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Joseph E. Brennan, Governor

DEPARTMENT OF CONSERVATION
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SURFICIAL GEOLOGIC MAP OF MAINE

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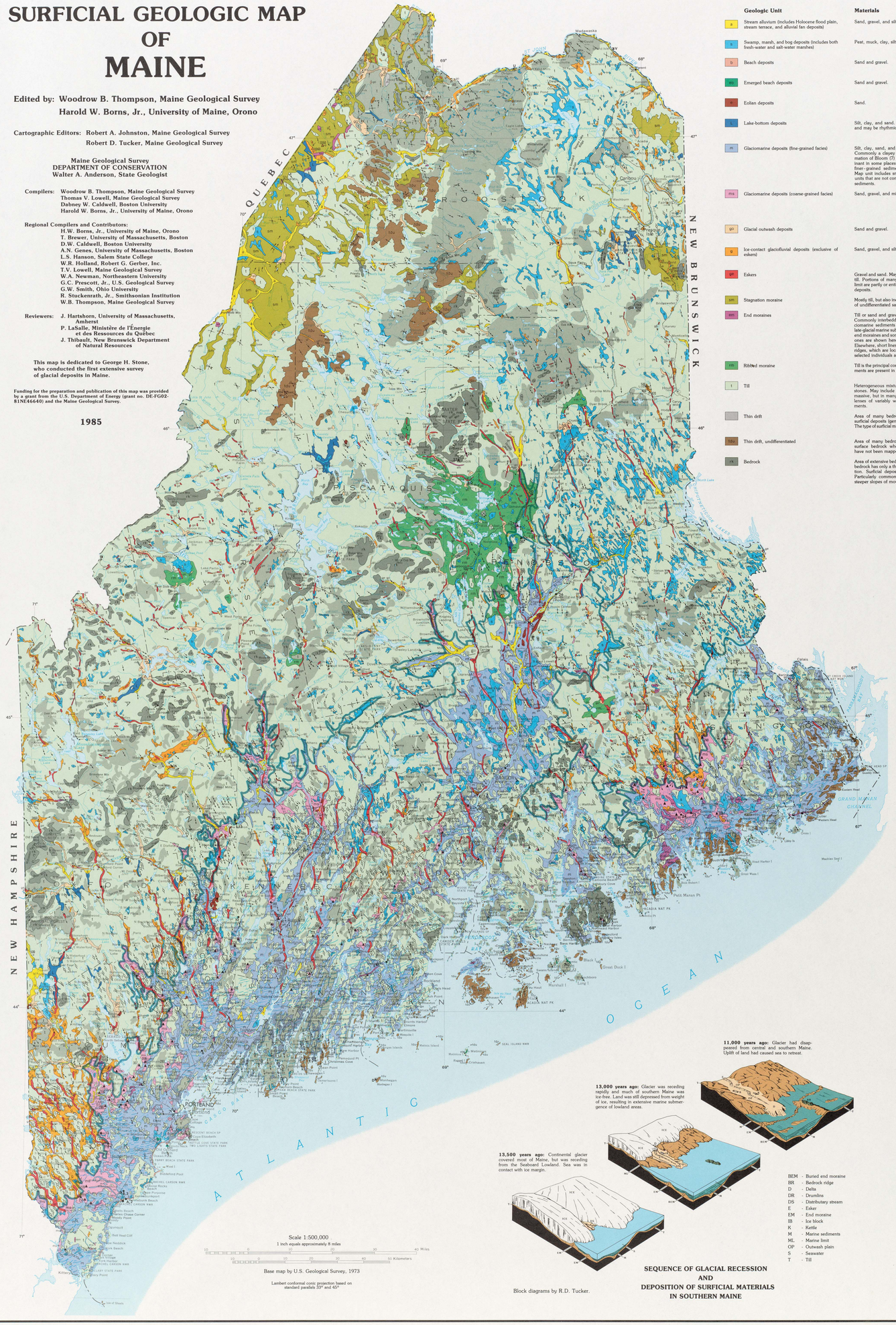
This map is dedicated to George H. Stone, who conducted the first extensive survey of glacial deposits in Maine.

Funding for the preparation and publication of this map was provided by a grant from the U.S. Department of Energy (grant no. DE-FG02-81NE46640) and the Maine Geological Survey.

