QUATERNARY GEOLOGIC MAP OF THE BLUE RIDGE 4° X 6° QUADRANGLE, UNITED STATES

QUATERNARY GEOLOGIC ATLAS OF THE UNITED STATES
MAP I-1420 (NJ-17)

State Compilations by
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1991

NOTE: This map is a 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. Second, these maps were integrated and locally supplemented by the editors; map unit symbols were revised to a uniform system of classification; and map unit descriptions were prepared from information received from the State compilers and from additional sources. The diagrams accompanying the map were prepared by the editors. The footnote on saprolite was prepared in part by E.T. Cleaves, Maryland Geological Survey, and in part by R.B. Daniels, North Carolina State University.

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

Less than forty percent of the surficial deposits of the conterminous United States have been mapped and described. Traditionally, mapping of surficial deposits has 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 Therefore, an effort has been made to classify, map, and describe these deposits, based in large part on unpublished interpretations, published and unpublished subsoil data, and the distribution of bedrock parent materials.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 end moraines, are distinguished as map units. Erosional landforms, such as stream terraces, are not distinguished, and differentiation of sequences of alluvial deposits of different ages in most regions is not possible at a scale of 1:1,000.000. Most landslide deposits are too small to be shown at this scale, but areas in which landslides are present are distinguished as map units. Areas of abundant and of scattered landslide deposits are distinguished in parts of Ohio and Kentucky (W.E. Davies, unpub. mapping, 1984), where they are identified as units **jla** and **jlb**. However, landslide deposits are known to be present throughout the area of unit **cla**. Similarly, open-pit coal mines and spoil piles, shown by symbol '**f**' where mapped, also are present throughout the coal mining area of unit **cla**, but have not been mapped on a regional scale.

For practical purposes, the map is a surficial materials map. 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 Blue Ridge 4°x 6° quadrangle and other published maps of the Miscellaneous Investigations Series (I-1420).
- An illustration showing the responsibility for state compilations.
- A chart showing correlation of map units.

LIST OF MAP UNITS

HOLOCENE AND LATE WISCONSIN

agg ALLUVIAL SANDY GRAVEL
al ALLUVIUM

HOLOCENE AND WISCONSIN

cba GRANITIC-BOULDER COLLUVIUM
cbb QUARTZITE-BLOCK LOAMY COLLUVIUM
cbc CARBONATE-BOULDER CLAYEY COLLUVIUM
cbd MAFIC-BOULDER LOAMY COLLUVIUM
csa SANDY SILTY COLLUVIUM
csb COLLUVIUM WITH HUGE BLOCKS
csh SANDY SHALY COLLUVIUM
cl LOAMY COLLUVIUM
cla SANDSTONE- AND SHALE-CLAST LOAMY COLLUVIUM
LANDSLIDE DEPOSITS AND LOAMY COLLUVIUM
jla Abundant landslide deposits
jlb Scattered landslide deposits
clc LOAMY COLLUVIUM WITH ERRATICS
cle CALCAREOUS SHALE-CHIP LOAMY COLLUVIUM
clf ACID SHALE-CHIP LOAMY COLLUVIUM
clh GRANITIC- TO DIORITIC-CLAST LOAMY COLLUVIUM
cca SHALE-CHIP LOAMY COLLUVIUM
ccb CARBONATE-CLAST LOAMY COLLUVIUM
ccc STONY SILTY CLAYEY COLLUVIUM
cch SHALE-CHIP CLAYEY LOAM COLLUVIUM WITH QUARTZITE-CLAST MANTLE

WISCONSIN

lca LAKE CLAY AND SILT
lla SLACKWATER LAKE CLAY, SILT, AND SAND
gg OUTWASH SAND AND GRAVEL
kg ICE-CONTACT SAND AND GRAVEL
LOAMY TILL
tl Ground moraine
tl End moraine
LOAMY TILL
tld Ground moraine
tld Stagnation moraine
tld End moraine
LOAMY TILL
tlg Ground moraine
tlg Stagnation moraine
tlg End moraine

LOAMY TILL

tlh Ground moraine

tlh End moraine

ILLINOIAN

lci LAKE CLAY AND SILT

llb SLACKWATER LAKE SILT AND SAND

ggi OUTWASH SAND AND GRAVEL

kgi ICE-CONTACT SAND AND GRAVEL

LOAMY TILL

tli Ground moraine

tli Attenuated drift

PRE-WISCONSIN

agn ALLUVIAL SAND AND GRAVEL

cci DEEPLY WEATHERED FELSIC- AND MAFIC-BOULDER COLLUVIUM AND ALLUVIUM

EARLY PLEISTOCENE

llc LAKE AND SLACKWATER CLAY, SILT, AND SAND

QUATERNARY AND TERTIARY

zgc CLAYEY SANDY GRAVEL DECOMPOSITION RESIDUUM

zsn SANDY SHALY DECOMPOSITION RESIDUUM

zla LOAMY DECOMPOSITION RESIDUUM

zlb LOAMY DECOMPOSITION RESIDUUM

zlc RED SILTY SAND TO SILTY CLAY DECOMPOSITION RESIDUUM

zrb CHERTY CLAY SOLUTION RESIDUUM, SANDY CLAY DECOMPOSITION RESIDUUM, AND SILTY CLAY DECOMPOSITION RESIDUUM

rcc CHERTY CLAY SOLUTION RESIDUUM

rch CLAY LOAM SOLUTION RESIDUUM

rci LOAMY TO CLAYEY SOLUTION RESIDUUM

rcj RED CLAY SOLUTION RESIDUUM

sga SANDY CLAYEY SAPROLITIZED GRAVEL

sgb CLAYEY SAPROLITIZED GRAVEL

ssa SILTY TO CLAYEY SANDY SAPROLITE, ROCK TORS, AND JOINT-BLOCK CORE BOULDERS

ssb SILTY TO CLAYEY SANDY SAPROLITE

ssd SANDY CLAY SAPROLITE

sse QUARTZ-RICH SAPROLITE

sla CLAYEY SAPROLITE

slb MICACEOUS SAPROLITE

slc SILTY TO CLAYEY SAPROLITE

slf THIN SILTY CLAY SAPROLITE ON SERPENTINITE

slg CLAYEY SAPROLITE, ROCK TORS, AND JOINT-BLOCK CORE BOULDERS

scb RED CLAY TO SILTY CLAY SAPROLITE

LIST OF MAP UNITS

CONTACT—Dashed where inferred

MELTWATER CHANNEL

ESKER

DIRECTION OF ICE MOVEMENT INDICATED BY STRIATIONS

OUTER LIMIT OF GLACIAL ADVANCE—Dashed where inferred. Ticks on side of advance

B BURIED MORAINE BENEATH LOAMY TILL (**tld**)

