# Geology of the Epps 7.5-Minute Quadrangle, LA

*Louisiana Geological Survey*

## Introduction, Location, and Geologic Setting

The Epps 7.5-minute quadrangle lies across the boundary between late Pleistocene uplands and Holocene alluvial deposits of the Mississippi River valley in the extreme northeastern portion of Louisiana (Figures 1–3). The quadrangle lies atop the Monroe uplift. Its surface consists exclusively of Holocene and terraced late Pleistocene strata (Figures 2, 3) deposited by the Mississippi River. All these strata consist of terrigenous sediment with varying proportions of sand, silt, mud, and/or gravel. The units recognized and mapped in this investigation are summarized in Figures 4 and 5.

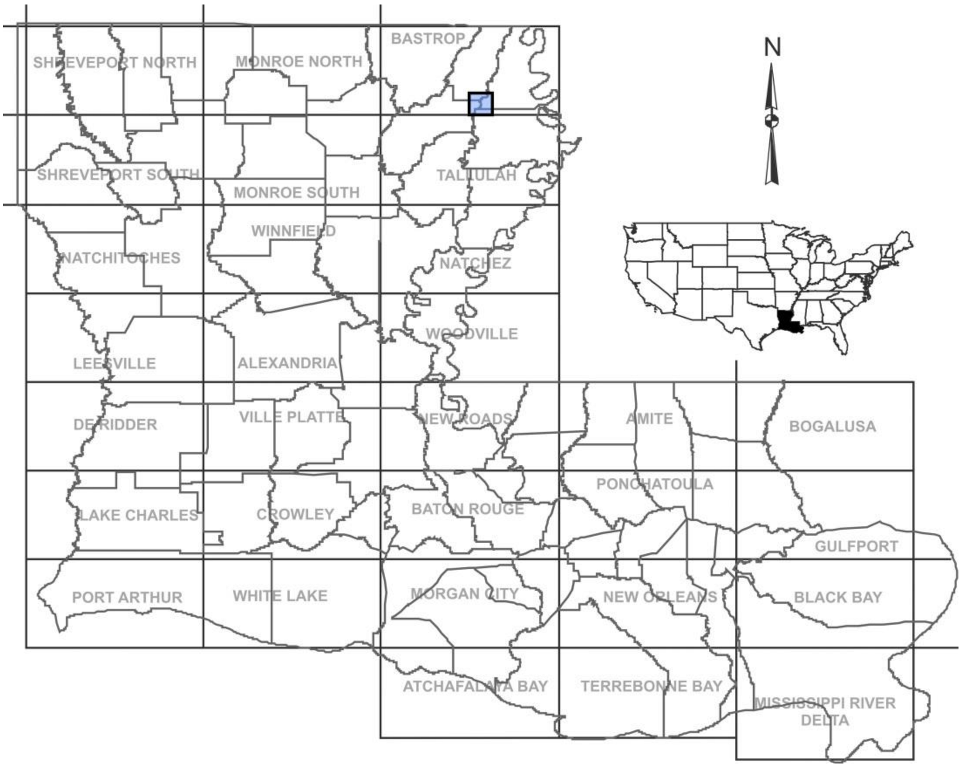
## Previous Work

The Epps quadrangle lies near the south-central edge of the Bastrop 30 × 60 minute quadrangle, compiled at 1:100,000 scale by the Louisiana Geological Survey (LGS) with STATEMAP support (Heinrich et al., 2014) and later produced as a lithograph (Heinrich et al., 2015). The quadrangle also was included in the area investigated and mapped at 1:250,000 scale by Saucier (1994a, b). The Tallulah 30 × 60 minute quadrangle to the south was compiled at 1:100,000 scale by LGS with STATEMAP support (Snead et al., 2014) and later produced as a lithograph (Snead et al., 2015).

