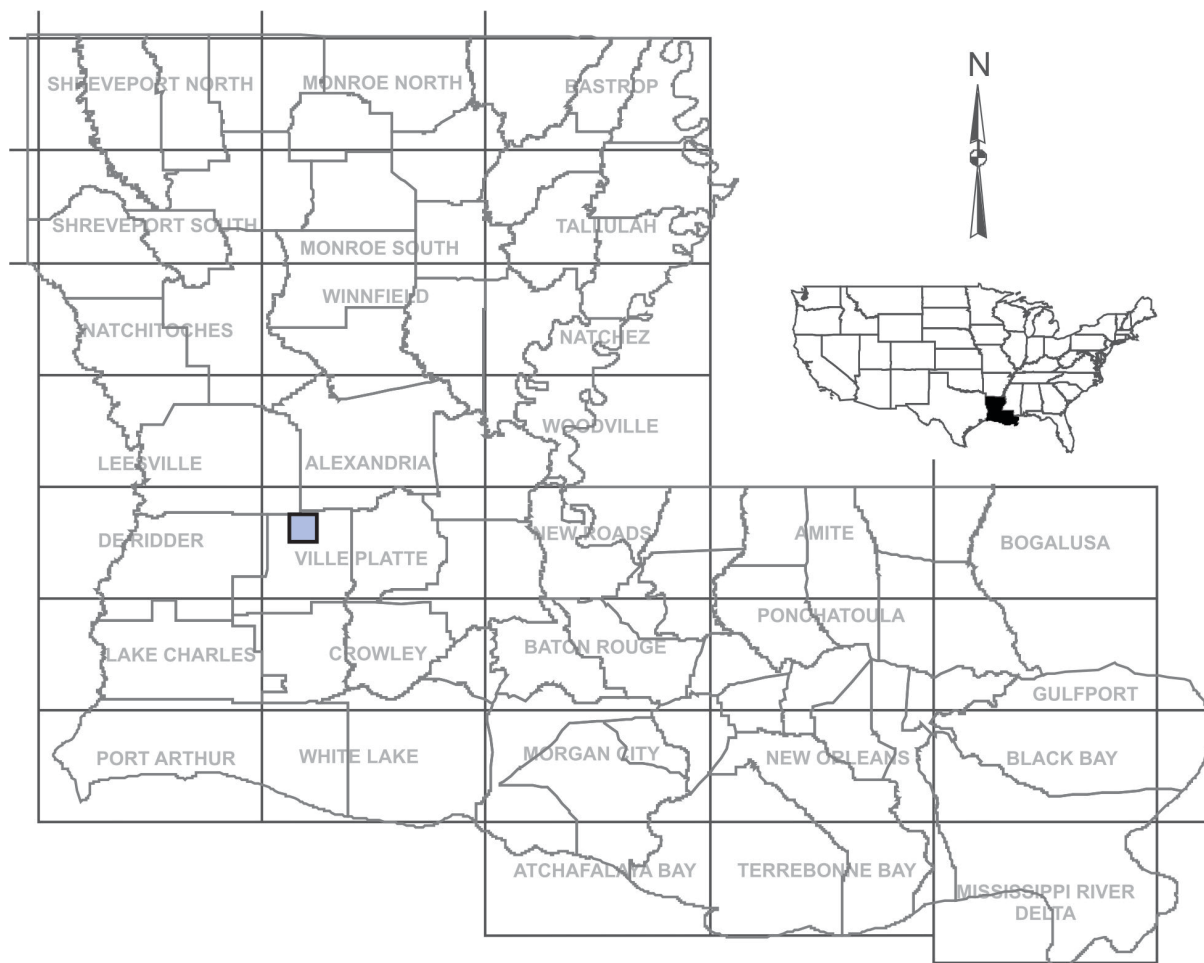
The units recognized and mapped in this investigation are summarized in Figures 3 and 4.

