Geology of the Carencro 7.5-Minute Quadrangle, LA

Louisiana Geological Survey

Introduction, Location, and Geologic Setting

The study area lies within the Gulf Coast salt basin, directly north of the northwestern terminus of the Five Islands salt-dome trend in southwestern Louisiana. It lies directly west of the western valley wall of the Holocene Mississippi River flood plain near the southern edge of coast-parallel outcrop belts of terraced Pleistocene strata. The area encompassing the Carencro quadrangle is transected in places by the traces of surface faults (Heinrich, 2005a, 2005b; Kinsland et al., 2012) interpreted as reactivated growth faults (McCulloh and Heinrich, 2012).

The area covers portions of two parishes (Figures 1, 2), Lafayette and St. Landry. The basic framework of surface geology of the region encompassing the study area was detailed by Howe and Moresi (1931, 1933) and Howe et al. (1935), and later was rendered at approximately 1:1,056,000 scale by Jones et al. (1954, Plate I) drawing in part upon unpublished work by Fisk (1948). Busch et al. (1974) differentiated Holocene Mississippi floodplain alluvium in the Atchafalaya basin, including the area occupied by the Mississippi River flood plain directly east of the Carencro quadrangle. Loess flanking the lower Mississippi River valley in Louisiana was investigated and mapped by Miller (1983) and summarized by Miller et al. (1985). Reviews and mapping of local environmental geology that include the study area were prepared by Rouly (1989) and Saxton (1986). The regional framework and context of the study area was updated at 1:1,100,000 scale in the compilation by Saucier and Snead (1989). Autin et al. (1991) and Saucier (1994a) reviewed, updated, and summarized the surface geology of the lower Mississippi valley. Saucier (1994b, his plate 11) revised the mapping of Mississippi River floodplain alluvium at 1:250,000 scale. Aspects of sediments of the Avoyelles Prairie (Avoyelles alloformation) were reviewed by Autin (1996) and Autin and Aslan (2001). As a part of regional studies of the Quaternary geology of the Mississippi alluvial valley, Mateo (2005) constructed a geological cross section from Vatican to Carencro, Louisiana based on four core holes, and also obtained four OSL dates from sediments in these cores.

Pleistocene strata previously mapped at 1:100,000 scale (Heinrich and Autin, 2000; Heinrich et al., 2003) comprise three subunits of the Prairie Allogroup: the Beaumont, Avoyelles, and Big Cane alloformations (Figure 2). The loess-covered Lafayette meander belt forms the surface of the Avoyelles alloformation. Two loess-covered unnamed meander belts, possibly related to a Pleistocene course of the Red River, form the surface of the Big Cane alloformation.

