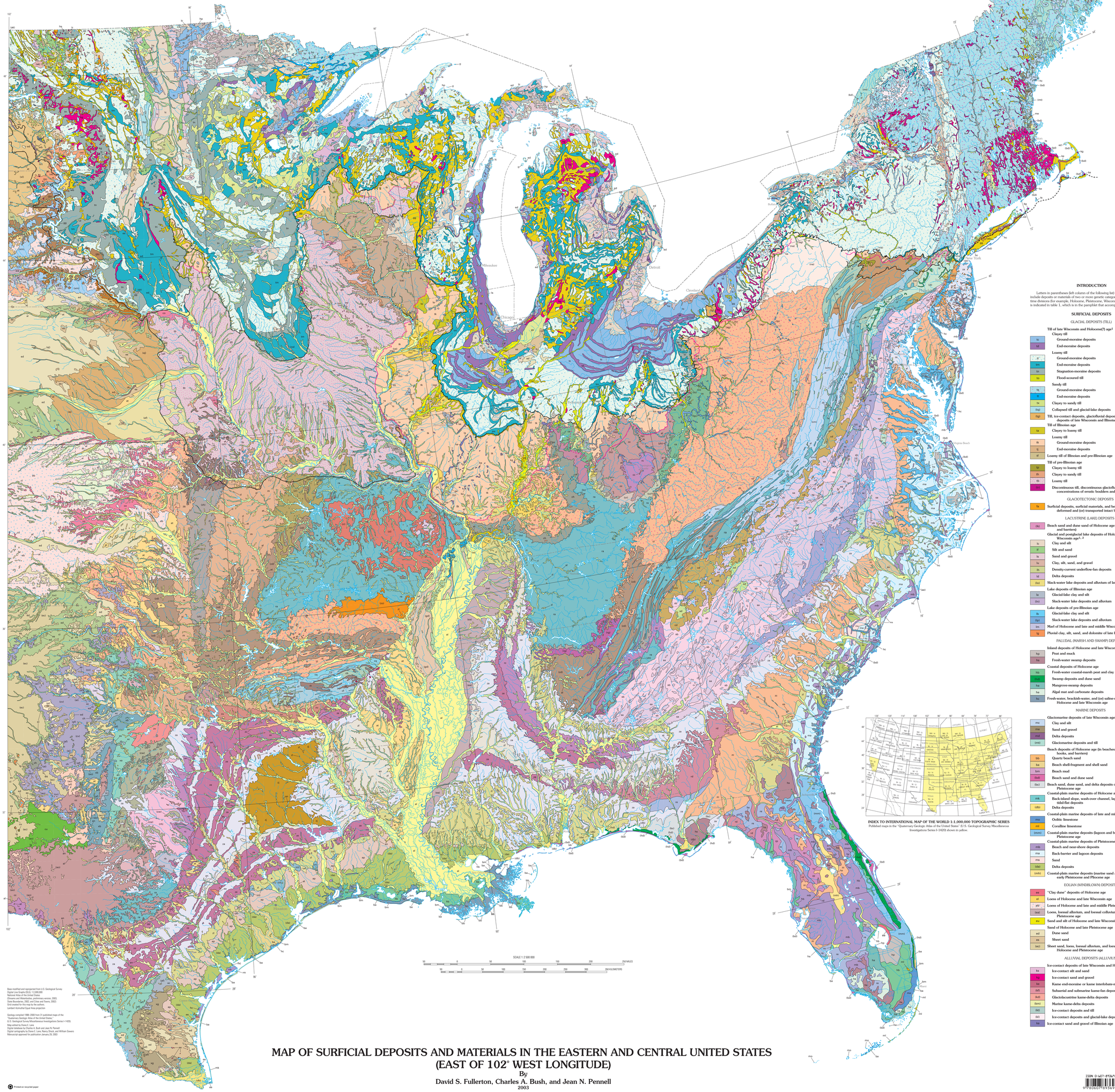
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

GEOLOGIC INVESTIGATIONS SERIES I–2789
Pamphlet accompanies map



Published maps in the "Quarternary Geologic Atlas of the United States" (U.S. Geological Survey Miscellaneous Investigations Series I-1420) shown in yellow.