Previous Work

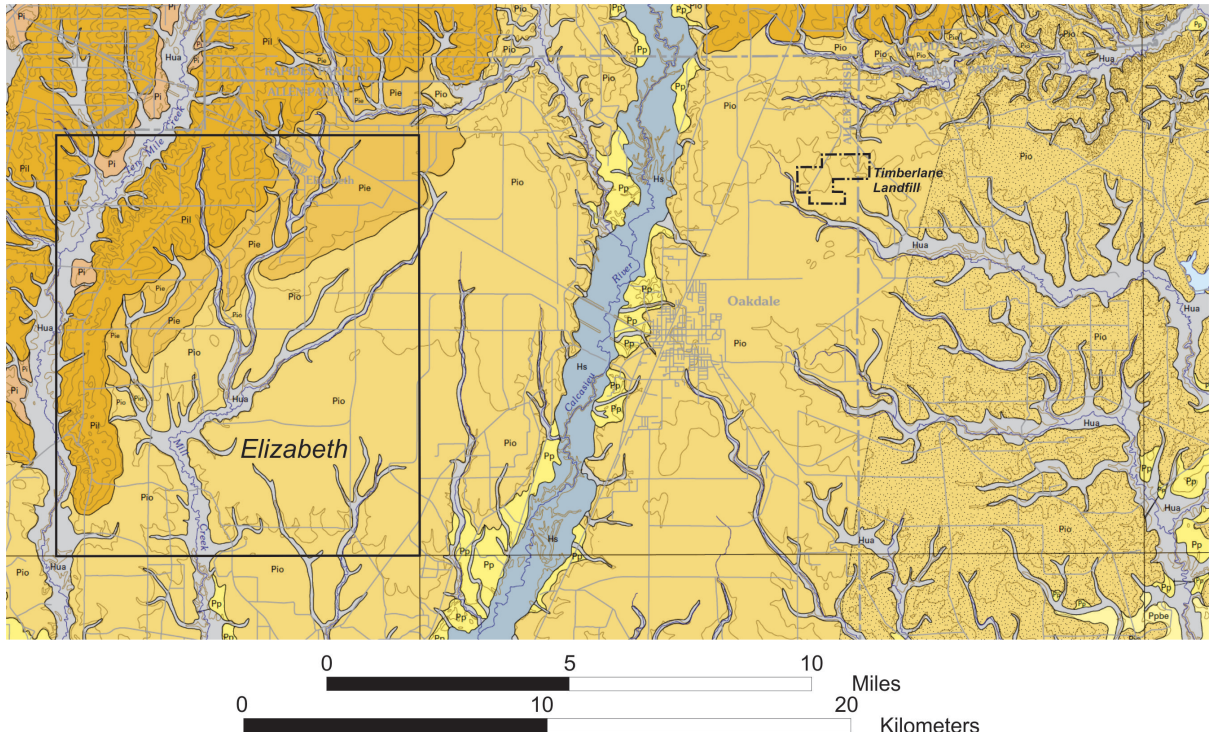
The basic framework of surface geology of the region encompassing the Elizabeth quadrangle was rendered at approximately 1:1,056,000 scale by Jones et al. (1954, their Plate I), drawing in part upon unpublished work by Fisk (1948). The first large-scale geologic maps of the area were by Holland et al. (1952) and Varvaro (1957); they recognized two pre-Prairie Pleistocene units, labeled Bentley and Montgomery following the classification of Fisk (1948). The regional framework and context of the proposed study area was updated at 1:1,100,000 scale in the compilation by Saucier and Snead (1989). The STATEMAP-supported compilation of the *Ville Platte 30 × 60 Minute Geologic Quadrangle* at 1:100,000 scale by Snead et al. (2002), in the northwest quarter of which lies the proposed study area, marked the first differentiation of the Elizabeth and Oakdale alloformations within the Intermediate allogroup. McCulloh et al. (2003a, 2003b) later summarized the geology and allostratigraphic approach to unit definitions reflected in this compilation. Milner and Fisher (2009) and Tomaszewski et al. (2002) detailed groundwater conditions pertinent to the Chicot aquifer, and Van Biersel and Milner (2010) summarized its distribution, recharge area, proportions of water-use categories, and pumpage rates. Numerous previous groundwater investigations include those by Harder et al. (1967), and Zack (1971).

Methods

The investigators reviewed legacy information and made new interpretations consulting remotely sensed imagery (comprising aerial photography, lidar DEMs, and other sources) and soils databases published by the Natural Resources Conservation Service (NRCS) to develop a draft surface geology layer for the study area. Field work was conducted to access the subsoil in road- and drainage-associated excavations, to examine and sample the texture and composition of the surface-geologic map units. Field observations were then synthesized with the draft surface geology to prepare an updated integrated surface geology layer for the 7.5-minute quadrangle.



