

Geology of the Youngsville 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 straddles the western valley wall of the Holocene Mississippi River flood plain near the southern edge of coast-parallel outcrop belts of terraced Pleistocene strata. Portions of the area are transected by surface traces of reactivated growth faults (Heinrich and Autin, 2000; McCulloh and Heinrich, 2012).

The area covers portions of four parishes (Figures 1, 2): Lafayette, St. Martin, Vermilion, and Iberia. 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 (1954, Plate I) drawing in part upon unpublished work by Fisk (1948).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 in the northeastern Youngsville 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 proposed 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) consist of sediment of the Avoyelles alloformation, Prairie Allogroup (Figure 2). The loess-covered Lafayette meander belt forms the surface of the Avoyelles alloformation.

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

Previous Work

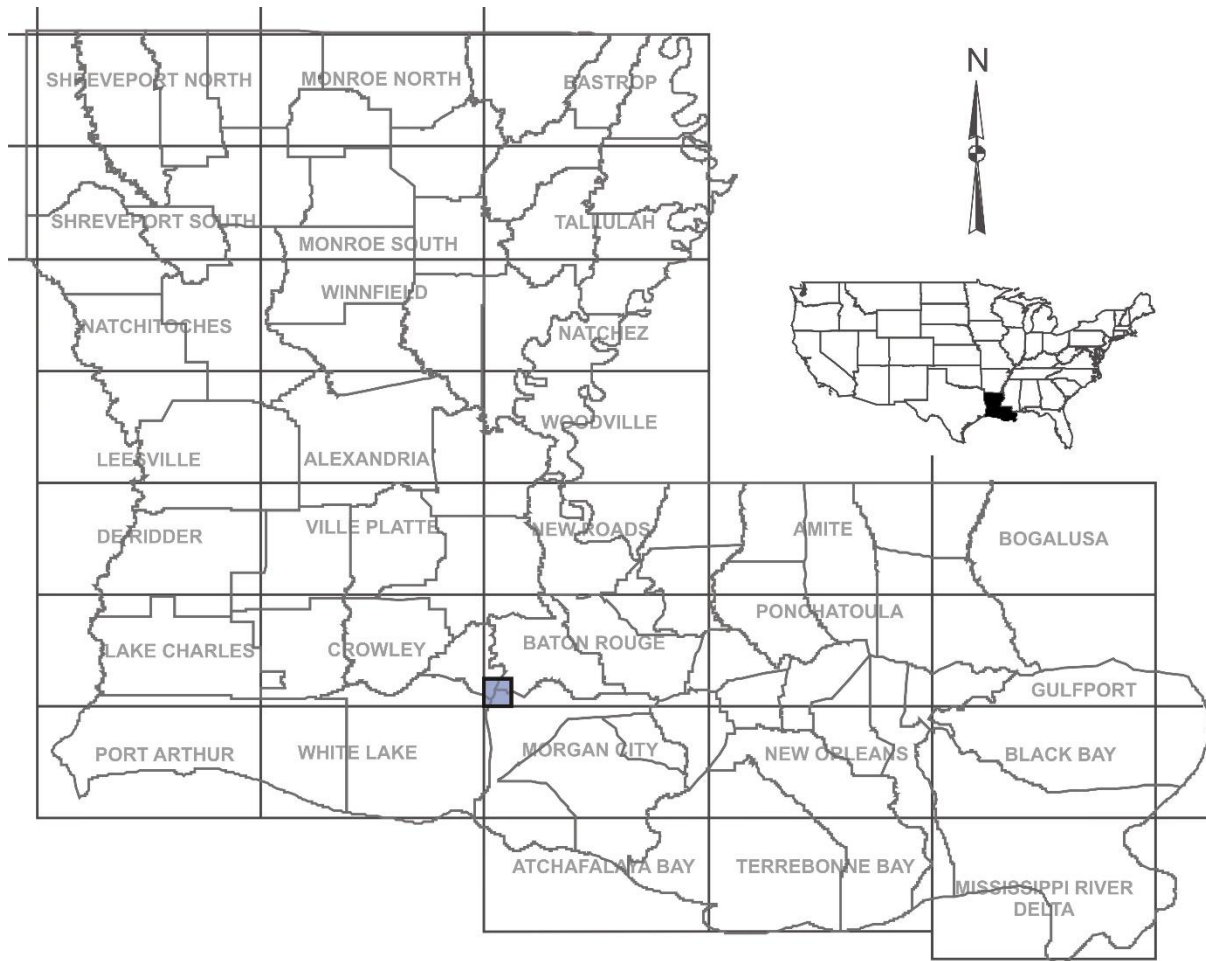
Support by the STATEMAP component of the National Cooperative Geologic Mapping Program led to three compilations at 1:100,000 scale overlapping and adjoining the study area, the *Baton Rouge 30 × 60 Minute Geologic Quadrangle* (Heinrich and Autin, 2000; Louisiana Geological Survey, 1994), the *Crowley 30 × 60 Minute Geologic Quadrangle* (Heinrich et al., 2003, 1997), and the *Morgan City 30 × 60 Minute Geologic Quadrangle* (Snead and Heinrich, 2012; Heinrich and Snead, 2011). Another compilation at 1:100,000 scale adjoining the study area, the *White Lake 30 × 60 Minute Geologic Quadrangle* (Heinrich, 2006), was prepared in-house at LGS without external support.

