

# QUATERNARY GEOLOGIC MAP OF THE QUEBEC 4° x 6° QUADRANGLE, UNITED STATES AND CANADA

State and Province compilations by

H. W. Borns, Jr., N. R. Gadd, Pierre LaSalle, Ghismond Martineau, Luc Chauvin,  
D. S. Fullerton, R. J. Fulton, W. F. Chapman, W. P. Wagner, and D. R. Grant

Edited and integrated by

Gerald M. Richmond and David S. Fullerton

NOTE: This map is the product of interorganizational collaboration. Following a regional meeting of State and Province compilers with the coordinators to establish map units and related matters, Quaternary maps and map explanations of the parts of the States and Provinces included in the quadrangle were prepared by each of the compilers. These were then integrated and locally supplemented by the editors to produce this quadrangle map and map explanation. Associated diagrams were prepared by the editors.

The map layout includes:

- 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 Quebec 4° x 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 ON PRINTED MAP

CONTACT

DUNE FIELD

DELTA

CIRQUE

ESKER—Direction of transport known

ESKER—Direction of transport unknown

STRIATION—Direction of ice movement known

STRIATION—Direction of ice movement unknown

DRUMLIN

ICE-MOLDED LANDFORM—Drumlinoid ridge, groove, or fluted bedrock

DISPERSAL FAN

MINOR MORAINES AND WASHBOARD MORAINES

OUTER LIMIT OF GLACIAL ADVANCE OR POSITION OF STABLE, GROUNDED, CALVING ICE MARGIN—Solid where marked by end moraine or minor moraine; dashed where inferred; ticks on side of advance

LOCATION OF IMPORTANT STRATIGRAPHIC SECTION

1. Ascot Section, Quebec—Type section for pre-Johnville sediments, Johnville Till, Massawippi Formation, Chaudière Till, and Lennoxville Till (McDonald and Shilts, 1971)
2. Gayhurst Dam Section, Quebec—Type section for Drolet Lentil of Lennoxville Till and type section for Gayhurst Formation. Composite of two sections and one borehole (McDonald and Shilts, 1971; Shilts, 1981)
3. Grand Coulee Section, Quebec—Reference section for pre-Johnville sediments. Composite of four adjacent sections (McDonald and Shilts, 1971; Shilts, 1981)
4. Nash Stream Section, New Hampshire—Late Wisconsin till overlies blocky, jointed, stained, pre-late Wisconsin till (Pessl and Koteff, 1970)
5. New Sharon Section, Maine—Late Wisconsin till overlies organic silt with spruce wood more than 52,000 radiocarbon years old, in turn underlain by two till units (Caldwell, 1959, 1960; Borns and Calkin, 1977)

## DESCRIPTION OF MAP UNITS

### HOLOCENE

- hps SALINE MARSH PEAT AND CLAY—Brown or brownish-gray to gray or black intertongued and interbedded *Spartina* sp. peat and organic clay, with minor sand. Occurs in tidal marshes. Mapped only in Nova Scotia. Thickness generally 1-10 m

### HOLOCENE AND LATE WISCONSIN

- hp PEAT—Brown to dark-brown fibrous peat, decomposed organic residues, and peaty sand. Generally occurs on flat areas; locally occupies ice-block depressions. Commonly overlies gray or white, fine-grained, carbonate mud (marl) with mollusc fragments, diatomite, shelly gyttja, muck, or organic clay. Mapped only in Vermont and New Brunswick; extensive areas of peat elsewhere are not mapped or are included in swamp deposits (hs). Thickness generally 2-10 m, rarely more than 20 m
- hs SWAMP DEPOSITS—Dark-brown to black muck, mucky peat, peat, and mixed organic residues and fine-grained mineral sediment. Occurs in abandoned glacial meltwater channels, ice-block depressions, and poorly drained areas. Map unit includes peat (**hp**) where peat and swamp deposits are not differentiated. Commonly overlies gray or white, fine-grained, carbonate mud (marl) with mollusc fragments or shelly gyttja. Mapped only where widespread; however, many extensive areas in Quebec, Maine, and New Brunswick are not shown. Thickness generally 1-5 m, rarely more than 15 m
- al ALLUVIUM—Yellowish-brown, reddish-brown, brown, olive, gray, or mottled silt, sand, and gravel. Generally calcareous, but locally noncalcareous. Poorly to well sorted. Poorly to well