INTRODUCTION

Letters in parentheses (left column of the following list) indicate map units that include deposits or materials of two or more genetic categories. The significance of time divisions (for example, Holocene, Pleistocene, Wisconsin, Illinoian, pre-Illinoian) is indicated in table 1, which is in the pamphlet that accompanies this map sheet.

SURFICIAL DEPOSITS

GLACIAL DEPOSITS (TILL)

Till of late Wisconsin and Holocene(?) age[1]
- Clayey till
  - tc — Ground-moraine deposits
  - td — End-moraine deposits
- Loamy till
  - tm — Ground-moraine deposits
  - tn — End-moraine deposits
  - ts — Stagnation-moraine deposits
  - to — Flood-scoured till
- Sandy till
  - tq — Ground-moraine deposits
  - tr — End-moraine deposits
  - tx — Clayey to sandy till
  - (tq) — Collapsed till and glacial-lake deposits
  - (tg) — Till, ice-contact deposits, glaciofluvial deposits, and glaciolacustrine deposits of late Wisconsin and Illinoian age

Till of Illinoian age
- ta — Clayey to loamy till
- Loamy till
  - tt — Ground-moraine deposits
  - tj — End-moraine deposits
- tf — Loamy till of Illinoian and pre-Illinoian age

Till of pre-Illinoian age
- tp — Clayey to loamy till
- tm — Clayey to sandy till
- tb — Loamy till
- (tb) — Discontinuous till, discontinuous glaciofluvial deposits, and concentrations of erratic boulders and cobbles

GLACIOTECTONIC DEPOSITS

- fa — Surficial deposits, surficial materials, and bedrock masses that were deformed and (or) transported intact by glacial ice

LACUSTRINE (LAKE) DEPOSITS

- (la) — Beach sand and dune sand of Holocene age (in beaches, spits, and barriers)

Glacial and postglacial lake deposits of Holocene and late Wisconsin age[1, 2]
- lc — Clay and silt
- lf — Silt and sand
- ls — Sand and gravel
- lu — Clay, silt, sand, and gravel
- lh — Density-current underflow-fan deposits
- ld — Delta deposits
- (lu) — Slack-water lake deposits and alluvium of late Wisconsin age

Lake deposits of Illinoian age
- la — Glacial-lake clay and silt
- (lc) — Slack-water lake deposits and alluvium

Lake deposits of pre-Illinoian age
- lb — Glacial-lake clay and silt
- (lp) — Slack-water lake deposits and alluvium
- lm — Marl of Holocene and late and middle Wisconsin(?) age
- lg — Pluvial clay, silt, sand, and dolomite of late Pleistocene age

PALUDAL (MARSH AND SWAMP) DEPOSITS

Inland deposits of Holocene and late Wisconsin age
- hp — Peat and muck
- hs — Fresh-water swamp deposits

Coastal deposits of Holocene age
- hb — Fresh-water coastal-marsh peat and clay
- (hs) — Swamp deposits and dune sand
- hs — Mangrove-swamp deposits
- he — Algal mat and carbonate deposits
- hc — Fresh-water, brackish-water, and (or) saline-marsh deposits of Holocene and late Wisconsin age

MARINE DEPOSITS

Glaciomarine deposits of late Wisconsin age
- mc — Clay and silt
- ms — Sand and gravel
- md — Delta deposits
- (mt) — Glaciomarine deposits and till

Beach deposits of Holocene age (in beaches, spits, tombolos, hooks, and barriers)
- bb — Quartz beach sand
- bs — Beach shell-fragment and shell sand
- bm — Beach mud
- (bd) — Beach sand and dune sand
- (bc) — Beach sand, dune sand, and delta deposits of Holocene and late Pleistocene age

Coastal-plain marine deposits of Holocene age
- mk — Back-island slope, wash-over channel, lagoon, and wind-tidal-flat deposits
- (db) — Delta deposits

Coastal-plain marine deposits of late and middle Pleistocene age
- (mo) — Oolitic limestone
- mr — Coralline limestone
- (mm) — Coastal-plain marine deposits (lagoon and beach deposits) of Pleistocene age