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

Previous Work

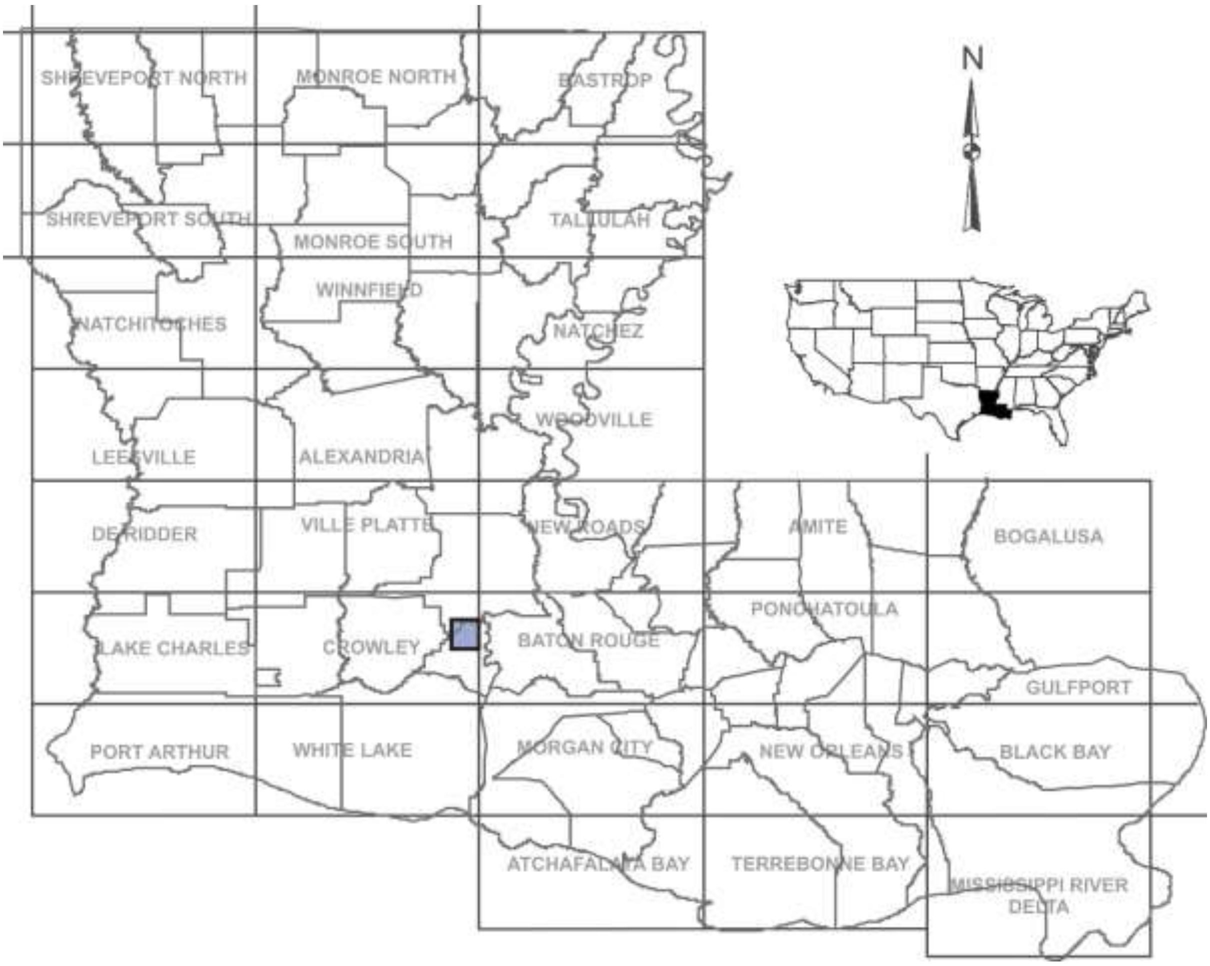
Support by the STATEMAP component of the National Cooperative Geologic Mapping Program led to two compilations at 1:100,000 scale overlapping and adjoining the study area, the *Baton Rouge 30 × 60 Minute Geologic Quadrangle* (Heinrich and Autin, 2000; Louisiana Geological Survey, 1994) and the *Crowley 30 × 60 Minute Geologic Quadrangle* (Heinrich et al., 2003, 1997).

Heinrich (2005a) researched fault-line scarps in southwestern Louisiana and (2005b) in the area to the southeast of the Carencro quadrangle. Kinsland et al. (2012) mapped surface faults in the Carencro quadrangle and adjoining areas. McCulloh and Heinrich (2012) interpreted south Louisiana surface faults generally as reactivated Paleogene and Neogene growth faults originally mapped in the subsurface in connection with oil and gas exploration.

