Geology of the Covington 7.5-Minute Quadrangle, LA

Louisiana Geological Survey

Introduction, Location, and Geologic Setting

The Covington 7.5-minute quadrangle lies in the “north shore” area of St. Tammany Parish (Figures 1, 2), at and immediately updip of the Toledo Bend Flexure (Lower Cretaceous shelf edge). The surface-geologic framework of this area in St. Tammany Parish was investigated and mapped by Cullinan (1969) at 1:62,500 scale, and the Holocene units in the southern half of the area later were differentiated at the same scale by May et al. (1984). The area to the north is underlain by the Pliocene Citronelle Formation (Upland allogroup), overlapped to the south by the Pleistocene Hammond alloformation (Prairie Allogroup). These Plio–Pleistocene strata are incised by deposits of Holocene age. The Hammond consists of deposits of the Mississippi and Pearl rivers and smaller coastal-plain streams, and its terrace surface exhibits constructional landforms of fluvial and deltaic origin in areas to the north and east of the proposed project area. These landforms, including oversized abandoned channels, appear to represent relict courses of the Pearl River formed during the Late Pleistocene. The Hammond also includes strike-parallel relict coastal ridges, which extend into the Covington quadrangle. In adjacent areas the Hammond is transected by active surface faults, aligned with the eastward extension of the Bancroft fault system of Murray (1961), which are discernible from their distinctive fault-line scarps.

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

Previous Work

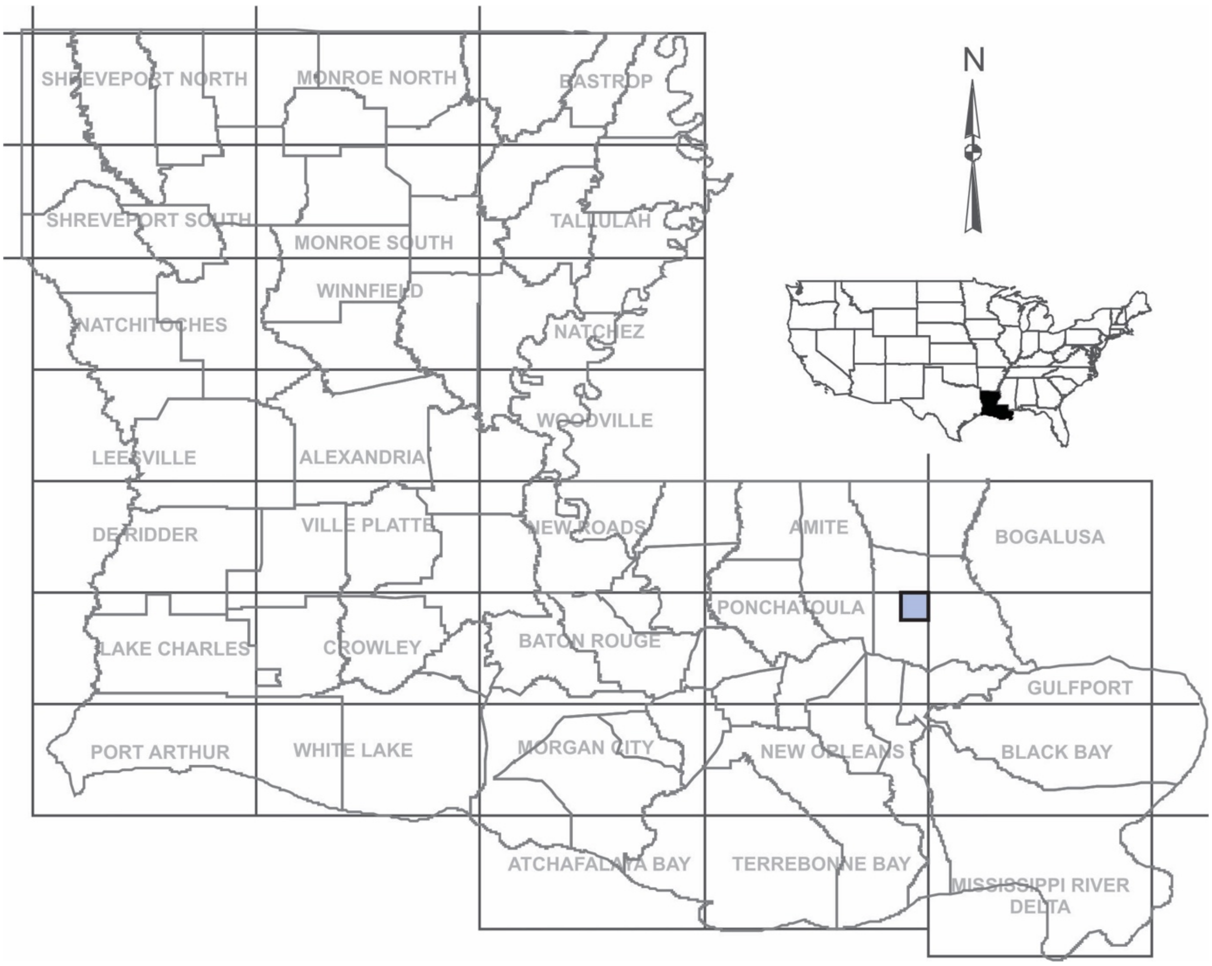
The Covington quadrangle lies in the northeastern portion of the Ponchatoula 30 × 60 minute quadrangle, the surface geology of which was compiled at 1:100,000 scale by McCulloh et al. (1997) with STATEMAP support, and later digitally recompiled and prepared as a Louisiana Geological Survey (LGS) lithograph (McCulloh et al., 2003a). The original 1996–1997 STATEMAP project involved compilations of the adjoining 30 × 60 minute quadrangles, also later prepared as lithographs: Amite (McCulloh and Heinrich, 2008; McCulloh et al., 2009), Bogalusa (Heinrich and McCulloh, 2007a), and Gulfport (Heinrich et al., 2004). The project benefited from a drilling component by which the most problematic map-unit assignments were tested with a Giddings hydraulic probe. STATEMAP support also made possible new mapping of 7.5-minute quadrangles at 1:24,000 scale totalling eight sheets between fiscal years 2000 and 2002, and one sheet in fiscal year 2019 (Figures 1, 2).