SAND AND GRAVEL OF TEAYS FORMATION (EARLY PLEISTOCENE OR PLIOCENE)

f AREAS OF OPEN-PIT COAL MINES AND SPOIL PILES

LOCATION OF IMPORTANT STRATIGRAPHIC SECTION

1 Clear Creek section, Ohio—Stratigraphic sequence, from oldest to youngest: silt and sand; gravel and pre-Illinoian till; "Yarmouth(?)" paleosol; pre-Illinoian or pre-Illinoian "pre-Rainsboro" till; gravel; Illinoian Rainsboro Till; sand and gravel; Rainsboro Till (Rosengreen, 1974)

2 Fall Creek section, Ohio—Stratigraphic sequence, from oldest to youngest: Illinoian Rainsboro Till; silt; "Sangamon" paleosol; late Wisconsin Boston Till (wood in till, 20,910± 240 BP, ISGS-44); rubble and gravel with weathered profile; late Wisconsin Caesar Till (Rosengreen, 1974)

3 Blinco Branch section, Ohio—Type section for Boston Till. Stratigraphic sequence, from oldest to youngest: Illinoian Rainsboro Till (wood in till, greater than 37,770 BP, ISGS-59); gravel and sand; "Sangamon" paleosol; late Wisconsin Boston Till; loess (Rosengreen, 1974)

4 Rainsboro section, Ohio—Stratigraphic sequence, from oldest to youngest: pre-Illinoian till or Illinoian Rainsboro Till; silt; gravel; Rainsboro Till; gravel; Rainsboro Till; sand; Illinoian Rainsboro(?) Till; gravel and sand; loess (Rosengreen, 1974)

DESCRIPTION OF MAP UNITS

HOLOCENE AND LATE WISCONSIN

agg ALLUVIAL SANDY GRAVEL—White, light-gray to dark-brown, poorly sorted, sandy pebble-to-boulder sized gravel; grades upward into sandy to silty clay; locally contains lenses of angular, moderately to well-sorted micaceous sand. Gravel consists predominantly of quartz and quartzite but, in places, includes some granitic crystalline rock or limestone. Underlies flood plains, alluvial fans, and low terraces. Thickness 3-10 m

al ALLUVIUM—Yellowish-brown, brown, reddish-brown, or gray silt, sand, and gravel. Calcareous to noncalcareous; stratified; moderately to well sorted; texture variable. Upper part mostly silt, fine sand, and minor lenses of clay and organic matter, lower part mostly sand and rounded gravel; locally cobble or boulder gravel. Clasts chiefly sandstone and shale; some platy limestone locally. North of Ohio River, includes clasts of crystalline rocks, and massive limestone and dolomite derived from glacial deposits. Underlies flood plains, low stream terraces, and alluvial fans. In places overlain by unmapped peat or swamp deposits. Mapped areas locally include small deposits of till, outwash, or ice-contact sand and gravel (**gg**, **kg**), and glaciolacustrine clay and silt (**lca**) as well as some old upland gravel. Along Ohio River includes late Wisconsin outwash sand and gravel (**gg**) that underlies a sequence of discontinuous low, middle, and high terrace remnants which are too narrow to show at map scale. Thickness commonly 1-4 m; rarely more than 10 m

HOLOCENE AND WISCONSIN

cba GRANITIC-BOULDER COLLUVIUM[1]—Pale- to dark-brown, yellowish-red, or grayish-yellow, poorly sorted, silty, sandy loam to sandy clay. Angular clasts and round to subround cobble- to boulder-size joint-block core stones of partly weathered feldspathic crystalline rocks comprise 15-60 percent of deposit. Mantles steep slopes; includes creep, mudflow, landslide, and possibly solifluction deposits. Mapped areas include some rock outcrops, small areas of saprolite, and bouldery alluvial-fan deposits. Overlies saprolite locally, especially at the base of slopes. Thickness ranges from about 2 m on upper slopes to as much as 10 m at the base of slopes

cbb QUARTZITE-BLOCK LOAMY COLLUVIUM[1]—Gray to yellowish-brown or pale-reddish-brown, unsorted sand, silt, and clay. Contains angular to subround blocks and cobble-size detritus of hard sandstone as large as 1 m in diameter. Mantles slopes and crests of quartzitic sandstone ridges. On steep slopes, commonly forms talus and debris cones that overlie weathered shale-chip loamy colluvium (**cca**) developed in shale bedrock. On gently sloping uplands, overlies thin decomposition residuum on quartzitic sandstone. Above 600 m elevation, commonly forms block fields and block streams. Mapped areas contain numerous rock outcrops. Thickness 1-10 m

cbc CARBONATE-BOULDER CLAYEY COLLUVIUM[1]—Yellowish-brown to reddish-brown, locally brick red, unsorted, sandy to silty clay. Contains abundant angular to subangular or rounded cobble- to boulder-size clasts of limestone or dolomite. Mantles slopes of knobs and ridges underlain by carbonate rock. Thickness 2-5 m

cbd MAFIC-BOULDER LOAMY COLLUVIUM[1]—Yellowish- to dark-brown, unsorted silt loam; contains angular clasts and round to subround joint-block core boulders of mafic volcanic rock, commonly partly weathered. Locally overlies saprolite. Mantles slopes of knobs and ridges underlain by mafic rock, which locally projects as tors and pinnacles on summit and crest areas. Thickness 1-2 m

csa SANDY SILTY COLLUVIUM[1]—Yellowish-brown to brownish-gray sandy silt and silty sand, mixed with loess; contains angular to subround clasts of sandstone, siltstone, and shale. Mantled by about 1 m of younger loess. Mapped areas include bedrock outcrops and numerous areas of strip-coal-mine waste, some mapped separately (**f**). Thickness generally 1-2 m

