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

Base from Geological Survey of Canada
International Map of the World (IMW) Series, 1961; revised 1974
Lambert Conformal Conic Projection

SCALE 1 : 1 000 000

CONTOUR INTERVAL 500 METRES, ABOVE MEAN SEA LEVEL
Modified from U.S. GEOLOGICAL SURVEY OIL AND GAS INVESTIGATIONS CHART OC-74 (1974)

Compiled in 1977–80
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GEOLOGICAL SURVEY OF CANADA
ONTARIO GEOLOGICAL SURVEY
UNIVERSITY OF VERMONT, DEPARTMENT OF GEOLOGY, AND
SLIPPERY ROCK STATE COLLEGE, DEPARTMENT OF GEOLOGY, PENNSYLVANIA

LIST OF MAP UNITS

HOLOCENE

- be — BEACH AND DUNE SAND
- lm — LAKE CLAY AND SILT (under Lake Ontario)
- la — LAKE SAND AND GRAVEL (under Lake Ontario)

HOLOCENE AND LATE WISCONSIN

- SANDY TILL
  - Ground moraine
  - End moraine
  - Discontinuous sandy till
- KAME MORAINE, GRAVEL, SAND, AND SILT
- ICE-CONTACT GRAVEL, SAND, AND SILT
- OUTWASH SAND AND GRAVEL
- al — ALLUVIUM
- as — ALLUVIAL SAND
- asi — ALLUVIAL SILT
- ac — MARINE CLAY AND SILT
- mc — DISCONTINUOUS MARINE CLAY AND SILT
- msg — MARINE SAND AND GRAVEL
- mar — DISCONTINUOUS MARINE SAND AND GRAVEL
- md — MODERN DELTA SAND AND GRAVEL
- mu — MARINE DEPOSITS, UNDIVIDED
- ed — DUNE SAND
- lc — LAKE SILT AND CLAY (under Lake Ontario)
- lca — LAKE SILT AND CLAY
- hp — PEAT
- hs — SWAMP DEPOSIT

LATE WISCONSIN

- LOAMY TILL
  - tlct — Ground moraine
  - tlka — Ground moraine under Lake Ontario
- LOAMY TILL
  - tl — Ground moraine
  - tlf — End moraine
  - tdb — Sandy loamy till
- LOAMY TILL
  - tlg — Ground moraine
  - tlgg — Ground moraine under Lake Ontario
- LOAMY TILL
  - tlc — Ground moraine
  - tlcc — End moraine
  - tlcr — Discontinuous loamy till
- SANDY LOAMY TILL
  - tdlt — Ground moraine
  - tdlr — End moraine
  - tdld — Discontinuous sandy loamy till
- SANDY LOAMY TILL
  - tdla — Ground moraine
  - tdr — Discontinuous sandy loamy till
- SANDY TILL
  - tdlm — End moraine
- KAME DELTA SAND AND GRAVEL
- gkd — OUTWASH SAND AND GRAVEL
- kcr — DISCONTINUOUS LAKE SILT AND CLAY
- lca — LAKE SAND AND GRAVEL
- lcs — DISCONTINUOUS LAKE SAND AND GRAVEL
- lds — LAKE DELTA SAND AND GRAVEL

- CONTACT
- DRUMLIN—Mapped only where areas of drumlins are too small to be shown at the same scale
- CIRQUE
- ESKER—Direction of transport indicated by chevrons
- ERRATIC TRAIN—Source at apex
- DIRECTION OF ICE MOVEMENT INDICATED BY STRIATED OR GROOVED BEDROCK
- ICE-MOLDED LANDFORM—Drumlin, rock drumlin, flute, or grooves
- LIMIT OF GLACIAL ADVANCE OR MAJOR STILLSTAND OF ICE MARGIN—Dashed where inferred. Queried where uncertain
- MELTWATER CHANNEL OR GLACIAL SPILLWAY

QUEBEC
N.R. Gadd and
Laurie Jackson

ONTARIO
N.R. Gadd (in)

CANADA
UNITED STATES

NEW YORK
D.S. Fullerton (2)

VERMONT
P.W. Stanford (3)

NEW HAMPSHIRE
J.B. Hyde (4)