The quadrangle is in northern St. Tammany Parish. 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. Surface-geologic maps at 1:62,500 scale were prepared of Washington and St. Tammany Parishes by Cullinan (1969), and of St. Helena and Tangipahoa Parishes by Campbell (1972).

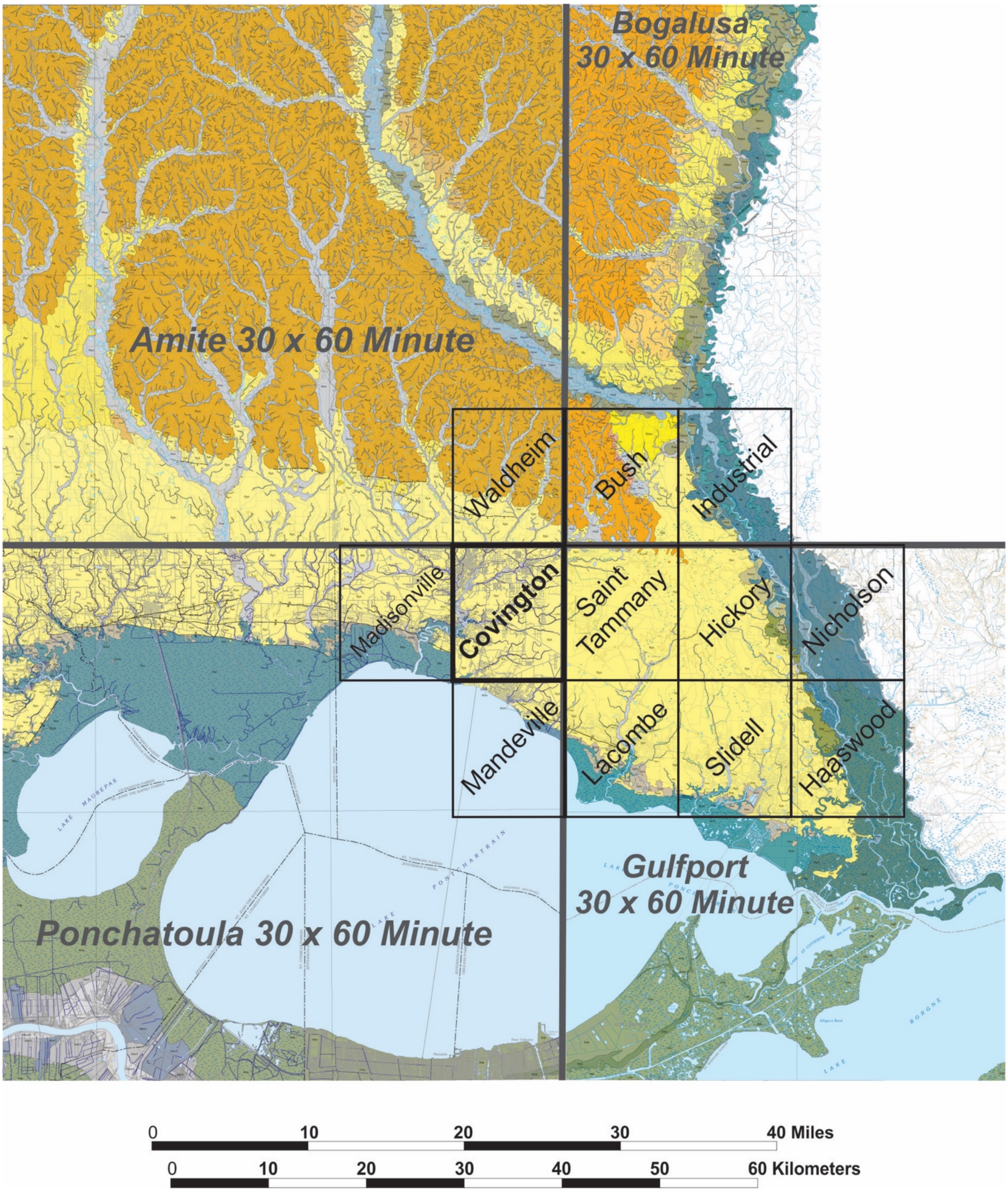
Tomaszewski et al. (2002) detailed groundwater conditions pertinent to the Southern Hills aquifer system, and Van Biersel and Milner (2010) summarized its distribution, recharge area, proportions of water-use categories, and pumpage rates.

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 Covington 7.5-minute quadrangle, southeastern Louisiana.



2. Surface geology of the area encompassing Covington 7.5-minute quadrangle, north shore area (mosaic of McCulloh et al., 2003a, 2009; Heinrich and McCulloh, 2007; and Heinrich et al., 2004). Previously mapped 7.5-minute quadrangles are outlined in black. The larger Holocene alluvial and deltaic plains (gray and green) lie to the south (Mississippi River) and east (Pearl River) of older Pleistocene (yellow, and green) to Pliocene (orange) sediment of the flanking uplands.