csb COLLUVIUM[1] WITH HUGE BLOCKS—Light-gray to pale-yellowish-brown, poorly sorted, sandy, silty clay loam; contains chips of siltstone and shale, and angular to slabby blocks of sandstone, some as much as 10-15 m in diameter. Occurs on steep slopes at west margins of the broad flat to gently sloping uplands west of the Appalachian Mountains in Tennessee (Cumberland Plateau). Mapped areas include some cherty clayey residuum (**rcc**). Thickness commonly 3-15 m, but may be as much as 30 m

csh SANDY SHALY COLLUVIUM[1]—Gray, bluish-gray, or greenish-gray, unsorted sandy loam, locally clayey or silty; contains abundant chips of shale, particles of clay, and small fragments of sandstone. No boulders. Sand mostly quartz. Present only locally on northwest slopes of foothills in Tennessee. Thickness generally less than 15 m

cl LOAMY COLLUVIUM[1,]—Pale-yellow, yellowish-brown, or brown to gray or black sandy silt or clay loam mixture; noncalcareous to weakly calcareous; locally very calcareous where derived from limestone. Clasts chiefly sandstone, quartzitic sandstone, siltstone, and shale; limestone or conglomerate clasts common locally. On gently sloping upland surfaces, commonly includes solifluction deposits and locally includes some clayey solution residuum developed on limestone. Thickness 1-2 m on gentle slopes; 2-4 m at foot of slopes, and locally more than 10 m at toes of colluvial fans and aprons

cla SANDSTONE- AND SHALE-CLAST LOAMY COLLUVIUM[1]—Light-gray, brownish-gray, or yellowish-gray, sandy loam to clay loam; poorly sorted; unstratified. Contains angular to subround, or slabby, pebble- to boulder-size fragments of sandstone, conglomeratic sandstone, and chips of shale. On steep slopes, clayey material tends to be unstable, and commonly is associated with soil creep and landslides. Landslide deposits are abundant to scattered, but have not been mapped in detail; they underlie 21-50 percent of the land surface. Mapped areas of colluvium include rock exposures on steep slopes and minor alluvium along streams. Thickness generally 2-7 m; as much as 25 m at foot of some steep slopes

LANDSLIDE DEPOSITS AND LOAMY COLLUVIUM[1]—Landslide deposits are developed in areas of colluvium (**cla**), chiefly as the product of earth flows and slumps. Both the colluvium and the underlying bedrock sandstone or shale commonly displaced. Earthflow deposits are pale-yellow, yellowish-brown, brown, to gray or black heterogeneous mixtures of sand, silt, and clay in variable proportions and include scattered sparse to abundant, small to large clasts of sandstone, siltstone, shale, and, locally, platy limestone or coal. Slump deposits are masses of colluvium and underlying bedrock that have rotated and slid downslope as a unit; original textures and bedding of both colluvium and bedrock commonly retained. Mapped areas may include some landslide deposits of pre-Wisconsin age. Thickness of earthflow deposit generally less than 5 m;, thickness of slump deposit generally 2-30 m; thickness of colluvium (**cla**) between landslide deposits 1-2 m on gentle slopes, 2-4 m on foot slopes, and more than 10 m at base of colluvial fans and aprons

jla Area characterized by abundant landslide deposits (10-50 percent of mapped area)—Mapped only in north-central part of quadrangle

jlb Area characterized by scattered landslide deposits (2-10 percent of mapped area)—Mapped only in

north-central part of quadrangle

clc LOAMY COLLUVIUM[1] WITH ERRATICS—Similar to the loamy colluvium (**cl**), but contains scattered erratics. Mapped areas include small deposits of older intensely weathered loamy till of Illinoian age. Till is orange red to yellowish brown, brown, or brownish gray, and leached throughout. Joint surfaces are intensely stained with manganese and iron oxide, and characterized by thick clay skins. Till is sparsely pebbly to moderately stony. Clasts in the till are mostly locally derived shale and sandstone, but erratic lag boulders and cobbles of limestone, granite, granitic gneiss, and quartzite are common on its surface. Colluvium and Illinoian till are mantled with loess 1-2 m thick. Thickness of till mostly less than 2 m; thickness of colluvium 1-4 m

cle CALCAREOUS SHALE-CHIP LOAMY COLLUVIUM[1]—Yellowish-brown silt clay loam characterized by abundant chips of calcareous shale and thin-bedded shaly limestone. Matrix moderately plastic. Underlies gently rolling terrain. The northward extension of unit **cle** in the Chesapeake Bay quadrangle, adjacent to the east, was inadvertently designated acid shale-chip loamy colluvium (**clf**), but properly is calcareous shale-chip loamy colluvium (**cle**). It is derived from the calcareous Martinsburg Shale. Thickness 0.3-1 m

clf ACID SHALE-CHIP LOAMY COLLUVIUM[1]—Dark- gray to grayish-brown, yellowish-brown or reddish-yellow, sandy to silty clay loam; contains slabs and chips of noncalcareous shale and thin-bedded sandstone. Commonly grades into underlying bedrock through a creep zone in which shale and sandstone beds are bent downslope and disintegrated. Upper part may be locally mantled with material derived from adjacent rock uplands. Thickness 1.5-3 m

clh GRANITIC- TO DIORITIC-CLAST LOAMY COLLUVIUM[1]—Brown to dark-brown, bouldery, sandy clay loam. Clasts angular to subangular; chiefly granite, granodiorite, and quartz-diorite igneous and metamorphic rocks. Mapped areas include thin residuum on gently sloping uplands and many rock outcrops. Thickness 0.5-2 m; thicker at base of slopes

cca SHALE-CHIP LOAMY COLLUVIUM[1]—Greenish-gray to pale-yellowish-gray, silty clay loam; locally blocks and chips of shale and siltstone in a matrix of disintegrated shale. Formed on steeply dissected terrain; slumped masses and creep structures common. Thickness generally 3-6 m; locally as much as 12 m

ccb CARBONATE-CLAST LOAMY COLLUVIUM[1]—Yellowish-brown to orange silty clay, containing scattered to numerous cobble- to boulder-size, subangular to subround limestone slabs and, locally, shale chips. Local karst features where overlies limestone. Mapped areas include local alluvium and bedrock exposures along streams. Thickness 1-2.5 m