INDEX TO INTERNATIONAL MAP OF THE WORLD
1:1,000,000 TOPOGRAPHIC SERIES

Showing location of the Quaternary Geologic Map of the Ottawa 4° × 6° quadrangle in red (U.S. Geological Survey, Miscellaneous Investigations Series Map I-1420 (NL-18)) and other published maps in the Quaternary Geologic Atlas of the United States in yellow

AREAS OF RESPONSIBILITY

(1) Geology of Canada
(2) U.S. Geological Survey
(3) University of Vermont, Department of Geology
(4) Slippery Rock State College, Department of Geology

QUATERNARY GEOLOGIC MAP OF THE OTTAWA 4° × 6° QUADRANGLE, UNITED STATES AND CANADA

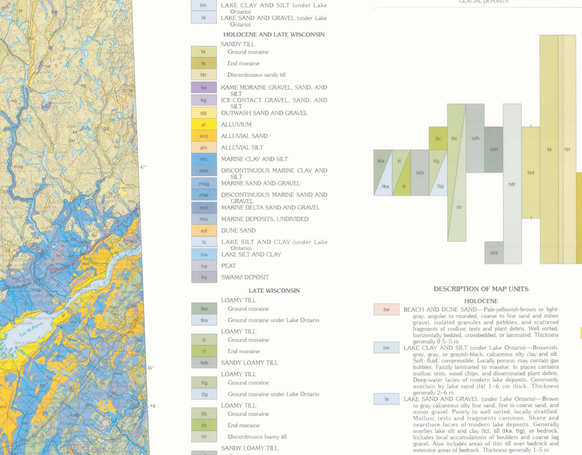
State and Provincial compilations by
Nelson R. Gadd, J.J. Veillette, David S. Fulleton,
Phillip W. Wagner, and William F. Chapman

Edited and integrated by
David S. Fullerton

1993

QUATERNARY GEOLOGIC ATLAS OF THE UNITED STATES

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

HOLOCENE

be BEACH AND DUNE SAND—Pale-yellowish-brown or light-gray, angular to rounded, coarse to fine sand and minor gravel, isolated granules and pebbles, and scattered fragments of mollusc tests and plant debris. Well sorted, horizontally bedded, crossbedded, or laminated. Thickness generally 0.5–5 m

lm LAKE CLAY AND SILT (under Lake Ontario)—Brownish-gray, gray, or grayish-black, calcareous silty clay and silt. Contains scattered mollusc tests and, locally, concentrations of pebbles. Locally bioturbated to massive. In places contains mollusc tests, wood chips, and disseminated plant debris. Generally massive facies of modern lake deposits. Commonly overlain by lake sand (la) 1–6 cm thick. Thickness generally 1–5 m

la LAKE SAND AND GRAVEL (under Lake Ontario)—Brown to gray calcareous fine to very fine sand; fine to coarse sand and minor gravel. Poorly to well sorted; locally stratified. Mollusc tests and fragments commonly present. Coarse and nearshore facies of modern lake deposits. Generally overlies lake silt and clay (lc) or till. Thickness generally 1–5 m. Includes local accumulations of boulders and concentrations of gravel. Also includes areas of thin till over bedrock and extensive areas of bedrock outcrop

