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

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

State compilations by
Thomas M. Scott, Michael S. Knapp, Michael S. Friddell, and David L.Weide

Edited and integrated by
Gerald M. Richmond, David S. Fullerton, and David L. Weide

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NOTE 1: This map is the product of interorganizational collaboration. Map units and related matters were established in general at a regional meeting of state compilers with the coordinator. Subsequently, Quaternary maps and map explanations of the part of each state included in the quadrangle were prepared by the state compilers. These were then integrated and supplemented by the editors to produce this geologic map and map explanation. Significant geologic problems were resolved by correspondence. The map was reviewed by the compilers prior to being submitted for publication. Other reviewers, to whom the editors are indebted, were W. A. White, Department of Geology, University of North Carolina, and J. B., Cathcart, U.S. Geological Survey.

NOTE 2: The Pliocene-Pleistocene boundary as defined by joint resolution of the International Union for Quaternary Research (INQUA) Subcommission 1–d on the Pliocene/Pleistocene Boundary, the International Commission on Stratigraphy (ICS) Working Group on the Pliocene/Pleistocene Boundary, and the Working Group of the International Geological Correlation Program (IGCP) Project No. 41 on the (Neogene/Quaternary Boundary) is at the Vrica section in southern Italy. The age of that boundary currently is inferred to be 1.65 Ma (Aguirre and Pasini, 1984).

Time boundaries between the early Pleistocene and middle Pleistocene and between the middle Pleistocene and late Pleistocene are being proposed by the INQUA Working Group on Major Subdivision of the Pleistocene. The boundary between the early Pleistocene and middle Pleistocene is placed at the Matuyama-Brunhes magnetic polarity reversal. The reversal has not been dated directly by radiometric controls. It is significantly older than the Bishop Tuff (revised K-Ar age 738 ka; Izett, 1982), and the estimated K-Ar age of 730 ka assigned to the reversal by Mankinen and Dalrymple (1979) is too young. In Utah, the Bishop volcanic ash bed overlies a major paleosol developed in sediments that record the Matuyama-Brunhes reversal (Eardley and others, 1973). The terrestrial geologic record is compatible with the astronomical age of 788 ka assigned to the reversal by Johnson (1982). The boundary between the middle Pleistocene and late Pleistocene is placed arbitrarily at the beginning of marine oxygen isotope substage 5e (at Termination II or the stage 6/5 transition). That boundary also is not dated directly. It was assigned provisional ages of 127 ka by CLIMAP Project members (CLIMAP Project Members, 1984) and 128 ka by SPECMAP Project Members (Ruddiman and McIntyre, 1984), based on uranium-series ages of the substage 5e high eustatic sea level stand.A sidereal age of 132 ka is derived by projection of the boundary onto the astronomical time scale of Johnson (1982).

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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 Jacksonville 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 tentative correlation of Quaternary and upper Pliocene lithostratigraphic and morphostratigraphic units of the Jacksonville and Florida Keys quadrangles with stratigraphic units in South Carolina.

LIST OF MAP SYMBOLS

CONTACT

BEACH RIDGES—Mapped along Atlantic coast and discontinuously along central carbonate ridge

CAROLINA BAY—Shallow, oval or elliptical closed depression, 100 m to many kilometers in length, in Atlantic Coastal Plain. Partly filled with mixed sand, silt, and clay containing abundant organic matter and by surface swamp deposits. Origin debated; attributed to meteorites, upwelling springs, eddy currents, eolian erosion, solution, or thaw of permafrost

DESCRIPTION OF MAP UNITS

HOLOCENE

asa ALLUVIAL GRAVELLY SAND—Pale-gray, yellowish-red, orange-red, or brownish-gray, poorly to well-stratified, coarse to fine sand and well-rounded pebble gravel. Deposits locally include interbedded or admixed silt and clay, the latter generally kaolinite; clay balls present in places. In northern part of quadrangle, gravel is primarily quartz and minor amounts of chert; in the central part of the quadrangle, chert is the major component. Deposits in eastern Florida are chiefly medium to fine sand with only minor gravel. Mapped areas include local organic muck and swamp deposits (**hs**) on flood plains, and colluvium along margins of valley floors. Thickness 5–10 m acd ALLUVIAL CLAY AND SILT—Light- to dark-gray, yellow to brown, poorly to well-stratified, clayey silt and silty clay alluvium. Deposit contains varying amounts of interbedded or admixed fine sand, lenses of kaolinitic clay, and scattered phosphatic pellets. Mapped areas include organic muck and swamp deposits (**hs**) on flood plains and colluvium along margins of valley floors. Thickness 5–10 m