ccc STONY SILTY CLAYEY COLLUVIUM[1]—Yellowish-, orange-, or reddish-brown, calcareous, silty clay loam. Contains abundant angular to subangular pebble- to boulder-size fragments of limestone and angular chips to slabs of shale; also contains scattered subangular to well-rounded erratics of limestone, dolomite, chert, quartz, and Precambrian igneous and metamorphic rocks, a colluvial lag from a former mantle of Illinoian till now extensively eroded and preserved only locally in undissected areas. Upper part includes admixed loess; loess generally less than 1 m thick locally mantles the colluvium on uplands and undissected gentle to moderate slopes. Mapped areas include numerous bedrock outcrops, especially on steep slopes. A few isolated sinkholes where limestone is at the surface. Thickness as much as 2 m

cch SHALE-CHIP CLAYEY LOAM COLLUVIUM[1] WITH QUARTZITE-CLAST MANTLE—Yellowish-brown to red clay loam, containing weathered chips of shale and rotted clasts of limestone. Uppermost part includes abundant angular to rounded fragments of sandstone and quartzite that form a resistant mantle on the shale-chip colluvium. The underlying shale or carbonate rock commonly are weathered to depths of 30 m or more; sinks are locally developed in the carbonate rocks. Thickness of colluvium 1-2 m; locally thicker

WISCONSIN

lca LAKE CLAY AND SILT-—Yellowish-brown, reddish-brown, brown to gray or bluish-gray, calcareous clay and silt. Well bedded to massive, commonly laminated, in places varved; locally interbedded with sand and fine gravel. Ice-rafted pebbles, cobbles, and boulders common in lower part. Commonly cut by gullies where adjacent to major streams. Chiefly on extensive flat, low-lying areas formerly occupied by glacial lakes, but also in small separate lake basins. Mapped areas include some slackwater lake clay, silt, and sand (**lla**), outwash and ice-contact sand and gravel (**gg**, **kg**), and alluvium (**al**). Commonly

overlain by unmapped alluvium, peat, or swamp deposits. Thickness generally 1-3 m; locally more than 10 m

lla SLACKWATER LAKE CLAY, SILT, AND SAND—Pale-yellow, yellowish-brown, and brown to bluish-gray or gray, calcareous to noncalcareous clay, silt, and fine sand. In some valleys, chiefly silt with local interbeds of plastic clay or fine sand; in other valleys, chiefly fine sand with interbeds of silt; locally includes laminated beds of clay and silt, and in places contains mollusc shells. Mapped areas include alluvium in upper parts of valleys and on valley walls, and narrow ribbons of alluvium inset into terraced slackwater lake deposits in lower parts of valleys. Commonly grades into or interfingers with alluvium (**al**) in upper parts of valleys and with outwash sand and gravel (**gg**) in lower parts. Materials were deposited in slackwater lakes in valleys tributary to major outwash valley fills. Thickness generally 1-4 m; locally more than 6 m

gg OUTWASH SAND AND GRAVEL—Gray, pale-yellowish-brown, brown, or dark-reddish-brown sand and gravel. Commonly calcareous medium sand, gravel, cobbles, and boulders in glaciated areas; weakly calcareous to noncalcareous sand, fine gravel, and scattered cobbles in unglaciated terrain. Local interbedded lenses of silt and clay. Well-stratified horizontal beds of well-sorted sand and gravel having local channel-and-fill structures and poorly sorted, irregular beds of cobble or boulder gravel. Alternating gravel and silt beds continuous for great distances in some valley train deposits. Gravel deposits locally cemented by calcium carbonate. Clasts generally rounded; chiefly sandstone, dolomite, limestone, siltstone, sandy shale, together with erratic igneous and metamorphic rocks in glaciated Ohio; chiefly sandstone, cherty sandstone, siltstone, and sandy shale in unglaciated terrain. Underlies terrace remnants, valley trains, outwash plains, delta topset beds, outwash fans and aprons, and fills of abandoned meltwater channels. Surfaces of deposit generally smooth, but locally pitted by ice-block depressions. Mapped areas include local ice-contact sand and gravel (**kg**), lake clay and silt (**lca**), and alluvium (**al**). Locally overlain by eolian sand and silt, alluvium, peat, or swamp deposits. Thickness 1-15 m; locally more than 30 m

kg ICE-CONTACT SAND AND GRAVEL—Yellowish-brown to gray, generally calcareous, sand and gravel. Texture changes abruptly, laterally and vertically, from fine sand and silt to cobble and boulder gravel. In places, contains lenses or masses of clay, silt, flow till, or till. Sorting variable; irregularly to well bedded; faults, folds, and slump or collapse structures common; locally cemented with calcium carbonate. Clasts rounded to subangular, clasts mostly similar to those of outwash sand and gravel (**gg**) in same area. Larger clasts chiefly dolomite, limestone, and erratic igneous and metamorphic rocks. Forms kames, kame terraces, kame deltas, interlobate moraines, and ice-fracture fillings. Ice-block depressions common. Mapped areas include small deposits of outwash sand and gravel (**gg**), lake clay and silt (**lca**), alluvium (**al**), and till. Locally overlain by thin loess, alluvium, peat, or swamp deposits. Thickness generally 2-30 m; locally more than 60 m

LOAMY TILL (part of Darby Till in Ohio)—Yellowish-brown to olive-gray, bluish-gray, gray, or dark-gray, calcareous loam and silt loam; compact. Nonsorted to poorly sorted. Typically has horizontal platy structure, breaking into irregular pieces 1.5-4 cm thick. Generally moderately pebbly to pebbly; locally cobbly or bouldery. Gravel lenses or interbeds common. Pebbles, cobbles, and small boulders chiefly dolomite and limestone; large boulders chiefly erratic crystalline igneous and metamorphic rocks and quartzite. The till locally is overlain by unmapped alluvium, peat, and swamp deposits. Mapped areas locally include bedrock outcrops and small deposits of outwash and ice-contact sand and gravel (**gg**, **kg**), lake clay and silt (**lca**), and alluvium (**al**)

tl Ground moraine—Thickness generally 1-3 m; rarely 6 m

tl End moraine—Forms broad, low ridges or complex areas of narrow, concentric or anastomosing ridges having knob-and-kettle topography and shallow undrained depressions. Thickness generally 8-30 m

