Geology of the Plaquemine 7.5-Minute Quadrangle, LA

Louisiana Geological Survey

Introduction, Location, and Geologic Setting

The Plaquemine 7.5-minute quadrangle lies in the southeastern portion of the south Louisiana coastal plain (Figures 1, 2), situated mostly in the Holocene Mississippi River flood plain but overlapping Pleistocene uplands at its northeast corner. The axis of the deep-subsurface lower Cretaceous shelf edge (Toledo Bend flexure), which trends west-northwest to east-southeast, lies approximately 30 km (18.6 mi) to the north of the study area. The surface of Plaquemine quadrangle comprises mostly Holocene deposits associated with the most recent course of the Mississippi River, course 1. The northeast corner uplands represent strata of the Pleistocene Hammond alloformation, Prairie Allogroup. The Hammond is covered by late Pleistocene Peoria Loess that is 3–5 m (~10–16 ft) thick.

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

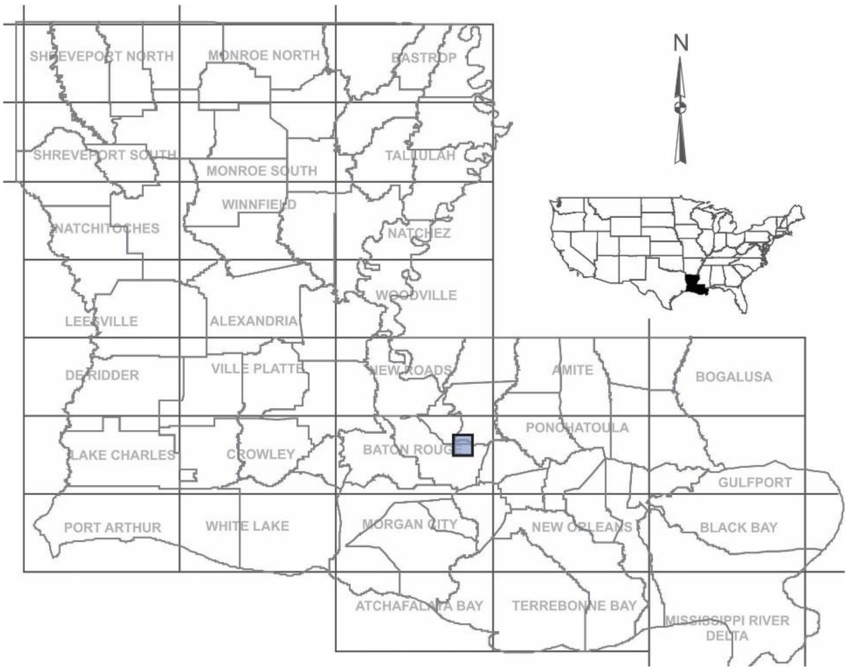
Previous Work

The Plaquemine quadrangle covers portions of three parishes (Figure 1), West Baton Rouge, East Baton Rouge, and Iberville. It lies in the northeastern portion of the Baton Rouge 30 × 60 minute quadrangle, the surface geology of which was compiled at 1:100,000 scale by Heinrich and Autin (2000), originally with STATEMAP support. Prior to this compilation, Self (1980, 1986) mapped the surface geology of the uplands of all of Louisiana's "Florida" parishes in southeastern Louisiana, though at 1:250,000 scale, and Autin and McCulloh (1991) mapped the surface geology of East Baton Rouge Parish at 1:24,000 scale.