Heinrich (2005a) researched fault-line scarps in southwestern Louisiana and (2005b) in the southern part of the study area. The most prominent of these scarps originally was discovered during preparation of the *Baton Rouge 30 × 60 Minute Geologic Quadrangle* (Heinrich and Autin, 2000; Figure 2). These fault-line scarps displace the loess-covered Lafayette meander belt at the surface of the Avoyelles alloformation. In addition, a short field investigation found evidence of damage to paved roads associated with the fault-line scarps that may reflect fault-related deformation.

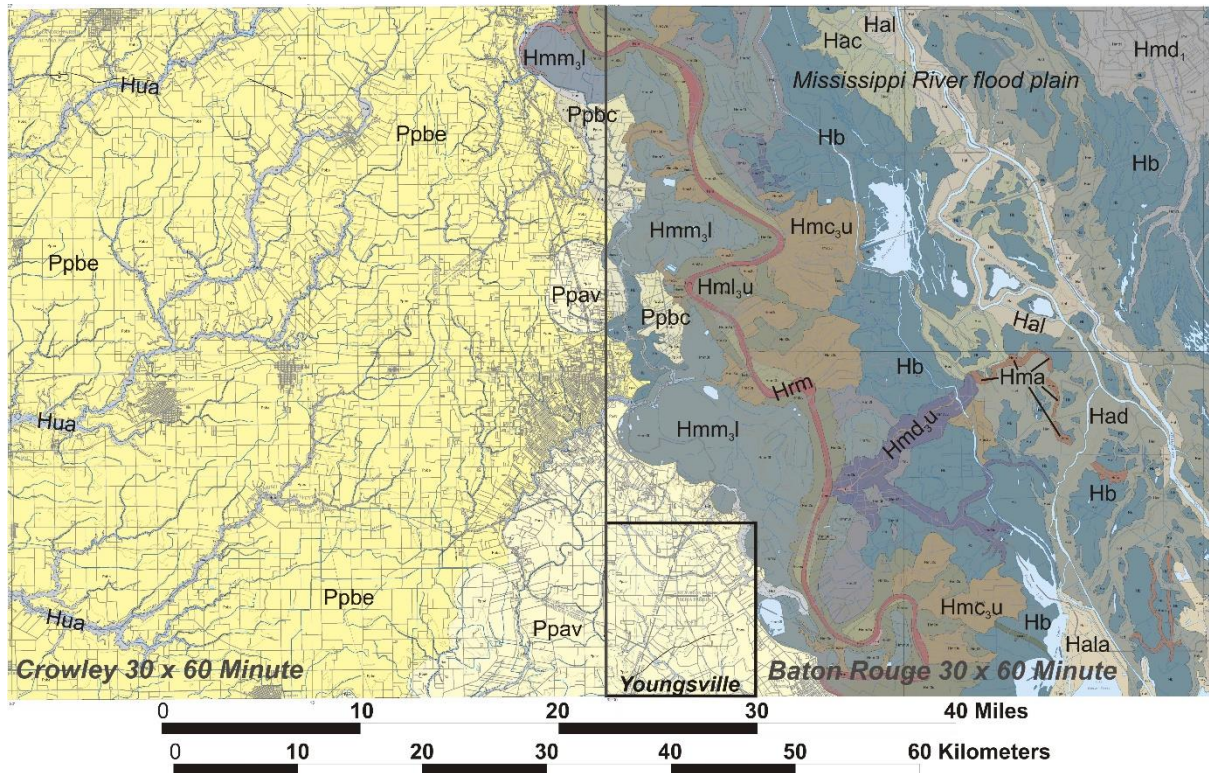
The lower Pleistocene Chicot aquifer of southwestern Louisiana underlies most of the study area, is the principal source of ground water for 13 parishes in southwestern Louisiana, and has prompted numerous previous groundwater investigations. Most recently, Tomaszewski et al. (2002) detailed groundwater 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 and to test the subsoil with hand-operated probes, 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 Youngville 7.5-minute quadrangle, southeastern 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; **Hmd₁**, Distributary complex of Mississippi River meander belt 1; **Hmc_{3u}**, Crevasse complex of Mississippi River meander belt 3, upper deposits; **Hmd_{3u}**, Distributary complex of Mississippi River meander belt 3, upper deposits; **Hml_{3u}**, Natural levee complex of Mississippi River meander belt 3, upper deposits; **Hm_{3l}**, 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
- Hb Backswamp deposits
- Hmd_{3u} Distributary complex of Mississippi River meander belt 3, upper deposits
- Hmm_{3l} Mississippi River meander belt 3, lower deposits