QUATERNARY SYSTEM

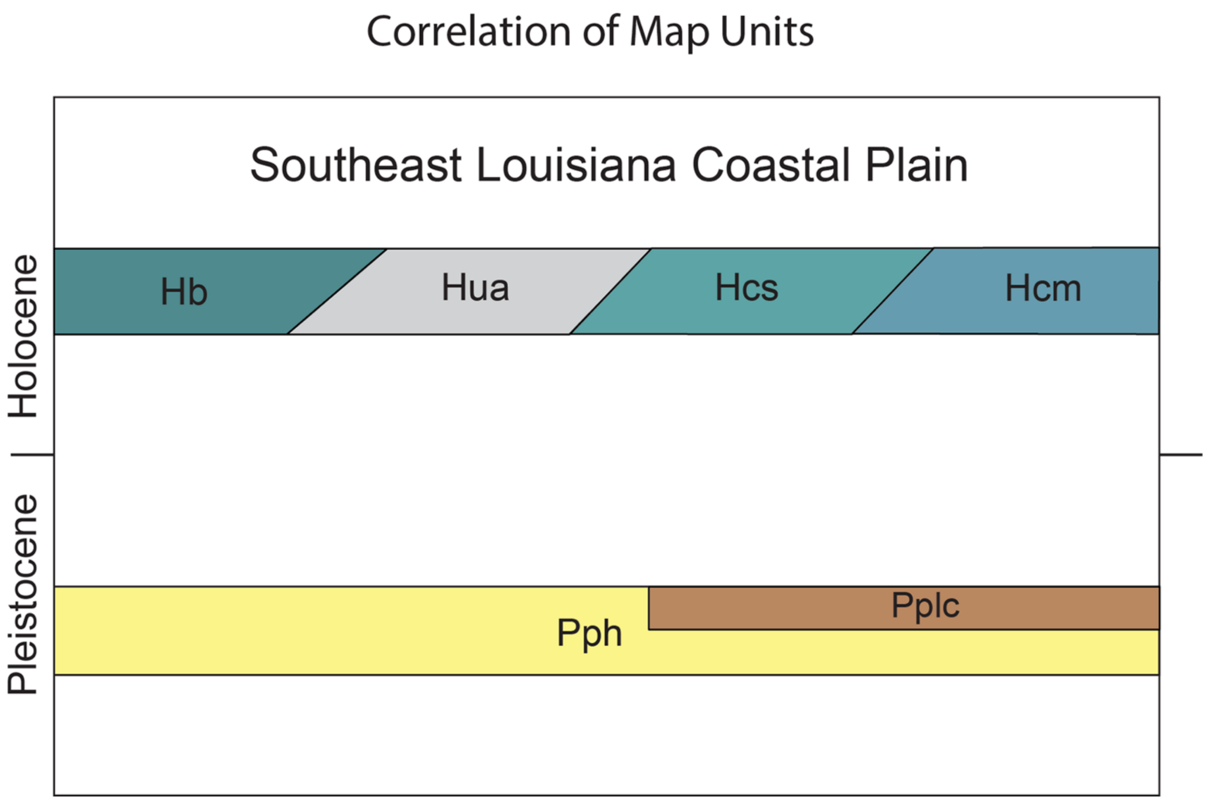
HOLOCENE

Hua	Holocene undifferentiated alluvium
Hb	Holocene backswamp
Hcs	Holocene coastal swamp
Hcm	Holocene coastal marsh

PLEISTOCENE

PRAIRIE ALLOGROUP
Pp Prairie Allogroup, undifferentiated
Pph Hammond alloformation
Pplc Relict Pleistocene coastal ridges

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



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

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Prairie Allogroup, undifferentiated (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).

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).

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 well-preserved 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. Within the Covington 7.5-minute quadrangle, the surface of the Hammond alloformation is well preserved and exhibits relict constructional topography.

The surface of the Hammond alloformation is well preserved and exhibits relict constructional topography within the Covington 7.5-minute quadrangle. Within this quadrangle, is surface is entrenched by the valleys of the Bouge Falaya, Tchefuncta River, and Albita Rivers. These valleys are filled with Holocene alluvium, isolated backswamps, and coastal swamp.

In the southwest part of the Covington 7.5-minute quadrangle, north of the valleys of the Bouge Falaya–Tchefuncta River the Hammond alloformation exhibits two surfaces. The oldest and topographically highest surface is a coast-parallel terrace. This surface dips gulfward (south) with a 0.1 percent slope. Its elevation drops from an elevation of about 10.5 m southward to 6.5 m above sea level with an internal relief of a few meters. The youngest and topographically lower surface of the Hammond alloformation lies adjacent to the Holocene river valleys and is separated from the upper surface by a well to poorly defined escarpment. The largest extent of this surface lies within a "v"-shaped area formed by the junction of Bouge Falaya with the Tchefuncta River. In this area, the lower surface descends southward from an elevation of about 5.5 m southward down to around 4 m with a 0.06 percent slope and an internal relief of a few meters.

