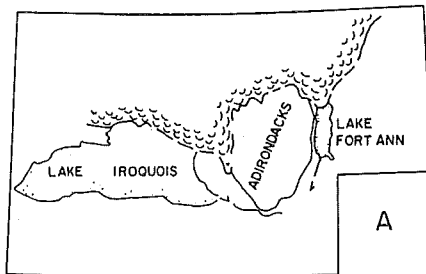


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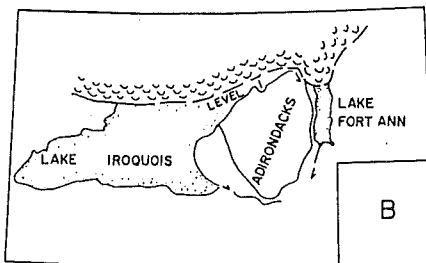
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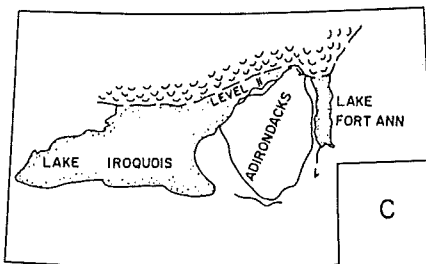
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PETER CLARK and J.S. STREET
CONTRIBUTORS: J.D. CARL, S.C.
CARLISLE, J.M. ERICKSON

GUIDEBOOK

47th Annual Reunion

NORTHEAST

FRIENDS OF THE PLEISTOCENE

Peter Clark
and
J.S. Street

Contributors:

J.D. Carl
S.C. Carlisle
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May 18-20, 1984

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DISCUSSION OF THE LATE QUATERNARY HISTORY OF THE ST. LAWRENCE LOWLAND, N.Y.

By

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Introduction

In 1965, MacClintock and Stewart published a regional description of surficial deposits of the St. Lawrence Lowland, New York. A late Pleistocene history was developed that remained the only substantive published research in the area. Recent mapping of Quaternary sediments of parts of the St. Lawrence Lowland (Figure 1) suggests that previous interpretations of the glacial and post-glacial history of this area should be substantially modified. Much of the material in this discussion has been excerpted from reports by Clark (1980, 1983a, 1983b) and Clark and Karrow (1983, 1984). On this trip, we will visit representative localities from which our present interpretations were developed.

Briefly, we conclude that: (1) evidence from surface till in the area for two Wisconsinan ice advances is lacking, and that surface till represents just one late Wisconsinan advance; (2) the last ice sheet advanced southwards into the Adirondack Mountains, and styles of northerly deglaciation were controlled largely by topography; (3) lake levels in the St. Lawrence Lowland are correlated with previously recognized lake levels in the Lake Ontario basin and the Champlain Lowland; and (4) the Champlain Sea post-dated Iroquois and post-Iroquois lake phases in the St. Lawrence Lowland and furthermore this marine event initially entered the Lake Ontario basin.

Geologic Setting

Bedrock in the St. Lawrence Lowland includes nearly horizontal Paleozoic sedimentary rock and, along the southern margin (northern Adirondack Mountains), folded Precambrian and mixed gneisses (Figure 2). The Potsdam Sandstone (Cambrian) unconformably overlying the Precambrian includes red, poorly sorted conglomeratic arkoses, red shales, and white orthoquartzites (Postel *et al.*, 1956). Interbedded sandstone and dolomite of the Ordovician Theresa Formation conformably overlie the Potsdam Sandstone. The Ogdensburg Formation lies conformably on the underlying Theresa Formation and is composed of a medium to dark gray dolostone that weathers light gray (Postel *et al.*, 1956). Beds of limestone are included within the formation, and it may be locally argillaceous at the top.

Till Stratigraphy

MacClintock (1958) and MacClintock and Stewart (1965) mapped the surficial distribution of two till sheets throughout the St. Lawrence Lowland, New York. One till was described as "exposed in many places in and near Malone,

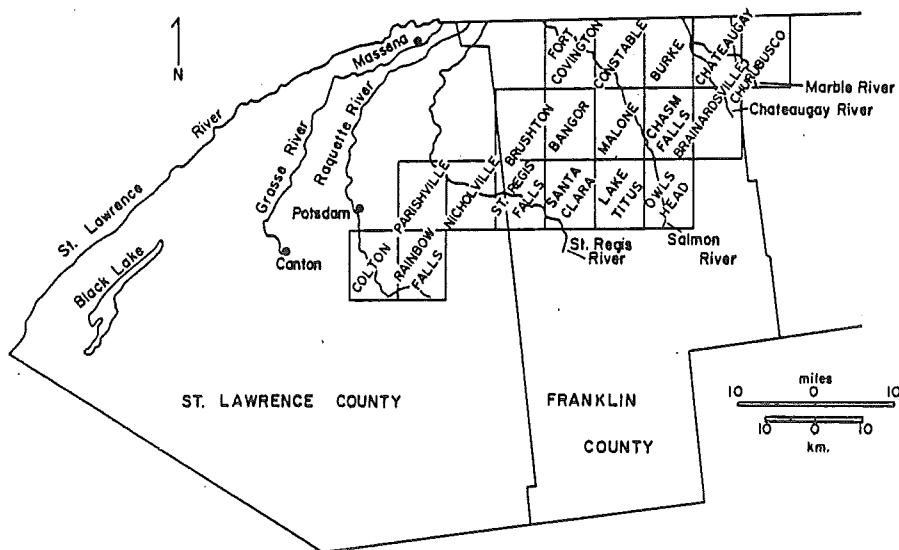
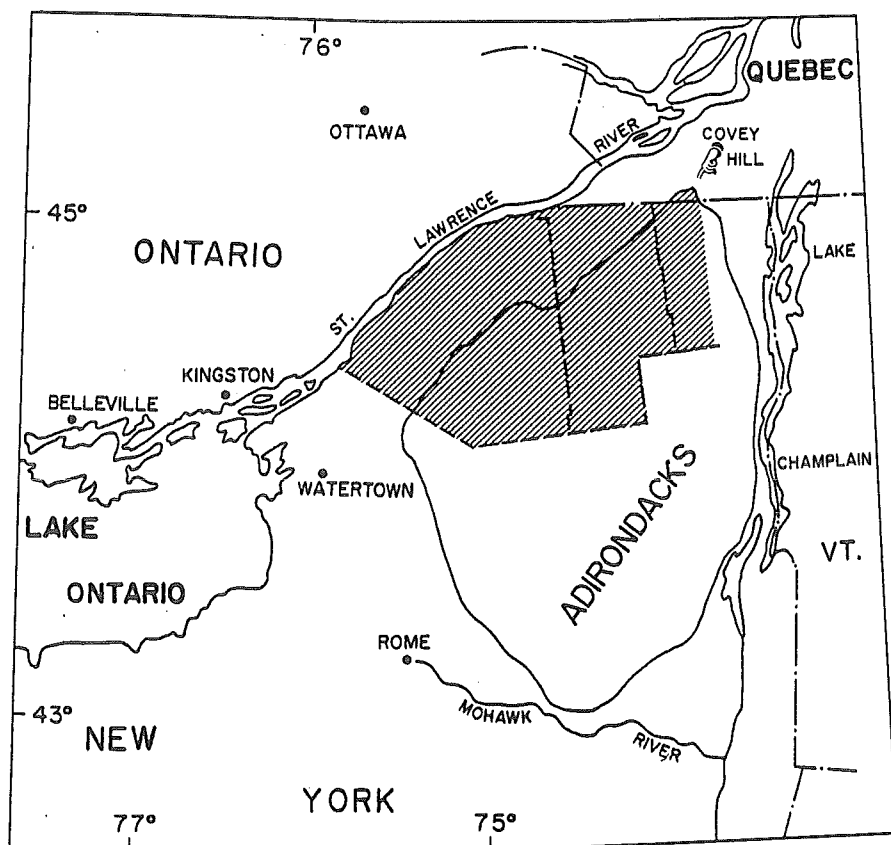