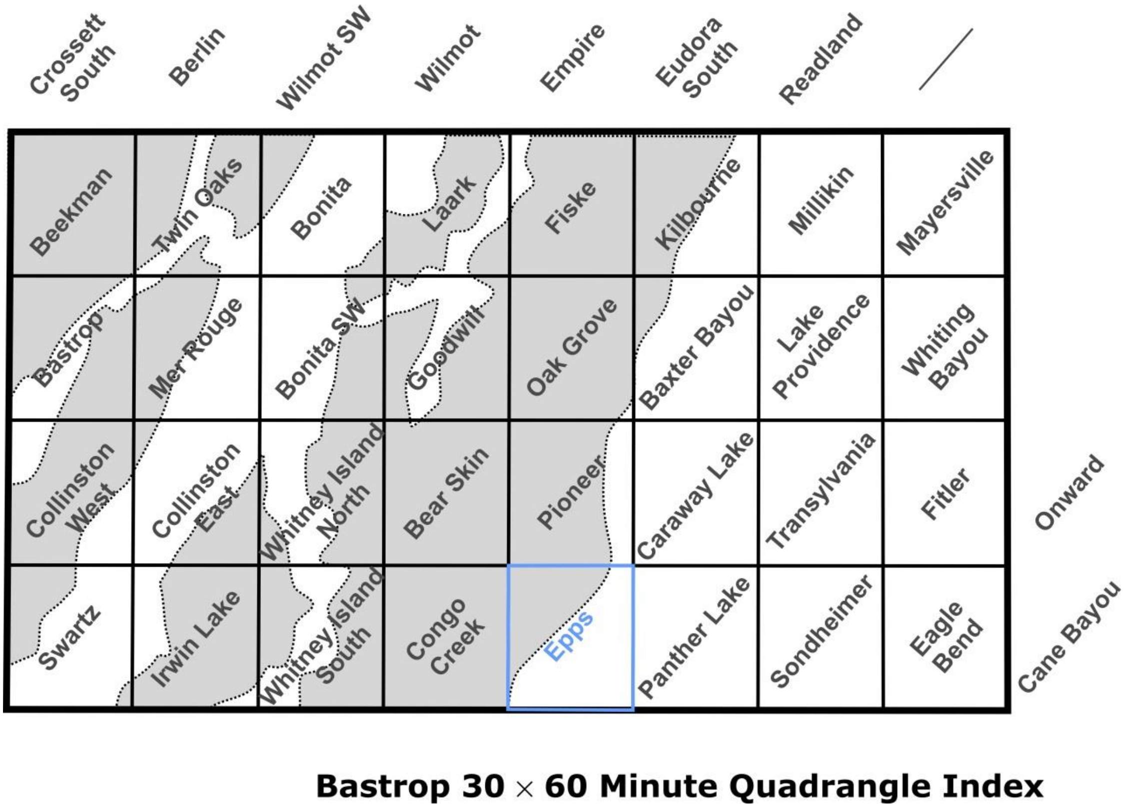
Prior to the above investigations, the recompilation of Louisiana surface geology at 1:500,000 scale (Snead and McCulloh 1984) differentiated Mississippi River floodplain alluvium following the source mapping of Saucier (1967). This floodplain mapping was amplified further when LGS (1993) compiled the Jackson 1 × 2 degree quadrangle at 1:250,000 scale with COGEOMAP support. This compilation consulted the mapping of Kolb and others (1968) and was guided in part by the regional compilation of lower Mississippi valley geology by Saucier and Snead (1989), and depicted the floodplain alluvium with much greater differentiation than had the state geologic map.

