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QUATERNARY GEOLOGIC MAP OF THE VICKSBURG 4° x 6° QUADRANGLE, UNITED STATES

QUATERNARY GEOLOGIC ATLAS OF THE UNITED STATES
MAP I-1420 (NI-15)

State compilations by
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NOTE: This map is the product of collaboration of State geological surveys, universities, and the U.S. Geological Survey, and is designed for both scientific and practical purposes. It was prepared in two stages. First, separate maps and map explanations of the parts of States included in the quadrangle were prepared by the State compilers indicated on the inset diagram, Areas of Responsibility. Second, these maps were combined, integrated, locally supplemented, and related to a uniform map symbol classification. The map unit descriptions also were combined, supplemented, and coordinated with those of other maps of this series so that individual unit descriptions are applicable throughout both this map and all other maps of the series. Diagrams accompanying the map were prepared by the editors.

Differences in mapping or interpretation in different areas were resolved by correspondence to the extent possible. Most simply reflect differences in available information or differences in philosophies of mapping. Such differences serve to encourage further investigation.

Less than forty percent of the surficial deposits of the United States have been mapped and described. Traditionally, mapping of surficial deposits has been focused on glacial, alluvial, eolian, lacustrine, marine, and landslide deposits. Slope and upland deposits have been mapped in detail only in restricted areas. However, an enormous amount of engineering construction and many important problems of land use and land management are associated with regions that have extensive slope and upland deposits (colluvium, residuum, and saprolite, for example). These materials have many different physical characteristics. Therefore, an effort has been made to classify, map, and describe there deposits, based in large part on unpublished interpretations of individuals, published and unpublished subsoil data, and the distribution of bedrock parent materials. The classification is crude, but represents a first step toward a more refined and useful product.

For scientific purposes, the map differentiates Quaternary surficial deposits on the basis of a combination of criteria, such as lithology, texture, genesis, stratigraphic relationships, and age, as shown on the correlation diagram and indicated in the map unit descriptions. Some geomorphic features, such as sand dunes, are distinguished as map units. Erosional features, such as stream terraces, are not distinguished, and differentiation of sequences of alluvial deposits of different ages is rarely possible at a scale of 1:1,000,000. Most landslide deposits also are too small to be shown at this scale.

For practical purposes, the map is a surficial materials map, on which materials are distinguished on the basis of texture, composition, and local specific characteristics such as swelling clay. It is not a map of soils as soils are recognized and classified in pedology or agronomy. Rather it is a generalized map of soils as recognized in engineering geology, or of subsoils or parent materials from which pedologic and agronomic soils are formed.

As a materials map it serves as a base from which a wide variety of derivative maps for use in planning engineering, land use, or land management projects can be compiled.

The map contains the following illustrations:

- An index map to the International Map of the World 1:100,000 topographic series showing the Quaternary geologic map of the Vicksburg 4°x 6° quadrangle and other published maps of the Miscellaneous Investigations Series (I–1420).
- An illustration showing the responsibility for State compilations.
- An illustration showing the correlation of map units.
- An illustration showing loess thickness and distribution in the map area

LIST OF MAP UNITS

HOLOCENE

asa ALLUVIAL SAND, SILT, CLAY, AND GRAVEL
as ALLUVIAL SILTY FINE SAND
asl ALLUVIAL SILT AND SAND
ac ALLUVIAL CLAY
aca ALLUVIAL CLAY
fl NATURAL LEVEE SILT AND CLAY

HOLOCENE AND LATE WISCONSIN

ed DUNE SAND
cbf BOULDERY SANDY COLLUVIUM
cbg CHERT FRAGMENT COLLUVIUM
cbh SANDSTONE BLOCK COLLUVIUM
cbi QUARTZITE BOULDER COLLUVIUM
cla SANDSTONE- AND SHALE-CLAST LOAMY COLLUVIUM
clf ACID SHALE-CHIP CLAY-LOAM COLLUVIUM

LATE PLEISTOCENE

asd ALLUVIAL FINE SAND AND SILT
acb ALLUVIAL CLAY AND SILT
asb ALLUVIAL GRAVEL AND SAND
asj ALLUVIAL SAND AND SILT
acc ALLUVIAL SILT AND CLAY