- stratified; commonly crossbedded or with cut-and-fill structure. Textures vary laterally and vertically; textural units may be intertongued or interbedded. Upper part commonly silt and fine sand, in places with stringers or lenses of clay and organic debris. Lower part commonly sand and rounded gravel, in places cobble or boulder gravel. In Vermont, in many places lower part is predominately sand. Lithologies mixed and variable, reflecting the compositions of local bedrock and other surficial materials. Occurs as overbank and stream channel deposits; underlies flood plains, stream terraces, and alluvial fans. Locally includes unmapped lake silt and clay (**lca**), marine silt and clay (**mc**), outwash sand and gravel (**gg**), or ice-contact sand and gravel (**kg**); in Quebec, locally includes marine sand and gravel (**msg**). Commonly overlies lake silt and clay (**lca**), marine silt and clay (**mc**), or outwash sand and gravel (**gg**); commonly overlain by unmapped peat (**hp**) and swamp deposits (**hs**). Thickness variable, generally 1-5 m, locally as much as 10 m
- ag ALLUVIUM—Yellowish-brown, brown, gray, or mottled silt, sand, and gravel. Noncalcareous; poorly to well sorted. Poorly to well stratified; commonly crossbedded or with cut-and-fill structure. Textures vary laterally and vertically; textural units may be intertongued or interbedded. Upper part commonly silt and fine sand; lower part commonly pebbly sand or pebble, cobble, or boulder gravel. Clasts almost entirely of igneous, metaigneous, and metasedimentary rocks. Occurs as overbank and stream channel deposits; underlies flood plains, stream terraces, and alluvial fans. Locally includes unmapped outwash sand and gravel (**gg**) or ice-contact sand and gravel (**kg**). Commonly overlain by unmapped peat (**hp**) and swamp deposits (**hs**). Thickness variable, generally 1-5 m, locally more than 10 m
- eu EOLIAN SAND AND SILT—Yellowish-brown, pale-brown, or yellowish-gray medium to fine sand and silt. Generally weakly calcareous. Well sorted; locally crossbedded. Commonly occurs downwind from areas of outwash sand and gravel (**gg**). Locally includes blowout or parabolic dunes; in Quebec, dune fields are shown by symbols. Commonly overlies outwash sand and gravel (**gg**), lake silt and clay (**lca**), or till (**tlc**, **tda**). Mapped only where extensive. Thickness of silt generally less than 1 m; sheet sand 1-3 m; dune sand 1-5 m
- mc MARINE SILT AND CLAY—Yellowish-brown, brown, reddish-brown, reddish-gray, bluish-gray, dark-blue, dark-gray, or mottled uniform fine silt and soft clay, with minor fine sand laminae. Locally displays color banding; colors reflect colors of bedrock source materials. Generally calcareous, but locally noncalcareous. In places, with thin horizontal layers one to several centimeters thick; elsewhere massive and structureless. Locally interbedded and intertongued with sand and gravel beds as much as 6 m thick. Dropstone clasts common locally. Generally fossiliferous in Quebec; elsewhere fossiliferous only locally. In Maine and New Brunswick, the unit is primarily glaciomarine silt and clay, deposited at or near calving or grounded ice margins. In Quebec, the unit is primarily marine silt and clay, deposited after deglaciation. Occurs chiefly in central parts of broad valleys. In Maine, marine silt and clay is included in till and marine deposits (**tm**) where till and marine silt and clay are not distinguished by reconnaissance mapping. Commonly overlain by unmapped peat (**hp**, **hps**), swamp deposits (**hs**), eolian sand and silt (**eu**), or alluvium (**al**). Thickness variable; generally 1-10 m, rarely more than 35 m
- msg MARINE SAND AND GRAVEL—Yellowish-brown, brown, or gray sand and gravel. Calcareous or noncalcareous. Generally loose and well sorted, with planar bedding. Textures vary laterally and vertically. Clasts generally well rounded. Commonly fossiliferous in Quebec; elsewhere fossiliferous only locally. Nearshore and littoral facies of elevated marine deposits. Occurs near basin margins and on emerged shoals. Locally includes unmapped marine silt and clay (**mc**), outwash sand and gravel (**gg**), ice-contact sand and gravel (**kg**), or till (**tlc**, **tda**, **ts**). Commonly overlies marine silt and clay (**mc**). Thickness generally 1-4 m, rarely as much as 7 m
- mu MARINE DEPOSITS, UNDIVIDED—Marine silt and clay (**mc**) and marine sand and gravel (**msg**) in Quebec and New Brunswick, where the units are not distinguished by reconnaissance mapping

#### LATE WISCONSIN

- lca LAKE SILT AND CLAY—Pale-yellow, yellowish-brown, brown, reddish-brown, olive, olive-gray, bluish-gray, or gray calcareous silt and clay. Well bedded; generally soft. Predominately thinly laminated; locally varved. In places stony or interbedded with sand; locally with included