HOLOCENE AND LATE WISCONSIN

SANDY TILL—Pink-, red-, maroon-, yellowish-orange, brownish-gray, grayish-yellow, yellow, yellowish-brown, reddish-brown, olive-brown, brown, olive, olive-gray, reddish-gray, blackish-gray, grayish-brown, gray, black, or mottled sand, loamy sand, and sandy loam; locally loam, silt loam, sandy clay loam, or silty clay. Colors and textures reflect composition of local bedrock. Generally noncalcareous; calcareous where bedrock is from marble, limestone, or dolomite. Generally very poorly sorted; contains boulders, cobbles, and scattered sand and gravel common. Upper part typically more clayey, silty, and stony than lower part. Commonly compact; friable; platy structure; abundant cobble and boulder pavements. Lower part typically nonstratified, dense, compact, firm, and fissile; may exhibit crude, weakly developed platy structure. Upper part typically nonstratified, massive and jointed, with iron oxide stains. Generally pebbly, cobbly, and bouldery. Clasts chiefly angular to subrounded; bouldery, or rubbly. In places resembles outcrop of ice-contact sand and gravel (gg, kg) but lacks stratification. Clast composition varies greatly, reflecting composition of underlying bedrock. Clasts chiefly sedimentary, metasedimentary, and metavolcanic rocks. Till commonly thin to moderately thick on hills and ridges, and on slopes, and valleys. North of St. Lawrence River, includes till of a minor glacial readvance (indicated by symbol) that fill a yellowish brown, brown, or gray, and much more clayey and silty than till mapped as unit to elsewhere in region. Map unit includes areas of bouldery till (tlc) and sandy loamy till (tdla, tdlr); also includes areas of outwash and ice-contact sand and gravel (gg, kg), kame and marine clay, silt, sand, and gravel (lca, lsa, mc, msg), alluvium (al, as), and bedrock outcrops. Locally overlain by dune sand (ed); peat (hp), or swamp deposits (hs). Thickness generally 1–5 m, locally more than 10 m; thickness in subsurface of buried bedrock valleys may exceed 100 m; reflection; deposit is mapped as discontinuous sandy till

tlc Ground moraine—Thickness generally 1–5 m, locally more than 10 m

tlcr End moraine (late Wisconsin)—Boulder-littered till ridges with undrained ice block depressions. Locally includes areas of kame terrace, gravel, sand, and silt (kt). Mapped only in New York

tsr Discontinuous sandy till—Thin, discontinuous deposits separated by numerous or extensive bedrock outcrops. Cobble and bouldery. Moderately permeable to rapidly permeable surfaces. In Canada, includes areas of outwash and ice-contact sand and gravel (gg, kg), lake and marine clay, silt, sand, and gravel (lca, lsa, mc, msg), alluvium (al), peat (hp), or swamp deposits (hs). Thickness generally less than 10 m

KAME MORAINE, GRAVEL, SAND, AND SILT—Pale-yellow, yellowish-brown, reddish-brown, olive-brown, brown, gray, gray, or mottled ice-contact deposit similar to unit kg, but includes an extensive linear or arcuate ridge of thick, undulating or hummocky topography with rare ridges. Ridges are composed of a complex assemblage of interbedded and interlensing deposits of local bedrock-derived sand and gravel, diamicton, and till or flowtill or is replaced laterally by till. In Canada, some deposits may be mapped as discontinuous sandy till (tsr). Locally overlies or is intertongued with lake or marine clay, silt, sand, and gravel (lca, lsa, mc, msg). Sorting, stratification, and textures vary vertically and laterally. Till, flowtill, and diamicton are commonly nonsorted, nonstratified, and nonlayered; commonly contain clasts subangular to rounded pebbles, cobbles, and boulders; clast composition similar to that of other stratified materials and till in same area. Surfaces hummocky, locally; commonly pitted with kettle and basin depressions; surfaces typically strewn with boulders. Deposits subsequently modified by gravity slumps and currents in Champlain Sea commonly are capped by discontinuous lenses of sand, silt, and clay (lsa, lca, mc, msg) and by kames, kame terraces, eskers, and fracture fillings. Some eskers are indicated by symbol. Includes kame moraine deposits of the delta deposits (kd) facies where those deposits are not distinguished. Includes some areas of outwash and ice-contact deposits (gg, kg), lake and marine clay, silt, sand, and gravel (lca, lsa, mc), alluvium (al), and bedrock outcrops. Locally overlain by dune sand (ed); peat (hp). Thickness generally 5–30 m, locally more than 60 m

