Loess Map of Louisiana

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Front cover: Loess cliff, Sicily Island Hills, Catahoula Parish, Louisiana. Photo by Richard P. McCulloh.

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Baton Rouge
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A layer of silt-size (0.004 to 0.06 mm) sediment, which is called "loess", blankets the surface of Louisiana on either side of the Mississippi Alluvial Valley. "Loess" is a geologic term of German origin that refers to widespread deposits composed of homogeneous layer(s) of friable and porous, silt with minor admixture of either clay or fine sand.

Loess map

A layer of silt-size sediment (grains 0.004-0.06 millimeter in diameter), called "loess," blankets the surface of Louisiana on either side of the Mississippi alluvial valley. "Loess" is a geologic term of German origin that refers to widespread deposits composed of homogeneous layers of friable and porous silt mixed with minor amounts of either clay or fine sand.

The loess map that accompanies this text shows the distribution and thickness of the loess deposits along the Mississippi alluvial valley. It was compiled from maps of loess deposits that were prepared by Dr. B. J. Miller, (1983), as overlays for the 1:250,000-scale quadrangle maps. Dr. Miller compiled these maps from data collected in a drilling program to delineate loess thickness statewide. The resulting data were used to construct cross sections along specific transects (i.e., fig. 1 of Miller et al. 1985) and loess-thickness contours. Miller (1983) was compiled to show the overall distribution of loess in Snead and McCulloh (1984) and Saucier and Snead (1989). The loess-thickness contours for Mississippi were modified from figure 1 of Wascher et al. (1948). Hydrology and Holocene alluvium were modified from Daigle et al. (2006).

Figure 1. Loess doll from Sicily Island Hills, Catahoula Parish, Louisiana. Ruler is one foot long. (Photograph courtesy of Dr. Whitney J. Autin)

Composition

Typically, unaltered loess consists of about 70 percent quartz and feldspar, 20 percent carbonate minerals, 6 percent mica, and 4 percent hornblende, epidote, garnet, zircon, and other minerals. The feldspar is mainly potassium feldspar with minor amounts of plagioclase. The carbonate minerals are dolomite and calcite. Within tens of feet of the surface, weathering has altered the loess, completely leaching it of carbonate and enriching it in clay. Where the loess is less than 3 feet (1 meter) thick, it is typically mixed with the underlying sediment (Snowden and Priddy 1968; Miller et al. 1985).

Two types of calcareous concretions are commonly found in loess exposures (Figure1). One type consists of large, smoothly rounded bodies that are commonly joined together in roughly cylindrical forms. Many of these concretions resemble either humans or animals and have been called "Lösskindchen," "Lössmänchen," "Lösspuppen," and "loess dolls." The other type has a more angular, commonly branched, cylindrical form that looks like a labyrinth of roots and rootlets (Krinitzsky and Turnbull 1967; Snowden and Priddy 1968).

Stratigraphy

Within Louisiana, two distinct layers of loess are recognized, the Sicily Island Loess and the Peoria Loess. The Sicily Island Loess, the oldest and lowermost of the two layers, consists of reddish-brown, brown, to yellowish-brown silt with a well-developed buried soil developed in its top. It covers Tertiary strata, the Citronelle Formation, the Intermediate allogroup, and older units of the Prairie Allogroup adjacent to the Mississippi alluvial valley. However, it is absent in areas underlain by younger units of the Prairie Allogroup and younger deposits. The abrupt change in loess thickness shown on the loess map represents the contact between the younger units of the Prairie Allogroup and younger deposits, which lack any Sicily Island Loess covering them, and the surface of the older parts of the Prairie Allogroup and older deposits, which are covered by Sicily Island Loess. According to numerous Optically Stimulated Luminescence (OSL) and Thermoluminescence (TL) dates, the

Sicily Island Loess accumulated between 27,000 and 55,000 years ago (Miller et al. 1985; Rutledge et al. 1996).

The Peoria Loess consists of dark-brown to yellowish-brown silt. It covers the Sicily Island Loess, Tertiary strata, the Citronelle Formation, the Intermediate allogroup, and the Prairie Allogroup adjacent to the Mississippi alluvial valley. The age of the Peoria Loess is well constrained by radiocarbon, OSL, and TL dating techniques as having accumulated between 14,000 and 25,000 years ago (Miller et al. 1985; Rutledge et al. 1996).