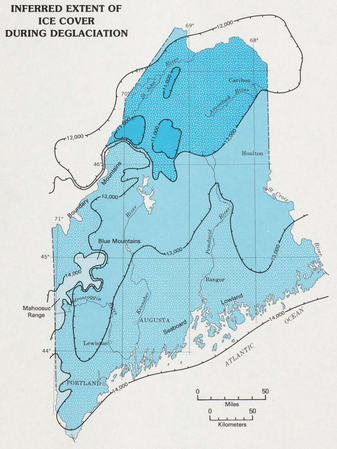
1985



EXPLANATION

	Geologic Unit	Materials	Topography	Origin
a	Stream alluvium (includes Holocene flood plain, stream terrace, and alluvial fan deposits)	Sand, gravel, and silt.	Flat to gently sloping on flood plains and stream terraces; gently to moderately sloping on alluvial fans.	Deposited on flood plains and stream beds by postglacial streams.
s	Swamp, marsh, and bog deposits (includes both fresh-water and salt-water marshes)	Peat, muck, clay, silt, and sand.	Flat.	Formed by accumulation of sediments and organic material in depressions and other poorly drained areas.
b	Beach deposits	Sand and gravel.	Gently to moderately sloping, with low ridges and mounds.	Includes beach sediments formed by wave and current action, and sand dunes derived from these deposits.
eb	Emerged beach deposits	Sand and gravel.	Low ridges or sloping surfaces. May be associated with wave-cut benches on hillsides.	Formed by wave erosion of till or other materials during the late-glacial marine submergence of parts of southern Maine.
e	Eolian deposits	Sand.	Dune ridges and mounds, or blanket deposit that conforms to surface of underlying unit.	Windblown sand. Derived from wind erosion of glacial sediments and deposited in late-glacial to postglacial time.
L	Lake-bottom deposits	Silt, clay, and sand. Commonly well stratified, and may be rhythmically bedded.	Flat to gently sloping except where dissected by modern streams.	Composed of sediments that washed out of late Wisconsinan glacial ice and accumulated on the floors of glacial lakes. Map unit may also include a few non-glacial lake deposits.
m	Glaciomarine deposits (fine-grained facies)	Silt, clay, sand, and minor amounts of gravel. Commonly a clayey silt (the Presumpscot Formation of Bloom (7) and others). Sand is dominant in some places, but may be underlain by finer-grained sediments. Locally fossiliferous. Map unit includes small areas of till and other units that are not completely covered by marine sediments.	Flat to gently sloping except where dissected by modern streams. Commonly has a branching network of steep-walled stream gullies.	Composed of glacial sediments that accumulated on the ocean floor. Formed during the late-glacial marine submergence of lowland areas in southern Maine.
ms	Glaciomarine deposits (coarse-grained facies)	Sand, gravel, and minor amounts of silt.	Flat to moderately sloping. Steeper on ice-contact slopes and delta fronts. May be kettled where deposited over stagnant ice blocks.	Deposited where glacial meltwater streams and currents entered the sea. Includes glaciomarine deltas, subaqueous kames and fans (subaqueous outwash), and outwash that prograded into shallow marine waters and locally covered earlier glaciomarine silt and clay deposits.
go	Glacial outwash deposits	Sand and gravel.	Flat to gently sloping. Steeper on ice-contact slopes and delta fronts. May be kettled where deposited over stagnant ice blocks.	Deposited by meltwater streams in front of the receding late Wisconsinan ice margin. Includes non-marine outwash plains, deltas, and fans.
g	Ice-contact glaciofluvial deposits (exclusive of eskers)	Sand, gravel, and silt.	Flat-topped kame terraces and deltas which are locally kettled and bounded by steep-sides, or hummocky terrain with numerous kames and kettles.	Deposited by meltwater streams adjacent to stagnant glacial ice.
es	Eskers	Gravel and sand. May include minor amounts of till. Portions of many eskers below the marine limit are partly or entirely buried by glaciomarine deposits.	Individual or multiple ridges. Complex eskers may have anastomosing patterns and be gradational with other types of ice-contact deposits.	Chiefly deposited by meltwater streams flowing in tunnels within or beneath the late Wisconsinan ice sheet. Map unit also includes small undifferentiated areas of units "g" and "go".
sm	Stagnation moraine	Mostly till, but also includes variable percentages of undifferentiated sand and gravel.	Undulating topography with local hummocks and ridges.	Deposited during the dissipation of stagnant glacial ice.
em	End moraines	Till or sand and gravel. May be very bouldery. Commonly interbedded with or overlain by glaciomarine sediments in areas that experienced late-glacial marine submergence. Only the largest end moraines and some dense clusters of smaller ones are shown here as a separate unit (em). Elsewhere, short lines mark the crests of moraine ridges, which are locally so numerous that only selected individuals are represented.	Ridges. Commonly arcuate, discontinuous, and in groups. May be multi-crested and hummocky. Size range: 1-30 m high, 5-200 m wide, and 30 m to over 10 km long.	Deposited at the margin of the late Wisconsinan ice sheet, by glacial ice and/or meltwater flowing out of the ice.
rm	Ribbed moraine	Till is the principal constituent, but stratified sediments are present in some of the deposits.	Numerous hummocks and short sub-parallel ridges which typically occur in lake basins and other lowland areas.	Origin uncertain. Deposited either at the margin of or beneath the late Wisconsinan ice sheet.
t	Till	Heterogeneous mixture of sand, silt, clay, and stones. May include many boulders. Generally massive, but in many places contains beds and lenses of variably washed and stratified sediments.	Generally a blanket deposit that conforms to the underlying bedrock topography. Also forms drumlins and other glacially streamlined hills.	Deposited directly by glacial ice.
	Thin drift	Areas of many bedrock outcrops and/or thin surficial deposits (generally less than 3 m thick). The type of surficial material is known or inferred.	Topography of these areas reflects the configuration of the bedrock surface, and ranges from smooth undulating hills to knobby terrain and high mountains.	Commonly the result of non-deposition of glacial sediments, but the surficial materials in some coastal areas have been largely removed by marine erosion in late-glacial time.
tdu	Thin drift, undifferentiated	Areas of many bedrock outcrops and/or near-surface bedrock where the surficial materials have not been mapped.	Same as other thin-drift areas.	Same as other thin-drift areas.
rk	Bedrock	Areas of extensive bedrock outcrop, or where the bedrock has only a thin cover of soil and vegetation. Surficial deposits are essentially absent. Particularly common on the ridge crests and steeper slopes of mountainous areas.	Hilly to mountainous terrain.	Same as the thin-drift areas.

