

QUATERNARY GEOLOGIC ATLAS OF THE UNITED STATES
MISCELLANEOUS INVESTIGATIONS SERIES MAP I-1420 (NL-18)

**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. Fullerton,
Phillip W. Wagner, and William F. Chapman

Edited and integrated by
David S. Fullerton

1993

This map is a product of collaboration of universities, the Geological Survey of Canada, 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 and Provinces included in the quadrangle were prepared by the compilers. Second, the maps were combined, integrated, and locally supplemented by the editor. Map unit symbols were revised to a uniform system of classification and map unit descriptions were prepared by the editor from information received from the compilers and from additional sources. Diagrams accompanying the map were prepared by the editor. Some differences in mapping or interpretation in different areas were resolved by correspondence. Most of the remaining differences simply reflect differences in available information or philosophies of mapping and should encourage further investigation.

For scientific purposes, the map differentiates Quaternary surficial deposits on the basis of a combination of criteria, such as lithology or composition, texture or particle size, structure, genesis, stratigraphic relationships, and age, as shown on the correlation diagram and indicated in the map unit descriptions. Some constructional geomorphic features, such as end moraines and eskers, are distinguished as map units or symbols. Erosional landforms, such as stream terraces, are not distinguished, although deposits that may be terraced are distinguished as map units. Differentiation of sequences of alluvial deposits of contrasting ages is not possible at a scale of 1:1,000,000. As a Quaternary geologic map it serves as a base from which a variety of maps relating Quaternary history can be derived. For practical purposes, the map is a surficial materials map. Materials are distinguished on the basis of lithology or composition, texture or particle size, and other specific physical chemical, and engineering characteristics. 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 substrata or parent materials in which pedologic and agronomic soils are formed. As a materials map it serves as a base from which a variety of maps for use in engineering, land use planning, or land management projects can be derived.

The Pleistocene-Holocene boundary is being proposed by the International Union for Quaternary Research (INQUA) Subcommittee on the Holocene. Currently in the United States and Canada it is placed arbitrarily at 10,000 B.P. (Hopkins, 1975; Fulton, 1984; Richmond and Fullerton, 1986).

Fulton, R.J., 1984, Summary—Quaternary stratigraphy of Canada, *in* Fulton, R.J., ed., Quaternary stratigraphy of Canada—A Canadian contribution to IGCP Project 24: Geological Survey of Canada Paper 84-10, p. 2-5.

Hopkins, D.M., 1975, Time stratigraphic nomenclature for the Holocene Epoch: *Geology*, v. 3, p. 10.

Richmond, G.M., and Fullerton, D.S., 1986, Summation of Quaternary glaciations in the United States of America: *Quaternary Science Reviews*, v. 5, p. 183-196.

The map contains illustrations of:

- An index to the International Map of the World 1:1,000,000 Topographic Series showing the location of the Quaternary geologic map of the Ottawa 4° × 6° quadrangle and other published maps in the Quaternary Geologic Atlas of the United States
- An illustration showing the areas of responsibility for compilation of the map with names and organizations of the compilers
- A chart showing the correlation of map units

DESCRIPTION OF MAP SYMBOLS

CONTACT

DUNE FIELD—Mapped only where areas of dunes are too small to be shown as dune sand (**ed**)

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 groove

LIMIT OF GLACIAL ADVANCE OR MAJOR STILLSTAND OF ICE MARGIN—Dashed where inferred;
ticks on side of advance

MELTWATER CHANNEL OR GLACIAL SPILLWAY

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. Soft, fluid, compressible. Locally porous; may contain gas bubbles. Faintly laminated to massive. In places contains mollusc tests, wood chips, and disseminated plant debris. Deep-water facies of modern lake deposits. Commonly overlain by lake sand (**ls**) 1-6 cm thick. Thickness generally 2-6 m
- ls LAKE SAND AND GRAVEL (under Lake Ontario)—Brown to gray calcareous silty fine sand, fine to coarse sand, and minor gravel. Poorly to well sorted; locally stratified. Mollusc tests and fragments common. Shore and nearshore facies of modern lake deposits. Generally overlies lake silt and clay (**lc**), till (**tka**, **tlg**), or bedrock. Includes local accumulations of boulders and coarse lag gravel. Also includes areas of thin till over bedrock and extensive areas of bedrock. Thickness generally 1-5 m

HOLOCENE AND LATE WISCONSIN

SANDY TILL—Pink, red, maroon, yellowish-orange, brownish-yellow, grayish-yellow, yellow, yellowish-brown, reddish-brown, olive-brown, brown, olive, olive-gray, reddish-gray, yellowish-gray, brownish-gray, bluish-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 derived in part from marble, limestone, or dolomite. Generally very poorly sorted. Stringers, lenses, clasts, and interbeds of sand and gravel common. Upper part typically more sandy; loose, gritty, stony; crude stratification; moderately compact, friable; platy structure; abundant cobbles and boulders. Lower part typically nonstratified, dense, compact, hard; locally fissile and weakly cohesive or massive and jointed, with iron oxide stains. Generally pebbly; cobbles and boulders common to abundant; locally gravelly, bouldery, or rubbly. In places resembles outwash or ice-contact sand and gravel (**gg**, **kg**) but lacks stratification. Clast composition varies greatly, reflecting composition of local bedrock. Clasts chiefly igneous, metaigneous, metasedimentary, and metavolcanic rocks. Till commonly thin and discontinuous on hill tops, ridge tops, and steep slopes. North of St. Lawrence River, includes till of a minor glacial readvance (indicated by symbol); that till is yellowish brown, brown, or gray and much more clayey and silty than till mapped as unit is elsewhere in region. Map unit includes areas of loamy till (**tlc**) and sandy loamy till (**tda**, **tdh**); also includes areas of outwash and ice-contact sand and gravel (**gg**, **kg**, **kd**), lake and marine clay, silt, sand, and gravel (**lca**, **lsa**, **mc**, **msg**), alluvium (**al**, **asq**, **aln**), and bedrock outcrops. Locally overlain by dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**). North of Ottawa and St. Lawrence Rivers, in Quebec, ground moraine and discontinuous till are distinguished primarily on basis of aerial photograph interpretation; where bedrock structure has surface reflection, deposit is mapped as discontinuous sandy till

- ts Ground moraine—Thickness generally 1.5-5 m, locally more than 10 m
- ts End moraine (late Wisconsin)—Boulder-littered till ridges with undrained ice-block depressions. Locally includes areas of kame moraine gravel, sand, and silt (**ke**). Mapped only in New York. Thickness generally 5-15 m, locally more than 30 m
- tsr Discontinuous sandy till—Thin, discontinuous deposits separated by numerous or extensive bedrock outcrops. Cobble and boulder litter common on till and bedrock surfaces. In Canada, includes areas of outwash and ice-contact sand and gravel (**gg**, **kg**), lake or marine clay, silt, sand, and gravel (**lca**, **lsa**, **mc**, **msg**), alluvium (**al**), peat (**hp**), or swamp deposits (**hs**). Thickness generally 0.5-2 m

- ke KAME MORaine GRAVEL, SAND, AND SILT—Pale-yellow, yellowish-brown, reddish-brown, brown, brownish-gray, gray, or mottled ice-contact deposit similar to unit **kg**, but occurs as massive linear or arcuate ridges or as belts of undulating or hummocky topography with rare ridges. Calcareous or noncalcareous, depending on composition of local bedrock. In places sand and gravel is interbedded with till or flowtill or is replaced laterally by till. In Canada, some deposits mapped may be end moraine composed of sandy till (**ts**). 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. Faults, folds, and slump and collapse structures common. Clasts subangular to rounded pebbles, cobbles, and boulders; clast composition similar to that of outwash and ice-contact sand and gravel (**gg, kg**) and till in same area. Locally overlain by dune sand (**ed**) or peat (**hp**). Thickness generally 5-30 m
- kg ICE-CONTACT GRAVEL, SAND, AND SILT—Pale-yellow, yellowish-brown, reddish-brown, olive-brown, grayish-brown, brown, brownish-gray, gray, or mottled sand and gravel. Textures vary laterally and vertically, ranging from fine sand containing minor silt and scattered pebbles to cobble and boulder gravel. Calcareous or noncalcareous, depending on composition of source materials. Poorly to well sorted; poorly to well stratified. Irregularly bedded to well bedded; beds thin to thick and discontinuous laterally. Locally interbedded with or contains masses of clay, silt, flowtill, or till. In places, mantled by thin veneer of till or flowtill. Gravel locally cemented by secondary calcium carbonate. Faults, folds, and slump and collapse structures common. Clasts subangular to rounded pebbles, cobbles, boulders, and blocks. Clast composition similar to that of other stratified materials and till in same area. Surfaces hummocky to knobby; commonly pitted with ice-block depressions; surfaces typically strewn with boulders. Deposits subsequently modified by waves and currents in Champlain Sea commonly are capped by discontinuous marine clay, silt, sand, and gravel (**mc, msg**). Occurs in kames, kame terraces, eskers, and ice-fracture fillings. Some eskers are indicated by symbol. Includes kame moraine deposits (**ke**) and kame delta deposits (**kd**) where those deposits are not distinguished. Includes some areas of outwash sand and gravel (**gg**), lake clay, silt, sand, and gravel (**lca, lsa, lds**), alluvium (**al**), and till. Locally overlain by dune sand (**ed**) or 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. Calcareous or noncalcareous, depending on composition of source materials. Generally pebble or cobble gravel containing lenses and interbeds of sand, silt, and clay and local lenses of boulders. Poorly to well sorted; crudely to well stratified. Bedding varies from horizontal beds of well-sorted or gravelly sand with ripple-drift, planar, or trough crossbeds to massive pebble, cobble, or boulder gravel or interbedded pebbly sand and cobble or boulder gravel. Cobbles and boulders abundant where outwash deposits head near end moraines or ice-contact deposits. Texture generally coarser with depth. Clasts subrounded to well rounded. Clast lithology varies with that of bedrock and other source materials; generally similar to that of till in same area. Clasts locally intensely stained by iron oxides; gravel locally cemented by secondary calcium carbonate. Locally terraced. Surface typically smooth to undulating; locally pitted with ice-block depressions. Occurs as terrace remnants, valley trains, outwash plains, fans and aprons, delta topset beds, and fills in meltwater channels. Includes some fill, ice-contact sand and gravel (**kg, ke, kd**), lake and marine clay, silt, sand, and gravel (**lca, lsa, mc, msg**), and alluvium (**al**). In basin of Champlain Sea, in many places modified by 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 mollusc tests and fragments. Locally overlain by dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**). In Ottawa River valley, locally overlain by flood deposits of poorly or moderately sorted gravel related to ancestral Great Lakes drainage. Thickness generally 2-10 m, locally more than 25 m
- al ALLUVIUM—Yellowish-brown, reddish-brown, brown, olive, brownish-gray, gray, or mottled silt, sand, and gravel. Generally calcareous; locally noncalcareous. Poorly to well sorted. Poorly to well stratified; bedding generally horizontal; cut-and-fill crossbeds common. Textures vary laterally and vertically; contrasting textures may be intertongued or interbedded. Upper part typically silt and fine sand containing stringers and lenses of clay and organic material; lower part typically sand or