## Methods

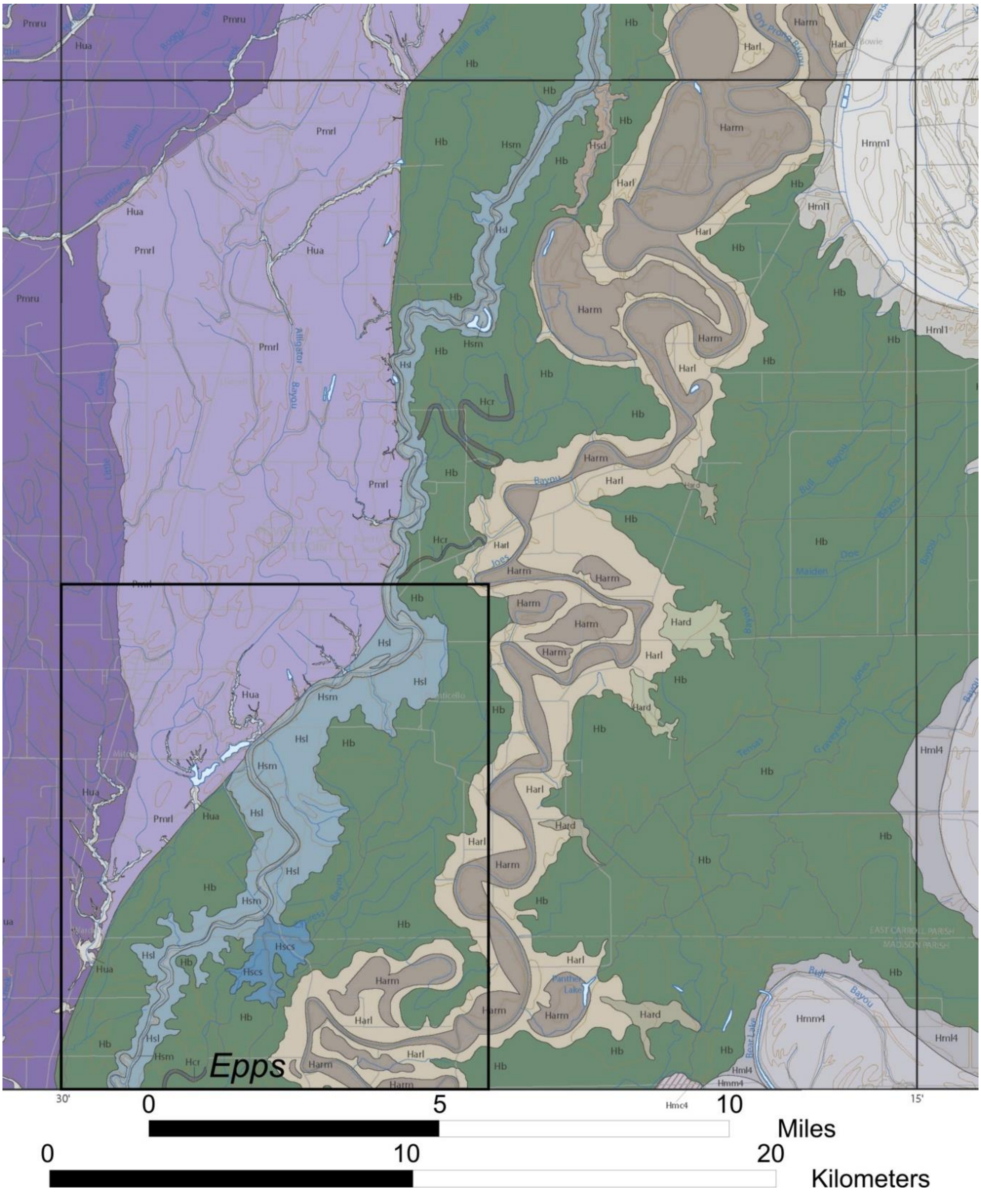
The investigators reviewed legacy information and made new interpretations consulting remotely sensed imagery (comprising aerial photography, LIDAR DEMs, and other sources) and soils databases published by the Natural Resources Conservation Service (NRCS) to develop a draft surface geology layer for the study area. Strategic field checking was conducted 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 Epps 7.5-minute quadrangle, northeastern Louisiana.




**2.** Epps 7.5-minute quadrangle in relation to generalized distribution of uplands (shaded), consisting exclusively of terraced late Pleistocene strata, and bottomlands (unshaded), consisting of Holocene river and stream deposits, in the Bastrop 30 × 60 minute quadrangle.