hs SWAMP DEPOSIT—Dark-brown to black muck, mucky peat, and organic residue mixed with fine to very fine quartz sand, silt, and kaolinitic clay, commonly thinly laminated; locally includes lenses of mottled clay. Large deposits extensively bioturbated. In topographic depressions, intermittently covered by 0.5–1 m of standing water. Where these areas have been drained for agriculture, oxidation of the swamp deposits has resulted in subsidence of as much as 3 m. Small, discontinuous areas of slightly higher ground are covered with light-to dark-brown, unconsolidated, medium to fine quartz sand. Thickness 3–10 m

hpc FRESHWATER MARSH PEAT AND CLAY—Gray to black herbaceous peat and clay, intermixed and interbedded. Color darkens as content of organic matter increases. Includes interbedded freshwater and brackish-water deposits. Mapped in part from distribution of freshwater vegetation. Thickness 1–3 m

hp PEAT—Dark-gray to black undecomposed to partially decomposed organic matter compacted into thick, fibrous mats, interbedded with thin layers of fine sand and silt. Mapped areas confined to deposits in which the volume of organic matter exceeds that of mineral matter. Thickness 2–5 m

hps SALINE MARSH DEPOSIT—Gray to black mud and silty mud containing numerous intermixed and interbedded layers of silt, fine sand, herbaceous peat, and clay. Color darkens as content of organic matter increases. Deposit commonly intensively bioturbated. Includes interbedded brackish-water deposits in places. Mapped in part from distribution of salt-tolerant vegetation. Thickness 1–3 m

hmm COASTAL MANGROVE SWAMP DEPOSIT—Dark-gray to black organic muck and woody debris intermittently covered by as much as 1 m of sea water. Overlies wave-beveled surfaces cut on soft, porous, shelly limestone. Mapped only in areas that support dense stands of both red and black mangrove along the Gulf of Mexico south of lat 30°. Thickness 0.5–1 m

he SWAMP DEPOSIT AND DUNE SAND—Swamp deposit consists of dark-gray to orange, mottled, silty, smectitic clay with abundant organic debris, that is present in parallel, linear, interdune depressions along Atlantic coast. Locally, deposit is compacted as a result of drainage for agriculture. Dune sand is white, unconsolidated, and fine- to medium-grained. It is composed of quartz mixed with moderate amounts of crushed shell. Deposit forms linear beach and dune ridges parallel to shore. Dunes are chiefly stabilized by vegetation although some are locally active. Mapped unit overlies the Anastasia Formation in eastern Florida. Thickness 5–15 m

be BEACH AND DUNE SAND—Light-tan, angular, fine to medium sand; well sorted, crossbedded; mostly quartz, traces of heavy minerals. Upper layers locally contain crushed shell that increases gradually in proportion from north to south. Occurs along coast at and above modern beach. Also present as thin deposits, too small to map, on coastal saline-marsh deposits (**hps**) and coastal freshwater-marsh deposits (**hpc**). Thickness 2–7 m

bc BEACH SHELL-FRAGMENT AND SHELL SAND—White to light-gray shell fragments and shell sand including minor amounts of fine quartz sand, silt, and clay. Locally, deposit may be weakly cemented by calcium carbonate. Thickness 1–5 m

bd BEACH MUD-Gray to black silt and clay; contains shell fragments and very fine grained organic matter; color darkens as amount of organic matter increases. Underlies beaches bordering saline marshes, estuaries, and lakes from which it has been transported. Present only along western coast of Florida. Thickness 0.5–1.5 m