FIGURE 1. Upper-Location map of St. Lawrence Lowland, New York. Area of lower map shown by pattern. Lower-Field area in St. Lawrence Lowland, New York, including location of U.S.G.S. 7.5' quadrangles investigated.

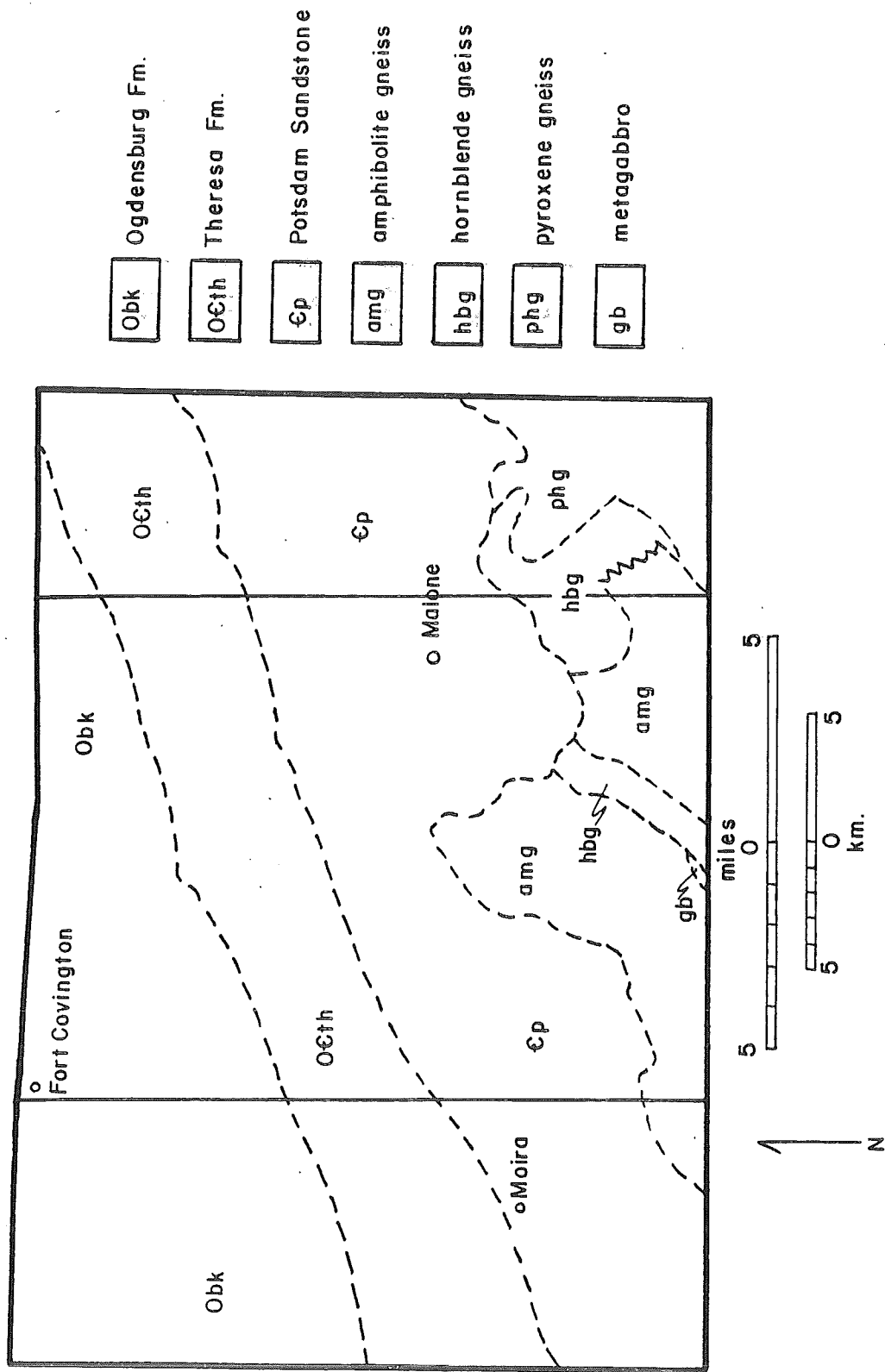


FIGURE 2. Geologic map of bedrock units in the Malone area, New York. From Postel et al. (1956).

so it has been named the Malone till" (MacClintock, 1958, p. 6). MacClintock and Stewart (1965) identified a second "gray-buff drift (which) forms a major moraine whose axis passes through Fort Covington (see, however, discussion by Carl, this volume), (so) it is designated Fort Covington till" (p. 6). These workers suggested that the two till sheets could be distinguished on the basis of fabric, color, and depth of leaching at the surface. They proposed "two episodes of glaciation in the Malone area, the first bringing red-brown drift from the northeast and the second bringing gray drift from the north and northwest" (MacClintock and Stewart, 1965, p. 69).

MacClintock (1958), MacClintock and Stewart (1965), and MacClintock and Dreimanis (1964) described stratigraphic relationships in the St. Lawrence Seaway excavations near Massena, New York. Here, two till units, separated by stratified glaciofluvial and glaciolacustrine beds, were correlated to previously defined Malone and Fort Covington tills on the basis of till fabric.