PLEISTOCENE

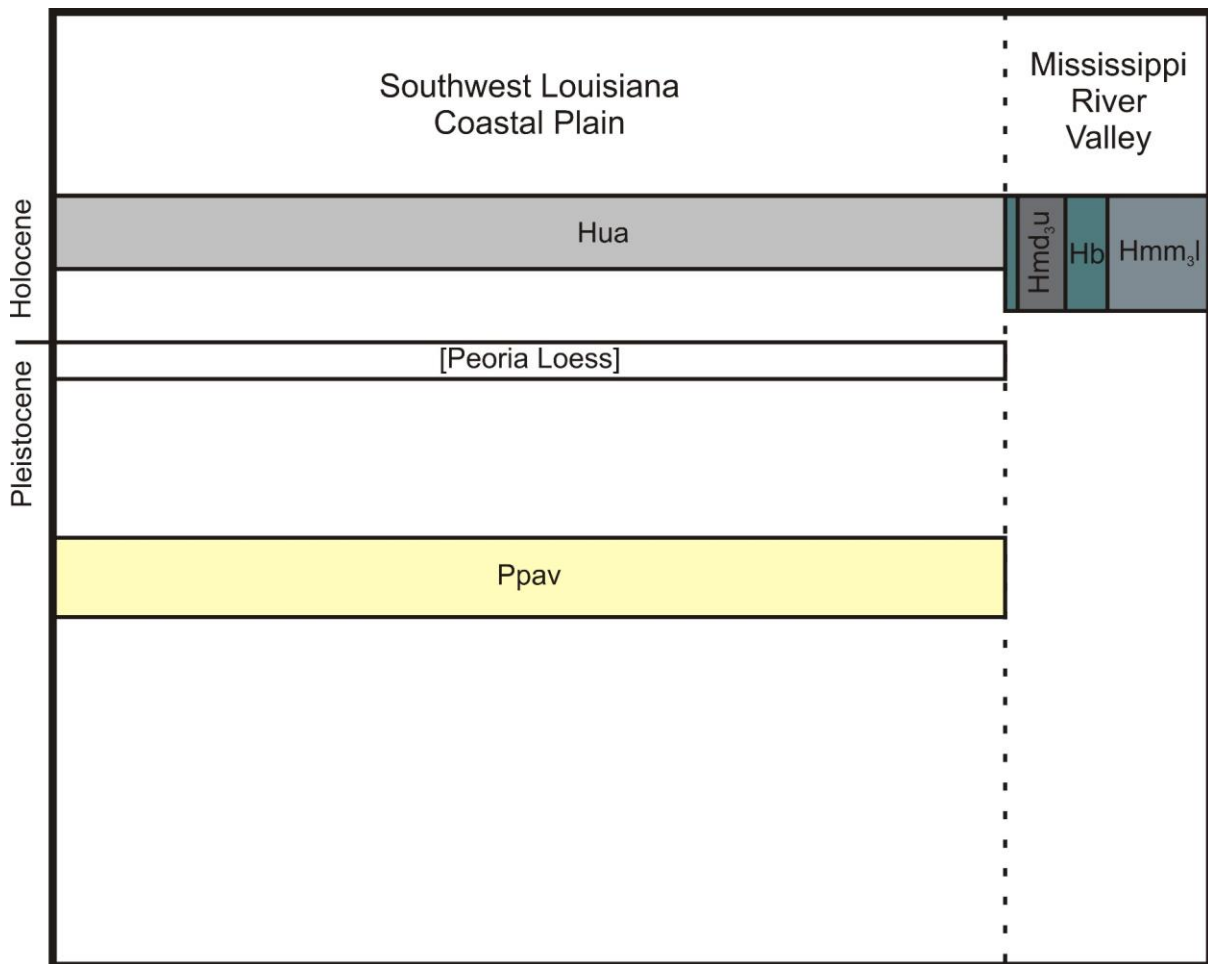
LOESS

[pattern] Peoria Loess

PRAIRIE ALLOGROUP

Ppav Avoyelles alloformation

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



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

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.

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

Mississippi River flood plain

The northeastern Youngsville quadrangle overlaps the western edge of the Mississippi River flood plain, and its surface Holocene map units comprise Mississippi River deposits (**Hb**, **Hmd_{3u}**, and **Hmm_{3l}**) characteristic of specific depositional processes and environments (Figure 2). These units show predictable depositional topography: natural levee deposits (**Hmd_{3u}**) lie at the highest elevations, backswamp deposits (**Hb**) lie at the lowest elevations, and meander belt (**Hmm_{3l}**) deposits lie at intermediate elevations.

Upland streams

Streams are incised into Pleistocene uplands west of the Mississippi River flood plain, and include courses tributary to the Mississippi River as well as headward reaches of courses that drain to the Gulf of Mexico. The alluvium mapped along these courses (**Hua**) is undifferentiated.

Summary of Results

The surface of the Youngsville quadrangle comprises late Pleistocene strata of the Prairie Allogroup (Avoyelles alloformation) consisting of sediment deposited by the Mississippi River, and Holocene sediment deposited in the Mississippi flood plain and by smaller upland tributaries 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 geologic map of Youngsville 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 northern Lafayette Parish directly to the north (U.S. Geological Survey, 2011); the Avoyelles alloformation is 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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References

- Autin, W. J., 1996, Pleistocene stratigraphy in the southern Lower Mississippi Valley: *Engineering Geology*, v. 45, p. 87–112.