- bodies of till or flowtill. Most deposits underlie flat, low areas or valley floors formerly occupied by glacial lakes. Locally includes unmapped lake delta sand and gravel (**lds**). Commonly overlain by unmapped eolian sand and silt (**eu**), peat (**hp**), swamp deposits (**hs**), or alluvium (**al**). Thickness generally 1-5 m, rarely more than 35 m
- lds** LAKE DELTA SAND AND GRAVEL—Pale-yellow, yellowish-brown, reddish-brown, brown, olive, brownish-gray, or gray sand and pebble or cobble gravel, commonly with foreset-topset crossbedding. Well stratified; moderately well to well sorted. Topset beds generally are pebble and cobble gravel, with sand and silt at depth; bottomset beds generally are silt and clay. Clasts subrounded to well rounded. Deposited chiefly in river deltas but also may represent kame deltas. Occurs as terrace-like features and as broad plains in the Connecticut River Valley. Mapped only in Vermont and New Hampshire. Thickness generally 5-10 m, rarely more than 30 m
- gg** OUTWASH SAND AND GRAVEL—Pale-yellow, yellowish-brown, grayish-brown, olive, or gray, fine to coarse sand or pebbly sand alternating with layers or beds of granule to cobble gravel and minor beds of silt; locally bouldery. Clasts generally subrounded to well rounded. Generally loose to weakly compacted. Textures vary laterally and vertically. Crudely to well bedded; commonly moderately well to well sorted within beds and poorly to well stratified. Generally with undisturbed horizontal bedding; local crossbedding or planar bedding. Clast lithologies variable, reflecting the compositions of local bedrock and till. Deposits form terraces, outwash plains, valley trains, fans, deltas, and meltwater channel fills. Surfaces locally pitted with ice-block depressions; locally with surface accumulations of boulders or a veneer of pebbly sand and silt where modified by waves and currents. Locally includes unmapped lake delta sand and gravel (**lds**), kame moraine deposits (**ke**), kame fan sand and gravel (**kgd**), and esker deposits too small to be mapped at this scale. Commonly covered by unmapped swamp deposits (**hs**), peat (**hp**, **hps**), alluvium (**al**), eolian sand and silt (**eu**), or marine silt and clay (**mc**). Thickness generally 1-10 m, rarely as much as 60 m
- gk** OUTWASH AND ICE-CONTACT SAND AND GRAVEL—Complex deposits of out-wash sand and gravel (**gg**) and ice-contact sand and gravel (**kg**). Locally includes minor kame moraine deposits (**ke**). Surfaces are flat to hummocky, locally with ridges and knob-and-kettle topography. Thickness generally 5-15 m, rarely 30 m
- kg** ICE-CONTACT SAND AND GRAVEL—Pale-yellow, yellowish-brown, reddish-brown, brown, light-olive, brownish-gray, or gray, fine to coarse sand and gravel with minor silt and local lenses or masses of till, flowtill, silt, or clay. Poorly to well sorted; poorly to well stratified. Commonly with distorted bedding, high-angle faults, folds, and slump or collapse structures. Bedding thin to thick and discontinuous horizontally. Textures vary laterally and vertically. Clasts range from granules to boulders; clasts are angular to well rounded. Clast lithologies are variable, reflecting the compositions of local bedrock and till. Smaller clasts generally are local bedrock lithologies; large cobbles and boulders chiefly erratic lithologies. Deposits form kame ridges, mounds, hummocks, terraces, and deltas. Surfaces locally pitted with ice-block depressions; locally with surface accumulations of boulders or pebbly sand and silt where modified by waves and currents. Includes unmapped outwash sand and gravel (**gg**), kame fan sand and gravel (**kgd**), and esker deposits too small to be mapped at this scale. Commonly covered by unmapped outwash sand and gravel (**gg**), lake silt and clay (**lca**), eolian sand and silt (**eu**), marine silt and clay (**mc**), alluvium (**al**, **ag**), peat (**hp**, **hps**), or swamp deposits (**hs**). Thickness generally 5-20 m, occasionally more than 30 m
- kgd** KAME FAN SAND AND GRAVEL—Yellowish-brown or brown to gray sand and gravel, commonly with crudely developed foreset crossbedding. Textures vary, ranging from fine sand to cobble gravel with boulders. Distorted bedding, faults, folds, and slump and collapse structures are common where deposits were emplaced on buried ice. Clasts generally rounded. Clast lithologies vary, reflecting the compositions of local bedrock and till. Occurs as terrace-like features, commonly at distal margins of kame moraine deposits (**ke**) or at terminations of esker segments. Many deposits were emplaced at esker mouths adjacent to a calving ice margin; most were emplaced below sea level, as submarine fans, rather than as true deltas. Mapped only in Maine. Thickness generally 5-20 m
- ke** KAME MORaine DEPOSITS—Complex deposits of ice-contact sand and gravel (**kg**) and till (**ts**, **tda**, **t1c**). Occurs as linear or arcuate ridges as much as 20 km in length and commonly 10-20 m high (rarely 60 m high), or as broad areas of hummocky, undulating, or rolling topography

