Geology of the Satsuma 7.5-Minute Quadrangle, LA

Louisiana Geological Survey

Introduction, Location, and Geologic Setting

The Satsuma 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 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, consisting of an older and higher subunit (Irene alloformation) and the extensive, younger and lower Hammond alloformation, each characterized by a preserved depositional surface with indistinct constructional topography. These Pleistocene strata are covered by late Pleistocene Peoria Loess that is thinner than 1 m, with the 1-m thickness contour lying up to 10 km (6 mi) to the west, and are incised by Holocene undifferentiated alluvium of the Amite River and its tributaries. The loess-covered Hammond surface in the southern portion of the quadrangle is transected by a down-to-basin fault, striking generally west-northwest to east-southeast (Figure 2).

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

Previous Work

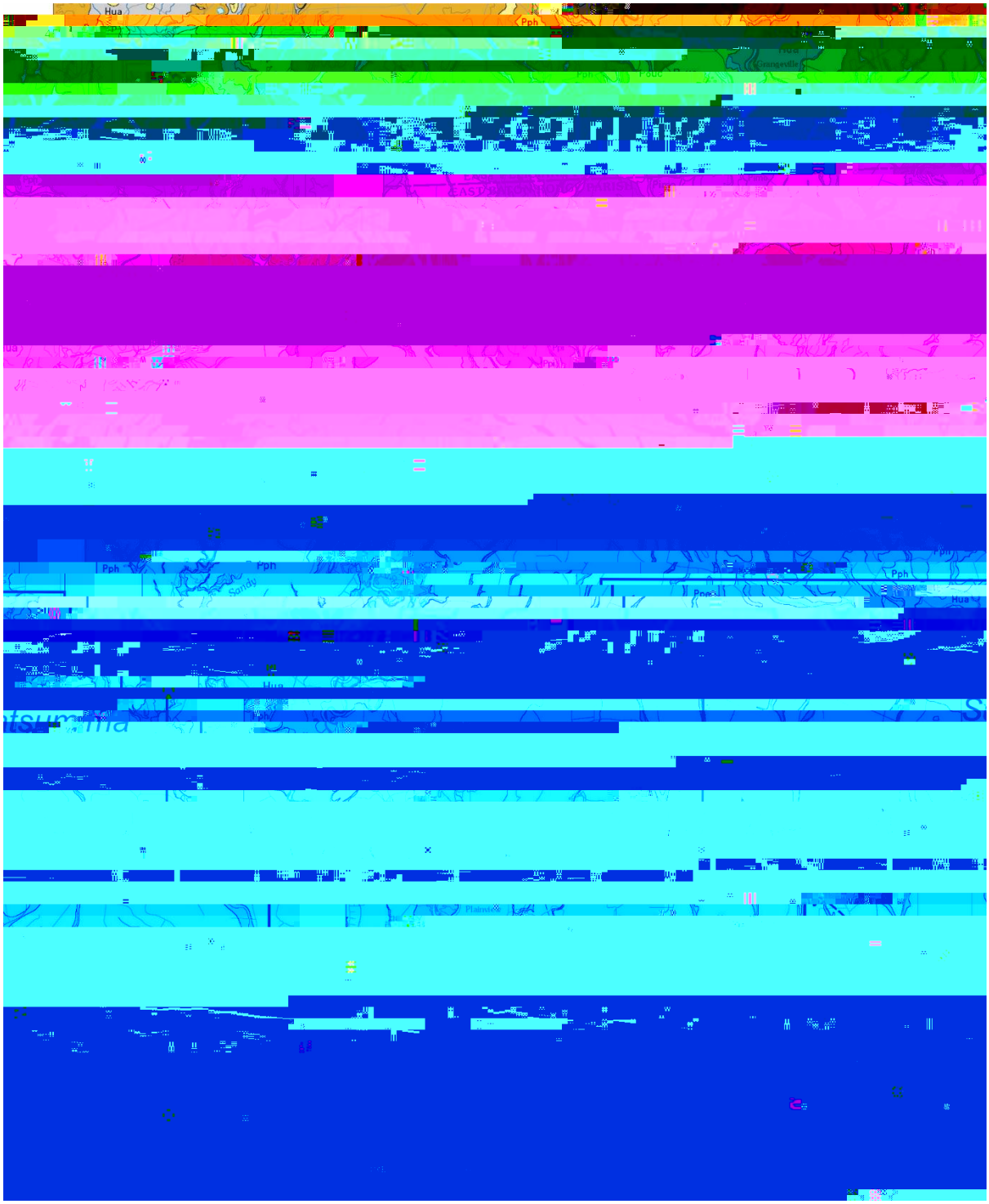
The Satsuma quadrangle lies in the southwestern portion of the Amite 30 × 60 minute quadrangle, the surface geology of which was compiled at 1:100,000 scale by McCulloh et al. (1997) and digitally recompiled by McCulloh and Heinrich (2008), both with STATEMAP support, and later prepared as a Louisiana Geological Survey (LGS) lithograph (McCulloh et al., 2009). The original 1996 1997 investigation 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 north-central Livingston Parish (Figures 1, 2). Self

