Geology of the Walker 7.5-Minute Quadrangle, LA

Louisiana Geological Survey

Introduction, Location, and Geologic Setting

The Walker 7.5-minute quadrangle lies within the Plio–Pleistocene uplands east of the lower Mississippi River valley, in the drainage basin of the Amite River in the southeastern Louisiana coastal plain (Figures 1, 2). The axis of the deep-subsurface lower Cretaceous shelf edge (Toledo Bend flexure), which trends west-northwest to east-southeast, lies beneath the northern edge of the study area. The surface comprises strata of the Pleistocene Prairie Allogroup, Hammond alloformation, characterized by a preserved depositional surface with indistinct constructional topography. The Hammond is covered by late Pleistocene Peoria Loess that is thinner than 1 m (3 ft), with the 1-m thickness contour lying in the adjacent Denham Springs 7.5-minute quadrangle to the west, and is incised by Holocene undifferentiated alluvium of tributaries of the Amite River in the Colyell Creek system. The loess-covered Hammond surface in the quadrangle is transected by down-to-basin, generally east-west-striking faults (Figure 2).

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

Previous Work

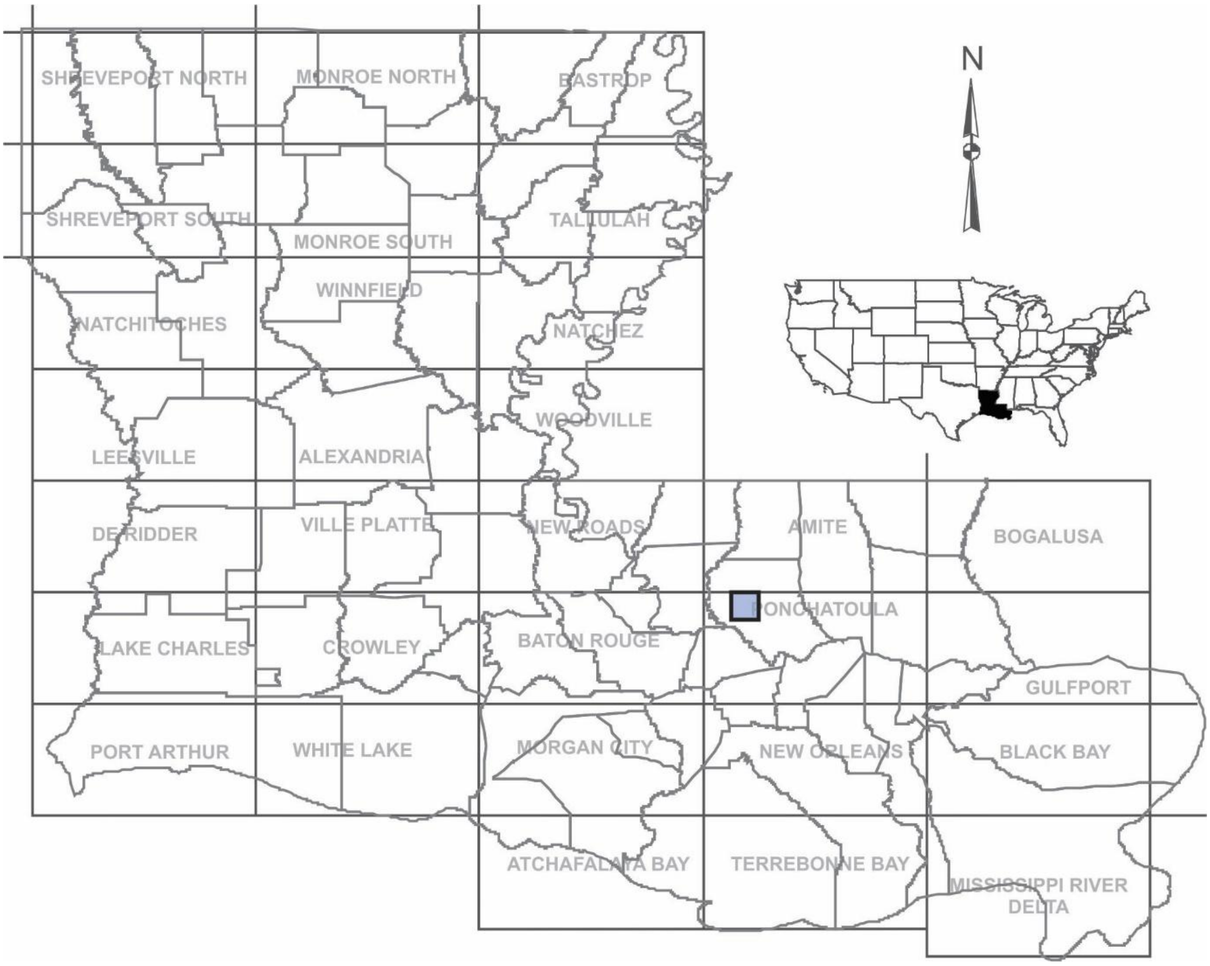
The Walker quadrangle is in the northwestern portion of the Ponchatoula 30 × 60 minute quadrangle, the surface geology of which was compiled at 1:100,000 scale by McCulloh et al. (1997) with STATEMAP support, and later prepared as a Louisiana Geological Survey (LGS) lithograph (McCulloh et al., 2003a). The original 1996–1997 STATEMAP project included compilation of the Amite 30 × 60 minute geologic quadrangle, adjoining Ponchatoula quadrangle on the north, also later prepared as a lithograph (McCulloh et al., 2009). It benefited from a drilling component by which the most problematic map-unit assignments were tested with a total of 15 holes drilled with a Giddings hydraulic probe.