rounded gravel and sand; cobble or boulder gravel in some areas. Clast lithologies vary, reflecting compositions of bedrock and other surface materials in vicinity. Overbank and stream channel deposit; underlies flood plains, low stream terraces, and alluvial fans. Mapped only in largest valleys. Includes areas of till, outwash and ice-contact sand and gravel (**gg, kg**), lake and marine clay, silt, sand, and gravel (**lca, lsa, mc, msg**), and bedrock. Locally overlain by dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**). Thickness of overbank and channel alluvium generally 1-5 m, rarely more than 10 m; thickness in alluvial fans locally more than 20 m

- asq ALLUVIAL SAND—Yellowish-brown, reddish-brown, brown, or gray sand and silty sand. Commonly mottled by iron oxides. Noncalcareous or calcareous, depending on composition of bedrock and other surficial materials in drainage basin. Generally well sorted and well stratified. Typically crossbedded medium and coarse sand containing lenses of well-rounded gravel near base, fining upward to ripple-drift silty fine sand containing lenses of coarser sand. Locally deltaic fine-to-medium sand containing ripple-drift crossbeds. Pebbles rare; cobbles and boulders extremely rare. Occurs as extensive sandplains, channel fills, and fluvial terrace deposits; locally includes deposits of lake or marine bars, spits, and deltas. In part derived from southeastward ancestral Great Lakes drainage. Deposits elevated above present drainage; graded to former glacial lakes and Champlain Sea. Includes areas of lake and marine clay, silt, sand, and gravel (**lca, lsa, mc, msg**) and till (**tic, tdh, ts**). Locally overlain by dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**). Thickness generally 1-3 m, locally more than 20 m
- aln ALLUVIAL SILT—Yellowish-brown, reddish-brown, gray, or mottled silt and silty clay. Noncalcareous or calcareous, depending on composition of bedrock and other surficial materials in drainage basin. Poorly to well sorted; poorly to well stratified. Commonly mottled by iron oxides. Locally contains tests of indigenous freshwater molluscs; may contain redeposited fragments and tests of marine molluscs. 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 sediments and areas of reworked landslide deposits. Also includes areas of lake and marine clay, silt, sand, and gravel (**lca, lsa, mc, msg**) and till (**tdh, ts**). Locally overlain by dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**). Thickness generally 1-3 m
- mc MARINE CLAY AND SILT—Pink, burgundy-red, reddish-brown, yellowish-brown, olive-brown, grayish-brown, brown, yellowish-gray, brownish-gray, olive, olive-gray, bluish-gray, gray, black, or mottled silty clay, clayey silt, and clay containing minor laminae of fine sand. Generally calcareous. Typically massive or weakly bedded; weak to strong blocky structure. Locally laminated. In places intertongued or interbedded with marine sand and gravel (**msg**). Stiff; plastic and slippery where damp, tough and intensely fractured where dry. Generally clast free; local dropstones. Calcium carbonate concretions common in places. Tests of saline or brackish-water molluscs common. Gullies common to abundant adjacent to major streams. Very susceptible to landslide activity; mudflow deposits locally abundant. Karst features common where deposit is thin over limestone or dolomite. Includes many small areas of wave- and current-washed till (**tic, tdh, ts**) and some areas of outwash and ice-contact sand and gravel (**gg, kg**) and marine sand and gravel (**msg, md**). Locally overlain by alluvium (**al, asq, aln**), dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**). Thickness generally 1-4 m, locally more than 70 m
- mcr 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 and alluvium (**al, asq, aln**). Karst features locally where bedrock is limestone or dolomite. Thickness generally less than 1 m
- msg MARINE SAND AND GRAVEL—Orange-yellow, reddish-brown, yellowish-brown, grayish-brown, brown, olive, brownish-gray, gray, or mottled very fine to coarse sand and gravel. Calcareous or noncalcareous. Textures vary laterally and vertically. Poorly to well sorted; poorly to well stratified; bedded or nonbedded. Commonly massive, horizontally bedded, planar-bedded, or cross bedded medium to fine silty sand; locally granule, pebble, or cobble gravel; in places pebbly sand. Clasts generally very well rounded. Clast lithologies vary, depending on composition of bedrock and other surficial materials in vicinity. Indigenous and reworked mollusc tests abundant in beach

- deposits. Nearshore and shore facies of marine deposits, typically near basin margins and on emerged shoals. Includes deposits of beaches, spits, and offshore bars. Includes areas of marine delta sand and gravel (**md**), marine clay and silt (**mc**), till (**tic**, **tdh**, **ts**), wave- and current-modified outwash and ice-contact sand and gravel (**gg**, **kg**, **ke**), and alluvium (**al**, **asq**, **aln**). Locally overlain by dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**). Thickness generally 1-12 m, locally more than 20 m
- msr** 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 sand and gravel (**gg**), or alluvium (**al**, **asq**). Karst features locally where bedrock is limestone or dolomite. Thickness generally less than 1 m
- md** MARINE DELTA SAND AND GRAVEL—Orange-yellow, pale-yellow, yellowish-brown, grayish-brown, brown, olive, gray, or mottled sand, pebbly sand, and gravel. Calcareous or noncalcareous, depending on composition of bedrock and other surficial materials in vicinity. Moderately well sorted; well stratified. Topset beds typically pebble or cobble gravel; foreset beds typically pebbly sand or gravel; bottomset beds typically horizontally bedded sand, silt, and clay. Indigenous and reworked tests of marine molluscs common locally. Clasts subrounded to well rounded; composition similar to that of outwash and ice-contact sand and gravel (**gg**, **kg**, **kd**), lake and marine sand and gravel (**lsa**, **msg**), and till in same region. Commonly perched on slopes. Mapped only in New York and Vermont; included in unit **msg** in Canada. Locally overlain by dune sand (**ed**). Thickness generally 5-20 m, locally more than 30 m
- mu** MARINE DEPOSITS, UNDIVIDED—Marine clay and silt (**mc**) and marine sand and gravel (**msg**)
ed DUNE SAND—Pale-yellow, brownish-yellow, pale-brown, or light-gray fine and medium sand. Generally calcareous. Well sorted; crossbedded. Grains subrounded or rounded, commonly frosted. Buried soils present locally. Some isolated areas of dunes shown by symbol. Typically barchan, parabolic, and ovoid dunes occurring in clusters, separated by flat areas thinly veneered by eolian sheet sand and silt. Tallest dunes locally 10-20 m high. Generally stabilized and inactive; locally where vegetation has been removed, dunes are active and blowouts are common. Thickness generally 1-10 m, locally more than 20 m
- lc** LAKE SILT AND CLAY (under Lake Ontario)—Light-brown, reddish-brown, reddish-gray, brownish-gray, or gray, very calcareous silty clay and clay. Generally well sorted. 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 (**ls**) 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 source materials. Well bedded to massive; soft to very firm. Sticky and plastic where damp; weak to strong blocky structure where dry; locally jointed or fractured. Commonly laminated; locally varved; ice-rafted clasts common in lower part. Generally coarser upward. In places, interbedded with sand or fine gravel or with flowtill or till. Calcium carbonate concretions common locally. Nonfossiliferous. Karst features locally where thin deposit overlies limestone or dolomite. Gullies common adjacent to major streams. Occurs chiefly in flat low areas formerly occupied by glacial and postglacial lakes. Includes areas of outwash and ice-contact sand and gravel (**gg**, **kg**, **ke**, **kd**), lake and marine sand and gravel (**lsa**, **lds**, **msg**), marine clay and silt (**mc**), alluvium (**al**, **asq**, **aln**), till, and bedrock. Locally overlain by dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**). Thickness generally 1-10 m, locally 30 m
- hp** PEAT—Black or dark-brown fibrous peat and decomposed organic residues, or fibrous peat and clay and silt containing comminuted plant material and organic residues. Commonly overlies gray or white marl, a very calcareous, soft, crumbly clay that contains mollusc tests and fragments. Overlies lake clay, silt, sand, or gravel (**lca**, **lsa**) or ice-contact or outwash sand and gravel (**kg**, **gg**) in low, poorly drained areas or occurs as bogs in ice-block depressions. Mapped only where extensive, in Vermont and New Hampshire. Included in swamp deposits (**hs**) where peat and swamp deposits have not been distinguished. Thickness generally 1-10 m