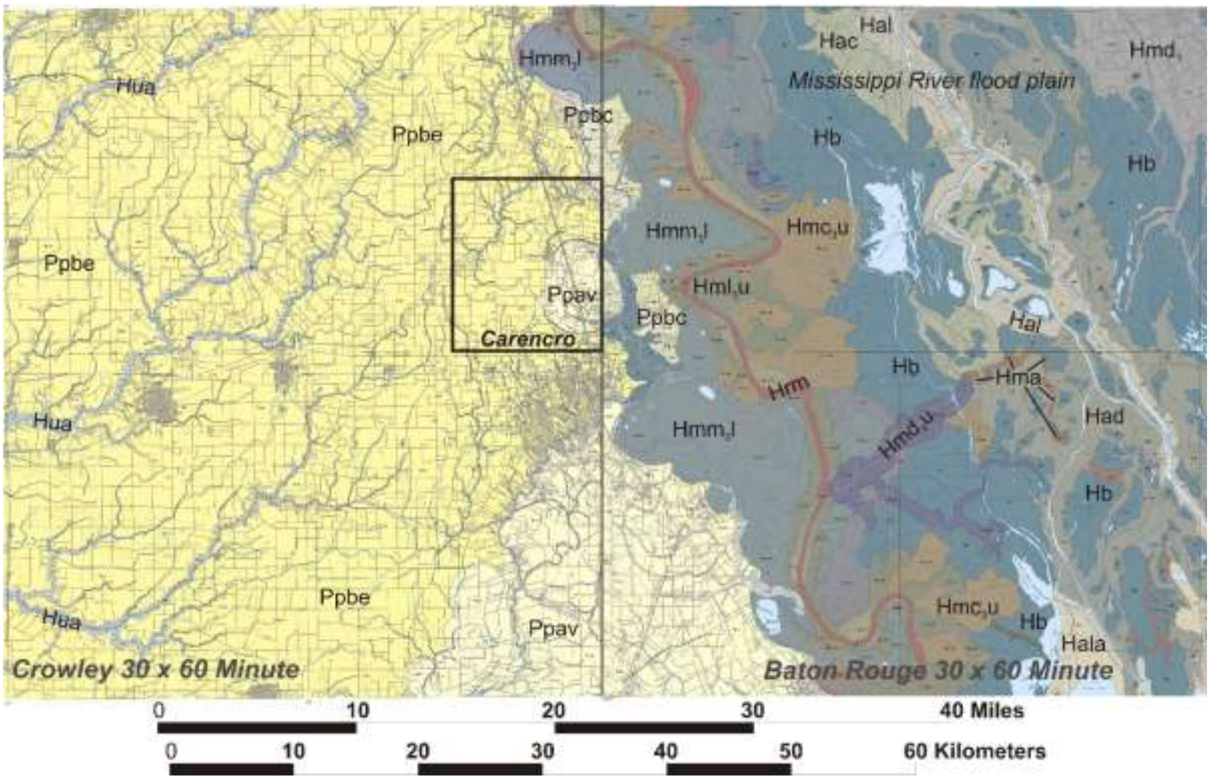
The lower Pleistocene Chicot aquifer of southwestern Louisiana underlies the study area, is the principal source of ground water for 13 parishes in southwestern Louisiana, and has prompted numerous previous groundwater investigations. Most recently, Tomaszewski et al. (2002) detailed groundwater conditions pertinent to the Chicot aquifer; Milner and Fisher (2009) chronicled in detail the geological framework and groundwater hydrology of the aquifer; and Van Biersel and Milner (2010) summarized the aquifer's 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 commercial excavations deeper than the thickness of the loess cover, to observe and describe the texture and composition of the surface-geologic map units. Field observations were then synthesized with subsurface information from operators of pits and landfills, and with the draft surface geology, to prepare an updated integrated surface geology layer for the 7.5-minute quadrangle.



1. Location of Carencro 7.5-minute quadrangle, southwestern Louisiana.



2. Surface geology of the greater Lafayette area and environs (mosaicked excerpts adapted from Heinrich et al., 2003, and Heinrich and Autin, 2000). (**Ppbe**, Beaumont Alloformation; **Ppav**, Avoyelles alloformation; **Ppbc**, Big Cane alloformation; **Hmd$_1$**, Distributary complex of Mississippi River meander belt 1; **Hmc$_3$u**, Crevasse complex of Mississippi River meander belt 3, upper deposits; **Hmd$_3$u**, Distributary complex of Mississippi River meander belt 3, upper deposits; **Hml$_3$u**, Natural levee complex of Mississippi River meander belt 3, upper deposits; **Hmm$_3$l**, Mississippi River meander belt 3, lower deposits; **Hb**, Backswamp deposits; **Hrm**, Red River meander-belt deposits; **Hala**, Lacustrine deposits associated with the Atchafalaya River; **Hal**, Atchafalaya River natural levee deposits; **Hac**, Atchafalaya River crevasse splay deposits; **Had**, Distributary complex of the Atchafalaya River; **Hma**, Distributary complex occupied by the Mississippi and Atchafalaya Rivers; **Hua**, Holocene undifferentiated alluvium).