**3.** Surface geology of Epps 7.5-minute quadrangle and vicinity (adapted from Heinrich et al., 2015). (**Pmrl**, **Pmru**: lower and upper Macon Ridge alloformation (Pleistocene); **Hmm1**, **Hml1**: Holocene meanderbelt and natural levee deposits of Mississippi River course 1; **Hmm4**, **Hml4**, **Hmc4**: Holocene meanderbelt, natural levee, and crevasse complex deposits of Mississippi River course 4; **Harm**, **Harl**: Holocene meanderbelt and natural levee deposits of the Arkansas River; **Hb**, Holocene backswamp deposits; **Hsm**, **Hsl**, **Hscs**: Holocene meanderbelt, natural levee, and crevasse splay deposits of small rivers; **Hcr**, Holocene river channel remnants; **Hua**, Holocene undifferentiated alluvium.) The Arkansas River sediments were reclassified for this investigation as deposits of a Mississippi River distributary course as discussed in the text.

QUATERNARY SYSTEM

HOLOCENE

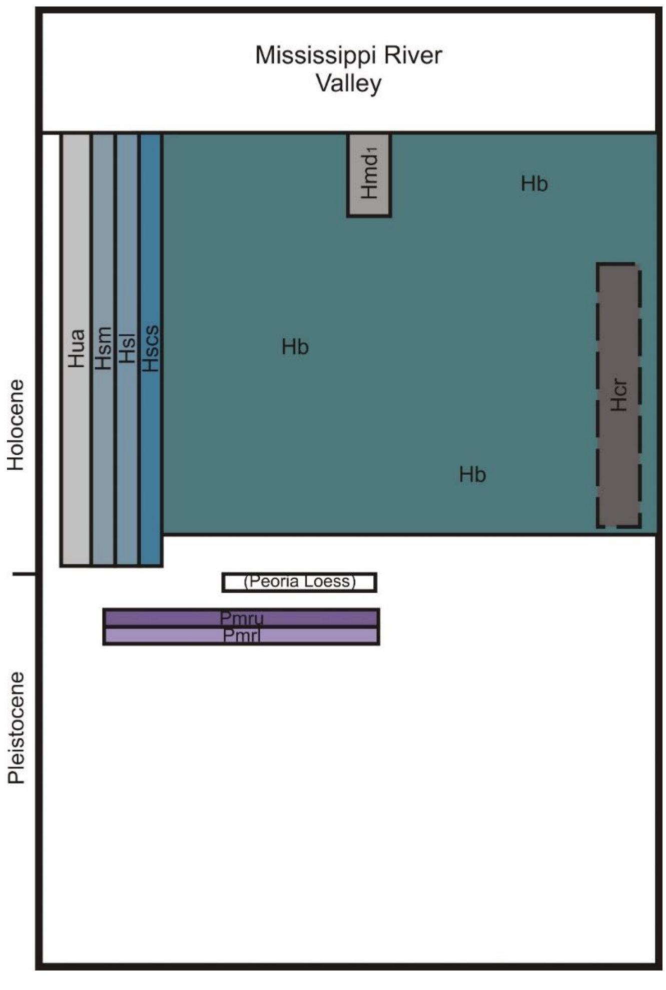
Hua Holocene undifferentiated alluvium
Hsm Small river meander-belt deposits
Hsl Small river natural levee deposits
Hscs Small river crevasse splay deposits
Hb Backswamp deposits
$Hmd_1$ Distributary complex of Mississippi River meander belt 1
Hcr River channel remnants

PLEISTOCENE

LOESS
[pattern] Peoria Loess

BRAID BELTS / VALLEY TRAINS
Pmru Upper Macon Ridge alloformation
Pmrl Lower Macon Ridge alloformation

**4.** Units mapped in the Epps 7.5-minute quadrangle.




**5.** Correlation of strata mapped in the Epps 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). 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 Epps quadrangle consists exclusively of Quaternary strata, which dictated a continuation of this practice for this investigation.