LOAMY TILL (Boston and Caesar Tills in Ohio)—Yellowish-brown, brown, dark-brown, or grayish-brown to gray, generally non-calcareous silt loam and sandy loam; nonsorted; compact. Contains sparse pebbles, and a few cobbles; boulders uncommon. Well-defined "boulder belts" on surface locally. Clasts chiefly dolomite and limestone; some sandstone, shale, and erratic igneous and metamorphic rocks. Mapped areas include small deposits of outwash and ice-contact sand and gravel (**gg**, **kg**), lake clay and silt (**lca**), alluvium (**al**), and bedrock outcrops. Locally, till is overlain by alluvium, peat, or swamp deposits

tld Ground moraine—Thickness generally less than 1.5 m on uplands, 3-6 m in valleys

tld Stagnation moraine—Broad, irregular areas of hummocky collapsed topography, typically with ice-disintegration features and ice-block depressions. Thickness generally 3-10 m

tld End moraine—Low ridges, generally with subdued constructional topography. Thickness generally 5-10 m; locally more than 15 m

LOAMY TILL—Pale-yellow, yellowish-brown, brown, or dark-brown to light-gray or bluish-gray, calcareous loam, silt loam, clay loam, and silty clay loam; nonsorted to poorly sorted. Typically has irregular horizontal platy structure and is well jointed. Calcium carbonate joint fillings. Till is sparingly pebbly to pebbly; cobbles and boulders locally common, particularly in end moraine. Pebbles, cobbles, and small boulders chiefly dolomite, limestone, sandstone, and siltstone; large boulders chiefly erratic crystalline igneous and metamorphic rocks and quartzite. Mapped areas locally include small deposits of outwash and ice-contact sand and gravel (gg, kg), lake clay and silt (lca), alluvium (al), and bedrock outcrops. Till locally overlain by loess 15-23 cm thick or by alluvium, peat, or swamp deposits

tlg Ground moraine—Thickness generally 1-3 m, rarely 6 m

tlg Stagnation moraine—Broad, irregular areas of hummocky collapsed topography, locally having ice-disintegration features and ice-block depressions. Thickness generally 3-10 m

tlg End moraine—Broad, low ridges or complex areas of narrow, concentric or anastomozing ridges characterized by irregular hummocks and shallow undrained depressions. Thickness generally 4-15 m

LOAMY TILL—Yellowish-brown, reddish-brown, grayish-brown, or bluish-gray, locally mottled, calcareous loam, silt loam, and clay loam; in places sandy loam or loamy sand. Nonsorted to poorly sorted; loose to compact, friable. Blocky structure. Calcium carbonate joint fillings. Moderately pebbly; cobbles and boulders locally abundant. Clasts chiefly limestone and dolomite; some shale, sandstone, chert, and erratics of granite, gneiss, and quartzite. Limestone clasts less abundant, chert clasts more abundant, and matrix more sandy and less clayey than in unit **tlg**. Mapped areas include bedrock outcrops and small deposits of outwash and alluvium. Commonly overlain by loess 0.2-0.4 m thick, rarely 0.9 m

tlh Ground moraine—Thickness commonly 2-3 m, rarely 6 m

tlh End moraine—Broad low ridges, narrow sharply defined ridges, or complex of concentric or anastomosing ridges characterized by irregular hummocks and shallow undrained depressions. Thickness 4-15 m

ILLINOIAN

lci LAKE CLAY AND SILT—Yellow, yellowish-brown, grayish-brown, or mottled yellow and grayish-brown to gray or bluish-gray silt and clay, locally with minor fine sand. Well bedded to massive; commonly laminated or varved. Locally underlain by gravel and sand. Commonly dissected by deep gullies. Underlies terrace remnants in valleys formerly blocked by Illinoian glacier. Mapped areas include small deposits of outwash and ice-contact sand and gravel (**ggi**, **kgi**) and alluvium (**al**). Locally overlain by 0.25-1.5 m of loess or colluvium. Thickness generally 2-10 m, locally 20 m

llb SLACKWATER LAKE SILT AND SAND—Pale-yellow, yellowish-brown, or dark-brown to gray, weakly calcareous or noncalcareous silt and fine sand, locally with interbeds of plastic clay. Intensely weathered and dissected. Underlies terrace remnants in valleys tributary to major outwash valley fills. May include some deposits of early Wisconsin age. Mapped areas include small inset deposits of alluvium (**al**). Thickness generally 1-4 m, locally more than 6 m

ggi OUTWASH SAND AND GRAVEL—Pale-yellow to yellowish-brown, red to reddish-brown, or brown to dark-grayish-brown, coarse sand and gravel. Calcareous or weakly calcareous in glaciated areas; weakly calcareous to noncalcareous in unglaciated terrain. Horizontally bedded; intensely weathered; gravel locally cemented by secondary calcium carbonate. Clasts rounded; average maximum size decreases downstream; in unglaciated terrain, most are less than 2 cm, rarely more than 8 cm, in long dimension. Clasts chiefly dolomite, limestone, sandstone, and igneous and metamorphic rocks. Underlies outwash plains on uplands and terrace remnants along valley walls. Mapped areas include peat or swamp deposits in depressions, and small deposits of late Wisconsin outwash sand and gravel (**gg**) and alluvium (**al**). Commonly overlain by loess or sand 0.5-3 m thick, within which is a buried Sangamon paleosol. Thickness generally 3-6 m, locally more than 30 m

kgi ICE-CONTACT SAND AND GRAVEL—Yellow, red, reddish-brown, or brown to brownish-gray calcareous sand and gravel. Textures vary abruptly, laterally and vertically; range from fine sand and rare pebbles to cobble gravel with lenses of flow till. Generally well stratified; moderately to poorly sorted. Locally characterized by faults, folds, and slump or collapse structures. Sand commonly crossbedded. Gravel commonly cemented by secondary calcium carbonate. Clasts rounded to subangular, chiefly dolomite, limestone, sandstone, and shale. Constructional surface marked by

subdued hummocks; ice-block depressions generally filled with alluvium, peat, or swamp deposits. Underlies kames and dissected kame terrace remnants. Mapped areas include small deposits of outwash sand and gravel (**ggi**), till (**tli**), and alluvium (**al**). Locally overlain by as much as 3 m of loess, alluvium, peat, or swamp deposits. Thickness generally 2-20 m, locally more than 30 m