In the southweast Covington 7.5-minute quadrangle, east of the valleys of the Albita River, Bouge Falaya, and Tchefuncta River, the surface Hammond alloformation is single westward dipping surface. This surface is the western, distal edge of an extensive alluvial apron of the Pearl River. Within this quadrangle, drops from an elevation of about 10.5 m southward to 7.5 m above sea level with a 0.05 percent slope and an internal relief of a few meters.

Outcrops of the Hammond alloformation were rare within both the Covington and Madisonville 7.5-minute quadrangles. Those outcrops found consisted of the banks of drainage ditches and burrow pits and ephemeral excavation storm and wastewater infrastructure. The sediment exposed in such outcrops typically consists of either brownish white light orangish brown, and light orangish red fine sandy clay, fine sandy mud, and muddy fine sand and light brownish white and light orangish white fine to medium grained sandy mud.

The age of the Hammond alloformation in the Covington 7.5-minute quadrangle has not been directly determined. 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). The main surface of the Hammond alloformation is judged to be a Marine Isotope Stage 5 coastal plain. The previously noted lower surface is regarded to be a Marine Isotope Stage 3 terrace.

Holocene deposits

Holocene undifferentiated alluvium

The Holocene alluvium that were mapped in the Covington 7.5-minute quadrangle along courses of upland waterways consist of undifferentiated unconsolidated alluvial deposits filling river and stream valleys. These deposits of upland rivers, 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. Within the Covington quadrangle, the amount of coarse-grained sediments within this unit present directly reflects the texture of the local "bedrock."

Holocene backswamp

Gray to grayish brown, fine-grained alluvial sediments, underlying isolated cypress swamps within the valleys of small streams and rivers.

Holocene coastal swamp

Gray to grayish brown, fine-grained, sometimes peaty underconsolidated sediments underlying freshwater coastal swamp.

Holocene coastal marsh

Gray to black, fine-grained, underconsolidated sediments, often with high organic content and peat beds, underlying coastal marsh.

Summary of Results

The surface of the Covington quadrangle comprises Pleistocene stratigraphic units of the Prairie Allogroup consisting of sediment deposited by coastal rivers and streams. Hammond alloformation of the Prairie Allogroup form part of a coast-parallel belt of terraced Pleistocene strata. Holocene strata dominantly comprise undifferentiated alluvium of the Tchefuncte River and its tributaries.

The geologic map of Covington quadrangle provides basic geologic data of potential value to the conduct of fill-mining activities (Heinrich and McCulloh, 1999; U.S. Geological Survey, 2011). 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 Covington–Madisonville area.

Acknowledgments

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References

Autin, W. J., 1988, Mapping alloformations in the Amite River, southeastern Louisiana: Geological Society of America Abstracts with Programs, v. 20, no. 4, p. 252.

Autin, W. J., S. F. Burns, B. J. Miller, R. T. Saucier, and J. I. Snead, 1991, Quaternary geology of the Lower Mississippi Valley, *in* Morrison, R. B., ed., Quaternary non-glacial geology: conterminous United States: Boulder, Colorado, Geological Society of America, The Geology of North America, v. K–2, Chapter 18, p. 547–582.

Campbell, C. L., 1972, Contributions to the geology of St. Helena and Tangipahoa parishes, Louisiana: U.S. Army Corps of Engineers, New Orleans District.

Cullinan, T. A., 1969, Contributions to the geology of Washington and St. Tammany parishes, Louisiana: U.S. Army Corps of Engineers, New Orleans District.

DuBar, J. R., T. E. Ewing, E. L. Lundelius, Jr., E. G. Otvos, and C. D. Winker, 1991, Quaternary geology of the Gulf of Mexico Coastal Plain, *in* Morrison, R. B. ed., Quaternary non-glacial geology: conterminous United States: Boulder, Colorado, Geological Society of America, The Geology of North America, v. K–2, 672 p.

Durham, C. O., Jr., C. H. Moore, Jr., and B. Parsons, 1967, An agnostic view of the terraces: Natchez to New Orleans, *in* Kolb, C. R. and C. O. Durham, Jr., eds., Lower Mississippi alluvial valley and terraces: Field trip guidebook, Geological Society of America 1967 annual meeting, New Orleans, Louisiana, Part E, 22 p.