Clark and Karrow (1983) examined compositional parameters of till samples collected from the Fort Covington and Malone area. Gray and red-brown till was recognized, as were differences in depths of carbonate leaching. However, till fabrics measured in different colored drift failed to distinguish them.

Compositional variations of clast and matrix content in till were related to the influence of underlying bedrock by Clark and Karrow (1983) (Figure 3). Color and depth of carbonate leaching are functions of original till composition. A gray color was related to till samples with high carbonate content, which invariably were sampled over carbonate (Ogdensburg and Theresa) rock formations (Figure 3). A red-brown color was related to till samples with high sandstone and Precambrian clast contents, which were sampled over Potsdam Sandstone and Precambrian bedrock. Depth of carbonate leaching is a function of original carbonate content in sediment (Dreimanis, 1957; Merritt and Muller, 1959). Consequently, till with low carbonate content fosters greater depths of leaching than till with high carbonate content. Gray Fort Covington till of MacClintock and Stewart (1965) had shallow depths of carbonate leaching (1 m), whereas red-brown Malone till of MacClintock and Stewart (1965) had greater depths of leaching (2-3 m). Clark and Karrow (1983) argued that these differences were related solely to original till composition (Figure 3), not to different units.

These observations led Clark and Karrow (1983) to suggest that color, depth of leaching, and till fabric were not useful criteria for distinguishing drift deposited by two separate glaciations. Instead, compositional variations related to underlying bedrock were interpreted as petrographic facies changes that occur within one extensive till unit. Distances of clast and matrix transport are short (<10 km), and rapid dilution in both fractions occurred in response to incorporation of other lithologies. Clark (1983a) calculated rates of till deposition as high as 93%/km for surface till (Figure 4), and interpreted such high rates to reflect a regional upslope depositional gradient which resulted in low basal ice velocities and high compressive stresses in ice.

Clark and Karrow (1983) correlated surface till in the Malone-Fort

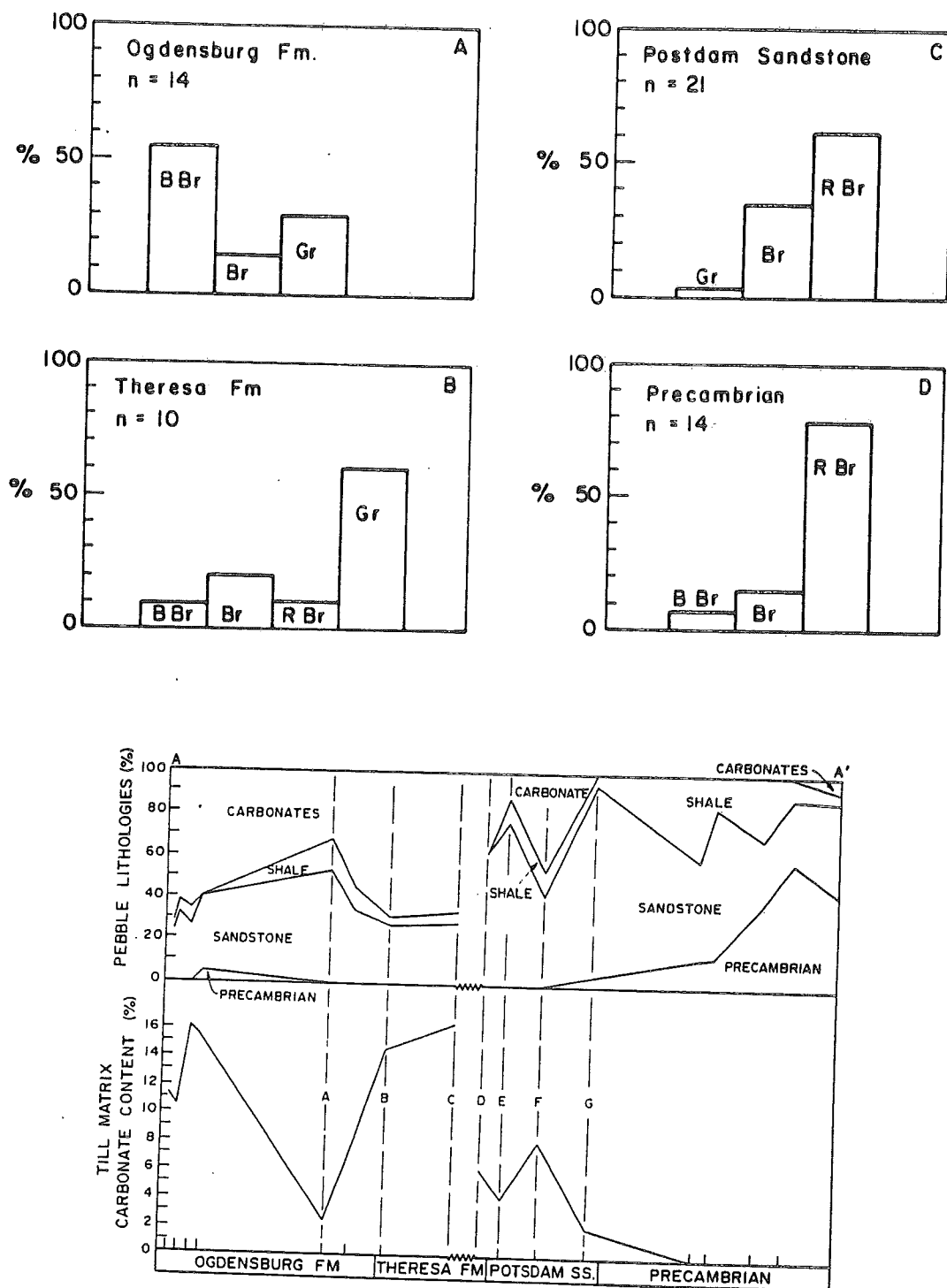


FIGURE 3. Upper-Histograms of till color in relation to four major bed-rock units (B Br=buff brown, Br=brown, Gr=gray, R Br=red brown). From Clark and Karrow (1983). Lower-Down-ice transect in Malone-Fort Covington area showing changes in till clast and matrix contents. From Clark and Karrow (1983).