LOAMY TILL (Rainsboro Till in Ohio)—Yellowish-brown to dark-gray, calcareous loam, silt loam, and minor sandy loam; pebbly to cobbly, locally stony. Large boulders uncommon. Nonsorted to very poorly sorted. Tough and compact; locally cemented by secondary calcium carbonate. Oxidized till typically has horizontal platy structure. Intensely weathered; generally leached throughout where less than 3 m thick. Thick clay skins and intense iron oxide and manganese oxide stains on joint surfaces. Clasts chiefly dolomite and limestone with minor sandstone, shale, and erratic igneous and metamorphic rocks. Ghost outlines of completely decomposed dolomite and limestone clasts and rotted granite pebbles common in leached till. Till is mostly thin and discontinuous; thick till chiefly on lower slopes beneath younger colluvium and solifluction deposits. Subdued rolling constructional surface is locally extensively dissected. Mapped areas include small solifluction and colluvial deposits, bedrock outcrops, outwash and ice-contact deposits, lake clay and silt, slackwater lake clay, silt, and sand (**lla**, **llb**), and alluvium (**al**). Till commonly overlain by 0.5-3 m of loess of Illinoian and Wisconsin age that locally includes a humic gley paleosol. Till thickness generally less than 10 m

tli Ground moraine

tli Attenuated drift—Discontinuous deposits of loamy till separated by areas of colluvium containing scattered erratics. Some areas of till are hummocky; others are merely thin veneers. Textures are more sandy than in ground moraine. Thickness generally less than 3 m

PRE-WISCONSIN

agn ALLUVIAL SAND AND GRAVEL—Yellowish- to reddish-brown or gray sand, gravel, cobbles, and boulders with lenses of silt and clay. Clasts mostly sandstone and quartzite. Underlies high terraces along Potomac River in Pennsylvania. Considered to be of possible Illinoian age. Thickness variable but commonly greater than 5 m

cci DEEPLY WEATHERED FELSIC- AND MAFIC-BOULDER COLLUVIUM[1] AND ALLUVIUM—Yellowish-red to dark-reddish-brown, silty clay loam; kaolinitic. Contains scattered angular to rounded pebbles, cobbles, and boulders of felsic and mafic rocks; stone lines and layers of saprolitized gravel common. Forms deeply dissected colluvial aprons or alluvial fans of possible Illinoian age. Overlie saprolite, which is exposed at surface between tongues or lobes of the colluvium or alluvium and commonly is thickest in those areas. Thickness of colluvium and alluvium 1-10 m; thickest on lower slopes

EARLY PLEISTOCENE

llc LAKE AND SLACKWATER CLAY, SILT, AND SAND (Minford Silt in Ohio and West Virginia)—Yellowish-brown, pinkish-brown, reddish-brown, dark-reddish-brown, light-greenish-gray, grayish-brown, or brownish-gray to blue, bluish-gray, or light-gray, generally noncalcareous clay and silt with some sand. Predominantly well laminated, moderately plastic, fine silt and clay overlying horizontally bedded alluvial fine sand and silt. Some small chert and quartz pebbles, secondary gypsum crystals, and ferruginous concretions in lower part. Slackwater deposits occur in valleys tributary to the ancestral Teays Valley; consist of fine sand, locally interbedded with clay and silt. Lake sediments have reversed magnetic polarity indicating an age older than the Brunhes Normal Polarity Chron. Occur as terrace remnants, scattered upland deposits, and extensive fills in abandoned ancestral valley of Teays River and other ancestral valleys tributary to the Ohio River. Generally dissected by deep gullies. Shown only locally in West Virginia; commonly overlain by alluvium. Mapped areas include some unmapped inset deposits of outwash (**gg**, **ggi**), lake clay and silt (**lca**), and alluvium (**al**). Commonly overlain by 1-3 m of loess or colluvium. Overlies sand and gravel of the Teays Formation (early Pleistocene or Pliocene); shown by symbol on map. M.R. Campbell (1900, 1901) named the formation after Teays P.O. on the Chesapeake and Ohio Railroad in the ancestral Teays Valley, in West Virginia, but the formation name was misspelled Teay in publication. (See also discussion by Rhodehamel and Carlston, 1963.) Thickness generally 5-30 m

QUATERNARY AND TERTIARY

zgc CLAYEY SANDY GRAVEL DECOMPOSITION RESIDUUM[2]—Yellowish-brown to dark-red pebbles,

gravel, and cobbles in a sandy to silty clay loam matrix. Underlies a sequence of high terraces and alluvial fans that are increasingly dissected with increasing height above stream. Clasts mostly quartzite and sandstone, deeply stained. Highest terrace surfaces characterized by lag boulder accumulations. Lower terrace deposits are increasingly fine grained upward. Sinkholes common in deposits overlying limestone. Thickness 3-10 m; locally as much as 80 m at foot of mountains

zsn SANDY SHALY DECOMPOSITION RESIDUUM[2]—Grayish-, yellowish-, or reddish-brown sandy loam to clay loam. Lower part contains shale chips or sandstone fragments. Mapped areas include some thin stony loam colluvium, especially on steep slopes, and bedrock outcrops, especially along ridge crests. Thickness commonly less than 3 m, but locally as much as 6 m

zla LOAMY DECOMPOSITION RESIDUUM[2]—Pale-yellow, yellowish-brown, brown, or dark-brown, noncalcareous to weakly calcareous sandy loam, loam, and silt loam on ridge crests. Derived from sandstone and, to a lesser extent, from shale bedrock. Mapped areas include small deposits of nonsorted, quartzite-block loamy colluvium (**cbb**) as thick as 3-5 m, and extensive bedrock outcrops. Rubble formed by frost shattering of sandstone and quartzitic sandstone; bouldery where derived from quartzitic sandstone; channery where derived from sandstone. Thickness of residuum 1-2 m

zlb LOAMY DECOMPOSITION RESIDUUM[2]—Yellowish-brown, reddish-brown or purple, noncalcareous loam, silt loam, and clay loam containing clasts of acid shale and sandstone. Underlies flat or gentle slopes. Mapped areas include some quartzite-block loamy colluvium (**cbb**) and scattered bedrock outcrops on steeper slopes. Thickness less than 1 m

zlc RED SILTY SAND TO SILTY CLAY DECOMPOSITION RESIDUUM[2]—Red, reddish-gray, reddish-brown, or purplish-red silty sandy loam to silty clay loam. Locally includes rounded pebbles and cobbles, chiefly quartz. Lower part contains chips and larger fragments of red shale or red sandstone and grades down into red sandstone or shale bedrock. Deposit contains crumbly clasts of diorite along lineaments aligned over underlying diorite dikes. Mapped areas locally include thin overlying colluvium or alluvium derived from adjacent uplands. Thickness 0.5-3 m