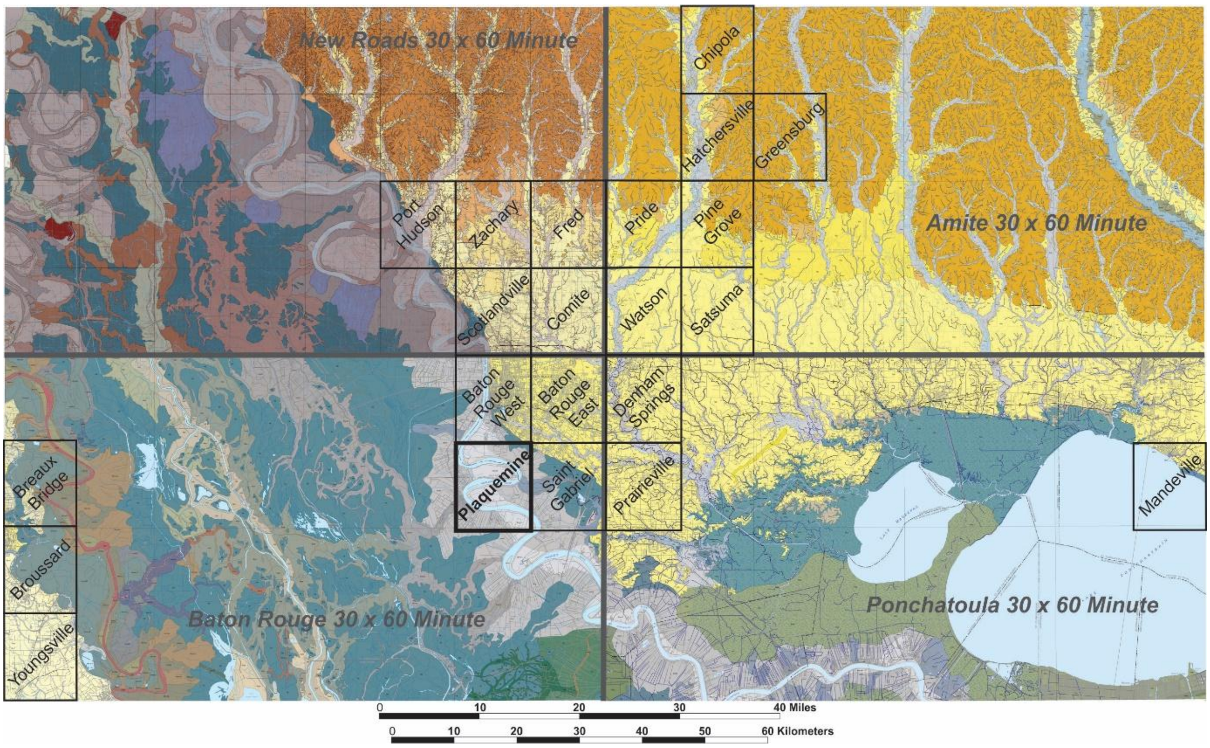
Tomaszewski et al. (2002) detailed groundwater conditions pertinent to the Southern Hills aquifer system, and Van Biersel and Milner (2010) summarized its distribution, recharge area, proportions of water-use categories, and pumpage rates.

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 examine and sample the subsoil in natural and artificial exposures and test it in places with hand-operated probes, to determine and characterize 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 Plaquemine 7.5-minute quadrangle, southeastern Louisiana.



2. Surface geology of the greater Baton Rouge area and environs (mosaic of Heinrich and Autin, 2000; Heinrich and McCulloh, 2007; and McCulloh et al., 2003a, 2009). Plaquemine 7.5-minute quadrangle is shown in relation to other mapped quadrangles. Port Hudson, Scotlandville, Baton Rouge West, Plaquemine, and Saint Gabriel quadrangles span the boundary between the Holocene Mississippi alluvial plain and Pliocene (orange) and Pleistocene (yellow to pale orange) sediment of the flanking uplands.

QUATERNARY SYSTEM

HOLOCENE

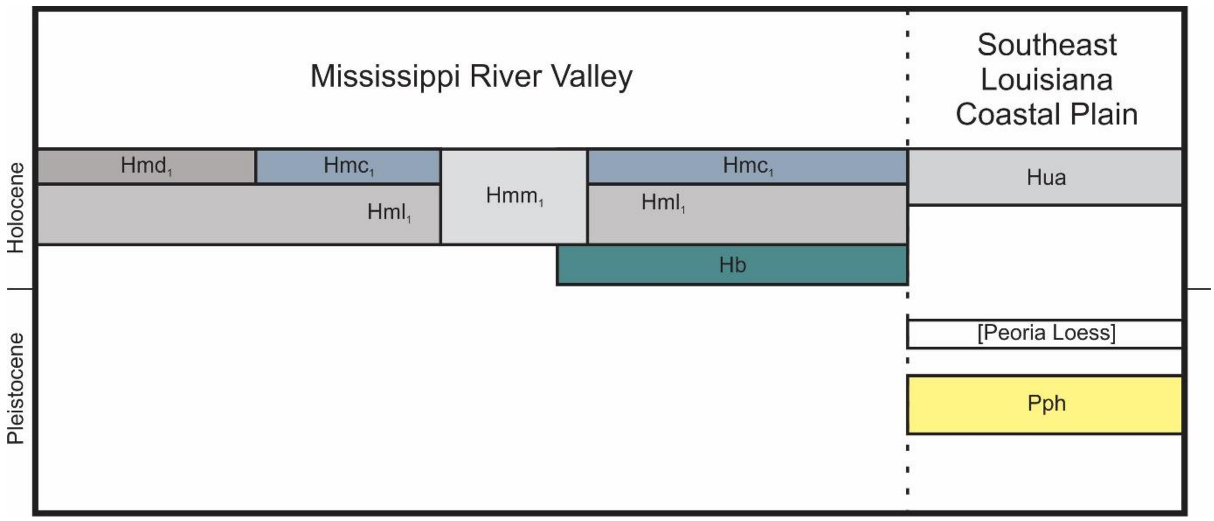
Hua Holocene undifferentiated alluvium
Hb Backswamp deposits
Hmm_1 Mississippi River meander belt 1
Hml_1 Natural levee complex of Mississippi River meander belt 1
Hmc_1 Crevasse complex of Mississippi River meander belt 1
Hmd_1 Distributary complex of Mississippi River meander belt 1