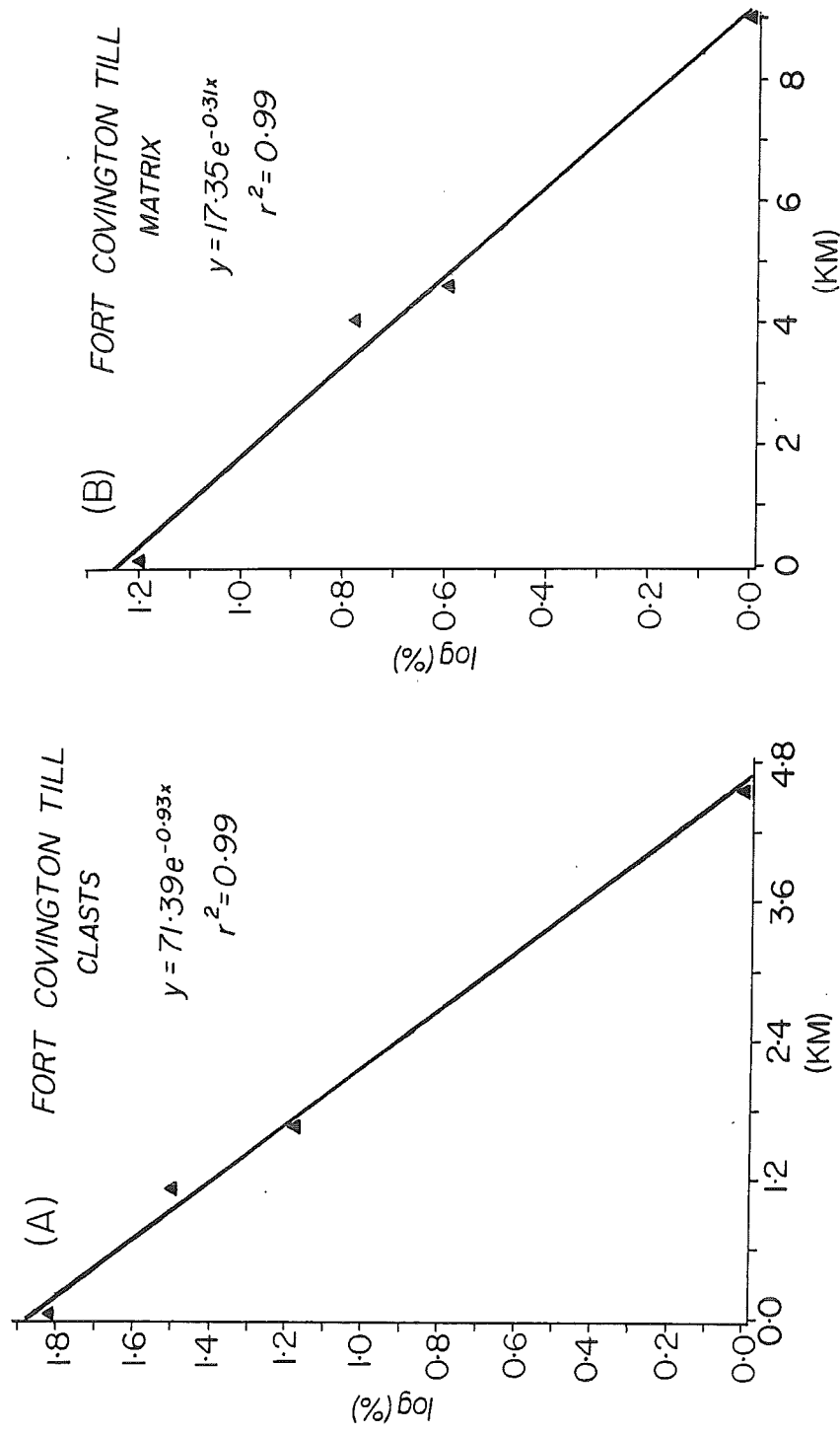


FIGURE 4. Lognormal plots of clast and matrix contents (log(%)) versus distance down-ice from bedrock source (km) in Fort Covington Till.

Covington area with upper till exposed in St. Lawrence Seaway excavations, and retained the name Fort Covington Till for this unit while suggesting that the term Malone Till no longer be used. They suggested that Fort Covington Till represents glaciation in the St. Lawrence Lowland at least throughout the late Wisconsinan. Gadd *et al.* (1981) reported a date of $>42,000$ yrs BP on organics collected below Fort Covington Till in the Ottawa Valley. Lamothe *et al.* (1983) reported finite C-14 ages on pre-advance lacustrine concretions subsequently incorporated in Gentilly Till (= Fort Covington Till? cf. Clark and Karrow, 1983, p. 1317) of $34,000 \pm$ yrs BP, suggesting "a maximum age of ca. 35 000 BP for the Gentilly Till deposition" (Lamothe *et al.*, 1983, p. 500).

Deglaciation

Clark (1983b) interpreted styles of deglaciation in the northern Adirondack Mountains and St. Lawrence Lowland primarily from landform assemblages. East-northeast of Colton, New York to Malone, New York, the region between an altitude of 300 m (1000 ft.) and 600 m (2000 ft.) has a relief of 60 m (200 ft.) to 300 m (1000 ft.). Deglaciation of this region was initially characterized by thinning of ice. Active ice remained in valleys while stagnation occurred over highlands. The ice front became lobate, with major tongues of ice projecting southwards up river valleys while an ice front between lobes was maintained along the major physiographic break separating the Adirondacks from the St. Lawrence Lowland. Northerly retreating ice lobes confined to valleys intermittently stabilized, constructing eskerrame moraine-outwash plain complexes, whereas large volumes of ablation sediments were deposited along the ice margin bordering the physiographic break. A period of ice margin stabilization along this physiographic break is inferred while lobate ice tongues retreated northwards out of river valleys. This stabilization of the ice front, interpreted to represent an affect of relief on styles of deglaciation, occurred immediately prior to incursion of Lake Iroquois (12,500 yrs BP maximum age) into the area from the Lake Ontario basin, and consequently may represent a time transgressive equivalent of the Highland Front Moraine in southeastern Quebec.

East-northeast of Malone, N.Y., at altitudes comparable to the region discussed above, styles of deglaciation were significantly different. This region has relief of less than 15 m. The retreating ice margin retained an active ice front, as suggested by ice marginal channels ("Chateaugay channels") eroded into till. Drainage of meltwater was to the west (versus present drainage to the north), across the regional slope, and then diverted south, debouching into local ice dammed lakes south of Malone.

Glacial Lakes and the Champlain Sea

MacClintock and Stewart (1965), Prest (1970), and Denny (1974) described former lake levels in the St. Lawrence Lowland, New York, and proposed differing correlations of strandlines in the St. Lawrence with strandlines of former lakes in the Lake Ontario basin to the southwest and the Champlain Lowland to the southeast. Spatial and temporal relationships between Lake Iroquois and the Champlain Sea have long been debated, most recently by Gadd (1980, 1981)

and Karrow (1981) (Table 1).