1. Location of Elizabeth 7.5-minute quadrangle, southeastern Louisiana.



2. Surface geology of Elizabeth quadrangle and the Elizabeth–Oakdale area (adapted from Snead et al., 2002). (**Pil**, Lissie Alloformation, Intermediate allogroup (Pleistocene); **Pie**, Elizabeth alloformation, Intermediate Allogroup (Pleistocene); **Pio**, Oakdale alloformation, Intermediate Allogroup (Pleistocene); **Pi**, Intermediate Allogroup, undifferentiated (Pleistocene); **Ppbe**, Beaumont Alloformation, Prairie Allogroup (Pleistocene); **Pp**, Prairie Allogroup, undifferentiated (Pleistocene); **Hua**, Holocene undifferentiated alluvium.)

QUATERNARY SYSTEM

HOLOCENE

Hua Holocene undifferentiated alluvium

PLEISTOCENE

PRAIRIE ALLOGROUP

Pp Prairie Allogroup, undifferentiated

INTERMEDIATE ALLOGROUP

Pi Intermediate allogroup, undifferentiated

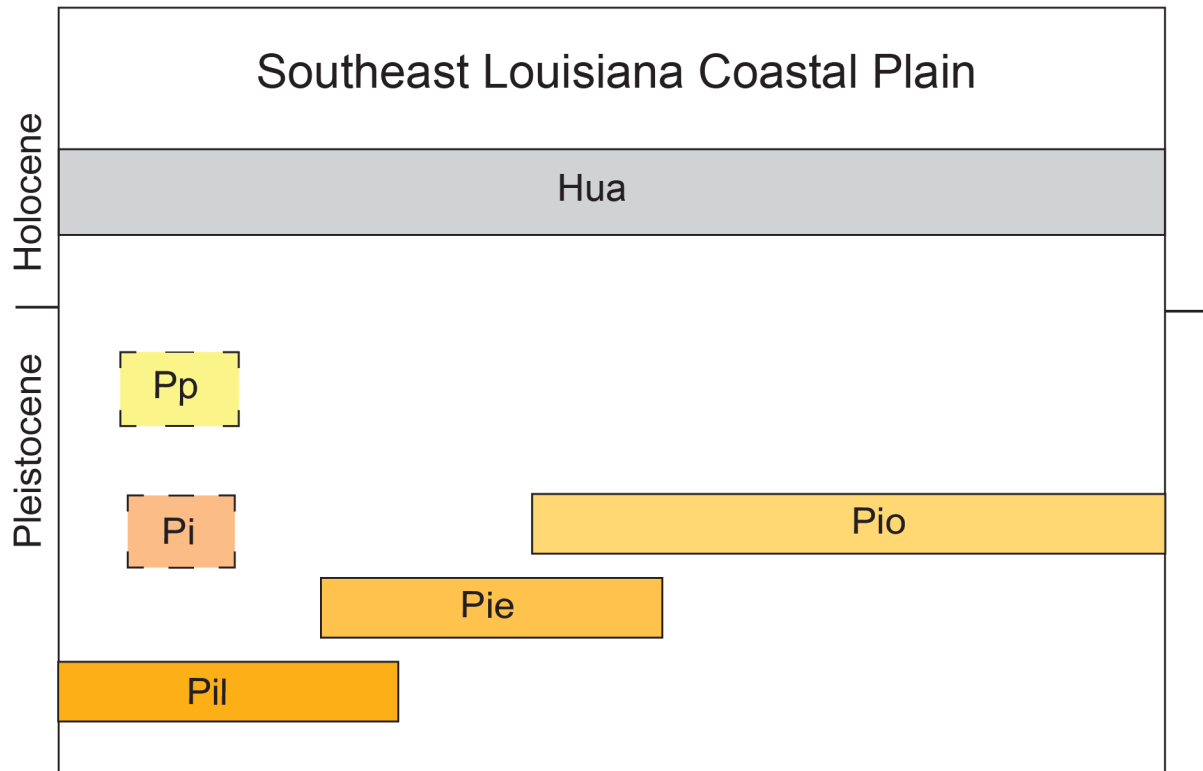
Pio Oakdale alloformation

Pie Elizabeth alloformation

Pil Lissie Alloformation, undifferentiated

3. Units mapped in the Elizabeth 7.5-minute quadrangle.

Correlation of Map Units



4. Correlation of strata mapped in the Elizabeth 7.5-minute quadrangle.

Allostratigraphic Approach to Pleistocene Unit Definitions

In the late 1980s the LGS had begun exploring the application of allostratigraphic concepts and nomenclature to the mapping of surface Plio–Pleistocene units (e.g., Autin, 1988). In Louisiana these units show a series of geomorphic attributes and preservation states correlative with their relative ages, which eventually led LGS to conclude that allostratigraphy offers an effective if not essential approach to their delineation and classification (McCulloh et al., 2003b). The Plio–Pleistocene strata for which allostratigraphic nomenclature presently has value to LGS all are situated updip of the hinge zone of northern Gulf basin subsidence and show a clear spectrum of preservation from pristine younger strata to trace relicts and remnants of older strata persisting in the coastal outcrop belt and on high ridgetops in places updip of it. All unit nomenclature has figured heavily in the STATEMAP-funded geologic mapping projects of the past two decades because Quaternary strata occupy approximately three-fourths of the surface of Louisiana. The surface of the Elizabeth quadrangle consists exclusively of Quaternary strata, which dictated a continuation of this practice for this investigation.