- 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., and A. Aslan, 2001, Alluvial pedogenesis in Pleistocene and Holocene Mississippi River deposits: Effects of relative sea-level change: *Geological Society of America Bulletin*, v. 113, no. 11, p. 1456–1466.
- 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.
- Busch, R. E. Jr., W. C. Ward, and H. C. Skinner (compilers), 1974, Physiographic map of the Atchafalaya Basin and a portion of the Lower Red River Valley, Louisiana: U.S. Army Corps of Engineers, New Orleans, Louisiana, scale 1:250,000.
- Fisk, H. N., 1948, Geological investigation of the lower Mermentau River basin and adjacent areas in coastal Louisiana: unpublished “Definite project report,” Mermentau River, Louisiana, Appendix II, U.S. Army Corps of Engineers, Mississippi River Commission, Vicksburg.
- Heinrich, P. V. (compiler), 2006, White Lake 30 × 60 Minute Geologic Quadrangle: Louisiana Geological Survey, Baton Rouge, Scale 1:100,000.
- Heinrich, P. V., 2005a, Distribution and origin of fault-line scarps of southwest Louisiana, USA: *Gulf Coast Association of Geological Societies Transactions*, v. 55, p. 284–293.
- Heinrich, P. V., 2005b, Surface faulting within the New Iberia, Louisiana region: *Louisiana Geological Survey NewsInsights*, v. 15, no. 1, p. 1–3.
- Heinrich, P. V., and J. Snead (compilers), 2011, Morgan City, Louisiana 30 × 60 minute geologic quadrangle: Unpublished map prepared in cooperation with U. S. Geological Survey, STATEMAP program, under cooperative agreement no. G10AC00383, Louisiana Geological Survey, Baton Rouge, scale 1:100,000.
- Heinrich, P. V., and W. J. Autin (compilers), 2000, Baton Rouge 30 × 60 minute geologic quadrangle: Louisiana Geological Survey, Baton Rouge, Scale 1:100,000.
- Heinrich, P. V., J. Snead, and R. P. McCulloh (compilers), 2003, Crowley 30 × 60 minute geologic quadrangle: Louisiana Geological Survey, Baton Rouge, Scale 1:100,000.
- Heinrich, P. V., J. Snead, and R. P. McCulloh (compilers), 1997, Crowley, Louisiana 30 × 60 minute geologic quadrangle (preliminary): Unpublished map prepared in cooperation with U. S. Geological Survey, STATEMAP program, under cooperative agreement no. 1434–