Fisk, H. N., 1938, Pleistocene exposures in western Florida Parishes, Louisiana, *in* Fisk, H. N., H. G. Richards, C. A. Brown, and W. C. Steere, Contributions to the Pleistocene history of the Florida Parishes of Louisiana: Louisiana Department of Conservation, Louisiana Geological Survey, Geological bulletin no. 12, p. 3–25.

Heinrich, P. V., 2006, Pleistocene and Holocene fluvial systems of the lower Pearl River, Mississippi and Louisiana, USA: Gulf Coast Association of Geological Societies Transactions, v. 56, p. 267–278.

Heinrich, P. V., and R. P. McCulloh (compilers), 2007, Bogalusa 30 × 60 minute geologic quadrangle: Louisiana Geological Survey, Baton Rouge, scale 1:100,000.

Heinrich, P. V., and R. P. McCulloh, 1999, Mineral resources map of Louisiana: scale 1:500,000, Louisiana Geological Survey, Baton Rouge.

Heinrich, P. V., R. P. McCulloh, and J. Snead (compilers), 2004, Gulfport 30 × 60 Minute Geologic Quadrangle: Louisiana Geological Survey, Baton Rouge, scale 1:100,000.

Matson, G. C., 1916, The Pliocene Citronelle formation of the Gulf Coastal Plain [Part 1], *in* Shorter contributions to general geology, 1916: U.S. Geological Survey Professional Paper no. 98–L, p. 167–192.

May, J. R., L. D. Britsch, J. B. Dunbar, J. P. Rodriguez, and L. B. Wlosinski, 1984, Geological investigation of the Mississippi River deltaic plain: U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Technical Report GL–84–15 (report 1), prepared for U.S. Army Corps of Engineers, New Orleans district [unpaginated: oversized pages, including plates at 1:62,500 scale].

McCraw, D. J., and W. J. Autin, 1989, Lower Mississippi Valley Loess: Mississippi Valley Loess Tour Guidebook, INQUA Commission on Loess, North American Working Group, Baton Rouge, Louisiana, 35p.

McCulloh, R. P., and P. V. Heinrich (compilers), 2008, Amite, LA 30 × 60 minute geologic quadrangle: Open-File Map 2008–03, Louisiana Geological Survey, Baton Rouge, scale 1:100,000.

McCulloh, R. P., P. V. Heinrich, and J. Snead (compilers), 2009, Amite 30 × 60 minute geologic quadrangle: Louisiana Geological Survey, Baton Rouge, scale 1:100,000.

McCulloh, R. P., P. V. Heinrich, and J. Snead (compilers), 2003a, Ponchatoula 30 × 60 Minute Geologic Quadrangle: Louisiana Geological Survey, Baton Rouge, scale 1:100,000.

McCulloh, R. P., Heinrich, P. V., and Snead, J. I., 2003b, Geology of the Ville Platte Quadrangle, Louisiana: Louisiana Geological Survey, Geological Pamphlet no. 14, 11 p. (to accompany the *Ville Platte 30 × 60 Minute Geologic Quadrangle*).

McCulloh, R. P., P. Heinrich, and J. Snead (compilers), 1997, Amite, Louisiana–Mississippi 30 × 60 minute geologic quadrangle: prepared in cooperation with U.S. Geological Survey, STATEMAP program, under cooperative agreement no. 1434-HQ-96-AG-01490, Louisiana Geological Survey, Baton Rouge, unpublished 1:100,000-scale map plus explanation and notes.

Miller, B. J. (compiler), [1983], [Distribution and thickness of loess in Jackson, Louisiana–Mississippi, Lake Charles, Louisiana–Texas, and Baton Rouge, Louisiana 1 × 2 degree quadrangles]: Louisiana State University Department of Agronomy, Louisiana Agricultural Center, Louisiana Agricultural Experiment Station, Baton Rouge, unpublished map, Louisiana Geological Survey, scale 1:250,000.