in southeastern Louisiana, though at 1:250,000 scale. Delcourt (1974) mapped the surface geology of East Feliciana Parish at 1:62,000 scale, and Campbell (1972) mapped that of St. Helena Parish at 1:62,500 scale. Autin and McCulloh (1991) mapped the surface geology of 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 Bi-3(he) de)7(tailed)-7(g)10(roQ4(quife)5(r)-6( )10(s)-10(y)20(st)-12(e)4(m,)8(a)4

composition of the surface-geologic map units. Field observations were then synthesized with



2. Surface geology of Satsuma 7.5-minute quadrangle and vicinity (adapted from McCulloh et al., 2009). (**$P_o$uc**, Citronelle Formation, Upland allogroup (Pliocene); **Pimo**, Montpelier alloformation, Intermediate allogroup (Pleistocene); **Ppi**, Irene alloformation, Prairie Allogroup (Pleistocene); **Pph**, Hammond alloformation, Prairie Allogroup (Pleistocene); **Pp**, Prairie Allogroup, undifferentiated (Pleistocene); **Hua**, Holocene undifferentiated alluvium.)

QUATERNARY SYSTEM

HOLOCENE

Hua Holocene undifferentiated alluvium

PLEISTOCENE

PRAIRIE ALLOGROUP
Pplr Relict Pleistocene ridges
Pph Hammond alloformation
Ppi Irene alloformation

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

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

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., 2003; 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).

Irene alloformation, Prairie Allogroup (Pleistocene)

The Irene alloformation is an unconformity-bounded stratigraphic unit separated from the underlying Montpelier alloformation and older units by a regional unconformity. The first use by Fisk (1938b) as

Florida Parishes of southeastern Louisiana. Fisk viewed this surface as the next elevated relict

alloformation of this report). Snead et al. (1998) used the name again in the same context, but in an allostratigraphic sense, to refer to the depositional sequence underlying the surface identified by Fisk. These -rank unit (alloformation) and referred to its subdivisions as allomembers; subsequent usage by the

This embayed and irregular character is exemplified by the dissected surface of the Irene alloformation in the Satsuma 7.5-
northeastern portion. This surface lacks any discernible relict constructional surface morphology except for rare relatively flat, sloping interfluves (ridge crests) and accordant summits. The slope of its terrace is too poorly preserved to accurately measure its dip. At this time, little is known about the lithology of the Irene alloformation, except that it is distinctly finer-grained than the underlying Citronelle Formation. Close to the Mississippi Valley, the

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).

are stratified. The upper silty facies consist of gray and brown silt. The gray silt occurs as lenticular to V-shaped fills of abandoned chute and thalweg channels. The brown silt comprises natural levees and the upper portion of abandoned chute and thalweg channel fills (Autin, 1985, 1989; Mossa and Autin, 1989). These sediments were differentiated by Autin (1989) into three alloformations, known as the Magnolia Bridge, Denham Springs, and Watson alloformations on the basis of unconformable boundaries, landscape morphology, and relative pedogenic development. These units were not mapped in this investigation because of lack of the detailed information needed to differentiate them.

Fault

The Hammond surface in the southern portion of the quadrangle is transected by a west-northwest- to east-southeast-striking down-to-basin fault (Figure 2). The fault is interpreted as the surface expression of a deep-subsurface growth fault reactivated since the late Pliocene by depositional loading induced by voluminous sedimentation accompanying continental deglaciation (Heinrich, 2005; McCulloh and Heinrich, 2012). The maximum surface displacement across this fault within the quadrangle extent, inferred from the maximum relief on the fault-line scarp, is 4 m (13 ft) and occurs along a short reach lying directly south of the approximate midpoint of the LIGO Livingston installation.

Summary of Results

The surface of the Satsuma quadrangle comprises strata of the Pleistocene Prairie Allogroup consisting of sediment deposited by the Amite River and by coastal processes. The Irene and Hammond alloformations of the Prairie Allogroup, form part of a coast-parallel belt of terraced Pleistocene strata. These Pleistocene strata are covered by late Pleistocene Peoria Loess up to slightly greater than 1 m thick. The Hammond surface is transected by a single mapped down-to-basin fault in the southern portion of the quadrangle. Holocene strata comprise undifferentiated alluvium of the Amite River and its tributaries.

The geologic map of Satsuma 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 1:24,0000 G[(re)7(a)-5(c)4(ti)-3(va)4(t

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