- hs SWAMP DEPOSIT—Dark-brown or black muck, mucky peat, and organic residues mixed with fine-grained mineral sediment. Locally overlies gray or white marl, a very calcareous, soft, crumbly clay that contains mollusc tests and fragments, or overlies shelly gyttja, an anaerobic, pulpy, freshwater mud containing abundant organic material. Includes peat (**hp**) where peat and swamp deposits have not been distinguished. Overlies lake silt, clay, sand, or gravel (**lca, lsa**) on former lake beds or ice-contact or outwash sand and gravel (**kg, gg**); also present in ice-block depressions, other shallow depressions, and poorly drained areas. Mapped only where extensive. Thickness generally 1-5 m, rarely more than 15 m

LATE WISCONSIN

- LOAMY TILL—Yellowish-brown, light-olive-brown, grayish-brown, gray, or mottled calcareous loam, silt loam, and sandy loam; locally clay loam or silty clay. Nonstratified. Commonly intertongued or interbedded with lake silt and clay (**lca**). May contain flowtill units near lower and upper contacts. Matrix carbonate varies; chiefly calcite. Scattered pebbles; sparse cobbles and boulders. Clasts chiefly local limestone and shale; some erratic igneous and metamorphic rocks. Discontinuous; includes areas of older loamy and sandy loamy till. Also includes some areas of outwash or ice-contact sand and gravel (**gg, kg, ke**), lake clay, silt, sand, and gravel (**lca, lsa**), alluvium (**al**), and bedrock. Locally overlain by peat (**hp**) or swamp deposits (**hs**)
- tka Ground moraine—Thickness generally 1-2 m, locally more than 5 m
- tka Ground moraine under Lake Ontario—Includes areas of bedrock and local accumulations of boulders, cobbles, and lag gravel. Thickness generally 1-2 m
- LOAMY TILL—Yellowish-brown, bluish-gray, gray, or mottled calcareous loam and silt loam; locally sandy loam or clay loam. Nonstratified or poorly sorted; nonstratified. Compact; horizontal platy structure typical. Moderately pebbly to pebbly; locally cobbly or bouldery. Pebbles chiefly local limestone, dolomite, sandstone, and shale. Boulders and cobbles commonly local limestone and dolomite and erratic igneous and metamorphic rocks. Includes small areas of outwash and ice-contact sand and gravel (**gg, kg, ke**), lake clay, silt, sand, and gravel (**lca, lsa**), alluvium (**al**), and bedrock. Locally overlain by dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**)
- tl Ground moraine—Thickness generally 1-3 m
- tl End moraine—Low ridges with knob-and-kettle topography. Thickness generally 4-20 m
- teb SANDY LOAMY TILL—Yellowish-brown, brown, brownish-gray, and gray, very calcareous sandy loam and loam. Grades northward into sandy till (**ts**). Nonstratified or poorly stratified; nonsorted. Contains abundant lenses of sand and gravel. Nonplastic; soft to very stiff. Moderately pebbly to pebbly. Clasts chiefly local limestone, dolomite, and siltstone; erratic igneous and metamorphic clasts common in some areas. Occurs chiefly as discontinuous ground moraine veneer on older loamy, sandy loamy, or sandy till or on bedrock. Includes areas of older sandy loamy or loamy till, outwash or ice-contact sand and gravel (**gg, kg**) lake clay, silt, sand, and gravel (**lca, lsa**), and alluvium (**al**). Locally overlain by peat (**hp**), swamp deposits (**hs**), or eolian sand (**ed**). Thickness generally less than 3 m
- LOAMY TILL—Pale-yellow, brownish-yellow, yellowish-brown, brown, bluish-gray, gray, or mottled calcareous loam, silt loam, silty clay loam, and clay loam. Nonstratified or poorly sorted; nonstratified or weakly stratified. Compact; irregular horizontal platy structure typical. Sparingly pebbly to pebbly; nearly pebble free where derived from incorporated lake sediments. Cobbles and boulders common to abundant. Pebbles, cobbles, and small boulders chiefly limestone, dolomite, sandstone, and shale; large boulders chiefly crystalline metamorphic rocks. Includes areas of lake clay, silt, sand, and gravel (**lca, lsa**), outwash and ice-contact sand and gravel (**gg, kg**), and bedrock. Locally overlain by peat (**hp**) or swamp deposits (**hs**)
- tlg Ground moraine—Thickness generally 1-3 m
- tlg Ground moraine under Lake Ontario—Includes extensive areas of bedrock and local accumulations of boulders, cobbles, and lag gravel. Thickness generally 1-2 m

LOAMY TILL—Reddish-brown, yellowish-brown, olive-brown, brown, olive, maroon, reddish-gray, olive-gray, bluish-gray, gray, olive-black, black, or mottled loam, silt loam, silty clay loam, and clay loam; locally loamy sand, sandy loam, or clay. Calcareous or noncalcareous, depending on composition of local bedrock and other source materials. Nonsorted or poorly sorted; nonstratified or poorly stratified. Locally interbedded with silt and sand. Lower part typically moderately indurated and compact; upper part typically loose and gravelly. Commonly stony; locally very cobbly or bouldery. Clasts angular to rounded. Clasts chiefly clastic and carbonate sedimentary rocks and igneous, metaigneous, metasedimentary, and metavolcanic rocks. Includes areas of sandy loamy till (**tda**) and sandy till (**ts**). Also 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, asq**), and bedrock. Locally overlain by dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**)

tlc Ground moraine—Thickness generally 1.5-5 m, rarely more than 10 m. In Vermont, thickest on north- and west-facing slopes and in valleys

tlc End moraine—Narrow low hummocky ridges. Thickness generally 5-10 m

tlr Discontinuous loamy till—Thin, discontinuous deposits separated by numerous or extensive bedrock outcrops on which are scattered erratic clasts. Thickness generally less than 2 m

SANDY LOAMY TILL—Pale-red, pale-yellow, brownish-yellow, reddish-brown, yellowish-brown, olive-brown, grayish-brown, brown, olive, yellowish-gray, olive-gray, brownish-gray, bluish-gray, gray, or mottled sandy loam and loamy fine sand; locally loam, silt loam, silty clay loam, or sand. Colors and textures reflect composition of bedrock. Calcareous or noncalcareous, depending on composition of local bedrock. Nonsorted; nonstratified. Firm to compact. Locally dense and hard; commonly friable. Massive, blocky, or fissile. Weak platy structure typical. Generally pebbly; commonly gritty, gravelly, cobbly, or stony; boulders abundant locally. Clast lithologies vary, depending on composition of bedrock and other source materials; clasts chiefly limestone, dolomite, shale, sandstone, and igneous, metaigneous, metasedimentary, and metavolcanic rocks. Clasts locally derived in most areas. Rolling, ridged, or hummocky topography; local isolated mounds or knolls. Oriented ridges commonly 2-10 m, locally 15-30 m, high, common in some areas; comprises drumlins in some areas. Commonly modified by waves and currents where submerged in glacial lakes or Champlain Sea. In places surface is veneered by nonfossiliferous sand or gravel; in other places surface is veneered by a coarse fossiliferous, stony diamicton with a boulder litter. Karst features locally where thin till overlies limestone or dolomite

tdh Ground moraine—Thickness generally 2-10 m, locally more than 125 m

tdh End moraine—Hummocky ridges. Thickness generally 5-15 m

tdr Discontinuous sandy loamy till—Thin, discontinuous deposits separated by numerous or extensive bedrock outcrops. Thickness generally less than 2 m

SANDY LOAMY TILL—Yellowish-orange, yellow, reddish-brown, yellowish brown, olive-brown, grayish-brown, yellowish-gray, olive-gray, bluish-gray, gray, black, or mottled sandy loam and loam; locally loamy sand, silt loam, or silty clay loam. Colors and textures reflect composition of local bedrock. Texture generally coarser on 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 loose and stony in upper part; compact, cohesive, and friable at depth. Locally partly indurated, hard, brittle. Gritty where derived from gneiss or schist. Till has foliated parting where bedrock is micaceous schist. Generally oxidized throughout. Generally pebbly; cobbles and boulders common to abundant; locally stony; boulder litter common on surface. Clast composition varies, reflecting composition of local bedrock and other source materials. Pebbles and small cobbles chiefly local bedrock; larger clasts chiefly erratic lithologies. Clasts generally angular-to-subrounded clastic sedimentary rocks and igneous, metaigneous, metavolcanic, and metasedimentary rocks. Till commonly discontinuous. In Vermont and New Hampshire, till thickest on north facing slopes and in valleys. Includes colluvium on and below steep slopes and local deposits of rock waste. Also includes areas of loamy till (**tlc**), sandy till (**ts**), outwash and ice-contact sand and gravel (**gg, kg, kd, ke**), lake clay,