INFERRED EXTENT OF ICE COVER DURING DEGLACIATION



Map shows successive positions of the late Wisconsinan ice margin in Maine from 14,000 to 11,000 years ago (adapted from Davis and Jacobson (37) and Denton and Hughes (38)). Extent of ice cover is based on limiting radiocarbon dates, inferred ice-surface gradients, and topography. Number and configuration of ice remnants at 11,000 yr B.P. are conjectural. Only the outer limits of essentially continuous ice cover are shown here, without implications regarding ice dynamics. Some mountainous areas locally protruded through the thinning ice sheet are omitted. Darker colors show progressively later areas of ice cover.

CORRELATION CHART

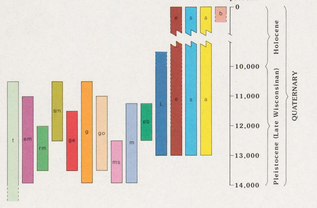
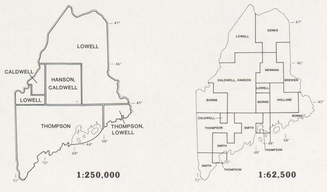


Chart shows the approximate time spans during which the surficial units were deposited. Only the deposits shown on the map are represented here. Late Wisconsinan chronology is based on radiocarbon dates. Oldest till deposits predate the late Wisconsinan glaciation.

COMPILATION RESPONSIBILITY



SEQUENCE OF GLACIAL RECESSION AND DEPOSITION OF SURFICIAL MATERIALS IN SOUTHERN MAINE

BEM - Buried end moraine
BR - Bedrock ridge
D - Delta
DR - Drumlins
DS - Distributary stream
E - Esker
EM - End moraine
IB - Ice block
K - Kettle
M - Marine sediments
ML - Marine limit
OP - Outwash plain
S - Seawater
T - Till

Block diagrams by R.D. Tucker.