zrb CHERTY CLAY SOLUTION RESIDUUM[3], SANDY CLAY DECOMPOSITION RESIDUUM[2], AND SILTY CLAY DECOMPOSITION RESIDUUM[2]—Unit comprises three residua that cannot be shown separately at scale of map. Cherty clay solution residuum is yellowish-brown to dark-reddish-brown; it contains subangular slabs of limestone in lower part and is developed on limestone characterized by sink holes and other karst features. Sandy clay decomposition residuum is yellowish-brown, porous and ferruginous or calcareous; it includes slabby sandstone fragments and is developed on sandstone. Silty clay decomposition residuum is pale-yellowish-brown to grayish-brown clay or silty clay that contains shale chips; it is characterized by creep structures on slopes and is developed on shale. Mapped areas include bedrock outcrops and some locally derived colluvium, as thick as 8 m, on steep slopes. Thickness generally less than 5 m, but locally as much as 10 m

rcc CHERTY CLAY SOLUTION RESIDUUM[3]—Reddish-yellow to yellowish-brown, or pale-brown to light-reddish-brown, commonly mottled, sandy or silty clay; plastic, locally cherty. Chert is gray, yellowish brown, or yellowish orange, locally light green or black, and is present in highly variable abundance as angular to subround chunks or boulders. Lower part of deposit contains solution-surfaced slabs of limestone; clay extends along fractures into underlying limestone bedrock. Contact with underlying bedrock is abrupt and pinnacled. Underlies valleys between mountain ridges; sinks and karst features common. Mapped areas include colluvium, derived from adjacent sandstone ridges, and small bedrock outcrops. Thickness highly variable; less than 2 m to as much as 25 m

rch CLAY LOAM SOLUTION RESIDUUM[3]—Reddish-brown clay to clay loam; contains subangular slabs of solution-surfaced limestone in places. Contact with bedrock irregular, locally pinnacled. Sinks and other karst features scattered to abundant. Mapped areas include sparse bedrock outcrops. Thickness 1-7 m

rci LOAMY TO CLAYEY SOLUTION RESIDUUM[3]—Pale-yellow, yellowish-brown, yellowish-red, and reddish-brown, noncalcareous to weakly calcareous tough to plastic silt loam, silty clay loam, clay loam, silty clay, and clay. On siliceous carbonate bedrock, contains chert fragments; on interbedded carbonate and clastic rock, contains fragments of chert, shale, and sandstone. Bedrock outcrops and sinkholes are common. Thickness commonly less than 1 m

rcj RED CLAY SOLUTION RESIDUUM[3]—Dark-red to reddish-brown clay, clay loam, or silty clay loam; includes some zones of sandy clay. Lower part commonly contains smooth limestone slabs or

boulders and is in abrupt solution contact with underlying limestone bedrock, into which it extends along fractures. Relatively few sinkholes. Mapped areas include local bedrock exposures and large amounts of colluvium reworked from the residuum. Thickness as much as 25 m; highly variable

sga SANDY CLAYEY SAPROLITIZED GRAVEL[4]—Dark-red to reddish-brown sandy or loamy clay. Contains scattered stained pebbles of quartz and ghost pebbles and cobbles of other rock types altered to clay. Underlies dissected flat ridgetops whose distribution suggests that deposits may be remnants of a former Tertiary alluvial terrace system. Exposed at numerous localities too small to map, particularly along meander loops of rivers. Thickness 1-10 m

sgb CLAYEY SAPROLITIZED GRAVEL[4]—Dark-red to reddish-brown sandy or loamy clay. Contains scattered stained pebbles of quartz and ghost pebbles and cobbles of other rock types partly altered to clay. Underlies dissected sloping ridgetops whose distribution suggests that deposits may be remnants of Tertiary alluvial fans. Locally, saprolite extends through the gravel into underlying bedrock where it changes in character depending of rock type and is of variable thickness. The saprolitized gravel ranges in thickness from 2 m to 6 m

ssa SILTY TO CLAYEY SANDY SAPROLITE [4], ROCK TORS, AND JOINT-BLOCK CORE BOULDERS—Dark-red, reddish-brown reddish-yellow, or white, slightly micaceous, sandy clay to silty or clayey medium sand. Developed in massive granite, granite gneiss, or similar massive felsic igneous or metamorphic rocks. Clay is mostly kaolinite in upper part, but gibbsite may equal or exceed kaolinite in lower part. Feldspar is the predominant weatherable mineral in lower part; muscovite or its pseudomorphs predominate in upper part. Saprolite is permeable and strongly acidic; it grades into bedrock through a zone of partly decomposed joint-block core boulders. Abundant joint-block core boulders are associated with bedrock knobs and tors in mountain and hill areas. Pavement outcrops, as much as 10 hectares, are present in some upland areas. Saprolite is present locally with both. Mapped areas of saprolite commonly include locally derived colluvium containing boulders, especially at base of steep slopes. Fragments of vein quartz are locally abundant in the colluvium. Thickness of saprolite commonly less than 2 m

ssb SILTY TO CLAYEY SANDY SAPROLITE[4]—Dark-red, reddish brown, reddish-yellow, or white, silty sand to slightly clayey sand. Developed in gneissic granite, felsic schist interlayered with gneiss, foliated granitic rocks, and felsic metavolcanic rocks. In upper part, clay predominantly kaolinite, but in lower part, gibbsite may equal or exceed kaolinite. Illite and vermiculite are minor components. Partly weathered feldspar is predominant weatherable mineral in lower part; muscovite or its pseudomorphs predominate in upper part. Permeable and strongly acidic. Grades into underlying bedrock through an irregular zone of partly weathered slabby fragments in matrix of micaceous silt to clayey sand. Mapped areas include bedrock exposures, commonly as micaceous rock ribs, and slabby to bouldery colluvium, especially at base of steep slopes. Colluvium commonly contains numerous vein-quartz fragments. Thickness commonly less than 2 m, but may exceed 6 m on well-drained uplands

ssd SANDY CLAY SAPROLITE[4]—Red, yellowish-red, dark-brown, yellow, light-gray, or greenish-gray slightly clayey sand to sandy clay. Developed in metamorphic or igneous rocks of intermediate composition. Clays are mixed smectite and kaolinite where saprolite developed on more mafic rocks; they have moderate shrink and swell potential. On more felsic source rocks, clay is predominantly kaolinite. Sand fraction is principally feldspar and quartz, and includes biotite, hornblende, and vermiculite in more mafic varieties. Soft rock fragments or ghosts of fragments may be abundant. Mapped areas include locally derived colluvium and bedrock exposures. Thickness commonly less than 5 m,