Miller, B. J., G. C. Lewis, J. J. Alford, and W. J. Day, 1985, Loesses in Louisiana and at Vicksburg, Mississippi: Field trip guidebook, Friends of the Pleistocene [South Central Cell], April 12–14, 1985, Louisiana State University Agricultural Center, 126 p.

Murray, G. E., 1961, Geology of the Atlantic and Gulf coastal province of North America: New York, Harper & Brothers, 692 p.

Otvos, E. G., 2005, Numerical chronology of Pleistocene coastal plain and valley development: Extensive aggradation during glacial low sea-levels: Quaternary International, v. 135, p. 91–113.

Pye, K., and R. Johnson, 1988, Stratigraphy, geochemistry, and thermoluminescence ages of Lower Mississippi Valley loess: Earth Surface Processes and Landforms. v. 13, no. 2, p. 103–124.

Saucier, R. T., 1994, Geomorphology and Quaternary geologic history of the Lower Mississippi Valley: volume 1, Vicksburg, Mississippi, U. S. Army Corps of Engineers, Waterways Experiment Station, 364 p. plus appendices.

Saucier, R. T., and J. I. Snead (compilers), 1989, Quaternary geology of the Lower Mississippi Valley, *in* Morrison, R. B., ed., Quaternary non-glacial geology: conterminous United States: Boulder, Colorado, Geological Society of America, The Geology of North America, v. K–2, Plate 6, scale 1:1,100,000.

Self, R. P., 1986, Depositional environments and gravel distribution in the Plio–Pleistocene Citronelle formation of southeastern Louisiana: Gulf Coast Association of Geological Societies Transactions, v. 36, p. 561–573.

Self, R. P., 1980, Pliocene to Recent gravel deposits of the Florida parishes, southeast Louisiana: unpublished report prepared for Louisiana Geological Survey, Baton Rouge, under Department of Natural Resources contract no. 21530-80-03, 83 p. plus plates (includes one 1:250,000-scale geologic map).

Shen, Z., N. H. Dawers, T. E. Tornqvist, N. M. Gasparini, M. P. Hijma, and B. Mauz, 2016, Mechanisms of late Quaternary fault throw-rate variability along the north central Gulf of Mexico coast: implications for coastal subsidence: Basin Research, p. 1–14, doi:10.1111/bre.12184.

Shen, Z., T. E. Törnqvist, W. J. Autin, Z. R. P. Mateo, K. M. Straub, and B. Mauz, 2012, Rapid and widespread response of the Lower Mississippi River to eustatic forcing during the last glacial-interglacial cycle: Geological Society of America Bulletin, v. 124, no. 5–6, p. 690–704.

Snead, J. I., P. V. Heinrich, R. P. McCulloh, and W. J. Autin (compilers), 1998, Quaternary geologic map of Louisiana: unpublished map plus 12-p. expanded explanation and notes, prepared in cooperation with U.S. Geological Survey, STATEMAP program, under cooperative agreement no. 1434–HQ–97–AG–01812, scale 1:500,000.

Tomaszewski, D. J., J. K. Lovelace, and P. A. Ensminger, 2002, Water withdrawals and trends in ground-water levels and stream discharge in Louisiana: Water resources technical report no. 68, Louisiana Department of Transportation and Development, Public Works and Water Resources Division, Water Resources Section, in cooperation with U.S. Geological Survey, Baton Rouge, 30 p.

U.S. Geological Survey, 2011, The mineral industry of Louisiana, *in* U.S. Geological Survey minerals yearbook—2008; 2008 Minerals Yearbook—Louisiana [advance release]: Reston, Virginia, U.S. Geological Survey, p. 20.1–20.2.

Van Biersel, T., and R. Milner (compilers), 2010, Louisiana's principal freshwater aquifers: Louisiana Geological Survey, Educational poster series no. 01–10, one oversized sheet.

Winker, C. D. (compiler), 1990, Quaternary geology, northwestern Gulf Coast, *in* Morrison, R. B., ed., Quaternary non-glacial geology: conterminous United States: Boulder, Colorado, Geological Society of America, The Geology of North America, v. K–2, Plate 8, scale 1:2,000,000.