QUATERNARY SYSTEM

HOLOCENE

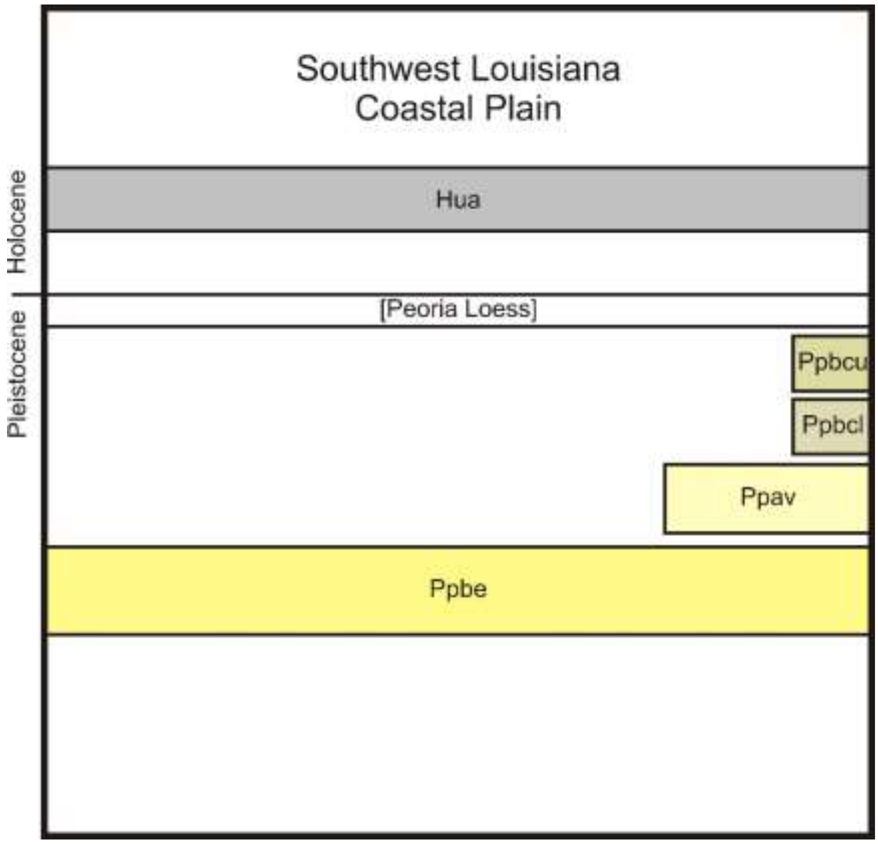
Hua Holocene undifferentiated alluvium

PLEISTOCENE

LOESS
[pattern] Peoria Loess

PRAIRIE ALLOGROUP
Ppbcu Upper Big Cane alloformation
Ppbcl Lower Big Cane alloformation
Ppav Avoyelles alloformation
Ppbe Beaumont Alloformation

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



4. Correlation of strata mapped in the Carencro 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., 2003; McCulloh, 2013). 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 Carencro quadrangle consists exclusively of Quaternary strata, which dictated a continuation of this practice for this investigation.

Beaumont Alloformation, Prairie Allogroup (Pleistocene)

The Beaumont Alloformation (**Ppbe**), known originally as the Beaumont Clay, is a regionally extensive coastal-plain unit extending westward from the western valley wall of the Mississippi River alluvial valley past the Rio Grande to the Tamaulipas Range in northeastern Mexico. Locally, adjacent to its eastern edge, it is blanketed by over 2 m of overbank deposits of the Avoyelles alloformation from the Lafayette meander belt and up to 5 m of Peoria Loess. Both the overbank deposits and loess thin rapidly westward from the Mississippi alluvial valley. The lower contact of the Beaumont Alloformation is a regionally and laterally extensive flooding surface and correlative unconformity that is correlated with the *Trimosina A* micropaleontological zone (~0.6 Ma) offshore (Young et al., 2012). The uppermost sediments of the Beaumont Alloformation have yielded optically stimulated luminescence (OSL) dates of about 90 ka (Shen et al., 2012).

As indicated by its original name, the Beaumont Alloformation is predominantly fine-grained and consists regionally of varicolored, laminated to massive, calcareous silty clays that in many places contain calcareous nodules and sandy fluvial bodies. Locally, it consists of gray, tan, brown, and red clay, silt, and sand, in places with Fe nodules (circa 2 mm). Subsurface data indicate that in its upper 80+ m the unit in places shows a transition from fining-upward gravel, overlain by coarse sand and gravel, to fining-upward sand (coarse to fine) and clay at the surface.

The Beaumont Alloformation in the northwestern Carencro quadrangle is transected by a surface fault that passes into the adjacent Mire quadrangle to the west. Based on its location this fault likely represents a reactivated growth fault of the Lake Arthur system (Murray, 1961; McCulloh and Heinrich, 2012).

Avoyelles alloformation, Prairie Allogroup (Pleistocene)

The surface of the Avoyelles alloformation (**Ppav**) consists of a complex of relict paleochannels and paleocourses of the Mississippi River known as the Lafayette meander belt. The surface of this meander belt is covered by 2 to 5 m of Peoria Loess. The base of the Avoyelles alloformation is assumed to be a fluvial composite scour surface created by the lateral migration of the Pleistocene Mississippi River.