On the basis of field mapping of relict strandlines in the upper St. Lawrence Lowland, including the Covey Hill region (Figure 5 upper; Table 2), Clark and Karrow (1984) identified four lake levels and the limit of submergence by the Champlain Sea (Figure 5, lower). This data show clearly that strandlines are tilted up to the northeast and therefore the isobase trend must be at some angle to the strandline trend. By comparison with the isobase trends in the basins to the east and west and water-level gradients in those basins (Figure 6, upper), experimental rotation of isobases (Andrews, 1970) led to the conclusion that isobases in the study area trend east-west, and that the direction of maximum uplift is to the north. This yields a reasonable arrangement of isobases and slopes through the three areas (Figure 6, upper).

Clark and Karrow (1984) correlated water levels in the St. Lawrence Lowland with previously identified levels in the Lake Ontario basin by means of an "extended" diagram (Figure 6, lower). The field area included the northwestern part of the Champlain Lowland, facilitating correlations of water bodies in the St. Lawrence and Champlain Lowlands. The highest lake (level I) in the St. Lawrence Lowland was continuous with Lake Iroquois in the Lake Ontario basin, and it drained into Lake Fort Ann in the Champlain Lowland across Covey Hill at 329-332 m. Level II, also confluent with Lake Iroquois, drained through Covey Hill Gap at 308-311 m into Lake Fort Ann. Level III was continuous with the post-Iroquois Sydney phase in the Lake Ontario basin and with the highest phase of Lake Fort Ann in the Champlain Lowland. Level IV in the St. Lawrence Lowland was continuous with the Belleville phase in the Lake Ontario basin and with a lower phase of Lake Fort Ann in the Champlain Lowland. Level V is the limit of the Champlain Sea in the St. Lawrence and Champlain Lowlands. Projection of the reconstructed marine water surface westward indicates that the Champlain Sea initially entered the Lake Ontario basin, where it was confluent with the estuarine post-Iroquois Trenton phase. Subsequent separation of water bodies in the Lake Ontario basin and St. Lawrence Lowland occurred as a result of isostatic uplift (Figure 7).

We feel that restrictions placed on ice-marginal positions by lake levels and the lake outlets indicate that the concept of contemporaneous marine and fresh-water events separated by a narrow ice dam is implausible. Instead, marine invasion of the St. Lawrence Lowland along the retreating ice margin occurred subsequent to drainage of glacial lakes through the Covey Hill channels and the Champlain Lowland (Figure 7).

TABLE 1. COMPARISON OF LAKE LEVELS FROM PREVIOUS STUDIES AND THIS STUDY

LAKE ONTARIO BASIN		ST. LAWRENCE LOWLAND (Altitudes at Covey Hill)			CHAMPLAIN LOWLAND
Mirynoch (1962)	MacClintock and Stewart (1965)	Prest (1970)	Denny (1974)	This study	Chapman (1937, 1942) Denny (1974)
Early Ontario	Champlain Sea	Champlain Sea	Champlain Sea	Level V	Champlain Sea
Admiralty	(160 m)	(160 m)	(160 m)	(160-163 m)	(160 m)
Trenton					
Belleville	Fort Ann (216 m)	Trenton		Level IV (207-210 m)	Fort Ann II (207 m)
Sydney	Iroquois	Belleville (229 m)	Fort Ann (225 m)	Level III (225-228 m)	
Frontenac		Sydney (270 m)	Iroquois (270 m)	Intermittent	
Iroquois	Fort Covington (308 m)	Frontenac (308 m)	Iroquois (308 m)	Level II (308-311 m)	Fort Ann I (228 m)
	Local lakes	Ellenburg (333 m)	Local lakes	Level I (329-332 m)	
		Iroquois (378 m)			

TABLE 2 LOCATIONS AND ALTITUDES OF STRANDLINE FEATURES

Lake level and strand no.	Strandline feature	Altitude (m)	Quadrangle (7.2' USGS)	Nearby town	Rivers (for deltas)
I	1 Delta	274-277	Colton, N.Y.	Colton	Raquette
	2 Beach	302-305	Bangor, N.Y.	Bangor	
	3 Channel	317-320	Burke, N.Y.	Burke	
	4 Col	329-332	Chunabasco, N.Y.	Clinton Mills	
II	5 Delta	267-270	Parishville, N.Y.	Parishville	W. Branch St. Regis
	6 Delta	274-277	Nicholville, N.Y.	Nicholville	St. Regis
	7 Delta	277-280	St. Regis Falls, N.Y.	Dickinson Center	Deer
	8 Delta	285-288	Bangor, N.Y.	Bangor	E. Branch Little Salmon
	9 Delta	293-296	Champlain Falls, N.Y.	Malone	Trout
	10 Delta	294-297	Burke, N.Y.	Burke	Little Trout
	11 Delta	296-299	Chateaugay, N.Y.	Chateaugay	Chateaugay
	12 Delta	299-302	Chateaugay, N.Y.	Chateaugay	Marble
	13 Col	308-311	St. Chrysostome, Quebec*	Covey Hill, Quebec	
III	14 Beach	204-207	Bangor, N.Y.	East Dickinson	
	15 Beach	207-210	Malone, N.Y.	Malone	
	16 Beach	213-216	Burke, N.Y.	Burke Center	
	17 Beach	219-222	Chateaugay, N.Y.	Earlville	
	18 Beach	225-228	St. Chrysostome, Quebec*	Maritana, Quebec	
IV	19 Delta	152-155	Canton, N.Y.	Pymies	Grasse
	20 Delta	166-169	Parishville, N.Y.	Southville	W. Branch St. Regis
	21 Delta	171-174	Parishville, N.Y.	Buckton	St. Regis
	22 Delta	174-177	North Lawrence, N.Y.	Lawrenceville	Deer
	23 Delta	177-180	Brushton, N.Y.	Alburg	Alburg Brook
	24 Delta	180-183	Bangor, N.Y.	East Dickinson	Stony Brook
	25 Delta	181-184	Bangor, N.Y.	West Bangor	Little Salmon
	26 Delta	186-189	Malone, N.Y.	Malone	Deer Creek
IV	27 Delta	189-192	Constable, N.Y.	Malone	Salmon
	28 Delta	192-195	Burke, N.Y.	Burke Center	Little Trout
	29 Delta	194-197	Burke, N.Y.	Burke Center	Alder Brook
	30 Delta	195-198	Chateaugay, N.Y.	Chateaugay	Chateaugay
	31 Delta	198-201	Chateaugay, N.Y.	Chateaugay	Marble
	32 Beach	207-210	St. Chrysostome, Quebec*	Maritana, Quebec	
V	33 Beach	140-143	Brushton, N.Y.	Lawrenceville	
	34 Beach	143-146	Bangor, N.Y.	North Bangor	
	35 Beach	146-149	Fort Covington, N.Y.	Fay	
	36 Beach	149-152	Constable, N.Y.	Malone	
	37 Beach	151-154	Burke, N.Y.	Coveytown Corners	
	38 Beach	152-155	Burke, N.Y.	Coveytown Corners	
	39 Beach	154-157	Chateaugay, N.Y.	Chateaugay	
	40 Beach	155-158	Chateaugay, N.Y.	Earlville	
	41 Beach	160-163	St. Chrysostome, Quebec*	Maritana, Quebec	

*St. Chrysostome, Quebec 31 H/4 quadrangle.