- silt, sand, and gravel (**lca**, **lsa**), alluvium (**al**), and bedrock outcrops. Locally overlain by dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**)
- tda Ground moraine—Thickness generally 1-5 m, locally more than 15 m
- tdr Discontinuous sandy loamy till—Thin, discontinuous deposits separated by numerous or extensive bedrock outcrops. Thickness generally less than 2 m
- tsa SANDY TILL—Brownish-yellow, yellowish-brown, brownish-gray, gray or mottled, very calcareous coarse sand, loamy sand, or sandy loam; locally reddish brown or reddish gray silty clay where derived from red shale and siltstone. Poorly sorted; nonstratified. In places intertongued with poorly sorted gravel. Typically compact; locally loose. Extremely stony; clasts chiefly angular and subangular pebbles, cobbles, boulders, and blocks of limestone. Commonly less than 2 percent of clasts are igneous and metamorphic rocks from Canadian Shield to north; crystalline boulders conspicuous locally. Typically very hummocky; irregular mounds generally less than 6 m high, locally 15 m high. Includes some crudely sorted outwash and ice-contact sand and gravel (**gg**, **kg**). Thickness generally 1-4 m, locally 30 m
- kd KAME DELTA SAND AND GRAVEL—Pale-yellow, yellowish-brown, reddish-brown, olive-brown, grayish-brown, brown, brownish-gray, gray, or mottled sand and pebble or cobble gravel with lenses of very fine sand and silt. Calcareous or noncalcareous, depending on composition of source materials. Moderately to well sorted; well stratified. Topset beds typically pebble and cobble gravel or pebbly sand and silt; foreset beds typically sand and pebble gravel; bottomset beds typically horizontally bedded fine sand, silt, and clay. Clasts subrounded or rounded; clast composition similar to that of ice-contact sand and gravel (**kg**) in same area. Similar to lake delta sand and gravel (**lds**), but characterized by steep headward ice-contact slopes in which bedding is disturbed by folds, faults, and other collapse structures. Deposited by streams that flowed from ice into ice-marginal lakes. Deposits commonly perched on slopes above valley floors. Many small kame delta deposits are included in ice-contact sand and gravel (**kg**). Includes deposits of lake delta sand and gravel (**lds**) where the two kinds of delta deposits are not distinguished. Locally overlain by dune sand (**ed**). Thickness generally 5-20 m, locally more than 25 m
- gkl OUTWASH SAND AND GRAVEL—Complex deposit of outwash sand and gravel (**gg**), ice-contact sand and gravel (**kg**), and lake clay, silt, sand, and gravel (**lca**, **lsa**) in interlobate area north of Lake Ontario. Chiefly outwash gravel, sand, and silt (**gg**); kames and kame ridges of ice-contact sand and gravel common along margins. In places outwash and ice-contact deposits overlain by lake clay, silt, sand, and gravel (**lca**, **lsa**), discontinuous loamy till (**tka**), flowtill, or eolian sand and silt (**ed**). Surface rolling to very hummocky; local relief generally less than 10 m, locally more than 20 m. Thickness generally 20-40 m, locally more than 60 m
- lcr DISCONTINUOUS LAKE SILT AND CLAY—Thin, discontinuous lake silt and clay (**lca**) overlying bedrock. Most of area is wave- or current-washed bedrock. Thickness generally less than 1 m
- lsa LAKE SAND AND GRAVEL—Pale-yellow, brownish-yellow, yellowish-brown, reddish-brown, olive-brown, grayish-brown, brown, olive, yellowish-gray, gray, or mottled fine to coarse sand containing pebble layers or lenses of silt and rounded gravel; locally pebble or cobble gravel. Calcareous or noncalcareous, depending on composition of source materials. Generally well sorted, well stratified. Commonly crossbedded; local lenticular or tabular foreset beds; massive in places. Friable; very weak coarse blocky structure common. Clasts generally well rounded; clasts composition varies, reflecting composition of materials transported by waves and currents. Nearshore, strand, and delta deposits of former glacial and postglacial lakes. Includes deposits of beach ridges, offshore bars, and spits. Also includes areas of outwash and ice-contact sand and gravel (**gg**, **kg**, **ke**, **kd**), lake silt and clay (**lca**), alluvium (**al**), till, and bedrock. Locally overlain by dune sand (**ed**), peat (**hp**), or swamp deposits (**hs**). Thickness generally 1-10 m, locally 30 m
- lsr DISCONTINUOUS LAKE SAND AND GRAVEL—Thin, discontinuous lake sand and gravel (**lsa**) overlying bedrock. Most of mapped area is wave- or current-washed bedrock. Thickness generally less than 1 m
- lds LAKE DELTA SAND AND GRAVEL—Pale-yellow, yellowish-brown, reddish-brown, olive-brown, grayish-brown, brownish-gray, gray, or mottled sand and pebble or cobble gravel containing lenses of fine sand and silt. Calcareous or noncalcareous, depending on composition of source

materials. Moderately to well sorted; well stratified. Topset beds typically pebble and cobble gravel or pebbly sand and silt; foreset beds typically sand and pebble gravel; bottomset beds typically horizontally bedded fine sand, silt, and clay. Clasts subrounded or rounded; clast composition similar to that of outwash and ice-contact sand and gravel (**gg, kg, kd**) in same area. Deposited in glacial lakes; commonly perched on slopes above valley floors. Many small lake delta deposits are included in kame delta sand and gravel (**kd**) and ice-contact sand and gravel (**kg**). Locally overlain by dune sand (**ed**). Thickness generally 5-20 m, locally more than 30 m

SOURCES OF INFORMATION

LAKE ONTARIO

- Lewis, C.F.M., and McNeely, R.N., 1967, Survey of Lake Ontario bottom sediments: International Association for Great Lakes Research, Tenth Conference on Great Lakes Research, Proceedings, p. 133-142.
- Thomas, R.L., Kemp, A.L.W., and Lewis, C.F.M., 1972a, Distribution, composition, and characteristics of the surficial sediments of Lake Ontario: *Journal of Sedimentary Petrology*, v. 42, p. 66-84.
- Thomas, R.L., Kemp, A.L.W., and Lewis, C.F.M., 1972b, Report on the surficial sediment distribution of the Great Lakes, Part 1—Lake Ontario: Geological Survey of Canada Paper 72-17, 52 p.
- Unpublished map of Lake Ontario surficial geology, by J.R. Bowlby and C.F.M. Lewis, compilers, Geological Survey of Canada Centre for Inland Waters, Burlington, Ontario, 1976, scale 1:1,400,000.
- Unpublished map of Great Lakes bottom sediment distribution, by R.L. Thomas, Canadian Bureau of Fisheries, scale 1:1,500,000.

NEW HAMPSHIRE

- Chapman, D.H., 1950, Clays of New Hampshire: New Hampshire Planning and Development Commission Mineral Resources Survey, pt. 12, 27 p.
- Goldthwait, J.W., 1925, The geology of New Hampshire: New Hampshire Academy of Science Handbook 1, 86 p.
- Goldthwait, J.W., Goldthwait, Lawrence, and Goldthwait, R.P., 1951, The geology of New Hampshire; Part I, Surficial geology: New Hampshire Planning and Development Commission, 83 p.
- Goldthwait, Lawrence, 1948, Glacial till in New Hampshire: New Hampshire Planning and Development Commission Mineral Resources Survey, pt. 10, 11 p.
- U.S. Soil Conservation Service, published soil survey maps of individual counties.
- Unpublished map information contributed by G. W. Stewart.

NEW YORK

- Alling, H.L., 1916, Glacial lakes and other glacial features of the central Adirondacks: *Geological Society of America Bulletin*, v. 27, p. 645-672.
- Alling, H.L., 1918, Pleistocene geology, in Miller, W.J., *Geology of the Lake Placid quadrangle*: New York State Museum Bulletin 211-212, p. 71-95.
- Alling, H.L., 1921, Glacial geology, in Kemp, J.F., *Geology of the Mount Marcy quadrangle*, Essex County, New York: New York State Museum Bulletin 229-230, p. 62-84.
- Buddington, A.F., 1934, Geology and mineral resources of the Hammond, Antwerp, and Lowville quadrangles: *New York State Museum Bulletin* 296, 182 p.
- Buddington, A.F., 1937, Geology of the Santa Clara quadrangle, New York: *New York State Museum Bulletin* 309, 56 p.
- Buddington, A.F., 1953, Geology of the Saranac quadrangle, New York: *New York State Museum Bulletin* 346, 100 p.
- Buddington, A.F., and Leonard, B.F., 1962, Regional geology of the St. Lawrence County magnetite district, northwest Adirondacks, New York: U.S. Geological Survey Professional Paper 376, 145 p.
- Buddington, A.F., and Whitcomb, Lawrence, 1941, Geology of the Willsboro quadrangle, New York: *New York State Museum Bulletin* 325, 137 p.
- Carl, J.D., 1978, Ribbed moraine-drumlin transition belt, St. Lawrence Valley, New York: *Geology*, v. 6, p. 562-566.
- Chadwick, G.H., 1928, Adirondack eskers: *Geological Society of America Bulletin*, v. 39, p. 923-929.
- Chapman, D.H., 1937, Late glacial and postglacial history of the Champlain Valley: *American Journal of Science*, v. 34, p. 89-124.
- Clark, P.U., 1980, Late Quaternary history of the Malone area, New York: Waterloo, Ontario, University of Waterloo, M.S. thesis, 188 p.