## Braid Belts / Valley Trains (Pleistocene)

Large portions of the Mississippi River alluvial valley, of which Macon Ridge is one, consist of extensive deposits of glacial outwash that form ridges and terrace surfaces that lie above the modern floodplain. These deposits of glacial outwash consist of large quantities of sand and gravel overlain by a relatively thin, 2–5-m (~7–16-ft) thick, layer of clay and silt. In many places these sand and gravel deposits extend 30–60 m (~100–200 ft) uninterrupted to the base of the Quaternary alluvial valley fill. However, the lower part of these sands and gravels likely includes outwash and other fluvial deposits that accumulated during earlier glacial cycles. Each of these outwash accumulations exhibits topographically distinct terrace levels that represent the cyclic but progressive entrenchment of the older surfaces by braided streams. Most of these terraces exhibit traces of an anastomosing network of abandoned channels of braided streams (Saucier, 1967, 1994a, 1994b; Autin et al., 1991).

## Lower and upper Macon Ridge alloformation (Pleistocene)

Approximately the northwestern third of the Epps 7.5-minute quadrangle lies within the eastern part of Macon Ridge. Based upon the presence of two distinct terrace surfaces, fluvial sediment elevations, and cross-cutting relationships, two subdivisions of the Macon Ridge alloformation, Lower (older) and Upper (younger), have been recognized and mapped. In the study area, the oldest subdivision, the Lower Macon Ridge alloformation, underlies a narrow, discontinuous valley train along the eastern margin of Macon Ridge and two valley train remnants to the south that comprise the Wallace Ridge and Catahoula segments. The surface of this valley train is designated as the “Upper Macon Ridge braid belt” by Rittenour (2004), which refers to its topographic position instead of its age and stratigraphic position. The younger of these two subdivisions, the Upper Macon Ridge alloformation, underlies the surface of a valley train that forms the surface of western and central Macon Ridge and is designated by Rittenour (2004) as the “Lower Macon Ridge braid belt,” which again refers to its topographic position. It is differentiated from the surface of the Lower Macon Ridge alloformation by its lower terrace and distinct crosscutting relationships (Rittenour, 2004; Rittenour et al., 2005, 2007; Snead et al., 2015; Heinrich et al., 2015).

Extensive optically stimulated luminescence dating of the valley train sediments underlying their surface by Rittenour (2004) and Rittenour et al. (2005, 2007) found that these surfaces within the Mississippi Alluvial Valley are associated with meltwater discharges during Marine Isotope Stages 4, 3, and 2. The older Lower Macon Ridge alloformation was found to date to 42–35 ka and the younger Upper Macon Ridge alloformation was dated to 33–30 ka. Radiocarbon ages of 29,100 ± 1200 and 31,200 ± 2400 14C ka BP, which are consistent with these ages, have been determined for samples collected from a shell-rich deposit underlying the Peoria Loess and overlying the sand on this surface (Saucier, 1968). Both stratigraphic units represent glacial outwash deposited during Marine Isotope Stage 3 (Rittenour, 2004; Rittenour et al., 2005, 2007).

## Loess (Pleistocene)

Within Macon Ridge, two layers of relatively homogeneous, seemingly nonstratified, unconsolidated, well-sorted silt blanket the surfaces of the Upper and Lower Macon Ridge alloformations. This surficial 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 (Rutledge and others, 1996; Saucier, 1994a).

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 (Rutledge and others, 1996; Saucier, 1994a).

Two loess sheets have been observed within the study region. From youngest to oldest, they are the Peoria Loess and Roxana Silt. Numerous radiocarbon, thermoluminescence, and optical luminescence dates and other lines of evidence have been used to determine the age of the Peoria Loess. It accumulated between 22,000 and 12,500 years BP during Marine Isotope Stage 2. The accumulation of Roxana Silt is argued to have occurred sometime during Marine Isotope Stage 3 (Rutledge and others, 1996).