Intermediate allogroup, undifferentiated (Pleistocene)

The Intermediate allogroup consists of Pleistocene terrestrial sediments underlying surfaces that are older than and commonly higher in elevation than the surfaces of Prairie Allogroup. These surfaces are typically lower than the topography of adjoining Upland Allogroup and Tertiary formations. Its surfaces are dissected to varying degrees and lack

distinct constructional topography. The Intermediate allogroup is divided into sedimentary sequences of alloformation rank designated as Oakdale, Elizabeth, and Lissie. These units are mapped on the basis of their associated geomorphic surfaces. The Intermediate allogroup is locally mapped as undifferentiated alluvial deposits where they underlie discontinuous terraces, which are preserved within valleys (McCulloh et al. 2003a, 2003b).

Lissie Alloformation, Intermediate allogroup (Pleistocene)

The Lissie Alloformation consists of the dissected alluvial deposits of early Pleistocene streams and rivers. The unit is bounded updip by the Willis Formation and downdip by younger subunits of the Intermediate allogroup (McCulloh et al. 2003a, 2003b).

In the Elizabeth 7.5-minute quadrangle, the Lissie Alloformation underlies a deeply dissected, hilly landscape between Tenmile Creek to the west and younger terrace surfaces to the east. The area mapped as Lissie Alloformation has a relief of between about 14 and 17 m (46 and 56 ft). West of Tenmile Creek, the surface of the Lissie Alloformation is less dissected and better preserved. Based upon the heights of accordant summits, the original terrace surface descends in elevation from an elevation of 56.5 m (185 ft) in the northern part of this quadrangle southward to an elevation of about 45.0 m (148 ft) with a 0.11 percent slope. Just north of the Elizabeth 7.5-minute quadrangle, where the original surfaces are better preserved, the surface of the Lissie Alloformation lies 12 m (39 ft) above the surface of the Elizabeth alloformation.

The lithology of the Lissie Alloformation is poorly known. One outcrop consists of light orange-red, orange-red, and dark red gravelly sand. Local water well logs indicate that the Lissie Alloformation typically consists of an upper layer of muddy, fine-grained sediments, which is tens of meters thick, overlying graveliferous sand.

Locally and regionally, the Lissie Alloformation is typically unfossiliferous. However, near DeRidder, Louisiana, in Beauregard Parish, fossil freshwater mussels and a gastropod of forms still living in Louisiana today are documented in the Lissie Alloformation by Holland et al. (1952) and Jones et al. (1954).

Elizabeth alloformation, Intermediate allogroup (Pleistocene)

The Elizabeth alloformation consists of the dissected alluvial deposits of early Pleistocene streams and rivers. This unit consists of sediments that are younger than those of the Lissie Alloformation and older than those of the Oakdale alloformation. Its surface lies topographically above the surface of the Oakdale alloformation and topographically below the surface of the Lissie Alloformation (McCulloh et al. 2003a, 2003b).

In the Elizabeth 7.5-minute quadrangle, the Elizabeth alloformation underlies a moderately dissected, hilly landscape. The area mapped as Elizabeth alloformation has a relief of between about 14 m (46 ft). Based upon the heights of accordant summits, the original terrace surface descends in elevation from an elevation of 46.4 m (152 ft) in the northern part of this quadrangle southward to an elevation of about 40.9 m (134 ft) with a 0.09 percent slope. Just north of the Elizabeth 7.5-minute quadrangle, where the original surfaces are better preserved, the surface of the Elizabeth alloformation lies 12 m (39 ft) below the surface of the Lissie Alloformation and 7 m (23 ft) above the surface of the Oakdale alloformation.

The lithology of the Elizabeth alloformation is poorly known. Local water well logs indicate that the Elizabeth alloformation typically consists of an upper layer of fine-grained sediments, which is a few meters thick, overlying reddish sand.