- Clark, P.U., and Karrow, P.F., 1983, Till stratigraphy in the St. Lawrence Valley near Malone, New York- Revised glacial history and stratigraphic nomenclature: Geological Society of America Bulletin, v. 94, p. 1308-1318.
- Clark, P.U., and Karrow, P.F., 1984, Late Pleistocene water bodies in the St. Lawrence Lowland, New York, and regional correlations: Geological Society of America Bulletin, v. 95, p. 805-813.
- Clark, P.U., and Street, J.S., 1984, Late Quaternary, St. Lawrence Lowland: Friends of the Pleistocene, Eastern Section, 47th annual meeting, Guidebook, 59 p.
- Craft, J.L., 1969, Surficial geology and geomorphology of Whiteface Mountain and Keene Valley, in Barnett, S.G., ed., Guidebook to field excursions: New York State Geological Association, 41st annual meeting, Plattsburgh, New York, Guidebook, p. 135-137.
- Craft, J.L., 1976, Pleistocene local glaciation in the Adirondack Mountains, New York: London, Ontario, University of Western Ontario, Ph.D. dissertation, 226 p.
- Craft, J.L., 1979, Evidence of local glaciation, Adirondack Mountains, New York: Friends of the Pleistocene, Eastern Section, 42nd annual reunion, Guidebook, 75 p.
- Cushing, H.P., 1907, Geology of the Long Lake quadrangle: New York State Museum Bulletin 115, p. 451-531.
- Cushing, H.P., 1916, Geology of the vicinity of Ogdensburg (Brier Hill, Ogdensburg, and Red Mills quadrangles): New York State Museum Bulletin 191, 64 p.
- Cushing, H.P., Fairchild, H.L., Ruedemann, Rudolf, and Smyth, C.H., Jr., 1910, Geology of the Thousand Islands region, Alexandria Bay, Cape Vincent, Clayton, Grindstone, and Theresa quadrangles, New York: New York State Museum Bulletin 145, p. 121-172.
- Cushing, H.P., and Newland, D.H., 1925, Geology of the Gouverneur quadrangle: New York State Museum Bulletin 259, 122 p.
- Dale, N.C., 1934, Preliminary report on the geology of the Russell quadrangle: New York State Museum Circular 15, p. 3-16.
- Dale, N.C., 1935, Geology of the Oswegatchie quadrangle: New York State Museum Bulletin 302, 101 p.
- Denny, C.S., 1967, Surficial geologic map of the Dannemora quadrangle and part of the Plattsburgh quadrangle, New York: U.S. Geological Survey Geologic Quadrangle Map GQ-635, scale 1:24,000.
- Denny, C.S., 1970, Surficial geologic map of the Mooers quadrangle and part of the Rouses Point quadrangle, Clinton County, New York: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-630, scale 1:24,000.
- Denny, C.S., 1972, The Ingraham esker, Chazy, New York: U.S. Geological Survey Professional Paper 800-B, p. B35-B41.
- Denny, C.S., 1974, Pleistocene geology of the northeast Adirondack region, New York: U.S. Geological Survey Professional Paper 786, 50 p.
- Eppler, D.T., 1973, Late Pleistocene geology of Elm Creek, Edwards, and Pitcairn Valleys, St. Lawrence County, New York: Syracuse, New York, Syracuse University, M.S. thesis, 67 p.
- Hayes, M.D., 1981, The late Pleistocene geologic history of the Canton, New York, 7.5-minute quadrangle: Canton, New York, St. Lawrence University, B.S. thesis, 59 p.
- Kemp, J.F., and Alling, H.L., 1925, Geology of the Ausable quadrangle: New York State Museum Bulletin 261, 126 p.
- Kemp, J.F., and Ruedemann, Rudolf, 1910, Geology of the Elizabethtown and Port Henry quadrangles: New York State Museum Bulletin 138, 173 p.
- Kirkland, J.T., and Coates, D.R., 1977, The Champlain Sea and Quaternary deposits in the St. Lawrence Lowland, New York: New York Academy of Science, Annals, v. 88, p. 70-89.
- MacClintock, Paul, 1958, Glacial geology of the St. Lawrence Seaway and power projects: New York State Museum and Science Service, 26 p.
- MacClintock, Paul, and Stewart, D.P., 1965, Pleistocene geology of the St. Lawrence Lowland: New York State Museum and Science Service Bulletin 394, 152 p.
- MacClintock, Paul, and Terasmae, Jaan, 1960, Glacial history of Covey Hill: Journal of Geology, v. 68, p. 232-241.
- Miller, W.J., 1919, Geology of the Lake Placid quadrangle: New York State Museum Bulletin 211-212, 106 p.

- Miller, W.J., 1926, Geology of the Lyon Mountain quadrangle: New York State Museum Bulletin 271, 101 p.
- Ogilvie, I.H., 1902, Glacial phenomena in the Adirondacks and Champlain Valley: *Journal of Geology*, v. 10, p. 397-412.
- Pair, Donald, 1986, Reconstruction and history of ice retreat, proglacial lakes, and the Champlain Sea, central St. Lawrence Lowlands, New York: Waterloo, Ontario, University of Waterloo, M.S. thesis, 204 p.
- Pair, Donald, Karrow, P.F., and Clark, P.U., 1988, History of the Champlain Sea in the central St. Lawrence Lowland, New York, and its relationship to water levels in the Lake Ontario basin, in Gadd, N.R., ed., *The late Quaternary development of the Champlain Sea basin: Geological Association of Canada Special Paper 35*, p. 107-123.
- Postel, A.W., 1952, Geology of Clinton County magnetite district, New York: U.S. Geological Survey Professional Paper 237, 88 p.
- Reed, J.C., 1934, Geology of the Potsdam quadrangle: New York State Museum Bulletin 297, 98 p.
- Smyth, C.H., Jr., and Buddington, A.F., 1926, Geology of the Lake Bonaparte quadrangle: New York State Museum Bulletin 269, 106 p.
- Taylor, F.B., 1924, Moraines of the St. Lawrence Valley: *Journal of Geology*, v. 32, p. 641-667.
- Trainer, F.W., and Salvias, E.H., 1962, Ground-water resources of the Massena-Waddington area, St. Lawrence County, New York, with emphasis on the effect of Lake St. Lawrence on ground water: New York Department of Conservation, Water Resources Commission Bulletin GW-47, 227 p.
- U.S. Soil Conservation Service, published soil survey maps of individual counties.
- Waller, R.M., 1976, Surficial geologic map of the Black River Basin, New York: U.S. Geological Survey Miscellaneous Field Studies Map MF-728A, scale 1:125,000.
- Woodworth, J.B., 1905a, Pleistocene geology of the Mooers quadrangle: New York State Museum Bulletin 83, 60 p.
- Woodworth, J.B., 1905b, Ancient water levels of the Champlain and Hudson Valleys: New York State Museum Bulletin 84, 265 p.

ONTARIO

- Barnett, P.J., 1980, Quaternary geology of the Fort Coulonge area, Renfrew County, Ontario: Ontario Geological Survey Geologic Series Preliminary Map P.2367, scale 1:50,000.
- Barnett, P.J., 1988, History of the northwestern arm of the Champlain sea, in Gadd, N.R., ed., *The late Quaternary development of the Champlain Sea basin: Geological Association of Canada Special Paper 35*, p. 25-36.
- Barnett, P.J., and Ainsworth, B., 1982, Quaternary geology of the Brudenell area, Ontario: Ontario Geological Survey Geological Series Preliminary Map P.2558, scale 1:50,000.
- Barnett, P.J., and Ainsworth, B., 1988, Quaternary geology of the Golden Lake area, Ontario: Ontario Geological Survey Geological Series Preliminary Map P.3125, scale 1:50,000.
- Barnett, P.J., and Clarke, W.S., 1980a, Quaternary geology of the Renfrew area, Ontario: Ontario Geological Survey Geological Series Preliminary Map P.2365, scale 1:50,000.
- Barnett, P.J., and Clarke, W.S., 1980b, Quaternary geology of the Cobden area, Renfrew County, Ontario: Ontario Geological Survey Geological Series Preliminary Map P.2366, scale 1:50,000.
- Barnett, P.J., and Leyland, J.G., 1980, Quaternary geology of the Bancroft area, southern Ontario: Ontario Geological Survey Geological Series Preliminary Map P.2376, scale 1:50,000.
- Barnett, P.J., and Leyland, J.G., 1988, Quaternary geology of the Pembroke area, Ontario: Ontario Geological Survey Geological Series Preliminary Map P.3124, scale 1:50,000.
- Burger, D., 1967, Distribution and origin of parent soil materials in part of the Ottawa and Bonnechere River valleys, Ontario: *Canadian Journal of Earth Sciences*, v. 4, p. 397-411.
- Canada Department of Agriculture, published soils maps of individual counties.
- Catto, N.R., Patterson, R.J., and Gorman, W.A., 1981, Late Quaternary marine sediments at Chalk River, Ontario: *Canadian Journal of Earth Sciences*, v. 18, p. 1261-1267.
- Catto, N.R., Patterson, R.J., and Gorman, W.A., 1982, The late Quaternary geology of the Chalk River region, Ontario and Quebec: *Canadian Journal of Earth Sciences*, v. 19, p. 1218-1231.