Coastal-plain marine deposits of Pleistocene and Pliocene age
- mb — Beach and near-shore deposits
- ma — Back-barrier and lagoon deposits
- ms — Sand
- (da) — Delta deposits
- (mh) — Coastal-plain marine deposits (marine sand and alluvial sand) of early Pleistocene and Pliocene age

EOLIAN (WINDBLOWN) DEPOSITS

- ee — "Clay dune" deposits of Holocene age
- el — Loess of Holocene and late Wisconsin age
- pl' — Loess of Holocene and late and middle Pleistocene age
- (ea) — Loess, loessal alluvium, and loessal colluvium of late and middle Pleistocene age
- eu — Sand and silt of Holocene and late Wisconsin age

Sand of Holocene and late Pleistocene age
- ed — Dune sand
- es — Sheet sand
- (se) — Sheet sand, loess, loessal alluvium, and loessal colluvium of Holocene and Pleistocene age

ALLUVIAL DEPOSITS (ALLUVIUM)

Ice-contact deposits of late Wisconsin and Holocene(?) age[1]
- ks — Ice-contact silt and sand
- kg — Ice-contact sand and gravel
- ke — Kame end-moraine or kame interlobate-moraine deposits
- (kf) — Subaerial and submarine kame-fan deposits
- (kd) — Glaciolacustrine kame-delta deposits
- (km) — Marine kame-delta deposits
- (kt) — Ice-contact deposits and till
- (ki) — Ice-contact deposits and glacial-lake deposits
- ka — Ice-contact sand and gravel of Illinoian age

Glaciofluvial (outwash) deposits of late Wisconsin and Holocene(?) age[1]
- gs — Outwash sand
- gg — Outwash sand and gravel
- (gt) — Outwash deposits and till
- (gl) — Outwash deposits and ice-contact deposits
- (gk) — Outwash deposits, ice-contact deposits, and glacial-lake deposits

Glaciofluvial (outwash) deposits of Illinoian age
- ge — Outwash silt, sand, and gravel
- (gd) — Outwash silt, outwash sand, and alluvium

Glaciofluvial (outwash) deposits of pre-Illinoian age
- gb — Outwash sand and gravel
- (gc) — Outwash sand and gravel and till

Catastrophic glacial outburst-flood deposits of late Wisconsin age
- ah — Flood deposits
- (ak) — Flood deposits and flood-scoured till

- (ag) — Alluvial, outwash, ice-contact, and glacial-lake deposits of Holocene and late Wisconsin age
- (ab) — Alluvial, outwash, ice-contact, and glacial-lake deposits of middle Pleistocene age
- af — Channel and flood-plain alluvium of Holocene and late Wisconsin age
- (ai) — Alluvial deposits, lake deposits, and eolian deposits of Holocene and late and middle Pleistocene age
- an — Channel and flood-plain alluvium of Holocene and Pleistocene age
- (aa) — Alluvial deposits and estuarine marine deposits of Holocene, Pleistocene, and Pliocene age
- (ao) — Channel and flood-plain alluvium of late and middle Pleistocene age
- ap — Cemented channel and flood-plain alluvium, fan alluvium, sheetwash alluvium, and pediment(?) alluvium
- at — Alluvial-delta deposits
- ae — Alluvium of Pleistocene age beneath terraces, in paleovalleys, and on upland surfaces
- ac — Arkosic alluvium of middle and early Pleistocene and Pliocene age
- ad — Channel and flood-plain alluvium of early Pleistocene and Pliocene age
- aa — Cemented alluvium
- (a) — Alluvial deposits and lake deposits
- (af) — Alluvial-fan and sheetwash-fan deposits of Holocene and late and middle Pleistocene age

Sheetwash alluvium of Holocene and late Wisconsin age
- wb — Sheetwash alluvium
- wa — Sheetwash alluvium in badland terrain
- (wc) — Sheetwash alluvium and lake deposits