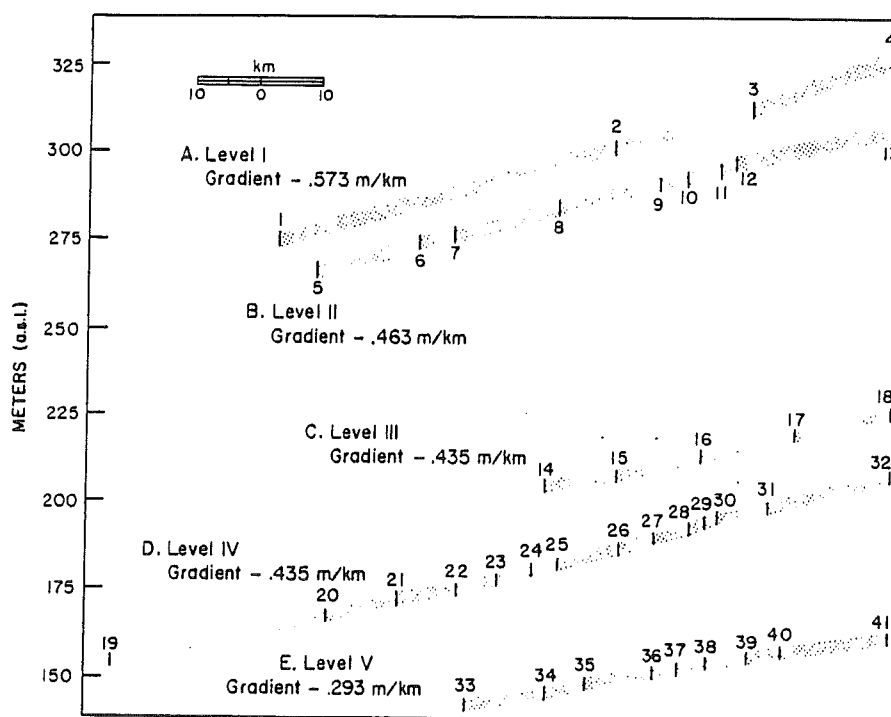
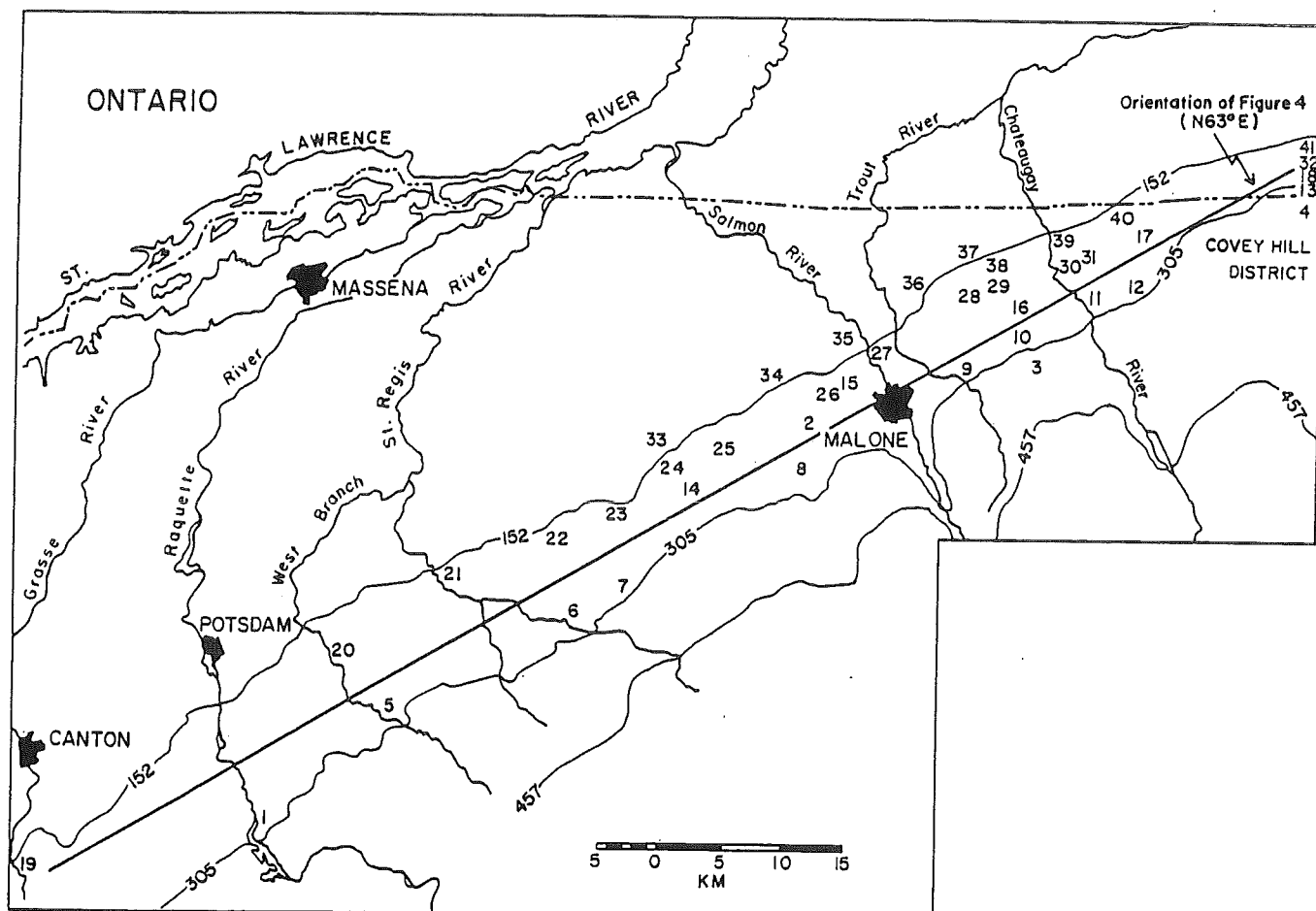


FIGURE 5. Upper-Locations of individual strandline features in field area used in reconstructing water levels (see Table 2). Orientation of lower diagram is shown. Contours are in meters. Lower-Distance-elevation diagram of tilted water levels I-V. From Clark and Karrow (1984).