The study of cores from Macon Ridge by Rittenour (2004) and Rittenour et al. (2005, 2007) found that different suites of loess cover the surfaces of the Lower and Upper Macon Ridge alloformations. The surface of the older valley train of the Lower Macon Ridge alloformation is covered by an upper layer of 1.2–4.5 m (3.9–14.8 ft) of Peoria Loess that thins to the south and west. It is underlain by a thin, discontinuous layer of Roxana Silt that is 0 to less than 1 m (3.3 ft) thick. The Roxana Silt lies directly upon a paleosol developed in the underlying fluvial sands of the Lower Macon Ridge alloformation. In the case of the Upper Macon Ridge alloformation, these authors found it was overlain by 0–3 m (0–9.8 ft) of westward thinning Peoria Loess that in places overlies a weak to moderately developed paleosol in the underlying fluvial sands. In some cores they observed a thin layer of Roxana Silt under the Peoria Loess.

## Tensas River Basin (Holocene)

Holocene fluvial sediments of the Tensas River Basin underlie the central and southeast portions of the Epps 7.5-minute quadrangle. This quadrangle straddles the western edge of the upper Tensas Basin that is defined by the scarp of Macon Ridge. The modern channel of the Mississippi River forms the eastern edge of the Tensas Basin. The northern end of this basin is defined by where the historic Mississippi River meander belt abuts Macon Ridge. Its southern end lies at Sicily Island, where the Ouachita River enters the Mississippi River alluvial valley (Fisk, 1944; Saucier, 1967). The geomorphology of the Tensas Basin is well known and the archaeology has been relatively well studied by Fisk (1944) and Saucier (1967, 1974, 1994a, 1994b, 1996). More recent research by Kidder (2006), Adelsberger and Kidder (2007), and Kidder et al. (2008) has shown that the Holocene stratigraphy of the Tensas Basin is considerably more complex than envisioned by previous studies because of the presence of numerous and still largely unmapped laterally and vertically superimposed Arkansas and Mississippi River channels, distributaries, and meander belts and their associated sedimentary facies. Within the Epps 7.5-minute quadrangle, the major features are natural levees and the meander belt of an unnamed Mississippi River distributary now occupied by Joe’s Bayou; a less well developed meander belt and associated natural levees and crevasse along a course now occupied by Bayou Macon; and surrounding backswamp deposits of the Tensas River Basin.

## Mississippi River distributary (Joe's Bayou) (Holocene)

Along the eastern edge and within the southeastern portion of the Epps 7.5-minute quadrangle, a well-defined meander belt and natural levees are associated with Joe’s Bayou. This meander belt has been interpreted and mapped as an ancient course of the Arkansas River by Fisk (1944) and Saucier (1967, 1974, 1994a, 1994b).

More recently, Kidder (2006), Adelsberger and Kidder (2007), and Kidder et al. (2008) conducted a more detailed study of the Tensas River Basin. As a result of a series of cores taken from the Tensas River Basin, including one from a natural levee of the distributary course occupied by Joe’s Bayou, they found a lack of any evidence for the Joe’s Bayou course ever having been a paleochannel of the Arkansas River, and identified it as only having been a distributary of the Mississippi River. They argued that the Joe’s Bayou course first developed as a distributary of the Mississippi River after the development of Mississippi River meander belt No. 4 and its channels. Later, the meandering channel of Meander Belt No. 1 of the Mississippi River intercepted the headwaters of the Joe’s Bayou course and temporarily reactivated this distributary. They inferred that at that time massive amounts of floodwaters and sediments were periodically funneled down Joe’s Bayou resulting in the development of its current meander belt, underfit channel, and natural levees (Kidder, 2006; Adelsberger and Kidder, 2007; Kidder et al., 2008).

## Small river deposits (Bayou Macon) (Holocene)

Associated with Bayou Macon are a less well developed meander belt and associated natural levees and crevasse. Not enough is known about them in order to determine the origin of Bayou Macon and its relationship to Mississippi River meander belts. However, Adelsberger and Kidder (2007) and Kidder et al. (2008) suggested that the crevasse mapped along it is the result of the flow of massive floodwaters down it from the Mississippi River.