gg OUTWASH SAND AND GRAVEL—Pale-yellow, yellowish-brown, reddish-brown, brown, gray, or mottled sand and gravel; minor silt, clay, and boulders. Well sorted and well stratified; commonly contains lenses of interbedded sand, gravel, and cobble gravel containing lenses and interbeds of sand, silt, and clay. Commonly contains lenses of boulders that are well sorted; crudely to well stratified. Bedding varies from horizontal beds to steeply dipping foreset beds. Forms kettle-dirt, planar, or trough crossbeds to massive pebble, cobble, or boulder beds. Cobbles and boulders abundant where outwash grades into ice-contact deposits. Texture generally coarser with depth. Clasts subrounded to well rounded. Clast composition varies with that of bedrock and other source materials. Clasts chiefly sedimentary and metasedimentary rocks. Clasts commonly stained by iron oxides; gravel locally cemented by secondary calcium carbonate. Locally terraced. Surface typically undulating to gently rolling with many of kettle depressions. Occurs as terrace remnants, valley trains, outwash plains, deltas, and kame terraces, and as kames, kame beds, and hills in meltwater channels. Includes some till, ice-contact sand and gravel (kg, kt), lake and marine clay, silt, sand, and gravel (lca, lsa, mc, msg), and alluvium (al). In basin of Champlain Sea, may be modified by action of waves and currents; veneered by discontinuous marine clay, silt, sand, and gravel (mc, msg). In these places, outwash is nonfossiliferous but overlying marine deposits may contain shells and shell fragments. Locally overlain by well-sorted silt or sand (bs) 2–28 cm thick. Thickness generally 1–5 m

lca LAKE SILT AND CLAY—Pale-yellow, yellowish-brown, reddish-brown, olive-brown, grayish-brown, brown, olive, pinkish-gray, reddish-gray, olive-gray, bluish-gray, gray, black, or mottled silt and clay, locally silt and very fine sand. Calcareous or noncalcareous; depending on composition of local bedrock. Commonly compact; platy to soft to very firm. Sticky and plastic where clayey; weak to strong blocky structure where clayey; locally jointed or fractured. Commonly laminated; locally varved; alternating clasts common in lower part. Generally coarser upward. In places, interbedded with sand or fine gravel or with diamicton or till. Calcium carbonate concretions common locally. Nonfossiliferous. Locally, where thin deposit overlies limestone or dolomite. Gullies common adjacent to marine seaways. Occurs chiefly in flat low-areas underdrain till overlain by bedrock outcrops. Includes areas of bedrock outcrop and extensive areas of till, outwash and ice-contact sand and gravel (kg, gg), lake and marine clay, silt, sand, and gravel (lca, lsa, mc, msg), alluvium (al), and, locally, peat (hp) or swamp deposits (hs). Thickness generally 1–10 m, locally more than 10 m; thickness in alluvial fans locally more than 20 m

asi ALLUVIAL SAND—Yellowish-brown, reddish-brown, brown, or gray sand and silt; minor clay and gravel; locally thin iron oxides. Noncalcareous or calcareous, depending on composition of bedrock and other source materials. Commonly weakly stratified. Locally contains lenses of gravel. Locally contains lenses of indigenous freshwater mollusks; may contain reworked mollusk fragments and tests of marine mollusks. Slackwater deposits of abandoned fluvial systems and shallow water deposits in abandoned lake basins. Deposits elevated above present drainage, graded to former glacial lakes and Champlain Sea. Includes extensive areas of landslide deposits composed of older lake and marine deposits and extensive areas of reworked landslide deposits. Also includes areas of lake and marine clay, silt, sand, and gravel (lca, lsa, mc, msg), and till (tl, tdl, tdr). Locally overlain by dune sand (ed), peat (hp), or swamp deposits (hs). Thickness generally 1–5 m, locally more than 15 m

ac MARINE CLAY AND SILT—Gray, olive-gray, brownish-gray, brown, yellowish-brown, olive brown, grayish-brown, olive, grayish-olive, reddish-gray, olive-gray, bluish-gray, gray, black, or mottled silty clay, clayey silt, and clay containing minor fine sand; locally calcareous. Typically massive or weakly bedded; weak to strong blocky structure. Locally varved. Commonly interbedded with interbedded and stratified with marine sand and gravel (msg, mdd). Locally overlies marine sand and gravel (msg, mdd). Locally overlain by dune sand (ed), peat (hp), or swamp deposits (hs). Thickness generally 1–4 m, locally more than 10 m

mc DISCONTINUOUS MARINE CLAY AND SILT—Thin, discontinuous deposits of marine clay and silt (mc) separated by numerous or extensive bedrock outcrops. Includes small areas of till (tl) and ice-contact sand and gravel (gg, kg). Generally less than 1 m