The quadrangle lies entirely within west-central Livingston Parish (Figures 1, 2). 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. Campbell (1972) mapped the surface geology of adjacent St. Helena and Tangipahoa Parishes at 1:62,500 scale. Autin and McCulloh (1991) mapped the surface geology of adjacent East Baton Rouge Parish at 1:24,000 scale. South Louisiana surface faults were summarized by McCulloh and Heinrich (2012), and interpreted as the surface expression of reactivated deep-subsurface growth faults originally known through oil and gas exploration work.

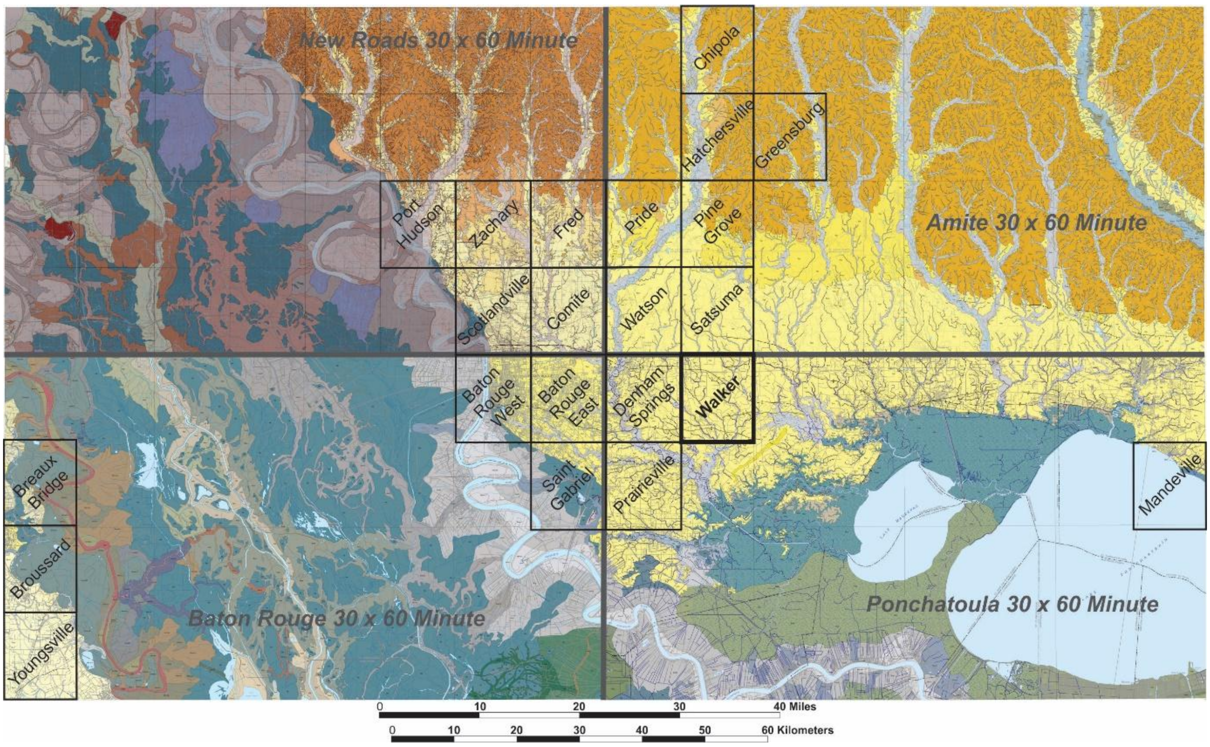
Tomaszewski et al. (2002) detailed groundwater conditions pertinent to the Southern Hills aquifer system, and Van Biersel and Milner (2010) summarized its distribution, recharge area, proportions of water-use categories, and pumpage rates.