Origin

Lyell (1847) first recognized loess as a major stratigraphic unit adjacent to the Mississippi alluvial valley. Chamberlin (1897) first proposed that it was created by the redeposition by wind of sediment from till sheets and glacial outwash within the floodplains of major rivers. Later, Russell (1944) argued that loess was created by in-situ alteration in a process called "loessification" of colluvial deposits derived from the downslope reworking of Pleistocene backswamp deposits. Although the loessification theory was strongly supported by Fisk (1951), it was abandoned in the next few decades as the evidence in favor of the windblown origin of loess eventually became overwhelming. The proponents of the loessification theory also failed to explain how backswamp clays could be diagenetically altered into loess (Krinitzsky and Turnbull 1967).

The well-sorted wind-blown silt that makes up the loess came from the Pleistocene floodplains of the Mississippi River. When large continental ice sheets covered the Midwestern United States, summer and spring melting at their southern edges created huge volumes of meltwater that flooded down the Mississippi, Missouri, and Ohio Rivers. As the ice sheet melted during the spring and summer, the meltwater carried large quantities of glacial sediment downstream with it. This sediment included considerable silt-size particles created by the grinding of ice sheets over bedrock and silt derived from Late Pleistocene sand dunes in Nebraska and eastern Colorado. The meltwater flowing down an extensive braided stream system spread the glacial sediment, including large volumes of silt, over the Pleistocene floodplain of the Mississippi River (Krinitzsky and Turnbull 1967; Snowden and Priddy 1968; Miller et al. 1985).

During the fall and winter, the melting of the southern edges of the ice sheets largely ceased. As a result, meltwater flowing down the Mississippi, Missouri, and Ohio Rivers diminished, if not entirely dried up. This caused large areas of the previously flooded Mississippi River Valley to become dry and commonly unvegetated floodplains. At that time, strong winds blew across the dry floodplains and eroded large quantities of predominantly silt-size sediment from it. Winds transported this sediment, sometimes as dust storms, out of the Mississippi alluvial valley and over the adjacent countryside. As it moved away from the valley, the silt-size dust settled out and accumulated as a blanket of well-sorted silt covering the adjacent uplands and terraces. Over thousands of years, the constant accumulation of silt created loess deposits that are many feet (several meters) thick (Krinitzsky and Turnbull 1967; Snowden and Priddy 1968; Miller et al. 1985; Saucier 1994).

That the Mississippi alluvial valley was the source of Louisiana loess is demonstrated by its characteristics. First, the occurrence of loess is restricted to either side of this alluvial valley. Second, the loess is thickest in the uplands adjacent to the eastern edge of the valley where prevailing winds would carry dust. Third, the loess decreases in grain size away from the valley. The decrease in grain size is expected, as the heaviest particles will settle first after being blown out of the floodplain. Fourth, as expected in the case of wind-blown sediment, the thickness of loess decreases with distance from the valley wall. Fifth, and finally, the composition of the loess matches the composition of the glacial sediment, which was carried along with it during periods of glaciation (Krinitzsky and Turnbull 1967; Miller et al. 1985).

Long-term (centennial to millennial) climatic cycles significantly influenced loess deposition. These climatic cycles altered the rate at which loess accumulated by affecting the amount of glacial meltwater and sediments produced by the disintegrating Laurentide ice sheet. By changing soil moisture and temperature, the same long-term climatic changes affected the degree to which soil processes altered the loess after it accumulated (Wang et al. 2003).

Figure 2. Land snails from Peoria Loess, Tunica Hills Wildlife Management Area, West Feliciana Parish, Louisiana. Green cube is one centimeter wide.

Figure 3. Mastodon bones from the Peoria Loess at the Angola Mastodon Site, Louisiana State Penitentiary, Angola, Louisiana. (Fossils courtesy of the Louisiana Museum of Natural Science)

Figure 4. Loess cliff on edge of former gravel pit, Sicily Island Hills, Catahoula Parish, Louisiana. Estimated height of cliff is approximatley 45 feet high. (Photograph courtesy of Mr. Richard P. McCulloh)

Fossils

The fossils found within Louisiana loess consist of the shells of various snails and clams and the bones of mastodons and other vertebrates. The fossil shells are those of land snails (pulmonate gastropods), freshwater snails (gastropods), and freshwater clams (pelecypods). The well-preserved and unbroken shells of land snails are the most abundant fossils found in Louisiana loess (Figure 2). These land snails are the types typically associated with deciduous forests. Rarely, small lenses of freshwater snails and clams occur within the loess. These fossils accumulated within small ponds that briefly existed within the landscape on which loess accumulated. Finally, the vertebrate bones, most notably mastodons, have been found in some places within the loess in Louisiana and adjacent parts of Mississippi (Figure 3) (Krinitzsky and Turnbull 1967; Miller et al. 1985; Saucier 1994).