LATE PLEISTOCENE AND MIDDLE PLEISTOCENE

ela LOESS AND LOESSIAL COLLUVIUM AND ALLUVIUM

LATE PLEISTOCENE TO EARLY PLEISTOCENE

agb ALLUVIAL GRAVEL AND SAND
asg ALLUVIAL CLAY, SILT, SAND, AND GRAVEL

MIDDLE PLEISTOCENE

alj ALLUVIAL SILTY CLAY, SAND, AND GRAVEL
ash ALLUVIAL DELTA SAND, SILT, AND CLAY

EARLY PLEISTOCENE TO PLIOCENE(?)

agf ALLUVIAL CHERT-PEBBLE GRAVEL AND SAND
agc ALLUVIAL PEBBLE GRAVEL AND SAND

QUATERNARY AND TERTIARY

zsa LIMONITIC SANDY DECOMPOSITION RESIDUUM
zsb QUARTZ SAND DECOMPOSITION RESIDUUM
zsd SANDY DECOMPOSITION RESIDUUM

zse CLAYEY, FINE TO MEDIUM SAND AND FINE SANDY CLAY DECOMPOSITION RESIDUUM
zsh MEDIUM TO FINE SILTY SAND, SANDY SILT, AND SAND DECOMPOSITION RESIDUUM
zsp FINE SANDY, SILTY, CLAY DECOMPOSITION RESIDUUM
zld CLAYEY SILT DECOMPOSITION RESIDUUM
zca SANDY CLAY DECOMPOSITION RESIDUUM
zcb SMECTITIC CLAY DECOMPOSITION RESIDUUM
zcc FINE SILTY CLAY DECOMPOSITION RESIDUUM
zcg SAND, GRAVEL, SILT, AND CLAY DECOMPOSITION RESIDUUM
zch SILTY OR MICACEOUS SANDY CLAY DECOMPOSITION RESIDUUM
zrg SHALEY CLAY AND CHERTY CLAY DECOMPOSITION AND SOLUTION RESIDUUM
rcc CHERTY CLAY SOLUTION RESIDUUM
rcg DARK CLAY SOLUTION RESIDUUM
sca CLAY SAPROLITE

LIST OF MAP SYMBOLS

CONTACT

SHORELINE

PLEISTOCENE VOLCANIC ASH BED—Possibly belonging to Pearlette family of volcanic ashes derived from calderas in and near Yellowstone National Park

DESCRIPTION OF MAP UNITS

HOLOCENE

asa ALLUVIAL SAND, SILT, CLAY, AND GRAVEL—Light-gray, yellowish- to brownish-gray, or reddish-orange, coarse to fine sand and subangular to well-rounded pebble gravel; massive to well stratified. Locally includes interbedded or admixed silt and clay especially in flood plains of major drainages. Gravel is chert, quartz, and sandstone, derived from older deposits. Mapped areas include swamp and organic muck deposits in backswamps and on flood plains, and local colluvium along margins of valley floors. Thickness 3–30 m

as ALLUVIAL SILTY FINE SAND—Gray to light-brown and brown silty sand; poorly to well sorted, poorly to well stratified; contains intermixed and interbedded silt and clay. Comprises channel, overbank, and natural-levee deposits of the Mississippi and Arkansas Rivers. Overlies intermixed and interbedded gravel, sand, silt, and clay of Pleistocene age that become coarser with depth and ranges in thickness from 10 m to more than 70 m. Mapped areas include swamp deposits, muck of oxbow lakes, and scattered areas of dark-brown to black organic clay. Thickness 3–10 m

asl ALLUVIAL SILT AND SAND—Grayish-tan to brown, poorly sorted, irregularly bedded, locally clayey, silt, and fine to very fine quartz sand; scattered interbedded or intermixed chert-pebble gravel. Mapped only in Mississippi where it is derived mainly from older loess and loessial colluvium (**ela**). Mapped areas include organic muck and swamp deposits on flood plains. Thickness 5–10 m

ac ALLUVIAL CLAY—Gray to reddish-brown, poorly to well bedded, clay-dominant material representing overbank deposits of the Mississippi and Arkansas Rivers. Contains intermixed and interbedded fine sand and silt and sparse deposits of dark-brown to black organic clay. Mapped areas include swamp deposits and muck that accumulated in oxbow lakes. Overlies intermixed and interbedded gravel, sand, silt, and clay that coarsen with depth and is about 10–70 m thick. Thickness of alluvial clay 3–12 m; locally 20 m where deposit fills channels in underlying Pleistocene alluvial sand