with occasional ridges. Ridges may be composed entirely of till, entirely of ice-contact sand and gravel, or of interbedded till and ice-contact sand and gravel. Stratification, bedding, and sorting in sand and gravel are extremely variable; post-depositional slump structures are common. Ice-contact structures may occur on both the distal and proximal sides of the ridges. Till textures are variable, ranging from sand or loamy sand to clay. Till may be stony, cobbly, or bouldery, or nearly clast free; may be either compact or friable, and may be interbedded with ice-contact sand and gravel. Surfaces locally smooth, with accumulations of boulders, gravel, or pebbly sand and silt where modified by waves and currents. Closely spaced, arcuate "washboard" moraines (indicated by symbols) are common in relatively flat areas between major moraine ridges. Clast lithologies vary, reflecting compositions of local bedrock and till. Ice-contact sand and gravel and till commonly are intertongued or interlayered with marine silt and clay (**me**), lake silt and clay (**lca**), or kame fan sand and gravel (**kgd**) on distal sides of ridges or ridge complexes. Locally includes unmapped outwash sand and gravel (**gg**) and areas of rock outcrops. Locally overlain by unmapped swamp deposits (**hs**), peat (**hp**, **hps**), alluvium (**al**, **ag**), eolian sand and silt (**eu**), lake silt and clay (**lca**), marine silt and clay (**me**), or marine sand and gravel (**msg**). Thickness of materials in major ridges generally 8-30 m, rarely 50-60 m

tm TILL AND MARINE DEPOSITS, UNDIVIDED—Till (**ts**, **tda**, **tic**), marine silt and clay (**me**), and marine sand and gravel (**msg**), where the respective materials have not been distinguished in reconnaissance mapping. Till generally constitutes 80-95 percent of area mapped. Marine silt and clay (**me**) occurs chiefly in central parts of broad valleys; marine sand and gravel (**msg**) occurs chiefly near basin margins and on emerged shoals. Includes unmapped outwash sand and gravel (**gg**), ice-contact sand and gravel (**kg**, **kgd**), kame moraine deposits (**ke**), alluvium (**al**), eolian sand and silt (**eu**), peat (**hp**, **hps**), and swamp deposits (**hs**). Mapped only in Maine

LOAMY TILL—Yellowish-brown, brown, olive-brown, olive, olive-gray, reddish-gray, bluish-gray, gray, olive-black, or black till. Calcareous to noncalcareous, depending on composition of source materials. Textures generally loam, silt loam, clay loam, and silty clay loam. Locally clayey where underlain by shale; locally sandy loam or loamy sand where underlain by coarse-grained igneous, metaigneous, metasedimentary, or volcanic rocks. Non-sorted to poorly sorted; locally interbedded with silt. Lower part generally moderately indurated and compact; upper part commonly loose and gravelly. Commonly stony; locally very bouldery. Clasts angular to rounded. Clast lithologies vary, reflecting complex local bedrock lithologies (chiefly limestone, shale, siltstone, sandstone, conglomerate, quartzite, graywacke, slate, argillite, granite, diorite, gabbro, diabase, and volcanic or metavolcanic rocks). In southeastern Quebec, dispersal fans (boulder trains) of granite, granodiorite, and nordmarkite (shown by symbol) trend southeastward from source outcrops. Includes areas of sandy loamy till (**tda**) and sandy till (**ts**) where textural information is limited. Locally includes ice-contact sand and gravel (**kg**), outwash sand and gravel (**gg**), and unmapped creep and solifluction deposits. Locally overlain by unmapped marine silt and clay (**me**), marine sand and gravel (**msg**), lake silt and clay (**lca**), eolian sand and silt (**eu**), alluvium (**al**), peat (**hp**), and swamp deposits (**hs**)

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

tlr Attenuated drift—Thin and discontinuous deposits of loamy till, separated by numerous or extensive bedrock outcrops, on which are scattered erratics. Thickness generally 0.5-2 m