- Chapman, L.J., 1975, The physiography of the Georgian Bay-Ottawa Valley area of southern Ontario: Ontario Division of Mines Geoscience Report 128, 33 p.
- Chapman, L.J., and Putnam, D.F., 1972, Physiography of the eastern portion of southern Ontario: Ontario Department of Mines and Northern Affairs Map 2227, scale 1:253,440.
- Chapman, L.J., and Putnam, D.F., 1984, The physiography of southern Ontario (3rd ed.): Ontario Geological Survey Special Volume 2, 270 p.
- Finamore, P.F., and Courtney, S.J., 1982, Quaternary geology of the Coe Hill area, southern Ontario: Ontario Geological Survey Geological Series Preliminary Map P.2536, scale 1:50,000.
- Ford, M.J., and Geddes, R.S., 1986, Quaternary geology of the Algonquin Park area: Ontario Geological Survey Open File Report 5600, 87 p.
- Ford, M.J., and Lall, R.A., 1983, Quaternary geology of Algonquin Park, northeastern part, Nipissing District and Renfrew County: Ontario Geological Survey Geological Series Preliminary Map P.2609, scale 1:50,000.
- Gadd, N.R., 1963a, Surficial geology of Ottawa map-area, Ontario and Quebec: Geological Survey of Canada Paper 62-16, 4 p.
- Gadd, N.R., 1963b, Surficial geology, Chalk River, Ontario-Quebec: Geological Survey of Canada Map 1132A, scale 1:63,360.
- Gadd, N.R., 1976, Surficial geology and landslides of Thurso-Russell map-area, Ontario: Geological Survey of Canada Paper 75-35, 18 p.
- Gadd, N.R., 1980, Late-glacial regional ice-flow patterns in eastern Ontario: Canadian Journal of Earth Sciences, v. 17, p. 1439-1453.
- Gadd, N.R., 1987, Geological setting and Quaternary deposits of the Ottawa region, in Fulton, R.J., ed., Quaternary geology of the Ottawa region, Ontario and Quebec: Geological Survey of Canada Paper 86-23, p. 3-9.
- Gwyn, Q.H.J., and Lohse, H., 1973, Quaternary geology of the Alexandria area, southern Ontario: Ontario Division of Mines Geological Series Preliminary Map P.906, scale 1:50,000.
- Gwyn, Q.H.J., and Thibault, J.J.L., 1975, Quaternary geology of the Hawkesbury-Lachute area, southern Ontario: Ontario Division of Mines Geological Series Preliminary Map P.1010, scale 1:50,000.
- Henderson, E.P., 1966, Surficial geology, Gananoque-Wolfe Island, Ontario: Geological Survey of Canada Map 13-1965, scale 1:50,000.
- Henderson, E.P., 1967a, Surficial geology, Westport, Ontario: Geological Survey of Canada Map 22-1966, scale 1:50,000.
- Henderson, E.P., 1967b, Surficial geology north of the St. Lawrence, Kingston to Prescott, in Jenness, S.E., ed., Geology of parts of eastern Ontario and western Quebec: Geological Association of Canada-Mineralogical Association of Canada Field Conference, Kingston, Ontario, Guidebook, p. 199-207.
- Henderson, E.P., 1970, Surficial geology of Brockville and Mallorytown map-areas, Ontario: Geological Survey of Canada Paper 70-18, scale 1:50,000.
- Henderson, E.P., 1973, Surficial geology of Kingston (north half) map-area, Ontario: Geological Survey of Canada Paper 72-48, 6 p.
- Johnston, W.A., 1917, Pleistocene and recent deposits in the vicinity of Ottawa, with a description of the soils: Geological Survey of Canada Memoir 101, 69 p.
- Kettles, L.M., and Shilts, W.W., 1987, Tills of the Ottawa region, in Fulton, R.J., ed., Quaternary geology of the Ottawa region, Ontario and Quebec: Geological Survey of Canada Paper 86-23, p. 10-13.
- Leyland, J.G., 1982, Quaternary geology of the Tweed area, southern Ontario: Ontario Geological Survey Geological Series Preliminary Map P.2615, scale 1:50,000.
- Leyland, J.G., 1984, Quaternary geology of the northeastern Lake Ontario basin: St. Catherines, Ontario, Brock University, M.S. thesis.
- Leyland, J.G., and Mihychuk, Mary-Anne, 1984, Quaternary geology of the Trenton-Consecon area, southern Ontario: Ontario Geological Survey Geological Series Preliminary Map P.2586, scale 1:50,000.
- Leyland, J.G., and Russell, T.S., 1983, Quaternary geology of the Bath-Yorkshire Island area, southern Ontario: Ontario Geological Survey Geological Series Preliminary Map P.2588, scale 1:50,000.

- Mihychuk, Mary-Anne, 1984, The surficial geology, sedimentology, and geochemistry of the late glacial sediments and Paleozoic bedrock in the Campbellford area, Ontario, with special reference to the Dummer complex: St. Catherines, Ontario, Brock University, M.S. thesis.
- Minning, G.V., 1972, Surficial geology, Arnprior, Ontario: Geological Survey of Canada Open-File 118, scale 1:50,000.
- Mirynech, Edward, 1962, Pleistocene geology of the Trenton-Campbellford map-area, Ontario: Toronto, Ontario, University of Toronto, Ph.D. dissertation, 197 p.
- Mirynech, Edward, 1967, Pleistocene and surficial geology of the Kingston-Coburg-Tweed area, Ontario, in Jenness, S.E., ed., Geology of parts of eastern Ontario and western Quebec: Geological Association of Canada-Mineralogical Association of Canada Field Conference, Kingston, Ontario, Guidebook, p. 183-198.
- Mirynech, Edward, 1978, Surficial geology, Belleville, Trenton, Tweed, Campbellford, and Sydenham map-areas, Ontario: Geological Survey of Canada Open-File 545, scale 1:50,000.
- Mollard, D.G., 1980, Bancroft and Haliburton areas, Southern Ontario Engineering Geology Terrain Study: Ontario Geological Survey Open-File Report 5317, 2 p.
- Ontario Soil Survey, published soils maps of individual counties.
- Owen, E.B., 1951a, Pleistocene and recent deposits of the CornwallCardinal area, Stormont, Dundas, and Grenville Counties, Ontario: Geological Survey of Canada Paper 51-12, 25 p.
- Owen, E.B., 1951b, Ground-water resources of Matilda Township, Dundas County, Ontario: Geological Survey of Canada Water-Supply Paper 310, 44 p.
- Owen, E.B., 1953, Ground-water resources of Edwardsburgh Township, Grenville County, Ontario: Geological Survey of Canada Water Supply Paper 316, 47 p.
- Richard, S.H., 1976a, Surficial geology, Carleton Place, Ontario: Geological Survey of Canada Open-File 361, scale 1:50,000.
- Richard, S.H., 1976b, Surficial geology of Ottawa map-area: Geological Survey of Canada Open-File 366, scale 1:50,000.
- Richard, S.H., 1976c, Surficial geology, Thurso, Ontario and Quebec: Geological Survey of Canada Open-File 368, scale 1:50,000.
- Richard, S.H., 1980, Surficial geology and geomorphology, Lachute, Quebec-Ontario: Geological Survey of Canada Open-File 548, scale 1:50,000.
- Richard, S.H., 1982a, Surficial geology, Vaudreuil, Quebec-Ontario: Geological Survey of Canada Map 1488A, scale 1:50,000.
- Richard, S.H., 1982b, Surficial geology, Huntingdon, Quebec-Ontario: Geological Survey of Canada Map 1489A, scale 1:50,000.
- Richard, S.H., 1982c, Surficial geology, Winchester, Ontario: Geological Survey of Canada Map 1491A, scale 1:50,000.
- Richard, S.H., 1982d, Surficial geology, Kemptville, Ontario: Geological Survey of Canada Map 1492A, scale 1:50,000.
- Richard, S.H., 1982e, Surficial geology, Morrisburg, Ontario-New York: Geological Survey of Canada Map 1493A, scale 1:50,000.
- Richard, S.H., 1982f, Surficial geology, Ottawa, Ontario-Quebec: Geological Survey of Canada Map 1506A, scale 1:50,000.
- Richard, S.H., 1982g, Surficial geology, Russell, Ontario: Geological Survey of Canada Map 1507A, scale 1:50,000.
- Richard, S.H., 1984a, Surficial geology, Lachute-Arundel, Quebec-Ontario: Geological Survey of Canada Map 1577A, scale 1:100,000.
- Richard, S.H., 1984b, Surficial geology, Arnprior, Ontario-Quebec: Geological Survey of Canada Map 1599A, scale 1:50,000.
- Richard, S.H., 1985, Surficial geology, Buckingham, Quebec-Ontario: Geological Survey of Canada Map 1678A, scale 1:100,000.
- Richard, S.H., Gadd, N.R., and Vincent, J.-S., 1977, Surficial materials and terrain features, Ottawa-Hull area, Ontario-Quebec: Geological Survey of Canada Map 1425A, scale 1:125,000.
- Sharpe, D.R., 1979, Quaternary geology of the Merrickville area, southern Ontario: Ontario Geological Survey Report 180, 54 p.

- Terasmae, Jaan, 1960, Surficial geology of Cornwall map-area, Ontario and Quebec: Geological Survey of Canada Paper 60-28, 4 p.
- Terasmae, Jaan, 1965, Surficial geology of the Cornwall and St. Lawrence Seaway project areas, Ontario: Geological Survey of Canada Bulletin 121, 54 p.
- Veillette, J.J., 1986, Former southwesterly ice flows in the Abitibi-Timiskaming region; Implications for the configuration of the late Wisconsinan ice sheet: *Canadian Journal of Earth Sciences*, v. 23, p. 1724-1741.
- Vincent, J.-S., 1976, Dépôts meubles du secteur sud de la carte de Thurso, Ontario et Québec: Geological Survey of Canada Open-File 370, scale 1:50,000.