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 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 Walker 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). Walker 7.5-minute quadrangle is shown in relation to other mapped quadrangles. Port Hudson, Scotlandville, Baton Rouge West, 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

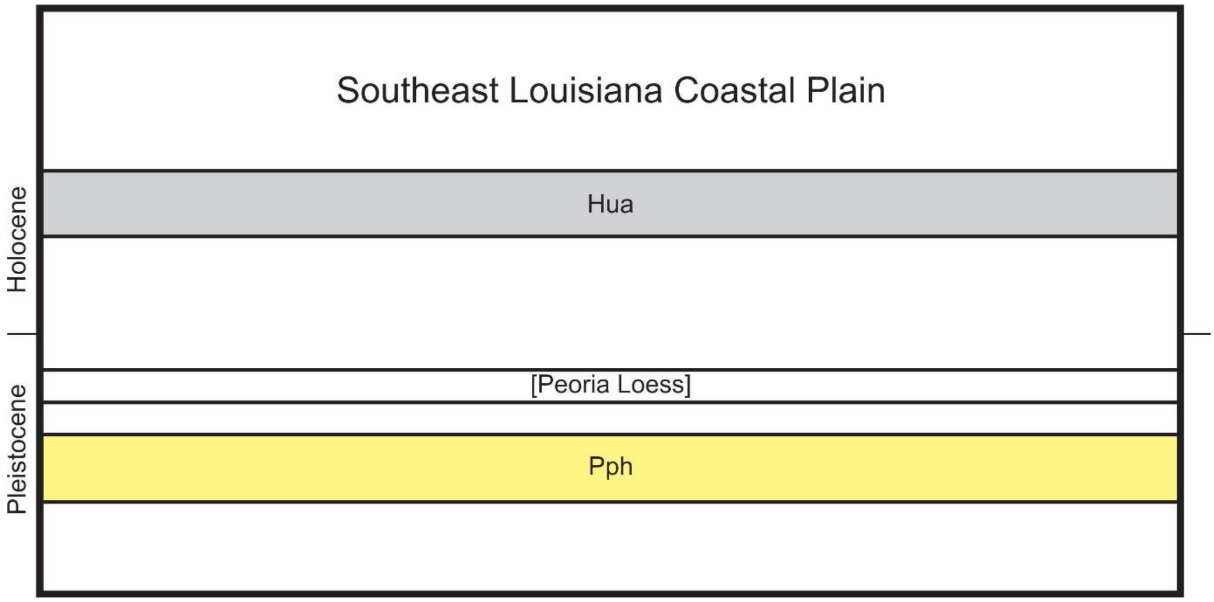
Hua Holocene undifferentiated alluvium

PLEISTOCENE

LOESS
[pattern] Peoria Loess

PRAIRIE ALLOGROUP
Pph Hammond alloformation

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



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

Hammond alloformation, Prairie Allogroup (Pleistocene)

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. In the Walker quadrangle and adjoining areas to the west and east, faulting has displaced the surface of the Hammond alloformation, creating numerous fault-line scarps.