SANDY LOAMY TILL—Yellowish-brown, reddish-brown, olive-brown, grayish-brown, olive, olive-gray, yellowish-gray, bluish-gray, gray, or black till. Colors generally reflect the colors of local bedrock. Calcareous to noncalcareous, depending on composition of source materials. Textures generally sandy loam, with some loamy sand, loam, and silt loam. Generally finer-grained in valleys and coarser-grained on upland slopes. Nonsorted to poorly sorted. Generally moderately compact to compact and friable; upper part commonly loose and gravelly. Commonly stony; locally very bouldery. Locally very sandy, resembling outwash sand and gravel (**gg**) or ice-contact sand and gravel (**kg**), but lacks stratification. Surfaces locally with accumulations of boulders or a veneer of gravel or pebbly sand and silt where modified by waves and currents. Clasts angular to rounded. Clast lithologies vary, reflecting complex bedrock lithologies (chiefly granite, pegmatite, granodiorite, rhyolite, diorite, gabbro, basalt, gneiss, crystalline schist, slaty schist, argillite, quartzite, and tuff). Includes areas of unmapped loamy till (**tlc**) and sandy till (**ts**) where textural information is limited. Locally includes ice-contact sand and gravel (**kg**), outwash sand and gravel (**gg**, **gk**), kame

- moraine deposits (**ke**), and unmapped colluvium and solifluction deposits. Locally overlain by unmapped lake silt and clay (**lca**), eolian sand and silt (**eu**), marine silt and clay (**me**), marine sand and gravel (**msg**), alluvium (**al**), peat (**hp**), or swamp deposits (**hs**)
- tda Ground moraine—Thickness generally 1.5-4 m, rarely more than 10 m
- tda Stagnation moraine—Broad areas of sandy loamy till with hummocky topography. In some areas distinct till ridges are lacking; in other areas till ridges are developed transverse to the direction of ice movement. Boulders are common. Includes unmapped outwash sand and gravel (**gg, gk**), isolated ridges of ice-contact sand and gravel (**kg**), and small eskers. Thickness generally 1.5-5 m, locally 10-40 m
- tdr Attenuated drift—Thin and discontinuous deposits of sandy loamy till, separated by numerous or extensive bedrock outcrops, on which are scattered erratics. Includes unmapped grus and felsenmeer in the north-central New Brunswick Highlands. Till thickness generally 0.5-2 m; grus and felsenmeer thicknesses 2 m to more than 5 m
- SANDY TILL—Yellowish-brown, brown, grayish-brown, olive, olive-brown, grayish-yellow, yellowish-gray, olive-gray, bluish-gray, gray, or black till. Weakly calcareous to noncalcareous, depending on composition of source materials. Textures generally sand, loamy sand, and sandy loam; locally, textures may be highly variable, ranging from sand to dense, fissile clay with boulders. Nonsorted to poorly sorted. Generally friable, lacking fissility; loose to moderately compact. Generally gravelly, cobbly, bouldery, or rubbly; in New Brunswick, cobbles, boulders, and blocks, chiefly of coarse-grained granitic rocks, commonly are concentrated on till surfaces. Locally resembles outwash sand and gravel (**gg**) or ice-contact sand and gravel (**kg**), but lacks stratification. Clasts angular to rounded. Clast lithologies vary, reflecting complex bedrock lithologies (chiefly granite, pegmatite, rhyolite, granodiorite, diorite, gabbro, diabase, basalt, gneiss, crystalline schist, slaty schist, slate, graywacke, argillite, quartzite, and tuff). In Nova Scotia, clasts are almost exclusively local slate and graywacke; erratic clasts are rare. Includes areas of loamy till (**tlc**) and sandy loamy till (**tda**) where textural information is limited. Map unit locally includes marine silt and clay (**mc**), marine sand and gravel (**msg**), ice-contact sand and gravel (**kg**), outwash sand and gravel (**gg, gk**), kame moraine deposits (**ke**), and unmapped colluvium and solifluction deposits. Locally overlain by unmapped eolian sand and silt (**eu**), lake silt and clay (**lca**), marine deposits (**mc, msg**), alluvium (**al, ag**), peat (**hp, hps**), and swamp deposits (**hs**). North of St. Lawrence River, in Quebec, ground moraine and attenuated drift are distinguished on the basis of air photo interpretation; where bedrock structures have surface reflection the till is mapped as unit **tsr**, and where structures are not evident the till is mapped as unit **ts**
- ts Ground moraine—Thickness generally 1.5-4 m, rarely more than 10 m
- tsr Attenuated drift—Thin and discontinuous deposits of sandy loamy till, separated by numerous or extensive bedrock outcrops, on which are scattered erratics. Thickness generally 0.5-2 m

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