MASS-MOVEMENT DEPOSITS

- js — Slump-block, earthflow, and mudflow deposits of Holocene age

Landslide deposits of Holocene and late Wisconsin age
- (ja) — Landslide deposits, bouldery colluvium, and sheetwash alluvium
- (jb) — Landslide deposits, disintegration residuum, and sheetwash alluvium
- (na) — Loamy solifluction deposits, colluvium, and decomposition residuum of Holocene and late and middle Pleistocene age
- (nb) — Loamy solifluction deposits of late Wisconsin age
- (cp) — Colluvium, sheetwash alluvium, and landslide deposits of Holocene and late Wisconsin age

Colluvium of Holocene and late Pleistocene age
- cj — Clayey chert-clast colluvium
- cg — Gravelly colluvium

Colluvium of Holocene and late and middle Pleistocene age
- cd — Crystalline-boulder colluvium
- ce — Diabase- and basalt-clast colluvium
- cb — Resistant-block or resistant-boulder colluvium and rock waste
- cq — Sandstone-block or sandstone-boulder colluvium
- cc — Carbonate-boulder or carbonate-clast colluvium
- ct — Clastic-clast colluvium
- (cv) — Locally gypsiferous clastic-clast colluvium and solution residuum
- cf — Acid shale–chip colluvium
- cs — Calcareous shale–chip and siltstone-clast colluvium
- co — Shale-clast, chalk-clast, and chalky limestone–clast colluvium
- ci — Calcrete-clast colluvium
- ck — Chert-clast colluvium
- ch — Sandy to clayey colluvium
- cu — Colluvium complex
- (cx) — Colluvium and loess
- (cr) — Colluvium and solution residuum
- (cm) — Colluvium, decomposition residuum, and solution residuum

Colluvium of Quaternary age
- (ca) — Colluvium and sheetwash alluvium
- (cz) — Colluvium, decomposition residuum, and solution residuum

- (cw) — Colluvium and decomposition residuum of Quaternary and Tertiary age
- (ct) — Colluvium and alluvium of Pleistocene age

RESIDUAL MATERIALS

Grus of Quaternary and Tertiary age
- gg — Glaciated granitic grus
- (db) — Feldspathic sandy grus

Disintegration residuum of Holocene and late Wisconsin age
- (sm) — Smectitic disintegration residuum and sheetwash alluvium on bentonitic shale, micaceous shale, and soft clayey shale
- (sh) — Silty clay loam disintegration residuum and sheetwash alluvium
- (si) — Loamy disintegration residuum and sheetwash alluvium on clayey shale
- (sk) — Loamy disintegration residuum, sheetwash alluvium, and colluvium on sandstone, siltstone, and shale
- (sd) — Loamy disintegration residuum, sheetwash alluvium, and colluvium on sandstone, siltstone, mudstone, claystone, shale, and lignite
- (sj) — Sandy disintegration residuum, sheetwash alluvium, and colluvium on soft sandstone, siltstone, and shale

Disintegration residuum of Holocene and late and middle Pleistocene age
- sg — Cemented, gravelly disintegration residuum
- sc — Quartz-sand disintegration residuum
- sa — Disintegration residuum on clastic rocks
- sb — Disintegration residuum on clastic rocks and carbonate rocks
- sd — Stony, gypsiferous disintegration residuum
- (ss) — Silty-clay disintegration residuums and gypsiferous solution residuum
- (sx) — Decomposition residuum and colluvium of Holocene and late and middle Pleistocene age on igneous and metamorphic rocks

Decomposition residuum of Quaternary and Tertiary age on sand and gravel
- (s) — Decomposition residuum on sand and gravel beneath high stream terraces and in alluvial fans
- (s) — Decomposition residuum on upland sand and gravel and on paleochannel fill deposits
- sn — Slack-water lake deposits and alluvium on channel gravel and sand
- sg — Crumbly quartz-clast decomposition residuum on sand and gravel
- sc — Decomposition residuum on sand or mixed-composition sand and gravel on upland surfaces
- sl — Quartz-pebble, chert-pebble, and quartzite-pebble decomposition residuum on sand and gravel on upland surfaces