## Backswamp deposits (Holocene)

Within the Epps 7.5-minute quadrangle, the backswamp of the Tensas Basin is underlain by fine-grained Holocene sediments. Research by Kidder (2006) and Kidder et al. (2008) indicate that backswamp deposits derived from both the Arkansas and Mississippi Rivers may be present. In addition, the presence of relict channel segments demonstrated that buried paleochannels of either Arkansas River or Mississippi River distributary paleocourses are present in the subsurface.

## Summary of Results

The Pleistocene strata comprise glaciofluvial outwash deposits of the Mississippi River system previously described as braided stream terraces or valley trains, and are here adapted as formation- and member-rank allostratigraphic units. These deposits comprise sand and gravel channel and bar deposits formed by the Mississippi River during a braided depositional regime associated with the transport of glacial outwash, and are mapped as the Macon Ridge alloformation. The deposits form braid belts in valley trains that commonly are capped by Peoria Loess, loess-derived colluvium and/or silty alluvium, and/or fine-grained floodbasin sediments. Although five geomorphic surfaces are discernible in the region owing to differing thicknesses of loess mantle, the deposits resolve into two principal braid belts. The older, stratigraphically lower subunit (geomorphically higher subunit of Rittenour et al., 2007) is discontinuous along the eastern margin of Macon ridge and comprises remnants at the southern end of Melville ridge and Wallace ridge in the Natchez 30 × 60 minute quadrangle and the Catahoula remnant in the Winnfield and Alexandria 30 × 60 minute quadrangles to the west and further south. The younger, stratigraphically higher subunit (geomorphically lower subunit of Rittenour et al., 2007) is differentiated from the adjoining Lower Macon Ridge alloformation by a generally lower surface elevation and distinct crosscutting relationships. Dating by the optically stimulated luminescence method (Rittenour et al. 2005, 2007) indicates that both braid belts in Louisiana are of middle Wisconsin age with the Upper Macon Ridge alloformation slightly the younger. The Macon Ridge alloformation is the oldest of four late Pleistocene glacial outwash units that have been recognized in the Lower Mississippi Valley. Within Louisiana, the other three glacial outwash units are buried by Mississippi River alluvium, and thus are not exposed at the surface (Blum and Roberts, 2012).

Holocene strata comprise differentiated alluvial facies of active and abandoned courses of the Mississippi River and of Bayou Macon in the western portion of the Mississippi River flood plain, and undifferentiated alluvium of tributaries draining the terraced late Pleistocene uplands to the west and northwest.

## Acknowledgments

The work described and summarized herein was supported by the National Cooperative Geologic Mapping Program, STATEMAP component, under cooperative agreement G15AC00247 with the U.S. Geological Survey.

## References

Adelsberger, K. A., and T. R. Kidder, 2007, Climate change, landscape evolution, and human settlement in the lower Mississippi Valley, 5500–2400 cal B.P., *in* Wilson, L., P. Dickinson, and J. Jeandron, eds., Reconstructing human-landscape interactions: Cambridge Scholars Publishing, Newcastle upon Tyne, United Kingdom, p. 84–108.

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.

Blum, M. D., and H. H. Roberts, 2012, The Mississippi Delta Region: Past, Present, and Future: Annual Review of Earth and Planetary Sciences, v. 40, p. 655–683.

Dörrbecker, M., 2008, Map of the Poverty Point archaeological site: http://en.wikipedia.org/wiki/Poverty_Point (accessed 4 September 2014).

Fisk, H. N., 1944, Geological investigation of the alluvial valley of the lower Mississippi River: Vicksburg, Mississippi, U.S. Army Corps of Engineers, Mississippi River Commission, 78 p. plus plates.

Heinrich, P. V., J. Snead, and R. P. McCulloh (compilers), 2015, Bastrop 30 × 60 minute geologic quadrangle: Louisiana Geological Survey, Baton Rouge, Scale 1:100,000.