aca ALLUVIAL CLAY (Backswamp deposits of Saucier, 1974)—Light- to dark-gray, yellowish-gray, or brownish-gray clay, silty clay, and organic silty clay. Contains a few thin layers of medium to fine quartz sand and thin lenses of reworked fine chert-pebble gravel. Peat layers, abundant

organic particles, and wood fragments are interspersed throughout. Deposits accumulated in abandoned river channels and overbank flood areas (backswamps) near natural levees of Mississippi River. Thickness 3–10 m; locally 20 m where deposit fills channels in underlying Pleistocene alluvium

fl NATURAL LEVEE SILT AND CLAY—Brown to grayish-brown, light- to medium-gray silt and silty clay; includes small amounts of fine quartz sand. The clay and silt locally contain abundant plant fragments. Deposit moderately to highly oxidized; forms broad, natural levees 2–5 m high along present and former courses of Mississippi River. Thickness 1–6 m

HOLOCENE AND LATE WISCONSIN

ed DUNE SAND—Light-brown, fine to medium sand; includes some silt, clay, and organic matter. The dunes are mostly on late Pleistocene braided stream terraces of Saucier (1974) underlain by alluvial gravel and sand (**asb**)

cbf BOULDERY SANDY COLLUVIUM[1]—Tan to brown, dark-grayish-brown, or yellowish-brown fine sand, silt, and minor silty clay containing sandstone boulders; some boulder fields at surface. Developed on moderate to steep slopes underlain by highly folded and faulted sandstone and shale. Thickness 0.5–1.5 m

cbg CHERT FRAGMENT COLLUVIUM[1]—White to gray, angular to subrounded chert and novaculite fragments 7–22 cm in diameter in a gray to dark-grayish-brown, silty clay matrix. Mapped areas include bedrock outcrops and abundant talus material on moderate to steep slopes. Thickness 0.25–1.0 m

cbh SANDSTONE BLOCK COLLUVIUM[1]—Orange to orange-brown, slightly silty to slightly clayey, well-rounded, medium to fine sand containing many angular to subround, boulder- to cobble-size sandstone blocks; local areas of orange sandy clay contain fragments of milky quartz. Developed on steep to moderate slopes. Mapped areas include many bedrock outcrops. Thickness 0.5–1.5 m

cbi QUARTZITE BOULDER COLLUVIUM[1]—Dark-grayish-brown, reddish-orange, or tan, sandy to silty clay containing abundant milky quartz fragments and blocks of quartzite and either phyllite or sandstone 5–20 cm in diameter. Developed on steep to moderate slopes. Mapped areas include many rock outcrops. Thickness 0.5–1.5 m; locally in Arkansas may exceed 3 m

cla SANDSTONE- AND SHALE-CLAST LOAMY COLLUVIUM[1]—Very dark grayish-brown to yellowish-brown silty clay, silt, and sand containing angular to subangular sandstone and shale fragments. Developed on moderate to steep slopes. Mapped areas include sparse outcrops and patches of eolian sand. Thickness 0.5–1.5 m

clf ACID SHALE-CHIP CLAY-LOAM COLLUVIUM[1]—Reddish- to greenish-brown or dark-grayish-brown sandy to silty clay containing shale chips and subangular to well-rounded clasts as much as 15 cm across. Clasts are chiefly sandstone, but locally are chert and quartzite. Developed on moderate to steep slopes. Mapped areas include rock outcrops and talus on steep slopes; small alluvial fans of sand and angular gravel on moderate slopes. Thickness 0.5–1.0 m

LATE PLEISTOCENE

asd ALLUVIAL FINE SAND AND SILT (Deposits of Deweyville terrace of Saucier, 1974, on Ouachita River)—Light-gray or light-brownish-gray to mottled red and brown, fine to very fine quartz sand and silt, containing scattered lenses of clay and layers of quartzite and fine pebble gravel composed of chert. In southern Arkansas, the sand and silt underlies two low terraces; pebble gravel lenses include clasts as much as 5 cm across. Abandoned oxbow channels on the terrace surfaces are filled with interbedded silt and clay. Thickness 2–15 m

acb ALLUVIAL CLAY AND SILT (Deposits of Deweyville terrace of Bernard, 1950; Saucier, 1974)—Light- to medium-gray, clay and silty clay. Poorly to well sorted, poorly to well bedded. Locally includes admixed or interbedded fine quartz sand. Thickness 3–5 m