GEOLOGIC SYMBOLS

- Contact — Boundary between adjacent map units.
- Inland marine limit — Inland limit of late-glacial marine submergence. Position of line is based on marine-limit altitude data compiled by Thompson and others (106) and the distribution of glaciomarine sediments. Many islands extended seaward of this line, but have not been shown because of space limitations.
- Moraine ridge — Lines mark the crests of individual end moraines. Symbol also is used in conjunction with unit "rm" to show orientation of drift ridges of uncertain origin.
- Glacial striation locality — Includes striations, grooves, crag-and-tails, and other types of ice-flow indicators on bedrock outcrops. Dot indicates point of observation. Arrowhead is omitted where ice-flow direction is uncertain. Flags indicate older trends.
- Glacially streamlined landform — Symbol shows long-axis orientation of drumlins, fluted till ridges, roches moutonnées, and other hills that have been elongated parallel to the flow of glacial ice.
- Cirque — Steep-walled, semicircular bedrock basin formed by glacial erosion in high mountainous areas.
- Meltwater channel — Channel eroded by glacial meltwater stream. Arrow indicates known or inferred direction of stream flow.
- ▲ 219 Glaciomarine delta — Number indicates surveyed altitude (in feet) of contact between topset and foreset beds, or of meltwater channel on delta surface, which approximately marks position of sea level in late-glacial time. Altitude data from Thompson and others (106).
- △ 572 Glaciolacustrine delta — Number indicates approximate altitude (in feet) of former glacial-lake surface.
- △ 344 Delta of uncertain origin — Delta formed near limit of late-glacial marine submergence. Number indicates approximate altitude (in feet) of contact between topset and foreset beds.

SITES OF SPECIAL INTEREST

• Location of special site

This list includes locations of important stratigraphic sections of Pleistocene deposits in Maine, and places where good examples of certain glacial features can be seen. The sites were selected partly on the basis of accessibility, ease of observation, and relative permanence of the features, such as eskers and DeGeer moraines, are so numerous that only a few of the best examples are included here.

Site	Town	Name/Description	Principal References
1	Eliot	Great Hill; pit exposure showing interior of drumlin.	Caldwell, Hanson, and Holland (30)
2	Kennebunk	Great Hill; coastal exposure showing two tills separated by radiocarbon-dated marine sediments.	Smith (87)
3	Kennebunk	Kennebunk landfill; type locality for Kennebunk Readvance (Bloom); pit exposure showing DeGeer moraines and other glaciomarine deposits indicative of oscillatory ice-margin retreat (Smith).	Bloom (7); Borns (8); Smith (86)
4	Buxton	Group of prominent DeGeer moraines.	Bloom (7)
5	Portland	Portland fossil-wood locality; pit exposure showing spruce logs and other plant remains buried in the Presumpscot Formation.	Hyland, Thompson, and Stuckenrath (59)
6	Freeport	Desert of Maine; modern eolian sand deposit with active dunes.	Caldwell (25)
7	Waldoboro	Waldoboro Moraine; viewpoint along Route 220 showing morphology of the moraine.	Smith (88); Stetmen (93); Stone (95)
8	Warren	Group of prominent DeGeer moraines.	Jong (61)
9	Oxford	Good example of an esker.	Borns (9); Leavitt and Perkins (67)
10	Winthrop	Winthrop till section; pit exposure showing stratigraphic relationship between two regional till units.	Thompson (100)
11	Wayne	Desert of Wayne; extensive area of late-glacial eolian sand with historically reactivated dunes.	Caldwell (25)
12	Gilead (and Shelburne)	Androscoggin Moraine; large end moraine deposited during deglaciation of the Androscoggin Valley.	Stone (95); Thompson (99)
13	Woodstock	Good example of an esker.	Borns (9); Stone (95)
14	Chesterville	Good example of an esker.	Borns (9); Stone (95)
15	New Sharon	New Sharon till section; exposure along bank of Sandy River showing tills separated by water-laid sediments containing tree remains.	Caldwell (24)
16	Phillips	Daggett's Rock; largest reported glacially transported boulder in Maine.	Caldwell (27)
17	New Portland	New Portland till section; exposure along bank of Carrabassett River showing interbedded tills and lake sediments.	Borns and Calkin (15)
18	Carrabassett Valley	Cirques on Crocker Mountain.	Borns and Calkin (15); Leavitt and Perkins (67)
19	Sedgwick	Group of prominent DeGeer moraines.	Bingham (6)
20	Mount Desert	Day Mountain beach; bouldery raised beach, formed during late-glacial marine transgression.	Borns (12)
21	Eddington	Eddington till section; exposure along bank of Penobscot River showing interbedded tills and fine-grained water-laid sediments.	Brady (20)
22	Aurora	The Whalesback; good example of an esker.	Borns (9); Stone (95)
23	T24 MD	Ice-disintegration deposits; area illustrating a wide variety of ice-contact glacial deposits and landforms.	Holland (52)
24	Columbia	Pinao Ridge Delta; large glaciomarine ice-contact delta with prominent kettles, meltwater channels, and other well-displayed features.	Borns (10)
25	Columbia	Pinao Ridge Moraine; large end moraine formed during Pinao Ridge Readvance.	Borns (8)
26	Lincoln	Smith's Pit; unusually complete section of local Penobscot Valley deposits, including ablation and lodgment tills overlying glaciofluvial gravel.	Holland (51)
27	Mount Katahdin Twp.	Mount Katahdin; cirques and other alpine glacial landforms.	Antevs (4); Caldwell (26); Davis (34); Tarr (97)
28	Mount Katahdin Twp.	Basin Ponds Moraine; large moraine ridge on east side of Mount Katahdin.	Antevs (4); Caldwell (26); Davis (34)
29	Ashland	Pit exposure showing till overlying glaciofluvial gravel (one of several such localities in this area).	Genes (41)
30	St. Francis	Golden Rapids till section; multiple-till exposure with interbedded waterlaid sediments.	Becker (5); Newman, Genes, and Brewer (78)
31	Van Buren	Gravel pit at Parent; exposure showing till overlying glaciofluvial gravel (one of several such localities in this part of the St. John River valley).	Kite (65)