sse QUARTZ-RICH SAPROLITE[4]—Gray, pale-yellow, pale-brown, or pale-yellowish-red, locally micaceous, slightly clayey to silty, very sandy saprolite. Clay is predominantly kaolinite. Angular or irregularly shaped, partly disintegrated chunks or slabs of rock common in lower part. Saprolite is developed in quartzite, quartz-rich metasedimentary rocks, or quartz-mica schist. Mapped areas include rock outcrops on steep slopes or ridge crests, and locally derived sandy, stony colluvium, especially at base of slopes. Thickness ranges from less than 0.5 m on steep slopes to about 3 m on gentle slopes

sla CLAYEY SAPROLITE[4]—Greenish-gray, pale-yellowish-orange, moderate-yellow, or dark-red, slightly micaceous to micaceous, clayey sand, sandy clay, or clayey silt. Developed in mafic metamorphic, mafic metavolcanic, and ultramafic rocks. Where rocks are massive to weakly gneissic, the saprolite commonly includes joint-block core stones ranging in size from boulder to pebble, and is characterized by a pinnacled bedrock base. Clay component is mixed smectite and kaolinite having low to high shrink and swell potential. Sand is chiefly calcic feldspar, biotite, vermiculite, hornblende, and minor quartz. Mapped area include small deposits of locally derived colluvium

commonly containing bedrock fragments, and widely scattered bedrock exposures. Thickness less than 1 m to as much as 15 m

slb MICACEOUS SAPROLITE[4]—Red, reddish-brown, dark-brown, yellowish-red, or gray, micaceous, clayey to slightly clayey sand to clayey sandy silt. Developed in felsic, micaceous schist. Clay is kaolinite, with lesser amounts of gibbsite. Mica mostly weathered to vermiculite and (or) kaolinite near ground surface. Shrink and swell potential generally low. Mapped areas include bedrock exposures and small deposits of locally derived colluvium containing rock fragments. Thickness less than 1 m to about 30 m

slc SILTY TO CLAYEY SAPROLITE[4]—Gray, greenish-gray, yellowish-brown, or red fine sandy silt to slightly clayey silt. Developed in phyllite, argillite, slate, and felsic metavolcanic rocks. Clasts of quartz and slabs and splinters of parent rock common in lower part. Clay is predominantly kaolinite but gibbsite present in places. Mapped areas include bedrock exposures on slopes and hill crests and locally derived colluvium, especially at base of slopes. Thickness ranges from less than 0.5 m on steep slopes to as much as 5 m on gentle lowland slopes

slf THIN SILTY CLAY SAPROLITE[4] ON SERPENTINITE—Pale-greenish-gray to pale-yellowish-brown silty clay. Contains small fragments and slabs of serpentinite. Extensive smooth pavement outcrops of serpentinite are common. Thickness of saprolite less than 1 m, commonly less than 0.5 m

slg CLAYEY SAPROLITE[4], ROCK TORS, AND JOINT-BLOCK CORE BOULDERS—Pale-yellowish-orange, orange-brown, or dark-red, sandy to silty clay. Developed on massive mafic rock, commonly diabase. Clay is mixed kaolinite and smectite; smectite particularly common in areas of poor drainage. Broad range of shrink and swell potential. Sand chiefly partly altered calcic feldspar. Angular pea-size grus present in places. Bedrock knobs or tors common and generally surrounded by saprolite containing abundant partly weathered joint-block core boulders. Mapped areas include small deposits of locally derived boulder colluvium, especially at base of steep slopes. Thickness of saprolite less than 2 m to more than 5 m

scb RED CLAY TO SILTY CLAY SAPROLITE[4]—Dark-red clay to silty clay; developed in metavolcanic greenstone. Clay chiefly kaolinitic. Mapped only in Virginia. Thickness 10-30 m

[1]COLLUVIUM is a general term applied for purposes of this map to material transported and deposited by mass-wasting processes.

[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.

[4]SAPROLITE is the product of extensive chemical weathering of crystalline rocks. The color of saprolite depends on the abundance of dark minerals in the parent rock and on the drainage. Bright reds and yellows are produced above the water table; grays, whitish grays, and greenish blues are produced below. Saprolites grade down through partly weathered rock into fresh parent rock.

The structure and texture of the bedrock are characteristically preserved in saprolite. However, in places, structureless saprolite may occur between structured material below and colluvium or modern soil above. Replication of bedrock features in saprolite results from isovolumetric chemical alteration of weatherable minerals. In weathering, the aluminosilicate minerals alter to clay minerals, density decreases by as much as 50 percent, and porosity increases greatly. Saprolite texture ranges from sandy to clayey depending upon the abundance of minerals that are resistant to weathering, such as quartz, in the parent rock. Quartz veins are commonly preserved in place in saprolite.

The clay mineralogy of saprolites depends on the kinds of rock-forming aluminosilicate minerals in the parent rock and the drainage regimen. For example, the clay minerals in saprolite developed on mafic rocks, in which hornblende and plagioclase are the primary minerals, are chiefly smectite and kaolinite in poorly drained areas, kaolinite in well-drained areas. In contrast, the clay minerals in saprolite developed on felsic rocks are chiefly kaolinite and illite in both poorly drained and well-drained areas; gibbsite develops as a persistent minor component only where internal drainage is excellent.

Saprolite thickness is directly related to slope angle and to the lithology and permeability of the parent rock, including the abundance of fractures. For example, the thickness of saprolite developed on felsic gneiss or schist on gently sloping uplands commonly exceeds 6 m (and locally may exceed 30 m); on slopes of 6°-12° the thickness commonly ranges from 2-6 m; on slopes exceeding 12° it is generally less than 2 m. In contrast, saprolite developed in quartzite and serpentinite is commonly less than 2 m thick regardless of slope angle.

Saprolite has been mapped in terms of variety only in very limited areas. For purposes of this map, it is mapped in accordance with the distribution of different kinds of bedrock from which differing varieties of saprolites are derived. Differences due to slope angle could not be effectively shown at the scale of this map. Information

on rock permeability suitable for mapping varieties of saprolite is not regionally available.

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