Oakdale alloformation, Intermediate allogroup (Pleistocene)

The Oakdale alloformation consists of the dissected alluvial deposits of middle Pleistocene streams and rivers. This unit consists of sediments that are younger than those of the Lissie and Elizabeth alloformation and older than those of the Prairie Allogroup. Its surface lies topographically below the surface of the Lissie and Elizabeth alloformation and topographically above the surface of the Prairie Allogroup (McCulloh et al. 2003a, 2003b).

In the Elizabeth 7.5-minute quadrangle, the Oakdale alloformation underlies a relatively flat landscape. The area mapped as the Oakdale alloformation has a relief of between about 2 to 3 m (7 to 10 ft). Its relatively flat surface descends in elevation from an elevation of 38.7 m (128 ft) in the northern part of this quadrangle southward to an elevation of about 31.4 m (103 ft) with a 0.06 percent slope. Just north of the Elizabeth 7.5-minute quadrangle, where the original surfaces are better preserved, the surface of the Oakdale alloformation lies 7 m (23 ft) below the original surface of the Elizabeth alloformation.

The lithology of the Oakdale alloformation is poorly known. According to subsurface data from the Timberlane Landfill near Oakdale, Louisiana (Figure 2), the Oakdale alloformation consists of red, dark brown, light gray, and dark gray clay and silty clay that contain sinuous, light gray, silty, sand bodies which are 2 to 3 m (7 to 9 ft) thick.

Prairie allogroup, undifferentiated (Pleistocene)

The Prairie Allogroup is a diverse assemblage of late Pleistocene depositional sequences of alloformation rank (Autin et al., 1991). The sediments of the Prairie Allogroup accumulated within a diverse suite of coastal-plain settings, i.e., fluvial (meander-belt and backswamp), colluvial, possibly eolian, estuarine, deltaic, and shallow-marine environments. These largely fine-grained sediments accumulated over a considerable part of the late Pleistocene (Sangamon to Wisconsin) (Autin et al., 1991; Otvos, 2005; McCulloh et al., 2003a, McCulloh et al., 2003b).

The surface of the Prairie Allogroup forms a coastal terrace along the northwest coast of the Gulf of Mexico from a point about 110 km (~70 mi) south of the Rio Grande within Mexico over to at least Mobile Bay, Alabama. This surface is the lowest continuous terrace lying above Holocene coastal and flood plains. This relatively undissected terrace exhibits constructional topography that is more poorly preserved than exhibited by terraces of the Deweyville Allogroup and lacking on older Pleistocene surfaces. It comprises multiple stratigraphic units of alloformation rank (Saucier and Snead, 1989; Autin et al., 1991; Dubar et al., 1991; Winker 1990).

In the Elizabeth 7.5-minute quadrangle, the only mapped occurrence of the Prairie Allogroup are low fluvial terraces located along Tenmile Creek. Based upon their low relief relative to the flood plain and presence of relict channels on their surfaces, they are assigned to the Prairie Allogroup. Because of the lack of outcrops and their inaccessibility, the nature of the sediment comprising them is unknown.

Holocene alluvium

The Holocene sediments mapped in the Elizabeth 7.5-minute quadrangle consist of undifferentiated deposits of small upland streams and comprise unconsolidated alluvial deposits of streams and creeks of the Tenmile Creek, Mill Creek, and Little Mill Creek systems filling valleys in the drainage basin of the Calcasieu River. These alluvial deposits of small upland streams and creeks have not been studied in detail and are poorly known. The textures of their sediments vary greatly from gravelly sand to either sandy mud or silty mud.

Typically, the amount of coarse-grained sediments present directly reflects the texture of the local “bedrock.”

Summary of Results

The surface of the Elizabeth quadrangle comprises strata of the Pleistocene Intermediate allogroup consisting of sediment deposited by the Calcasieu River and its tributaries. The Lissie Alloformation, Intermediate allogroup, forms part of an extensive coast-parallel belt of terraced Pleistocene strata. The younger Elizabeth alloformation, of very limited extent, incises the Lissie and itself is incised by the next younger and more extensive Oakdale alloformation. Holocene strata comprise undifferentiated alluvium of tributaries of the Calcasieu River belonging to the Tenmile Creek, Mill Creek, and Little Mill Creek systems.

The geologic map of Elizabeth quadrangle provides basic geologic data of potential value to the exploration for aggregate in its Pleistocene strata and in the Holocene alluvium of the stream courses incised into them. The 1:24,000-scale surface-geologic map of the study area also should serve efforts at protection of the Chicot aquifer system in southwestern Louisiana.

Acknowledgments

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