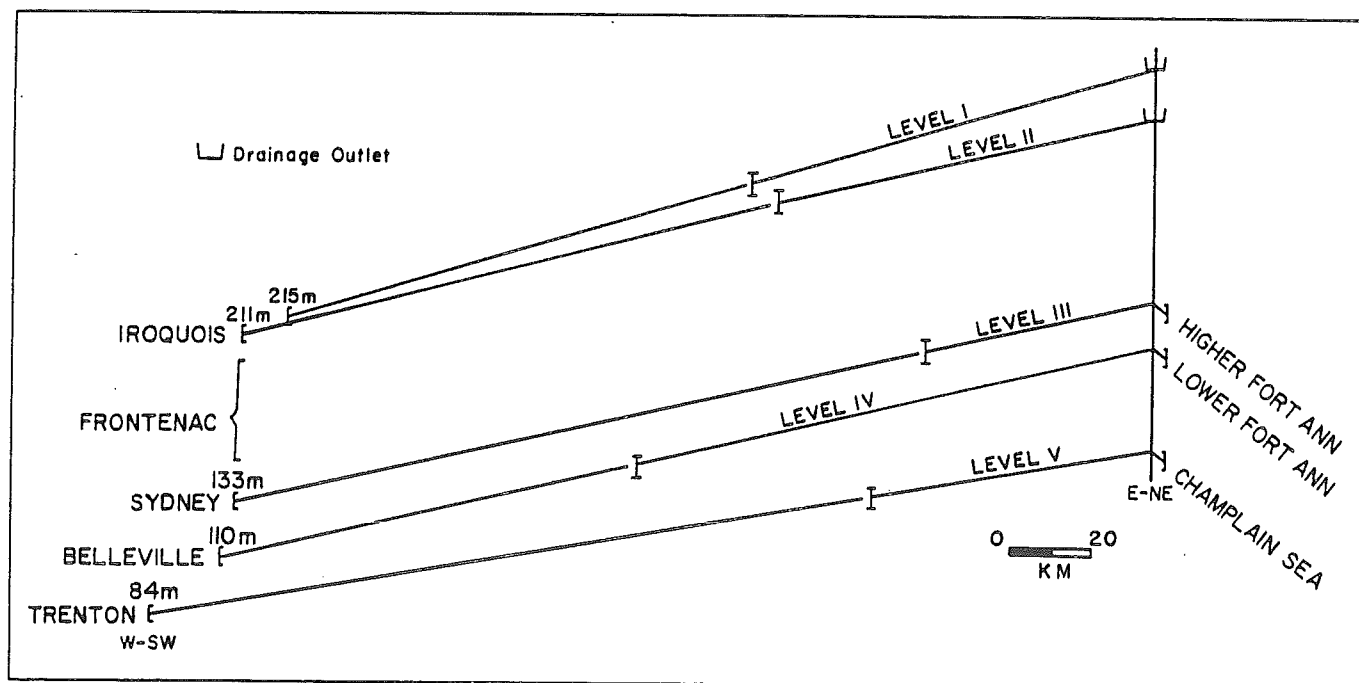
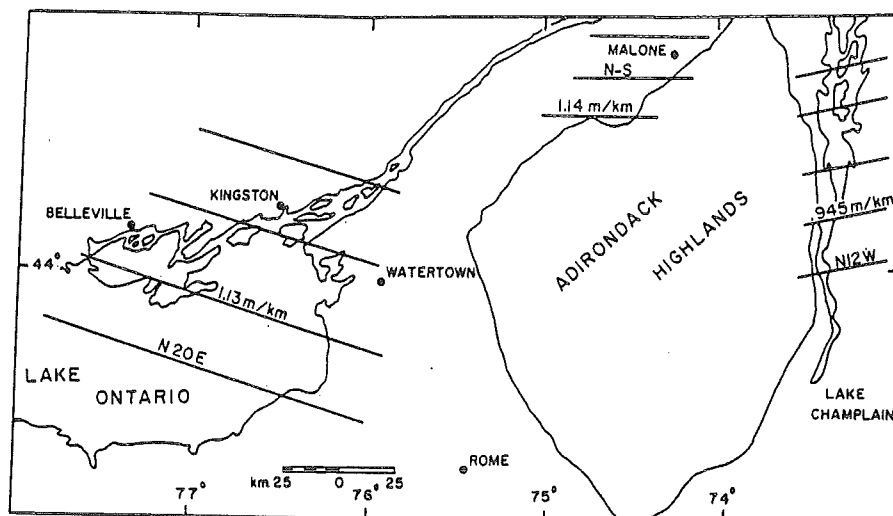


FIGURE 6. Orientations of isobases in Lake Ontario basin, St. Lawrence Lowland, and Champlain Lowland. Lower- "Extended" diagram showing projection of water levels I-V to the Lake Ontario basin. Also shown are correlations with lakes in the Champlain Lowland. From Clark and Karrow (1984).