QUEBEC:

- Bernard, Claude, 1967, Les environs du lac Brome et de la bordure appalachienne dans le sud-ouest de l'Estrie; Etude de géomorphologie structurale: Montreal, Quebec, University of Montreal, Ph.D. dissertation, 347 p.
- Boissonnault, Paul, 1983, Géomorphologie et lithostratigraphie Quaternaires à l'est du Lac Memphrémagog: Sherbrooke, Quebec, University of Sherbrooke, M.S. thesis, 150 p.
- Boissonnault, Paul, and Gwyn, Q.H.J., 1983, l'évolution du lac proglaciaire Memphrémagog, sud du Québec: *Géographe physique et Quaternaire*, v. 37, p. 197-204.
- Boissonnault, Paul, Gwyn, Q.H.J., and Morin, B., 1981, Le lac proglaciaire Memphrémagog; Géologie, géomorphologie, archéologie: Sherbrooke, Quebec, University of Sherbrooke Department of Geography Research Bulletin 55, 42 p.
- Byers, A.R., 1949, The nature and origin of the glacial and postglacial deposits lying between the City of Montreal and the Canadian Shield: Montreal, Quebec, McGill University, M.S. thesis.
- Canada Department of Agriculture, published soils maps of individual counties.
- Catto, N.R., Patterson, R.J., and Gorman, W.A., 1982, The late Quaternary geology of the Chalk River region, Ontario and Quebec: *Canadian Journal of Earth Sciences*, v. 19, p. 1218-1231.
- Cloutier, Marc, 1982, Géologie et géomorphologie Quaternaires de la région de Cowansville-Knowlton-Sutton, Quebec: University of Quebec at Montreal, M.S. thesis, 147 p.
- Corbeil, Paul, 1984, Géologie du Quaternaire de la région de Rigaud/Rivière Beaudette, Québec; Quelques applications à l'environnement: University of Quebec at Montreal, M.S. thesis, 103 p.
- Denis, Robert, 1974, Late Quaternary geology and geomorphology in the Lake Maskinongé area, Québec: Uppsala Universitet Naturgeografiska Institutionen Rapport 28, 125 p.
- Denis, Robert, and Prichonnet, Gilbert, 1973, Aspects du Quaternaire dans la région au nord de Joliette: Second Conference on the Quaternary of Quebec, University of Quebec at Montreal, Guidebook, 53 p.
- Doiron, André, 1981, Les dépôts Quaternaires de la région de Granby-Waterloo, Québec; Cartographie, sédimentologie, et stratigraphie: University of Quebec at Montreal, M.S. thesis, 100 p.
- Dubé, J.-C., 1983, Géomorphologie Quaternaire et déglaciation à l'ouest du Lac Memphrémagog: Sherbrooke, Quebec, University of Sherbrooke, M.S. thesis, 139 p.
- Elson, J.A., 1962a, Geomorphology of the St. Lawrence Lowland and the Sutton area: Montreal, Quebec, McGill University, M.S. thesis.
- Elson, J.A., 1962b, Pleistocene geology of the St. Lawrence Lowlands, in Clark, T.H., ed., Guidebook: New England Intercollegiate Geological Conference, 54th annual meeting, Montreal, Quebec, p. 15-24.
- Fulton, R.J., and Rodrigues, C.G., 1987, Glacial and glaciomarine deposits and deglaciation of the area northwest of Ottawa, in Fulton, R.J., ed., Quaternary of the Ottawa region and guides for day excursions: International Union for Quaternary Research (INQUA), XII Congress, Ottawa, Ontario, Guidebook for Excursion C, p. 37-43.
- Gadd, N.R., 1955, Pleistocene geology of the Bécancour map-area, Québec: Urbana, University of Illinois, Ph.D. dissertation, 181 p.
- Gadd, N.R., 1959, Surficial geology, Yamaska, Quebec: Geological Survey of Canada Preliminary Map 43-1959, scale 1:63,360.
- Gadd, N.R., 1960a, Surficial geology, Aston, Quebec: Geological Survey of Canada Preliminary Map 50-1959, scale 1:63,360.

- Gadd, N.R., 1960b, Surficial geology of the Bécancour map-area, Quebec: Geological Survey of Canada Paper 59-8, 34 p.
- Gadd, N.R., 1960c, Surficial geology, Upton, Quebec: Geological Survey of Canada Paper 60-27, 4 p.
- Gadd, N.R., 1963, Surficial geology of Ottawa map-area, Ontario and Quebec: Geological Survey of Canada Paper 62-16, 4 p.
- Gadd, N.R., 1971, Pleistocene geology of the central St. Lawrence Lowlands: Geological Survey of Canada Memoir 359, 153 p.
- Gadd, N.R., 1987, Geological setting and Quaternary deposits of the Ottawa region, in Fulton, R.J., ed., Quaternary geology of the Ottawa region, Ontario and Quebec: Geological Survey of Canada Paper 86-23, p. 3-9.
- Gadd, N.R., and Karrow, P.F., 1960, Surficial geology, Trois Rivières map-area, Quebec: Geological Survey of Canada Preliminary Map 54-1959, scale 1:63,360.
- Gadd, N.R., LaSalle, Pierre, Dionne, J.-C., Shilts, W.W., and McDonald, B.C., 1972, Quaternary geology and geomorphology, western Québec: International Geological Congress, 24th session, Montreal, Quebec, Guidebook for excursion A44-C44, 74 p.
- Gadd, N.R., McDonald, B.C., and Shilts, W.W., 1972, Deglaciation of southern Quebec: Geological Survey of Canada Paper 71-47, 19 p.
- Karrow, P.F., 1957, Pleistocene geology of the Grondines map-area, Quebec: Urbana, University of Illinois, Ph.D. dissertation, 97 p.
- Karrow, P.F., 1959, Surficial geology, Grondines map-area, Quebec: Geological Survey of Canada Preliminary Map 41-1959, scale 1:63,360.
- Kettles, L.M., and Shilts, W.W., 1987, Tills of the Ottawa region, in Fulton, R.J., ed., Quaternary geology of the Ottawa region, Ontario and Quebec: Geological Survey of Canada Paper 86-23, p. 10-13.
- Kugler-Gagnon, M., 1977, The geoscientific information system for the north Montreal region: Geological Survey of Canada Paper 76-26, 15 p.
- Lamarche, R.Y., 1974, Southward, northward, and westward ice movement in the Asbestos area of southern Quebec: Geological Society of America Bulletin, v. 85, p. 465-470.
- Lamothe, Michel, 1977, Les dépôts meubles de la région de Saint-Faustin/Saint Jovite, Québec; Cartographie, sédimentologie, et stratigraphie: University of Quebec at Montreal, M.S. thesis, 118 p.
- Lamothe, Michel, 1985, Lithostratigraphy and geochronology of the Quaternary deposits of the Pierreville and Saint-Pierre-les-Becquets areas, Quebec: London, University of Western Ontario, Ph.D dissertation, 240 p.
- LaSalle, Pierre, 1963, Géologie des dépôts meubles de la région de Verchères, Québec: Ministère des Richesses Naturelles Québec Rapport Préliminaire 505, 9 p.
- LaSalle, Pierre, 1966, Late Quaternary vegetation and glacial history in the St. Lawrence Lowlands, Canada: Leidse Geologische Mededelingen, v. 38, p. 91-128.
- LaSalle, Pierre, 1970, Notes on the St-Narcisse morainic system north of Quebec City: Canadian Journal of Earth Sciences, v. 7, p. 516-521.
- LaSalle, Pierre, 1981, Géologie des dépôts meubles de la région de St-Jean/Lachine: Ministère de l'Énergie et des Ressources Québec Rapport Préliminaire DPV-780, 13 p.
- LaSalle, Pierre, David, P.P., and Bouchard, M.A., eds., 1982, Pleistocene, Drummondville-St. Hyacinthe area: Friends of the Pleistocene, Eastern Section, 45th annual meeting, University of Montreal, Guidebook, 60 p.
- LaSalle, Pierre, and Elson, J.A., 1962, Région de Beloeil, géologie des dépôts meubles: Ministère des Richesses Naturelles Québec Rapport Préliminaire 497, 10 p.
- LaSalle, Pierre, and Elson, J.A., 1975, Emplacement of the St. Narcisse moraine as a climatic event in eastern Canada: Quaternary Research, v. 5, p. 621-625.
- Laverdière, Camille, and Courtemanche, Albert, 1959, La géomorphologie glaciaire de la région du Mont Tremblant, part 1; Généralités et traits d'ensemble: Revue Canadienne Géographie, v. 4, p. 102-134.
- L'evesque, G., 1982, Géologie des dépôts Quaternaires de la région de Oka/Ste-Scholastique, Québec: University of Quebec at Montreal, M.S. thesis, 139 p.
- McDonald, B.C., 1966, Surficial geology, Richmond-Dudswell, Quebec: Geological Survey of Canada Preliminary Map 4-1966, scale 1:63,360.