LATE PLEISTOCENE

ANASTASIA FORMATION—Present mostly in subsurface and shown by pattern on map. Light-gray to yellow, complexly interbedded, sandy marine limestone, calcareous sandstone, sand, and friable to variably cemented coquina. Locally contains thin, discontinuous lenses of black silty muck and decayed organic matter. The Anastasia Formation has a Th^{230}/U^{234} age of about 110,000 years (Osmond and others, 1970). Exposures of the formation, too small to show at scale of map, occur discontinuously along the Atlantic coastal ridge of eastern Florida However, most of unit is covered by younger late Pleistocene beach sand or undifferentiated beach sand and lagoonal deposits (**bmk**) and by thin swamp deposits, beach sand, and dune sand (**he**, **be**) of Holocene age. Thickness as much as 30 m

bma BEACH AND NEAR-SHORE MARINE SAND (Barrier island facies of Silver Bluff Formation in Georgia)-White to gray, light-tan to yellowish-brown, well-sorted, fine to medium quartz sand; planar bedded to crossbedded. Local humic layers at depths of 0.5–1 m. Basal part is commonly coarse to very course sand; deposit is leached to a depth of about 4 m, below which is unleached calcareous shell debris. Includes washover sheet-fan and tidal inlet channel deposits. Thickness 18–20 m

bmb BEACH AND NEAR-SHORE MARINE SAND (Barrier island facies of Princess Anne Formation in Georgia)—White to gray, light-tan to yellowish-brown, fine to medium quartz sand; well sorted to very well sorted, planar bedded to low-angle crossbedded; washover sheet-fan and tidal-inlet channel-and-fill structures common. Local humic layers at depth of 0.5–1 m. Basal beds are coarse to very coarse sand. Deposit leached to a depth of about 4 m, below which it includes unleached calcareous shell debris. Thickness 18–20 m

mlb MARINE SILT AND CLAY (Lagoon facies of Princess Anne Formation in Georgia)—Light-gray to tan silty sand or silt that grades down into bluish-gray to gray silty clay or clay. Smectite is the predominant clay; kaolinite is subordinate and illite is rare. Deposit is massive to finely laminated, and contains thin laminae of silt, well-sorted fine quartz sand, silty sand, and organic debris. Mapped areas include small deposits of eolian sand and alluvium (**asa**). Thickness 1–15 m

LATE PLEISTOCENE TO MIDDLE PLEISTOCENE

bmk BEACH AND MARINE SAND, WEATHERED AND OXIDIZED—Light-yellow to dark-orange quartz sand mixed with and stained by organic matter. Underlain at depths of as much as 0.5 m by fine quartz sand compacted and mixed with insoluble clay; locally, weakly to strongly cemented with calcium carbonate. Basal part of unit consists of as much as 7 m of consolidated sand containing abundant whole but rotted bivalve shells. Much shell material has been leached from upper part of the deposit, resulting in reduction of thickness by as much as 1.5 m. In places, the dissolved shell material has been redeposited with insoluble clay to form a subsurface hardpan. Deposit overlies sand, clayey sand, or shelly sand, of older, Pleistocene beach-ridge deposits (**bml**). Mapped only in Florida. Thickness 6–9 m

mba BEACH AND MARINE SAND AND LAGOONAL DEPOSITS, UNDIFFERENTIATED—Light-gray, yellowish-gray, light-green, and brownish-gray, poorly to well-sorted sand, silt, and clay, intermixed and interbedded. Locally includes thin stringers of well-rounded quartz pebbles and shell hash in remnants of old tidal channels. In places, also contains the insoluble residues of beach sand and sandy lagoonal deposits associated with older Pleistocene shorelines. Mapped areas include small swamp deposits (**hs**), organic muck, shell debris, and eolian sand of Holocene age. Mapped only in Florida; in general, correlative with units **bma**, **bmb**, **mlb**, **bmc**, and **mlc** in Georgia. Thickness 10–25 m