PLEISTOCENE

LOESS
[pattern] Peoria Loess

PRAIRIE ALLOGROUP
Pph Hammond alloformation

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



4. Correlation of strata mapped in the Plaquemine 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. Allounit 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 Plaquemine quadrangle consists exclusively of Quaternary strata, which dictated a continuation of this practice for this investigation.

Hammond alloformation, Prairie Allogroup (Pleistocene)

The Prairie Allogroup is a collection of late Pleistocene depositional sequences of alloformation rank (Autin et al., 1991; Heinrich, 2006). 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; Heinrich, 2006). East of Plaquemine quadrangle, along Bayou Manchac in northwestern Ascension Parish, a mastodon jaw was recovered from a marl bed containing freshwater ostracods (Blackman, 1960).

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).

Within the Florida Parishes, the youngest and most extensive surficial unit is the Hammond alloformation of the Prairie Allogroup (Heinrich, 2006; McCulloh et al., 2009). Its name is derived from Hammond, Louisiana and the Hammond terrace of Matson (1916). It is an allostratigraphic unit that forms part of the Prairie Allogroup. The surface of the Hammond alloformation is a coast-parallel terrace that is 16–40 km (10–25 mi) wide and extends from the eastern valley wall of the Mississippi River alluvial valley eastward across the Florida Parishes and the Pearl River into Mississippi. It is the lowest and best preserved of the Pleistocene terraces found between the Mississippi and Pearl rivers. In the Florida Parishes it exhibits moderately to poorly preserved relict constructional landforms. These landforms include relict river courses, meander loops, ridge-and-swale topography, coastal ridges, and beach ridges. In some areas, they include valley walls and flood plains of entrenched valleys. Overall, the surface of the Hammond alloformation consists of a series merged alluvial cones that abruptly flatten out into a broad coastal plain. Faulting has displaced the surface of the Hammond alloformation, creating numerous fault-line scarps.

Information concerning the age of the Hammond alloformation in the quadrangle is lacking. However, optical luminescence dates from the Baton Rouge and Denham Springs areas indicate that the Hammond alloformation is a mixture of sediments that accumulated during Marine Isotope Stages 5 and 3 and postdates Marine Isotope Stage 7 (Shen et al., 2012, 2016).

Peoria Loess (Pleistocene)

In the northeastern Plaquemine 7.5-minute quadrangle, a mantle of relatively homogeneous, seemingly nonstratified, unconsolidated, well-sorted silt blankets the Pleistocene Hammond alloformation. This surficial layer of well-sorted silt, which is called “loess,” is recognizable by its unusually massive nature, uniformly tan to brown color, and extraordinary ability to form and maintain vertical slopes or cliffs (Miller et al., 1985; Pye and Johnson, 1988; McCraw and Autin, 1989; and Saucier, 1994).

Loess is eolian sediment that accumulated during times of near-maximum to early-waning glaciation. During such periods, seasonally prevailing, strong, north and northwest winds deflated large amounts of silt from recently deposited and unvegetated glacial outwash that accumulated within glacial valley trains. These seasonal winds then transported the material for tens to hundreds of kilometers (tens to hundreds of miles) to the east and south. Eventually, this deflated silt fell out of suspension and incrementally accumulated within adjacent uplands as a drape over either preexisting terraces or dissected, hilly landscape. The greatest amount and relatively coarsest of the silt accumulated closest to the source areas (Miller et al., 1985; Pye and Johnson, 1988; McCraw and Autin, 1989; and Saucier, 1994).