asb ALLUVIAL GRAVEL AND SAND (Deposits of braided stream terraces of Saucier, 1974)—White to gray or brown, poorly to well-sorted, fine to coarse quartz sand and gravel; includes minor silt and clay. Forms a broad terrace along west side of Mississippi River flood plain in Louisiana and Arkansas; includes both glacial outwash and nonglacial alluvium; contains relict channels filled with interbedded silt and clay. Thickness 3–8 m; locally 10–40 m where deposit fills channels cut in underlying Pleistocene alluvial sand and gravel (**asg**)

asj ALLUVIAL SAND AND SILT (Sand and silt facies of Prairie terrace of Saucier, 1974)—Light- to dark-brown, red, or reddish-brown, fine to coarse silty sand, locally interbedded with silt lenses and gravel lenses. Gravel, chiefly chert and quartzite, more abundant than in deposits of the Prairie terrace farther south. Locally covered by thin patches of loess. Mapped areas include organic silt and clay deposits of abandoned channels and oxbow lakes, and oxidized sand and silt deposits of natural levees (**fl**). Thickness 2–5 m; locally 10 m where deposit fills channels cut in underlying Pleistocene alluvial sand and gravel (**asg**)

acc ALLUVIAL SILT AND CLAY (Silt-clay facies of Prairie terrace of Saucier, 1974)—Brown to red and dark-red clayey silt characterized by numerous, closely spaced, circular depressions and small silty clay mounds. Depressions range from 3 to 150 m in diameter and are filled with light- to medium-gray silty clay grading downward to red-brown silt containing abundant dark-red iron-manganese "buckshot" pellets. Silt matrix contains rare gravel lenses. Grades down into underlying Pleistocene alluvial sand and gravel (**asg**). Mapped only in Louisiana along edge of Mississippi River flood plain. Thickness 1.5–7 m; locally 50 m where it fills paleochannels cut in underlying Pleistocene alluvium

LATE PLEISTOCENE AND MIDDLE PLEISTOCENE

ela LOESS AND LOESSIAL COLLUVIUM AND ALLUVIUM—Yellow, brown to reddish-brown, or grayish-brown to yellowish-brown silt mixed with clay and fine sand; locally contains thin lenses of very fine to fine quartz sand. Near rivers, deposits are cut by ravines 20–30 m deep, forming extremely rugged terrain. In southeast Mississippi, east of mapped area, thin loess occurs locally on and is intermixed and interbedded with other mapped units. Thickness ranges from a maximum of 30 m along the Mississippi River to 3 m at eastern limit of mapped unit

LATE PLEISTOCENE TO EARLY PLEISTOCENE

agb ALLUVIAL GRAVEL AND SAND (Terrace gravel of the Arkansas River restricted to mountainous terrain in Arkansas and Oklahoma)—Light- brown, yellowish- to reddish-brown, and dark-red, medium to coarse sand; contains abundant pebbles and cobbles of chert. Terrace remnants are 10–12 m above present flood plain of Arkansas River. Thickness 2–5 m

asg ALLUVIAL CLAY, SILT, SAND, AND GRAVEL (Undifferentiated alluvial terrace deposits of Deweyville, Beaumont, Lissie, and Willis age in Texas; undifferentiated terrace deposits in Arkansas and Oklahoma)—Light-brown to reddish-brown, fine to coarse sand and silt, pinkish-orange and yellowish-tan mottled clay, and well rounded to subangular quartz and chert gravel; clasts 1–4 cm in diameter. Mapped areas include local colluvial deposits. Thickness 0.5–5 m

MIDDLE PLEISTOCENE

alj ALLUVIAL SILTY CLAY, SAND, AND GRAVEL—Reddish-brown to dark-gray silty clay; lenses of sand and scattered chert and limestone gravel in basal part. Underlies a sequence of river terraces and is mapped only in Oklahoma in northwestern part of the quadrangle. Deposit contains Pleistocene vertebrate fossils in places. Thickness 3–15 m

ash ALLUVIAL DELTA SAND, SILT, AND CLAY (Fine-grained channel facies of Bentley and Montgomery Formations of Fisk, 1938, 1940, in Louisiana)—Light-gray to brown or orange-brown, medium to fine sand, silt, and sandy clay; some interbedded lenses of gravel. In places, deposit characterized by channel-and-fill structures and graded bedding that indicate deposition in meander channels, point bars, and braided channels on landward part of delta plain. Locally, surface of deposit characterized by clusters of pimple mounds or mantled by low dunes of Holocene age. Thickness 5–15 m

EARLY PLEISTOCENE TO PLIOCENE(?)