msg MARINE SAND AND GRAVEL—Pale-yellow, yellowish-brown, yellowish-brown, grayish-brown, brown, olive, olive-gray, brownish-gray, gray, reddish-gray, or mottled sand and gravel; minor silt, clay, and boulders. Commonly contains lenses of marine clay, silt, sand, and gravel (lca, lsa, mc, msg), alluvium (al), peat (hp), or swamp deposits (hs). Thickness generally 1–5 m, locally more than 10 m

mar DISCONTINUOUS MARINE SAND AND GRAVEL—Thin, discontinuous deposits of marine sand and gravel (msg) separated by numerous or extensive bedrock outcrops. Includes small areas of till, outwash and ice-contact sand and gravel (gg, kg). Rarely exceeds 5 m

md MARINE DELTA SAND AND GRAVEL—Pale-yellow, yellowish-brown, brown, gray, or mottled sand and gravel; minor silt, clay, and boulders. Commonly contains lenses of marine clay, silt, sand, and gravel (lca, lsa, mc, msg), alluvium (al), peat (hp), or swamp deposits (hs). Thickness generally 5–30 m

mu MARINE DEPOSITS, UNDIVIDED—Marine clay and silt (mc) and marine sand and gravel (msg)

ed DUNE SAND—Yellowish-brown, brown, yellow, pale-brown, or light-gray fine and medium sand. Generally calcareous. Well sorted, well rounded, and well stratified. Commonly forms parallel ridges. Includes areas of reworked beach deposits in Vermont; included in unit msg in Canada. Locally overlies marine clay and silt (mc) and marine sand and gravel (msg, mdd). Locally more than 30 m

lc LAKE SILT AND CLAY (under Lake Ontario)—Light-brown, reddish-brown, reddish-gray, brownish-gray, or gray, very fine sand, silt, and clay; minor fine sand and gravel. Massive to laminated; locally varved. Ice-rafted clasts common; organic detritus absent. Much more compact than unit lm. Offshore and deep-water facies of deposits of former glacial and postglacial lakes. Commonly overlain by well-sorted silt or sand (bs) 2–28 cm thick. Thickness generally 1–5 m

lca LAKE SILT AND CLAY—Pale-yellow, yellowish-brown, reddish-brown, olive-brown, grayish-brown, brown, olive, pinkish-gray, reddish-gray, olive-gray, bluish-gray, gray, black, or mottled silt and clay, locally silt and very fine sand. Calcareous or noncalcareous; depending on composition of local bedrock. Commonly compact; platy to soft to very firm. Sticky and plastic where clayey; weak to strong blocky structure where clayey; locally jointed or fractured. Commonly laminated; locally varved; alternating clasts common in lower part. Generally coarser upward. In places, interbedded with sand or fine gravel or with diamicton or till. Calcium carbonate concretions common locally. Nonfossiliferous. Locally, where thin deposit overlies limestone or dolomite. Gullies common adjacent to marine seaways. Occurs chiefly in flat low-areas underdrain till overlain by bedrock outcrops. Includes areas of bedrock outcrop and extensive areas of till, outwash and ice-contact sand and gravel (kg, gg), lake and marine clay, silt, sand, and gravel (lca, lsa, mc, msg), alluvium (al, asa), alluvial fans (af), and bedrock outcrops. Locally overlain by dune sand (ed), peat (hp), or swamp deposits (hs). Thickness generally 1–10 m, locally more than 15 m; thickness in alluvial fans locally more than 20 m

hp PEAT—Black or dark-brown decomposed organic residues, or fibrous peat and clay and silt containing commensurate plant material and organic residues. Commonly overlies gray or white marl, a very calcareous, soft, earthy deposit composed of shells and fragments. Overlies lake clay, silt, sand, or gravel (lca, lsa, mc), alluvium (al), or bedrock outcrops. Locally, in low, poorly drained areas or records of bogs in upland or upland slopes and finer in valleys; Calcareous or noncalcareous, depending on composition of local bedrock and other source materials. Nonsorted or poorly sorted, nonstratified. Typically more compact and finer grained than till. Commonly contains lenses of sand and gravel. Locally overlies bedrock outcrops