- McDonald, B.C., 1967a, Surficial geology, Sherbrooke-Oxford-Memphremagog, Quebec: Geological Survey of Canada Preliminary Map 5-1966, scale 1:63,360.
- McDonald, B.C., 1967b, Pleistocene events and chronology in the Appalachian region of southeastern Quebec, Canada: New Haven, Connecticut, Yale University, Ph.D. dissertation, 161 p.
- McDonald, B.C., and Shilts, W.W., 1971, Quaternary stratigraphy and events in southeastern Quebec: Geological Society of America Bulletin, v. 82, p. 683-698.
- Occhietti, Serge, 1977, Stratigraphie du Wisconsinien de la région de Trois Rivières-Shawinigan, Québec: Géographie physique et Quaternaire, v. 31, p.307-322.
- Occhietti, Serge, 1979, Le Quaternaire de la région de Trois Rivières-Shawinigan, Québec; Contribution à la paléogéographie de la vallée moyenne du St-Laurent et corrélations stratigraphiques: Ottawa, Ontario, University of Ottawa, Ph.D dissertation, 408 p.
- Pagé, P., 1977, Les dépôts meubles de la région de Saint-Jean de Matha—Sainte-Emelie-de-l'Energie, Québec; Cartographie, sédimentologie, et stratigraphie: University of Quebec at Montreal, M.S. thesis, 118 p.
- Parry, J.T., 1963, The Laurentians; A study in geomorphological development: Montreal, Quebec, McGill University, Ph.D. dissertation, 222 p.
- Parry, J.T., and MacPherson, J.C., 1964, The St. Faustin-St. Narcisse moraine and the Champlain Sea: Revue de Géographie de Montreal, v. 18, p. 235-248.
- Prest, V.K., and Hode-Keyser, J., 1962, Géologie des dépôts meubles et sols de la région de Montréal, Québec: Cite de Montréal, service des travaux Publics 36, 35 p.
- Prest, V.K., and Hode-Keyser, J., 1977, Geology and engineering characteristics of surficial deposits. Montreal Island and vicinity, Quebec: Geological Survey of Canada Paper 75-27, 29 p.
- Prichonnet, Gilbert, 1977, La déglaciation de la vallée du Saint-Laurent et l'invasion marine contemporaine: Géographie physique et Quaternaire, v. 31, p. 323-345.
- Prichonnet, Gilbert, 1984a, Réévaluation des systèmes morainiques du sud du Québec (Wisconsinien supérieur): Geological Survey of Canada Paper 83-29, 20p.
- Prichonnet, Gilbert, 1984b, Les dépôts Quaternaires de la région de Granby, Québec: Geological Survey of Canada Paper 83-30, 8 p.
- Prichonnet, Gilbert, 1988, Glacial marine facies of the late Wisconsinan Champlain Sea (southern Quebec), in Gadd, N.R., ed., The late Quaternary development of the Champlain Sea basin: Geological Association of Canada Special Paper 35, p. 91-105.
- Prichonnet, Gilbert, Cloutier, Marc, and Doiron, André, 1982, Données récentes lithostratigraphiques. Nouveaux concepts sur la déglaciation Wisconsinienne, en bordure des Appalaches au sud du Québec: Association Canadienne-francaise pour l'Avancement des Sciences Congress (ACFS), 50e Congrès, University of Quebec at Montreal, Guidebook, 53 p.
- Prichonnet, Gilbert, Doiron, André, and Cloutier, Marc, 1982, Le mode de retrait glaciaire tardiwisconsinien sur la bordure Appalachienne au sud du Québec: Géographie physique et Quaternaire, v. 36, p. 125-137.
- Prichonnet, Gilbert, Durand, Marc, Elson, J.A., Gagnon, P., Schroeder, J., and Veillette, J.J., 1987, Wisconsin glaciations and deglaciations in southern Québec (Montréal region): International Union for Quaternary Research (INQUA), 12th Congress, Ottawa, Ontario, Guidebook for Field Excursion A-7/C-7, 50 p.
- Quebec Department of Agriculture, published soils maps of individual counties.
- Richard, S.H., 1976, Surficial geology, Wakefield, Quebec: Geological Survey of Canada Open-File 369, scale 1:50,000.
- Richard, S.H., 1980, Surficial geology and geomorphology, Lachute, Quebec and Ontario: Geological Survey of Canada Open-File 548, scale 1:50,000.
- Richard, S.H., 1982a, Surficial geology, Vaudreuil, Quebec-Ontario: Geological Survey of Canada Map 1488A, scale 1:50,000.
- Richard, S.H., 1982b, Surficial geology, Huntingdon, Quebec-Ontario: Geological Survey of Canada Map 1489A, scale 1:50,000.
- Richard, S.H., 1982c, Surficial geology, Ottawa, Ontario-Quebec: Geological Survey of Canada Map 1506A, scale 1:50,000.
- Richard, S.H., 1984a, Surficial geology, Lachute-Arundel, Quebec-Ontario: Geological Survey of Canada Map 1577A, scale 1:100,000.

- Richard, S.H., 1984b, Surficial geology, Arnprior, Ontario-Quebec: Geological Survey of Canada Map 1599A, scale 1:50,000.
- Richard, S.H., 1985, Surficial geology, Buckingham, Quebec-Ontario: Geological Survey of Canada Map 1678A, scale 1:100,000.
- Richard, S.H., Gadd, N.R., and Vincent, J.-S., 1977, Surficial materials and terrain features, Ottawa-Hull area, Ontario-Quebec: Geological Survey of Canada Map 1425A, scale 1:125,000.
- Sabourin, R.J.E., 1957, Glacial map of Quebec: Quebec, Quebec, University of Laval, Department of Geology and Mineralogy Contribution 128, scale 1:2,027,520.
- Taylor, J., 1979, A detailed study of Pleistocene deposits of the Buckingham area, Quebec: Ottawa, Ontario, Carleton University, B.S. thesis, 86 p.
- Terasmae, Jaan, 1960, Surficial geology of Cornwall map-area, Ontario and Quebec: Geological Survey of Canada Paper 60-28, 4 p.
- Veillette, J.J., 1986, Former southwesterly ice flows in the Abitibi-Timiskaming region; Implications for the configuration of the late Wisconsinan ice sheet: *Canadian Journal of Earth Sciences*, v. 23, p. 1724-1741.
- Veillette, J.J., 1987, Géologie des formations en surface, Grand Lake Victoria North, Québec: Geological Survey of Canada Map 1641A, scale 1:100,000.
- Vincent, J.-S., 1976, Dépôts meubles du secteur sud de la carte de Thurso, Ontario et Québec: Geological Survey of Canada Open-File 370, scale 1:50,000.
- Warren, B., and Bouchard, M.A., 1976, Carte des dépôts meubles, Drummondville: Ministère des Richesses Naturelles Québec Rapport Préliminaire DP-437, scale 1:50,000.
- Wilson, J.T., 1938, Glacial geology of part of north-western Quebec: Royal Society of Canada, Transactions, section 4, p. 49-59.
- Unpublished manuscript on geomorphology and Pleistocene geology of the Sutton area, by J.A. Elson, McGill University Department of Geological Sciences, 1972, 8 p.
- Unpublished map of surficial geology of Cobden map-area (Quebec portion), by R.J. Fulton, Geological Survey of Canada, 1980, scale 1:100,000.
- Unpublished maps by S.H. Richard, Geological Survey of Canada on Quaternary geology and geomorphology, Papineauville-Wakefield region, Quebec, 1980, scale 1:50,000; Quaternary geology and geomorphology, Shawbridge, Quebec, 1981, scale 1:50,000.

VERMONT

- Behling, R.E., 1965, A detailed study of the Wisconsin stratigraphic sections of the upper Lamoille Valley, north-central Vermont: Oxford, Ohio, Miami University, M.S. thesis, 125 p.
- Calkin, P.E., 1965, Glacial geology of the Middlebury fifteen minute quadrangle: Vermont Geological Survey Open-file Report, 23 p.
- Cannon, W.F., 1964, The petrology of tills in northern Vermont: Oxford, Ohio, Miami University, M.S. thesis.
- Chapman, D.H., 1937, Late glacial and postglacial history of the Champlain Valley: *American Journal of Science*, v. 34, p. 89-124.
- Connally, G.G., 1966, Surficial geology of the Mount Mansfield 15-minute quadrangle, Vermont: Vermont Geological Survey Open-file Report, 33 p.
- Latimer, W.J., Perkins, S.O., Lesh, F.R., Smith, L.R., and Goodman, K.V., 1937, Soil survey (reconnaissance) of Vermont: U.S. Department of Agriculture, Bureau of Chemistry and Soils, series 1930, no. 54, 80 p.
- Shilts, W.W., 1965, A laboratory study of the late Pleistocene sediments in the Jay Peak, Irasburg, and Memphramagog quadrangles, Vermont: Oxford, Ohio, Miami University, M.S. thesis.
- Stewart, D.P., 1961, The glacial geology of Vermont: Vermont Geological Survey Bulletin 19, 124 p.
- Stewart, D.P., 1971, Geology for environmental planning in the Barre-Montpelier region, Vermont: Vermont Geological Survey Environmental Geology no. 1, 32 p.
- Stewart, D.P., and MacClintock, Paul, 1964, The Wisconsin stratigraphy of northern Vermont: *American Journal of Science*, v. 262, p. 1089-1097.
- Stewart, D.P., and MacClintock, Paul, 1969, The surficial geology and Pleistocene history of Vermont: Vermont Geological Survey Bulletin 31, 251 p.

- Stewart, D.P., and MacClintock, Paul, 1970, Surficial geologic map of Vermont: Vermont Geological Survey, scale 1:250,000.
- Wagner, W.P., 1969, The late Pleistocene of the Champlain Valley, Vermont, *in* Barnett, S.G., ed., Guidebook to field excursions: New York State Geological Association, 41st annual meeting, Guidebook, p. 65-80.