agf ALLUVIAL CHERT-PEBBLE GRAVEL AND SAND (Gravel of Crowleys Ridge in Arkansas)—Pale-buff, light-brown to dark-brown pebbles, cobbles, and a few boulders in a matrix of fine sand, silt, and clay; poorly sorted; unconsolidated; locally stained with iron or manganese oxide. Silt and clay increasingly abundant in upper part. Clasts mostly well rounded, a few angular; composed primarily of chert, sparse quartzite, sandstone, and claystone. Sand, chiefly quartz, grains of zircon, tourmaline, staurolite, and topaz, and minor kyanite and sillimanite indicate probable source in headwater area of ancestral Mississippi River. Deposit characterized by

channel-and-fill cross-bedding; foreset beds dip mainly west or south. Thickness as much as 20 m

agc ALLUVIAL PEBBLE GRAVEL AND SAND (Citronelle Formation)—Light-gray to orange-brown, orange, or reddish-orange, gravelly, coarse to fine sand; includes lenses of moderate- to dark-red sandy silt and white to light-gray clay. Gravel consists of subangular to subround chert or quartz granules to medium-size pebbles, commonly in a loose, coarse sand matrix. The Citronelle Formation is considered middle Pliocene to possible early Pleistocene in age on the basis of fossil leaves found in Mississippi (Berry, 1916; Stringfield and Lamoureaux, 1957). A vertebrate fauna, collected from a dark-gray clay beneath oxidized sand typical of the Citronelle Formation in Alabama has been assigned a Hemphillian (middle Pliocene) age by F. C. Whitmore (Isphording and Lamb, 1971). Mapped areas include locally derived gravelly sand, alluvium, and colluvium. Thickness variable; as much as 60 m

QUATERNARY AND TERTIARY

zsa LIMONITIC SANDY DECOMPOSITION RESIDUUM[2]—Dark-reddish-brown, brown, or yellowish-brown, fine to medium quartz sand and clay to silty clay. Sand is irregularly cemented to hard, limonitic masses; numerous limonite veins and nodules. Deposit grades down into sandstone, shale, and siltstone bedrock. Mapped areas include locally derived colluvium, alluvium, and bedrock outcrops. Thickness 1–15 m

zsb QUARTZ SAND DECOMPOSITION RESIDUUM[2]—Pale-gray to reddish-brown, slightly clayey coarse to medium quartz sand, commonly containing muscovite. Locally characterized by irregular, hard, limonite-cemented masses, nodules, and veins. Mapped areas include younger locally derived colluvium, bedrock outcrops, and broad, low sand dunes of late Pleistocene and Holocene age. Thickness 1–3 m

zsd SANDY DECOMPOSITION RESIDUUM[2]—Very dark grayish-brown, olive-brown, yellowish-brown, or gray, fine sandy loam to silty clay loam containing angular sandstone fragments and shale chips; developed principally on flat to gently sloping terrain. May contain intermixed eolian silt or fine sand and colluvium. Thickness 0.5–2 m

zse CLAYEY, FINE TO MEDIUM SAND AND FINE SANDY CLAY DECOMPOSITION RESIDUUM[2]—Brown to buff, clayey, fine to medium quartz sand and orange to yellowish-red, fine sandy, silty clay. In Louisiana, commonly contains small fragments of lignite. Thin where developed on layers of hard volcanic tuff in Texas. Mapped areas include colluvium and bedrock outcrops. Thickness 1–3 m

zsh MEDIUM TO FINE SILTY SAND, SANDY SILT, AND SAND DECOMPOSITION RESIDUUM[2]—Tan to light-brown silty fine sand with small amounts of reddish-brown silty to sandy clay; chiefly quartz sand in northern Arkansas. Thickness 0.5–2 m

zsp FINE SANDY, SILTY, CLAY DECOMPOSITION RESIDUUM[2]—Light-brown to reddish-brown very fine sand, gray clay, reddish-brown silty clay, and some gravel. Clasts chiefly sandstone; a few are of limestone. Mapped areas include colluvium and bedrock outcrops. Thickness 0.5–2 m

zld CLAYEY SILT DECOMPOSITION RESIDUUM[2]—Olive-brown to grayish-brown clay loam to silt loam containing small fragments of sandstone and chips of shale in lower part. Mapped areas include colluvium and bedrock outcrops. Thickness 1–1.5 m