MIDDLE PLEISTOCENE

bmc BEACH AND NEAR-SHORE MARINE SAND (Barrier island facies of Pamlico Formation in Georgia)—Fine to medium quartz sand commonly leached throughout, deeply weathered to yellowish-red with brown or gray mottled horizons, and locally cemented with iron oxide. Where unweathered, white to gray, light-tan to yellowish-brown. Sand is well sorted to very well sorted; planar bedded or low-angle crossbedded; washover sheet-fan and tidal-inlet channel-and-fill structures common. Basal beds are coarse to very coarse sand. Thickness 6–10 m

mlc MARINE SILT AND CLAY (Lagoon facies of Pamlico Formation in Georgia)—Light-gray to tan silty sand or silt that grades down into bluish-gray or gray silty clay or clay. Smectite is predominant clay; kaolinite is subordinate and illite rare. Deposit is massive to finely laminated, and contains thin laminae of well-sorted fine quartz sand, silty sand, and organic debris. Mapped areas include small deposits of eolian sand and alluvium (**asa**). Thickness 1–15 m

bmd BEACH AND NEAR-SHORE MARINE SAND (Barrier island facies of Talbot Formation in Georgia)—Fine to medium quartz sand, commonly leached throughout; deeply weathered to yellowish-red with brown or gray mottled horizons, and locally cemented with iron oxide, where unweathered, it is white to gray, light-tan to yellowish-brown. Sand is well-sorted to very well sorted; planar or low-angle crossbedded; Washover sheet-fan and tidal-inlet channel-and-fill structures common. Basal beds are coarse to very coarse sand. Thickness 6–10 m

mld MARINE SILT AND CLAY (Lagoon facies of Talbot Formation in Georgia)—Uppermost layers of light-gray to tan silty sand or silt grade down into bluish-gray or gray silty clay or clay. Smectite is predominant clay; kaolinite is subordinate, illite rare. Deposit is massive to thin bedded, and contains thin laminae of silt, well-sorted fine quartz sand, silty sand, and organic debris. Upper layers commonly leached of organic matter that has been translocated downward and redeposited as a compact humate layer 30–50 cm below surface. Mapped areas include small deposits of eolian sand and alluvium (**asa**). Thickness 1–15 m

bme BEACH AND NEAR-SHORE MARINE SAND (Barrier island facies of Penholoway Formation in Georgia)—Fine to medium quartz sand; commonly leached throughout; deeply weathered to yellowish-red with brown or gray mottled horizons, and locally cemented with iron oxide. Where unweathered, it is white to gray, light tan to yellowish brown. Sand is well sorted to very well sorted; planar bedded or low-angle crossbedded. Washover sheet-fan bedding and tidal-inlet channel-and-fill structures common. Basal beds are coarse to very coarse sand. Thickness 6–10 m

mle MARINE SILT AND CLAY (Lagoon facies of Penholoway Formation in Georgia)—Bluish-gray or gray silty clay or clay that grades upward into loamy sand or loam near ground surface. Smectite is predominant clay; kaolinite is subordinate, and illite rare. Deposit is massive to thin bedded, and contains thin laminae of silt, well-sorted fine quartz sand, silty sand, and organic debris. Upper layers commonly leached of organic matter that has been translocated downward and redeposited as a compact humate layer 20–50 cm below surface. Mapped areas include small deposits of eolian sand and alluvium (**asa**). Thickness 1–15 m

MIDDLE PLEISTOCENE TO EARLY PLEISTOCENE

bml BEACH AND MARINE SAND AND SANDY CLAY—White, yellow, reddish-yellow to reddish-orange, well-sorted phosphatic sand and clayey sand. Locally contains lenses of red to orange-red, well-sorted, coarse sand, stained and cemented with iron. Deposit overlies older Tertiary rocks and fills karst depressions, which are abundant along the crests of resistant limestone ridges. Locally overlain by small deposits of white, very well sorted, quartz sand and thin deposits of black to blue-gray organic muck. Thickness 1–10 m mbb BEACH AND MARINE SAND AND LAGOONAL DEPOSITS, UNDIFFERENTIATED—Fine to medium sand with abundant shell and soft limestone fragments; commonly deeply weathered to yellowish red or reddish orange and cemented with iron oxide in places. Where unweathered, deposit is white to greenish gray, or dark green. Locally includes lithified coquina fragments and pockets of organic-rich clay. Sandy layers support well-developed podzolic soils and in places include a shallow hardpan of translocated humic material. Mapped only in Florida. Generally correlative with units **bmd**, **mld**, **bme**, **mle**, **bmf**, and **mlf** in Georgia. Thickness 5–35 m