Only one loess layer, Peoria Loess, occurs within the Plaquemine 7.5-minute quadrangle and is 3–5 m thick (Miller, 1983). It thins eastward to the point that it is completely mixed into the underlying sediment as part of the modern soil east of the Amite River. Numerous radiocarbon, thermoluminescence, and optical luminescence dates and other lines of evidence have been used to determine the age of the Peoria Loess. It has been found to be unquestionably of Late Wisconsin age, between 22,000 and 12,500 years BP, and consistent with the age of known meltwater valley trains (Miller et al., 1985; Pye and Johnson, 1988; McCraw and Autin, 1989; and Saucier, 1994).

Holocene alluvium

Mississippi River flood plain

The Plaquemine quadrangle lies in the eastern portion of the Mississippi River flood plain, and its surface Holocene map units comprise Mississippi River deposits (**Hb**, **Hmm$_1$**, **Hml$_1$**, **Hmc$_1$**, and **Hcr**) characteristic of specific depositional processes and environments (Figure 2). These units show predictable depositional topography: natural levee deposits (**Hml$_1$**) lie at the highest elevations, backswamp deposits (**Hb**) and channel-remnant sediments (**Hcr**) lie at the lowest elevations, and the point bar (**Hmm$_1$**) and crevasse splay (**Hmc$_1$**) deposits lie at intermediate elevations.

The backswamp deposits within this quadrangle consist typically of gray and light gray, commonly organic-rich, plastic clay as encountered by geotechnical borings and excavations along Burbank Drive. The clay commonly contains logs, roots, and buried in situ, upright cypress trunks. Cross-sections of Saucier (1969) show that the backswamp deposits are, in places, over 25 m (82 ft) thick. They lie upon braided stream deposits of the Macon Ridge alloformation (Rittenour et al., 2007). This contact is a major unconformity that represents a regional exposure surface. This unconfirmity has been mapped in the subsurface within the northwestern Gulf of Mexico as the Holocene–Pleistocene surface by Milliken et al. (2008) and Heinrich et al. (2015).

Adjacent to the Mississippi River, crevasse splay and natural levee deposits overlie the backswamp sediments. In general, they consist of well-oxidized brown to grayish-brown silts, silty clays, and clays (Saucier, 1969). Ephemeral exposures in local excavations often reveal the presence of a buried cypress forest where the crevasse splay and natural levee deposits overlie backswamp deposits (Heinrich, 2009).

Within the Plaquemine quadrangle, the point bar deposits are restricted to the narrow width of Meander Belt no. 1 as shown by cross-sections of Saucier (1969). Research by Clift et al. (2019) on the False River point bar, which lies about 30 km (19 mi) north of this quadrangle, found that most of the upper point bar sediment is silty, sandy silt or silty sand, with very little clay, excluding the channel plug. Point bar sediments generally fine upwards in grain size with a transition from medium sand upward into inclined, heterolithic, interbedded layers of silts and fine to medium sand at a depth of about 10 m (33 ft). Point bar deposits are typically 29 to 32 m (95 to 105 ft) thick. The lower contact of point bar deposits is a composite scour surface that is cut below the base of the backswamp deposits and into the underlying braided-stream deposits. The point bar deposits are covered by a variable thickness of natural levee deposits.

The channel-remnant features are sinuous depressions within the backswamp of Bluff Swamp. These depressions were mapped using historic aerial photography and lidar. They are interpreted to be the surface expression of the abandoned course of an older, now-buried river course that predates Meander Belt no. 1 (Heinrich, 2009).

Summary of Results

The surface of the Plaquemine quadrangle comprises Holocene sediment of the Mississippi River flood plain, and the Pleistocene Hammond alloformation, Prairie Allogroup, consisting of sediment deposited by the Mississippi and Amite Rivers and by coastal processes. The Hammond forms part of a coast-parallel belt of terraced Pleistocene strata, and is covered by late Pleistocene Peoria Loess up to 5 m thick.

The 1:24,000-scale surface-geologic map of Plaquemine quadrangle provides basic geologic data of potential value to planners in the southern greater Baton Rouge area.

Acknowledgments

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