zca SANDY CLAY DECOMPOSITION RESIDUUM[2]—Pale-yellow, orange, reddish-orange, or greenish-gray, mottled, poorly sorted, fine sandy clay; in places contains medium to coarse sand or pebbly sand, chiefly quartz. Mapped areas include local colluvium and bedrock outcrops. Thickness 1–2 m

zcb SMECTITIC CLAY DECOMPOSITION RESIDUUM[2]—Light-brown to brown, reddish-brown, yellowish-gray or mottled pinkish-orange, clay, silty clay, silt, and fine sand, locally containing calcareous nodules. Clay is smectitic; expands when wet; shrinks and develops a crack structure, called gilgai when dry. Mapped areas include local colluvium and bedrock outcrops. Thickness commonly less than 1 m, locally 2 m

zcc FINE SILTY CLAY DECOMPOSITION RESIDUUM[2]—Black to dark-gray or dark-brown silty clay; light brown to reddish brown where oxidized; contains areas of fine sand and chert-pebble gravel in Arkansas. Clay is strongly smectitic; expands when wet, shrinks and forms a crack structure, called gilgai, when dry. Mapped areas include local colluvium and bedrock outcrops. Thickness 0.5–1 m, locally 2 m

zcg SAND, GRAVEL, SILT, AND CLAY DECOMPOSITION RESIDUUM[2]—Dark-gray, olive-gray, grayish-brown to reddish-brown clay loam, silt loam, fine to medium sand, or clayey sandy gravel; contains both calcium carbonate concretions and limonite concretions. Sand chiefly quartz; gravel, 2–10 cm in diameter, is of novaculite, quartz, quartzite, and sandstone. Clay is mostly smectite; expands when wet and shrinks when dry. Mapped areas include local colluvium and bedrock outcrops. Thickness 0.5–2 m

zch SILTY OR MICACEOUS SANDY CLAY DECOMPOSITION RESIDUUM[2]—Brown silty clay and micaceous, fine sandy clay, commonly limonite cemented. Lower part may locally contain fragments of lignite and petrified wood. Mapped areas include local colluvium and bedrock outcrops. Thickness 1–2 m

zrg SHALEY CLAY AND CHERTY CLAY DECOMPOSITION AND SOLUTION RESIDUUM[2,3]—Yellowish- to reddish-orange, yellowish- to reddish-brown clay and minor amounts of sand and silt. Clasts chiefly of iron-stained, chalcedonic chert fragments and shale chips. Base is very uneven; residuum extends deeply into underlying bedrock along fractures. Mapped areas include locally derived sheetwash on steeper slopes, and bedrock outcrops. Thickness 0.5–2 m

rcc CHERTY CLAY SOLUTION RESIDUUM[3]—Reddish-orange, grayish-brown to dark-brown clay and silty clay containing subangular to angular, white, tan, black, green, or gray, gravel- to cobble-size chert clasts. Contains slabs of sandstone, siltstone, and locally limestone or dolomite at or near the surface. Contact with underlying bedrock is an abrupt pinnacled, karst surface. Mapped areas include colluvium and bedrock exposures. Where colluvium overlies the residuum on steep slopes, both deposits tend to be unstable. Thickness 0.5–1.5 m, locally more than 5 m

rcg DARK CLAY SOLUTION RESIDUUM[3]—Yellowish-gray, dark-gray to black, or dark-brown, fine, sandy clay containing scattered, very light gray, chalky, calcium carbonate nodules and marcasite concretions. Relatively high degree of plasticity; occurs in areas of low relief and rests in abrupt contact on underlying limestone bedrock. Mapped areas include small deposits of colluvium and bedrock exposures, the latter chiefly in areas of high relief. Thickness less than 1 m

sca CLAY SAPROLITE—Red to dark-brown clay saprolite developed on nepheline syenite. Clay contains residual angular, subangular, and rounded boulders and core stones. Includes some bauxite and areas of grus. Thickness 0.5–3 m

[1]COLLUVIUM, for purposes of this map, is defined as material transported and deposited by mass-wasting processes. In this quadrangle the processes are chiefly creep, solifluction, mudflow, frost heave, landslide and sheetwash.

[2]DECOMPOSITION RESIDUUM, for purposes of this map, is defined as material derived primarily by in-place chemical decay of clastic rock with no appreciable subsequent lateral transport.

[3]SOLUTION RESIDUUM, for purposes of this map, is defined as material derived by in-place solution of carbonate rock or carbonate-cemented rock with no appreciable subsequent lateral transport.

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