Heinrich, P. V., J. Snead, and R. P. McCulloh (compilers), 2014, Bastrop 30 × 60 Minute Geologic Quadrangle: Unpublished map prepared in cooperation with U.S. Geological Survey, STATEMAP program, under cooperative agreement no. G13AC00166, Open-File Map 2014–01, Louisiana Geological Survey, Baton Rouge, Scale 1:100,000.

Kidder, T. R., 2006, Climate change and the Archaic to Woodland transition (3000–2600 cal B.P.) in the Mississippi River Basin. American Antiquity, v. 71, p. 195–231.

Kidder, T. R., K. A. Adelsberger, L. J. Arco, and T. M. Schilling, 2008, Basin-scale reconstruction of the geological context of human settlement: an example from the lower Mississippi Valley, USA: Quaternary Science Reviews, v. 27, p. 1255–1270.

Kolb, C. R., W. B. Steinriede, Jr., E. L. Krinitzsky, R. T. Saucier, P. R. Mabrey, F. L. Smith, and A. R. Fleetwood, 1968, Geological investigation of the Yazoo basin, lower Miss. valley: U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, Tech report no. 3–480 [unpaginated—oversized plates include 1:62,500-scale stacked-unit geologic maps in 15-minute quadrangle format].

Louisiana Geological Survey (compiler), 1993, Jackson, MS., LA. 1:250,000 geologic quadrangle [Louisiana portion]: Unpublished map plus explanation and notes, prepared in cooperation with U.S. Geological Survey, COGEOMAP program, under cooperative agreement no. 1434–92–A–1070, scale 1:250,000.

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.

Rittenour, T. M., 2004, Fluvial evolution of the lower Mississippi valley over the last glacial cycle: Ph.D. dissertation, University of Nebraska, Lincoln, 295 p.

Rittenour, T. M., M. D. Blum, and R. J. Goble, 2007, Fluvial evolution of the lower Mississippi River valley during the last 100 k.y. glacial cycle; response to glaciation and sea-level change: Geological Society of America Bulletin, v. 119, no. 5–6, p. 586–608.

Rittenour, T. M., R. J. Goble, and M. D. Blum, 2005, Development of an OSL chronology for Late Pleistocene channel belts in the lower Mississippi valley, USA: Quaternary Science Reviews, v. 24, p. 2539–2554.

Rutledge, E. M., M. J. Guccione, H. W. Markewich, D. A. Wysocki, and L. B. Ward, 1996, Loess stratigraphy of the Lower Mississippi Valley: Engineering Geology, v. 45, p. 167–183, doi:10.1016/S0013-7952(96)00012-9.

Saucier, R.T., 1996, A contemporary appraisal of some key Fiskian concepts with emphasis on Holocene meander belt formation and morphology: Engineering Geology, v. 45, p. 67–86, doi:10.1016/S0013-7952(96)00008-7.

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., 1974, Quaternary geology of the lower Mississippi valley: Arkansas Archeological Survey, Research Series 6, 26 p.

Saucier, R. T., 1968, A new chronology for braided stream surface formation in the Lower Mississippi Valley: Southeastern Geology, v. 9, p. 65–76.

Saucier, R. T., 1967, Geological investigation of the Boeuf–Tensas basin, lower Mississippi valley: U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, Tech Report 3–757 [unpaginated—oversized plates include 1:62,500-scale stacked-unit geologic maps in 15-minute quadrangle format].

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.

Snead, J. I., and R. P. McCulloh (compilers), 1984, Geologic map of Louisiana: Louisiana Geological Survey, Baton Rouge, scale 1:500,000.

Snead, J., Heinrich, P. V., and R. P. McCulloh (compilers), 2015, Tallulah 30 × 60 minute geologic quadrangle: Louisiana Geological Survey, Baton Rouge, Scale 1:100,000.

Snead, J., P. Heinrich, and R. P. McCulloh (compilers), 2014, Tallulah 30 × 60 Minute Geologic Quadrangle: Unpublished map prepared in cooperation with U.S. Geological

Survey, STATEMAP program, under cooperative agreement no. G13AC00166, Open-File Map 2014–02, Louisiana Geological Survey, Baton Rouge, Scale 1:100,000.