Physical Properties

When dry, loess has the ability to stand as steep, vertical bluffs (Figure 4). The loess in these bluffs tends to fracture along vertical joints. When wet, loess can loose its strength and subside, flow, or slide. It is readily eroded and can rapidly form deep gullies and piping of embankments. Typically, loess is also highly permeable and exhibits low capacity for shrinking or swelling and low plasticity (Krinitzsky and Turnbull 1967).

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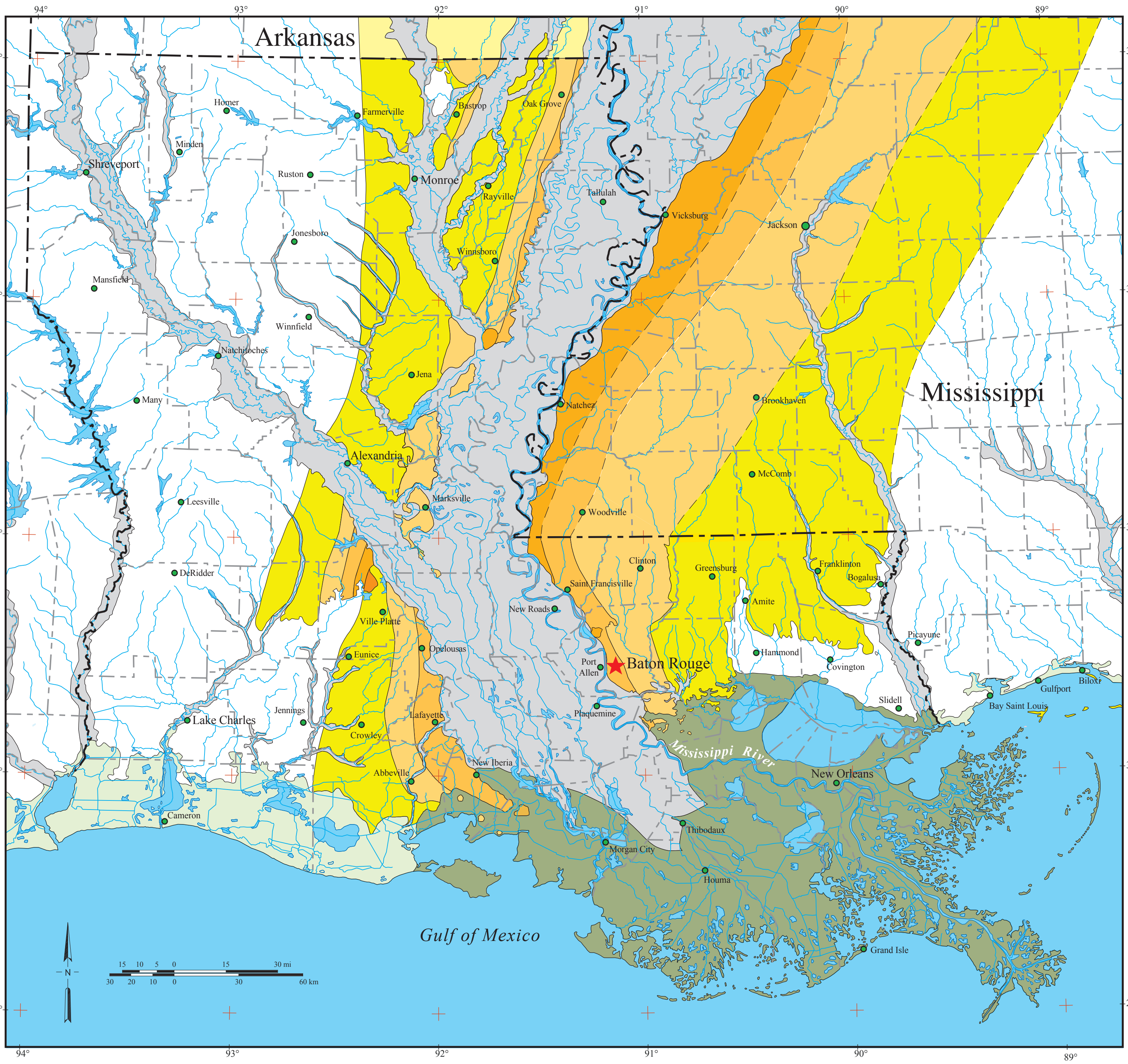

Key

- Greater Than 9 m (30 ft) of loess
- 5 to 9 m (15 to 30 ft) of loess
- 3 to 5 m (10 to 15 ft) of loess
- 1 to 3 m (3 to 10 ft) of loess
- Less than 1 m (3 ft) of loess
- Loess of unspecified thickness
- Holocene alluvium
- Deltaic plain
- Chenier / coastal plain
- Water
- Parish or county line
- State line
- Town

Albers Equal Area Projection