- HQ-96-AG-01490, Louisiana Geological Survey, Baton Rouge, 1:100,000-scale map plus explanation and notes.
- Howe, H. V., and C. K. Moresi, 1933, Geology of Lafayette and St. Martin Parishes: Louisiana Department of Conservation, Louisiana Geological Survey, Geological bulletin no. 3, 238 p.
- Howe, H. V., and C. K. Moresi, 1931, Geology of Iberia Parish: Louisiana Department of Conservation, Louisiana Geological Survey, Geological bulletin no. 1, 187 p.
- Howe, H. V., R. J. Russell, J. H. McGuirt, B. C. Craft, and M. B. Stephenson, 1935, Reports on the Geology of Cameron and Vermilion Parishes: Louisiana Department of Conservation, Louisiana Geological Survey, Geological bulletin no. 6, 242 p.
- Jones, P. H., A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Geology and ground-water resources of southwestern Louisiana: Louisiana Department of Conservation, Louisiana Geological Survey, Geological bulletin no. 30, 285 p. plus plates.
- Louisiana Geological Survey (compiler), 1994, Baton Rouge 1:100,000 geologic quadrangle: Unpublished map prepared in cooperation with U. S. Geological Survey, STATEMAP program, under cooperative agreement no. 1434-93-A-1154, Louisiana Geological Survey, Baton Rouge, 1:100,000-scale map plus explanation and notes.
- Mateo, Z. R. P., 2005, Fluvial response to climate and sea-level change, Prairie Complex, Lower Mississippi Valley: M.S. thesis, University of Illinois, Chicago.
- McCulloh, R. P., 2013, Application of allostratigraphic nomenclature by the Louisiana Geological Survey to geologic map units of Quaternary age: Louisiana Geological Survey NewsInsights, v. 23, no. 1, p. 19-20.
- McCulloh, R. P., and P. V. Heinrich, 2012, Surface faults of the south Louisiana growth-fault province, in Cox, R. T., M. P. Tuttle, O. S. Boyd, and J. Locat, eds., Recent Advances in North American Paleoseismology and Neotectonics East of the Rockies: Geological Society of America Special Paper 493, p. 37-50, doi:10.1130/2012.2493(03).
- McCulloh, R. P., Heinrich, P. V., and Snead, J. I., 2003, 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*).
- 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.

- Milner, L. R., and C. Fisher, 2009, Geological characterization of the Chicot/Atchafalaya aquifer region: southwest Louisiana: Louisiana Geological Survey, Water resources series no. 4, 39 p.
- Rouly, K. C., 1989, Quaternary and environmental geology of south-western St. Martin Parish, Louisiana: M.S. thesis, University of Southwestern Louisiana, Lafayette, Louisiana.
- Saucier, R. T., 1994a, 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., 1994b, Geomorphology and Quaternary geologic history of the Lower Mississippi Valley: volume 2, Vicksburg, Mississippi, U. S. Army Corps of Engineers, Waterways Experiment Station [unpaginated: 31 oversized pages, including 28 plates (1:250,000-scale)].
- 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.
- Saxton, D. C., 1986, Quaternary and environmental geology of northern Lafayette Parish, Louisiana: M.S. thesis, University of Southwestern Louisiana. Lafayette, Louisiana.
- Snead, J., and P. V. Heinrich (compilers), 2012, Morgan City 30 × 60 minute geologic quadrangle: Louisiana Geological Survey, Baton Rouge, scale 1:100,000.
- 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.