RADIOCARBON-DATED SITES

Explanation of symbols used to designate sites on the map:

- Material in place between late Wisconsinan tills.
- Material that predates or is contemporaneous with the advance of the late Wisconsinan ice sheet.
- Material that postdates or is contemporaneous with the recession of the late Wisconsinan ice sheet.
- Material that approximately dates the onlap of the sea during the late-glacial marine transgression.
- Material that approximately dates the offlap of the sea.

Site	Name/Town	Date (yr B.P.)	Laboratory No.	Material	Reference
A	Great Hill (Kennebunk)	13,830 ± 100	QL-192	marine shells between tills	Smith (87)
B	Kennebunk	13,200 ± 120	Y-2208	shells in deformed glaciomarine sediments	Stuiver and Borns (96)
C	Little Falls (Gorham)	11,450 ± 90	SI-4747	shells in marine sediments	Smith (87)
D	Monhegan Island (Monhegan)	10,565 ± 110	SI-2711a	shells in marine sediments	Bostwick (19)
E	Whitney Corner (Warren)	11,720 ± 125	DIC-1599	shells in marine sediments	Smith (87)
F	Cape Rosier (Brooksville)	12,780 ± 160	Y-2214	barnacles on bedrock, buried by marine sediments	Stuiver and Borns (96)
G	Swans Island	12,905 ± 110	SI-4651	shells in marine sediments	Smith (87)
H	Machias Bay (Cutler)	12,020 ± 120	Y-2201a	shells in marine sediments	Stuiver and Borns (96)
I	Pond Ridge Moraine (Cutler)	13,320 ± 200	Y-2217	seaweed in end moraine	Stuiver and Borns (96)
J	Moulton Pond (Bucksport, Dedham)	13,500 ± 300	I-5639	organic material in lake-bottom sediments	Davis and others (36)
K	Hampden	11,450 ± 100	Y-2204b	shells in marine sediments	Stuiver and Borns (96)
L	New Sharon	>52,000	Y-2683	wood between tills	Borns and Calkin (15)
M	Embden Pond (Embden)	13,020 ± 240	Y-1477	shells in marine sediments	Stuiver and Borns (96)
N	Gould Pond (Dexter)	11,790 ± 395 (lacustrine sediments)	SI-5370	lake-bottom sediments with plant remains, overlying fossiliferous marine sediments	Anderson, Jacobson, and Davis (3)
		13,280 ± 410 (marine sediments)	SI-5371		
O	South Lincoln (Lincoln)	12,270 ± 120	Y-2213	shells in marine sediments	Stuiver and Borns (96)
P	Boundary Pond (T2 R9 WBKP)	11,220 ± 200	GSC-1248	organic material in lake-bottom sediments	Mott (74)
Q	Lower Togue Pond (T5 R9 WELS)	11,630 ± 260	SI-2992	organic material in lake-bottom sediments	Davis and Davis (35)
R	Upper South Branch Pond (T5 R9 WELS)	10,965 ± 230	SI-4463	organic material in lake-bottom sediments	Anderson and others (2)
S	Oxbow (T9 R5 WELS)	10,500 ± 110	average of SI-5097 and SI-5097b	basal peat, underlain by till	Newman, Genes, and Brewer (78)
T	Rideout Pond (T19 R12 WELS)	10,385 ± 140	SI-4658	organic material in lake-bottom sediments	Davis and Jacobson (37)
U	Fort Kent	>38,000	W-2572	wood from drilled well	Rubin (85)
V	Green River, New Brunswick	10,220 ± 350	I(GSC)-2	basal peat, underlain by lake-bottom sediments	Kite (65)

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