EARLY PLEISTOCENE TO LATE PLIOCENE

bmf BEACH AND MARINE SAND (Barrier island facies of Wicomico Formation in Georgia)—Fine to medium quartz sand; commonly leached throughout; deeply weathered to yellowish-red with brown and gray mottled horizons; locally cemented with iron oxide. Where unweathered, deposit is white to gray, light-tan or yellowish-brown. Sand is well sorted to very well sorted; planar bedded to low-angle crossbedded. Washover sheet-fan and tidal-inlet channel-and-fill structures common. Basal beds are coarse to very coarse sand. Thickness 6–10 m

mlf MARINE SILT AND CLAY (Lagoon facies of Wicomico Formation in Georgia)—Light-gray to yellowish-brown silty sand or silt that grades down into bluish-gray to gray silty clay or clay. Smectite is predominant clay, kaolinite is subordinate, and illite rare. Deposit is massive to thin bedded and contains laminae of well-sorted fine quartz sand and thin lenses of organic debris. Mapped areas include small deposits of eolian sand and alluvium (**asa**). Thickness 1–15 m

EARLY PLEISTOCENE AND PLIOCENE

bmp BEACH AND NEAR-SHORE MARINE SAND AND PEAT (Trail Ridge sequence of Florida)—Comprises a thick surface sand and an underlying peat. The sand is white to light-yellow near surface, but becomes yellow, orange, and red or brown downward. Sand is very uniformly textured, medium to fine grained, crossbedded in a southerly direction, and loose to slightly cemented with iron oxide. Deposit is chiefly quartz, but locally included 3–4 percent of heavy minerals: ilmenite, leucoxene, zircon, and monazite. Contains no garnet, epidote, or hornblende, which are common constituents of marine sands at lower altitudes to east. The sand underlies Trail Ridge, a well-preserved broad high ridge that trends south from Georgia for about 215 km along the axis of the Florida Peninsula. Shape of ridge and direction of crossbedding of sand indicates deposition as a spit or bar by southerly longshore currents. On west slope of ridge, sand is locally overlain by younger high-level sand (included in unit **mbb**) that contains a marine fauna representing a variety of species living in coastal waters today but no extinct species, thus clearly Pleistocene in age (Pirkle and Czel, 1983). The sand of the Trail Ridge sequence is older, and considered correlative with the high shoreline deposit (**bmf**) of the Wicomico Formation in Georgia. Thickness of sand12–22m. The peat beneath the sand consists of woody peat and sapropel, and locally contains trunks, branches, and roots of trees, some in upright position. Its age is late Pliocene or early Pleistocene (Pirkle and Czel, 1983). The peat overlies a sequence of Pliocene deposits consisting, from top downward, of lagoonal clays, a bed of poorly preserved molluscan shells, and a basal marine sand that overlies the Miocene Hawthorne Formation. Thickness of peat 4–9 m.

The Trail Ridge sequence as a whole is considered to be mostly early Pleistocene but possibly in part late Pliocene in age. It may represent the maximum stand of sea level during deposition of the Caloosahatchee Formation in southern Florida. Total thickness 16–30 m

msa MARINE AND ALLUVIAL SAND (Facies of Citronelle Formation)—Upper part is white to light-yellow, fine to coarse, loose quartz sand, but most of unit is red, orange, yellow, or brown, crossbedded, pebbly, coarse to fine sand, and thin beds of white, highly kaolinitic, well-sorted fine quartz sand containing numerous shrimp burrows. Locally includes pockets of white, kaolinitic clay, and thin stringers of discoid quartz and quartzite pebbles; most are less than 2 cm in diameter, a few as much as 8 cm. The sand was deposited on, and in places is collapsed into, karst terrain developed on limestone. Its distribution is coextensive with and forms an important part of Lake Wales Ridge (Pirkle and Yoho, 1970), a major topographic feature that forms the central divide of the Florida peninsula for 250–300 km. The sand is considered in part of marine littoral and delta origin, in part of alluvial origin; it has been correlated with the Pliocene Citronelle Formation (Grogan and others, 1964; Pirkle and others, 1963; White, 1970) which, at its type locality at Citronelle, Alabama, contains a vertebrate fauna assigned a Pliocene Hemphillian age by F. C. Whitmore (Isphording and Lamb, 1971), and fossil leaves of Pleistocene age (Berry, 1916; Stringfield and LaMoreaux, 1957; Doering, 1958). Thickness 12–15 m