The Avoyelles alloformation consists of two major units. The upper unit consists of 1.5 to 6 m of gray, tan, and brown clay, silt, and sand, in places calcareous and/or carbonaceous, or with clay pockets, silt seams, laminae of clayey silt and sand, sand layers, organic matter, iron-oxide stains and/or nodules (less than or equal to 2 mm), and brown mottles. The lower unit consists of upward-fining sand that contains sparse ripple and parallel laminations and interbeds of silty loam. Judging from water well records, the lower unit has a maximum thickness of about about 30 m. Locally, the sediments of the Avoyelles alloformation have been OSL dated between about 45 and 55 ka.

Big Cane alloformation, Prairie Allogroup (Pleistocene)

The Big Cane alloformation consists of two units: a thicker lower unit (**Ppbcl**) composed of brown silty sand, sand, and gravelly sand, occupying higher elevations, and a thinner upper unit (**Ppbcu**) incised into the older unit and occupying lower elevations, consisting of gray to brown, in places mottled yellowish- to reddish-brown, silt and clay with sand, organic matter, and iron oxide concretions.

The surfaces of these units comprise two unnamed meander belts that may have been formed by the Pleistocene Red River. The surface of the older, higher meander belt (upper surface of the **Ppbcl**) is covered by 4 to 5 m of Peoria Loess, which in turn is covered by about 0.6 to 1.5 m of alluvium. The surface of the younger, lower meander belt (upper surface of the **Ppbcu**) in one soil boring in Broussard 7.5-minute quadrangle to the southeast is interpreted to be covered by about 1.5 m of Peoria Loess, which is overlain by about 0.5 m of alluvium. The base of the Big Cane alloformation is assumed to be a fluvial composite scour surface created by the lateral migration of the Pleistocene Red River. The terrace segment formed by these two meander belts is the southernmost of three terrace segments found along the western valley wall of the Mississippi alluvial valley: (1) just east of Opelousas, Louisiana, (2) west of Arnaudville, Louisiana, and (3) west of Breaux Bridge, Louisiana.

Peoria Loess (Pleistocene)

Peoria Loess is a regionally extensive unit associated with the Mississippi River drainage system. It extends southward into Louisiana from the southern edge of the maximum extent of the Laurentide Ice Sheet of the last glacial period, and consists of eolian sediment predominantly comprising silt. Peoria Loess mantles older Pleistocene strata and is indicated on the map with a red stipple pattern overlaid on the units it covers.

Throughout the quadrangle, the Peoria Loess consists of highly weathered, mottled, light gray to dark grayish-brown to dark brown silt and silty clay. These sediments are noticeably uniform in texture and contain less than five percent sand. Typically, the Peoria Loess contains abundant sesquioxide concretions and organic material and is completely leached of carbonates. Near the base of the Peoria Loess where it overlies older alluvium, the loess contains increasing amounts of the underlying alluvium mixed into it as a basal mixing zone. This mixing is the result of pedogenic processes, mainly bioturbation, as the loess gradually accumulated upon and ultimately buried the alluvium.

Holocene alluvium

Upland streams

Streams are incised into the Pleistocene strata of the uplands, and predominantly comprise courses tributary to the Mississippi River, though the southern Carencro quadrangle also is traversed by headward reaches of courses that drain to the Gulf of Mexico. Only the courses that drain generally east to the Mississippi River flood plain contain alluvium that is mappable at 1:24,000 scale. The alluvium mapped along these courses (**Hua**) is undifferentiated.

Summary of Results

The surface of the Carencro quadrangle comprises late Pleistocene strata of the Prairie Allogroup (Beaumont, Avoyelles, and Big Cane alloformations) consisting of sediment deposited by the Mississippi and Red Rivers, and Holocene sediment deposited by upland tributary streams incised into the Prairie. The Prairie Allogroup forms part of a coast-parallel belt of terraced Pleistocene strata in the south Louisiana coastal plain, and in the study area is covered by late Pleistocene Peoria Loess 3–5 m thick. The Beaumont Alloformation in the northwestern Carencro quadrangle is transected by a surface fault that likely represents a reactivated growth fault of the Lake Arthur system.

The geologic map of Carencro quadrangle provides basic geologic data of potential value to future aggregate exploration and production in Pleistocene strata of the Prairie Allogroup. Sand and gravel previously have been produced from the Beaumont Alloformation in southern Carencro quadrangle (U.S. Geological Survey, 2011); the Avoyelles and Big Cane alloformations are sand-rich near the surface and may have potential to become a sand resource. The 1:24,000-scale surface-geologic map of the study area also should serve efforts at protection of the Chicot aquifer in the greater Lafayette area.

Acknowledgments

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