Decomposition residuum of Quaternary age on sedimentary rocks that contain swelling-clay minerals or that weather to form swelling-clay minerals
- se — Smectitic-clay decomposition residuum
- sp — Sand, silt, and smectitic-clay decomposition residuum
- sv — Gravel, sand, silt, and smectitic-clay decomposition residuum
- (j) — Decomposition residuum complex
- sv — Decomposition residuum complex

Decomposition residuum of Quaternary and Tertiary age on other sedimentary rocks
- za — Clayey to sandy decomposition residuum
- zf — Ferruginous sand and clay decomposition residuum
- (zd) — Decomposition residuum and colluvium on shale, siltstone, and sandstone
- zs — Decomposition residuum on sandstone, siltstone, shale, limestone, and dolomite
- (zt) — Decomposition residuum and colluvium on arkose, sandstone, argillite, shale, and conglomerate
- (zu) — Clayey to sandy decomposition residuum and solution residuum
- (zh) — Cherty decomposition residuum, solution residuum, and colluvium on limestone, shale, and sandstone
- (zc) — Clayey to sandy decomposition residuum and solution residuum on sandstone, quartzite, shale, dolomite, and cherty limestone
- (zr) — Clayey to sandy decomposition residuum and solution residuum on clay, shale, coal, sandstone, and limestone
- (zm) — Loamy decomposition residuum and colluvium on sedimentary rocks of mixed composition

Solution residuum of Quaternary and Tertiary age
- rc — Chert-poor or chert-free, clayey to sandy solution residuum
- ra — Cherty, clayey to sandy solution residuum
- rb — Solution residuum complex
- rd — Cherty, quartz-sand solution residuum
- re — Sandy solution residuum
- (rg) — Plastic-clay solution residuum and cherty colluvium
- (rh) — Solution residuum and decomposition residuum
- sg — Clayey to sandy, saprolitized sand and gravel of Quaternary and Tertiary age

Saprolite of Quaternary and Tertiary age on crystalline igneous and metamorphic rocks
- sa — Clayey to sandy saprolite on granite, gneiss, schist, and other felsic, mafic, and ultramafic igneous and metamorphic rocks
- sb — Micaceous saprolite on felsic micaceous schist or rocks of mixed composition
- se — Clayey saprolite on diabase and basalt
- sf — Clayey saprolite on nepheline syenite
- sc — Clayey to sandy saprolite on phyllite, argillite, slate, marble, greenstone, serpentinite, metabasalt, metarhyolite, and other felsic metavolcanic rock
- sd — Quartz-rich saprolite of Quaternary and Tertiary age

OTHER MATERIALS

BAKED AND FUSED BEDROCK (CLINKER) OF QUATERNARY AGE

- (cb) — Clinker and colluvium

MAN-MADE LAND

- f — Man-made land

Contact

Limit of glacial advance—Dashed where inferred. Hachures point in direction of glaciated area
- **Late Wisconsin**—Southern limit of glaciation during Late Wisconsin time, 35,000–11,150 yr ago
- **Illinoian**—Southern limit of glaciation during Illinoian time, 310,000–128,000 yr ago
- **Illinoian or pre-Illinoian**—Southern limit of glaciation during Illinoian or pre-Illinoian time, earlier than 128,000 yr ago
- **Pre-Illinoian**—Southern limit of glaciation prior to Illinoian time, earlier than 310,000 yr ago

[1]Some glacial, ice-contact, glaciofluvial, and glacial-lake deposits in northeastern Minnesota, northern Wisconsin, and northern Michigan may be earliest Holocene in age.
[2]Postglacial lakes persisted in parts of some of the basins of former large glacial lakes long after meltwater ceased to enter those basins. The sediments deposited in the late Wisconsin glacial lakes and the Holocene postglacial lakes in the same basins have not been distinguished.

Base modified and reprojected from U.S. Geological Survey Digital Line Graphs (DLG), 1:2,000,000
National Atlas of the United States
(Streams and Waterbodies, preliminary version, 2002)
State Boundaries, 2002, and Cities and Towns, 2002)
Grid created for this map by the authors.
Lambert Azimuthal Equal Area projection

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MAP OF SURFICIAL DEPOSITS AND MATERIALS IN THE EASTERN AND CENTRAL UNITED STATES (EAST OF 102° WEST LONGITUDE)

By
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