LAND PEBBLE PHOSPHATE DEPOSIT—Present only in subsurface and shown by pattern on map. Phosphatic pellets and nodules, quartz sand, and smectitic clay; chiefly massive and structureless but locally crossbedded or with horizontal laminations. Locally includes pockets of clay that fill sinkholes in underlying limestone. Phosphate deposit is believed by Cathcart and others (1952) to be a residuum derived from the underlying Pliocene Bone Valley Formation and by Sellards (1915) to have been deposited in a shallow marine environment following erosion of the Miocene Hawthorn Formation. Phosphate deposit is overlain by as much as 10 m of younger wave-reworked beach sand and clayey sand (**bml**). Thickness 2–18 m

PLIOCENE

ase ALLUVIAL SAND—White, light-gray to light-yellow, coarse to fine, poorly to well-sorted, slightly clayey sand. Locally contains lenses and beds of angular to rounded quartz-pebble gravel and sandy kaolinitic clay. Grain size decreases gradually and deposit becomes increasingly sorted from northwest to southeast. Mapped areas include extensive, locally derived, thin surface deposits of eolian sand of late Pleistocene and Holocene age. Thickness 5–15 m

QUATERNARY AND TERTIARY

zsc SAND AND CLAY DECOMPOSITION RESIDUUM[1]—White, light-yellow, yellowish-orange or grayish-red, commonly mottled, poorly sorted, fine to medium sand. Chiefly subangular to subrounded, quartz. Sand locally grades into areas of light-gray to greenish-gray clay and in places contains small lenses of silt and very fine gravel. Mapped areas include some locally derived colluvium and bedrock outcrops. Thickness 1–3 m

zsh MEDIUM TO FINE SILTY SAND AND SANDY SILT DECOMPOSITION RESIDUUM[1]—Yellowish-gray to grayish-white, medium to fine calcareous sand mixed with silt and minor smectitic clay. Mapped areas include numerous small patches of eolian sand and locally derived alluvium and colluvium. Bedrock exposures of sandy limestone with well-developed karst structures are common. Mapped only in Florida. Thickness 1–2 m

zca SANDY CLAY DECOMPOSITION RESIDUUM[1]—Pale-yellow, orange, reddish-orange or greenish-gray mottled, poorly sorted, fine sandy clay, clayey fine sand, and clay. Locally contains lenses of medium to coarse pebbly sand, chiefly of quartz with minor amounts of chert. Mapped only in Florida. Mapped areas include some locally derived colluvium and outcrops of unconsolidated bedrock. Thickness 1–3 m

rsf CLAYEY SAND SOLUTION RESIDUUM WITH CHERT BLOCKS[2]—Yellowish-gray, grayish-pink to reddish-brown, ferruginous, clayey, fine to medium quartz and calcareous sand. Locally contains small lenses and stringers of subrounded to subangular chert pebbles which increase in quantity and size to the northwest. Deposit develops on limestone and dolomite; karst features, including small, clay-filled sinkholes, are common. Mapped areas include bedrock outcrops and deposits of locally derived colluvium and alluvium. Thickness 1.5–4 m; locally as much as 10 m in karst depressions rsg SANDY CARBONACEOUS CLAY SOLUTION RESIDUUM[2]—Yellowish orange to grayish-red, commonly mottled, limonitic, medium-grained, subangular to subrounded quartz sand with traces of heavy minerals mixed with clay and small fragments of carbonate and chert residual following solution and development of karst features in the underlying limestone. Mapped areas include deposits of eolian sand, locally derived colluvium, and bedrock outcrops. Mapped only in Florida. Thickness 1–2 m

[1]Decomposition residuum, for purpose of this map, is defined as material derived primarily by in-place chemical decay of clastic rock with no appreciable subsequent lateral transport.

[2]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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