Within the Walker 7.5-minute quadrangle, the surface of the Hammond alloformation is well preserved and exhibits relict constructional topography. Very little is known about the lithology of the Hammond alloformation within this quadrangle. However, geotechnical borings, as deep as 61 m (200 ft) below ground surface from the Woodside landfill and Recycling Center near Walker, Louisiana, provide local information about the nature of these sediments (Earth Tech, Inc., 2001; Golder Associates, Inc., 1988). Beneath the Woodside landfill and Recycling Center, the Hammond alloformation consists primarily of soft to stiff brown, and stiff to very stiff tan and light gray, silty clay and clay that in many places exhibits iron-manganese mottles. Deeper down, layers of mottled dark green-gray silty clay and clay alternate with layers of light gray and tan silty clay and clay. Within the entire drilled interval, wood fragments, rootlets, calcareous nodules, iron-manganese nodules, slickensides, and mostly discontinuous sand layers occur scattered throughout the silty clay and clay. Engineering studies of these borings consistently recognize three paleochannels composed of a mixture of gray clayey, silty, and well sorted sand with associated gray clayey silt overbank deposits. These paleochannels lack any recognizable channel belt deposits. Within the silty clays and clays, organic clay occurs as very thin beds. These beds are typically discontinuous with the exception of one bed that is locally correlatable between borings and caps an equally persistent paleosol. This bed is interpreted to have been a locally extensive short-lived swamp. These sediments are indicative of terrestrial coastal-plain sediments. No evidence of marine influence was observed in the descriptions of these sediments.

In the quadrangle, the Hammond alloformation exhibits two surfaces. The oldest and topographically highest is a coast-parallel terrace, which is moderately well dissected by main courses and tributaries of the modern Amite River. The terrace surface is still well preserved and exhibits relict constructional topography. The coast-parallel terrace is entrenched by paleovalleys of a course of the late Pleistocene Amite River (in the quadrangle’s southwest corner) and of one of its tributaries (elsewhere in the quadrangle). The floors of these paleovalleys are relatively undissected and exhibit well-preserved, relict fluvial landforms. The edges of the paleovalleys show relief up to approximately 4 m (13 ft) and are indicated on the geologic map with an escarpment symbol.

Information concerning the age of the Hammond alloformation in the Walker 7.5-minute 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 Walker 7.5-minute quadrangle, a blanket of relatively homogeneous, seemingly nonstratified, unconsolidated, well-sorted silt blankets the formations of Pleistocene and Tertiary age. This surficial layer of well-sorted silt, which is called “loess,” is distinctive because of 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).

The loess in Walker 7.5-minute quadrangle is thinner than 1 m (3 ft) and consists of a single sheet, the Peoria Loess (Miller, 1983). 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

The Holocene sediments mapped in the Walker 7.5-minute quadrangle consist of undifferentiated deposits of small upland streams and comprise unconsolidated alluvial deposits of streams and creeks of the Colyell Creek system filling valleys in the drainage basin of the Amite River. The deposits of small upland streams and alluvial deposits of minor streams and creeks have not been studied in detail and are poorly known. The textures of these 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."

Faults

The Hammond surface in the quadrangle is transected by several generally west-east-striking down-to-basin faults (Figure 2). The faults, comprising four individual segments, are interpreted as the surface expression of deep-subsurface growth faults reactivated since the late Pliocene by depositional loading induced by voluminous sedimentation accompanying continental deglaciation (Heinrich, 2005; McCulloh and Heinrich, 2012). The western end of the northernmost segment bends southwest to terminate against the next segment to the south, suggesting a process of composite fault trace development via linkage of originally separate shorter individual segments. The maximum surface displacement across these faults within the quadrangle extent, inferred from the maximum relief on their fault-line scarps, ranges from approximately 2 m (6.6 ft) to 5 m (16.4 ft).

Summary of Results

The surface of the Walker quadrangle comprises strata of the Pleistocene Prairie Allogroup consisting of sediment deposited by the Amite River and by coastal processes. The Hammond alloformation, Prairie Allogroup, forms part of a coast-parallel belt of terraced Pleistocene strata. These Pleistocene strata are covered by late Pleistocene Peoria Loess less than 1 m (3 ft) thick. The Hammond surface is transected by four mapped down-to-basin faults in the quadrangle extent. Holocene strata comprise undifferentiated alluvium of tributaries of the Amite River belonging to the Colyell Creek system.

The geologic map of Walker quadrangle provides basic geologic data of potential value to the conduct of aggregate-mining activities in the Amite River flood plain. The area hosts sizable sand and gravel resource potential in Holocene floodplain sediment and Pleistocene strata of the Prairie Allogroup (Heinrich and McCulloh, 1999). The area has produced significant sand and gravel in the past decade (U.S. Geological Survey, 2011), and production activities have moved progressively northward in recent years. The 1:24,000-scale surface-geologic map of the study area also should serve efforts at protection of the Southern Hills aquifer system in the upper Amite River area.

Acknowledgments

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