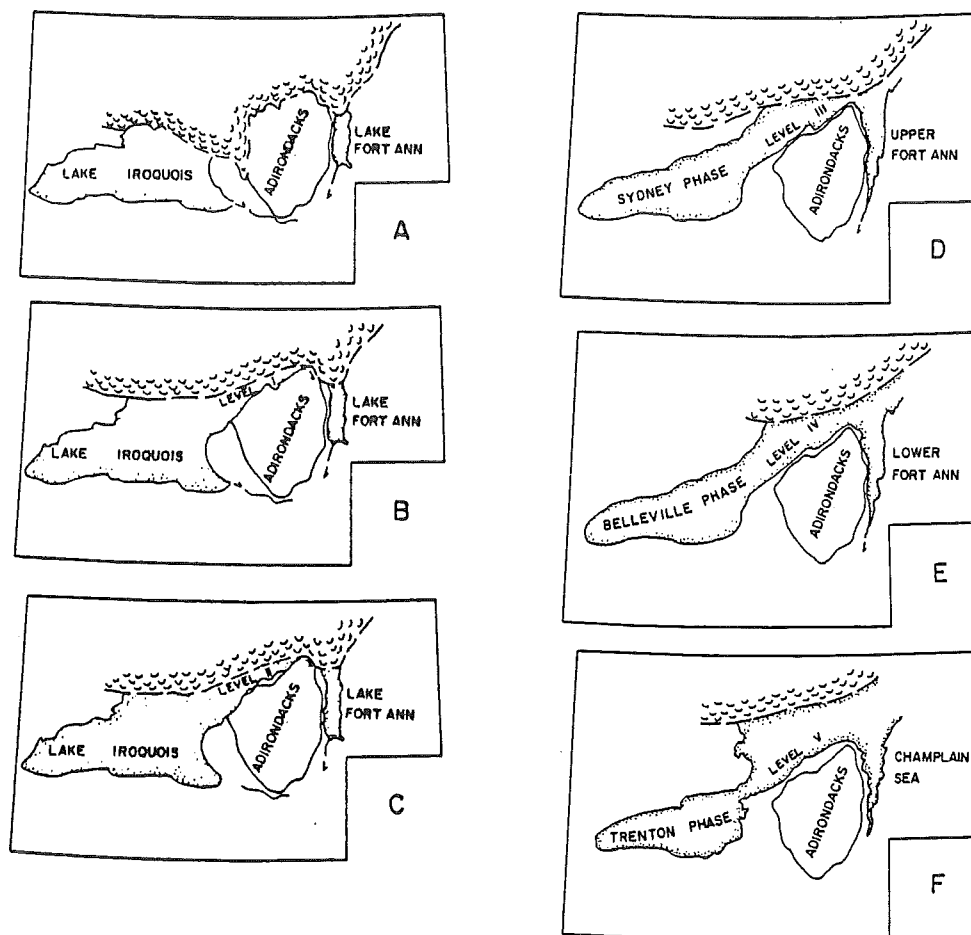


FIGURE 7A. Glacial lake phase 1: drainage of Lake Iroquois through the Rome, N.Y., outlet into the Mohawk River. B. Glacial lake phase 2: drainage of Lake Iroquois through the St. Lawrence Lowland across Covey Hill into Lake Fort Ann. C. Glacial lake phase 3: drainage of Lake Iroquois through Covey Hill Gap into Lake Fort Ann. D. Glacial lake phase 4: confluence of lakes following ice-marginal retreat from Covey Hill. E. Glacial lake phase 5: relative lowering of lake levels by differential isostatic uplift. F. Marine episode 1: confluence of the Champlain Sea with waters in the Lake Ontario basin. From Clark and Karrow (1984).

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RIBBED MORaine IN THE ST. LAWRENCE VALLEY

By

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A belt of discontinuous, low-lying ridges of till makes up the "oriented till ridges subsection" of the St. Lawrence Valley (MacClintock and Stewart, 1965). These ridges have a northeast-southwest orientation that is perpendicular to glacial flow. They make a crude ripple pattern in the topography (Figure 1) and contribute to the spillway appearance of the St. Lawrence River by forming islands between Massena, New York and Cornwall, Ontario. Carl (1978) compared them to Swedish Rogen moraine, Finnish hummocky active-ice moraine and ribbed moraine in Canada. Important observations include the following:

(1) The ridges are larger than most previously described ribbed moraine, generally 2 to 4 km long, 400-700 m wide, 10 to 30 m high. Spacing is variable, often less than ridge width. Till fabric studies indicate glacial overriding from the NNW (MacClintock and Stewart, 1965).

(2) The ridges assume a north-south alignment to become large drumlins at higher bedrock elevations in the West Potsdam area (Figure 2, area 3).

(3) The ridges are variable in form (Figure 3). Smooth-sided ridges occur side by side with those molded into small drumlins which, in turn, have fairly regular spacing (Figure 3, ridges 6,8). Some ridges consist solely of small en-echelon drumlins that are aligned north-south. This drumlinoid molding has been used as evidence for multiple glaciation and for re-advance of the latest ice sheet (Chapman and Putnam, 1966; Terasmae, 1965).

(4) Some northeasterly ridges show a tendency for southwest ends to bend down-ice. At least one ridge has a bent limb molded into small drumlins (Figure 3, ridge 9).

(5) The ridges are confined to the area of outcrop of Paleozoic rocks. They disappear upslope to the south toward highland Precambrian rocks and to the southwest toward miniature ridge and valley topography on Precambrian metasediments.

Carl (1978) called the area a ribbed moraine-drumlin transition belt and proposed that the topography formed during a single ice advance, a viewpoint recently advocated for the till (Clark and Karrow, 1983). The transition from ribbed moraine upslope to drumlins in the West Potsdam area was compared to shield areas where ribbed moraine in a bedrock basin give way to drumlins in the rise. The northeasterly alignment of ridges and the tendency for southwest ends to bend down-ice was attributed to refraction of the ice sheet as it encountered Covey Hill. A narrow belt of long ridges that passes through Massena (Figure 2) may represent a thick accumulation of till (washed by post-glacial submergence) whose western end migrated southward while the eastern end was essentially motionless.

Figure 1. Sketch of ribbed moraine and drumlins in the St. Lawrence Valley, New York and Canada. Figure is necessarily interpretive and illustrates dual topographic alignment (north-south; northeast-southwest) and variation in forms over the the region. No specific contour intervals were selected because outline of hills varies with bedrock elevation which increases to the south. Density of black coloration is unrelated to quantity of till. Drumlinoïd molding on top of ribbed moraine is more abundant than depicted here. Numbers refer to individual ridges shown in Figure 3.

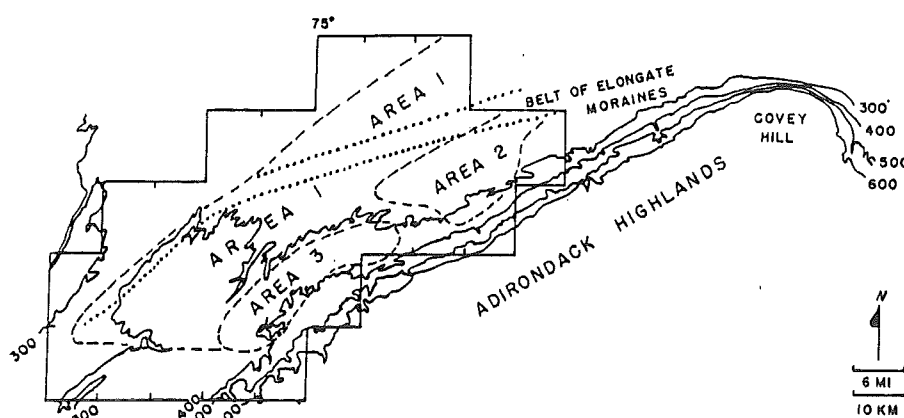
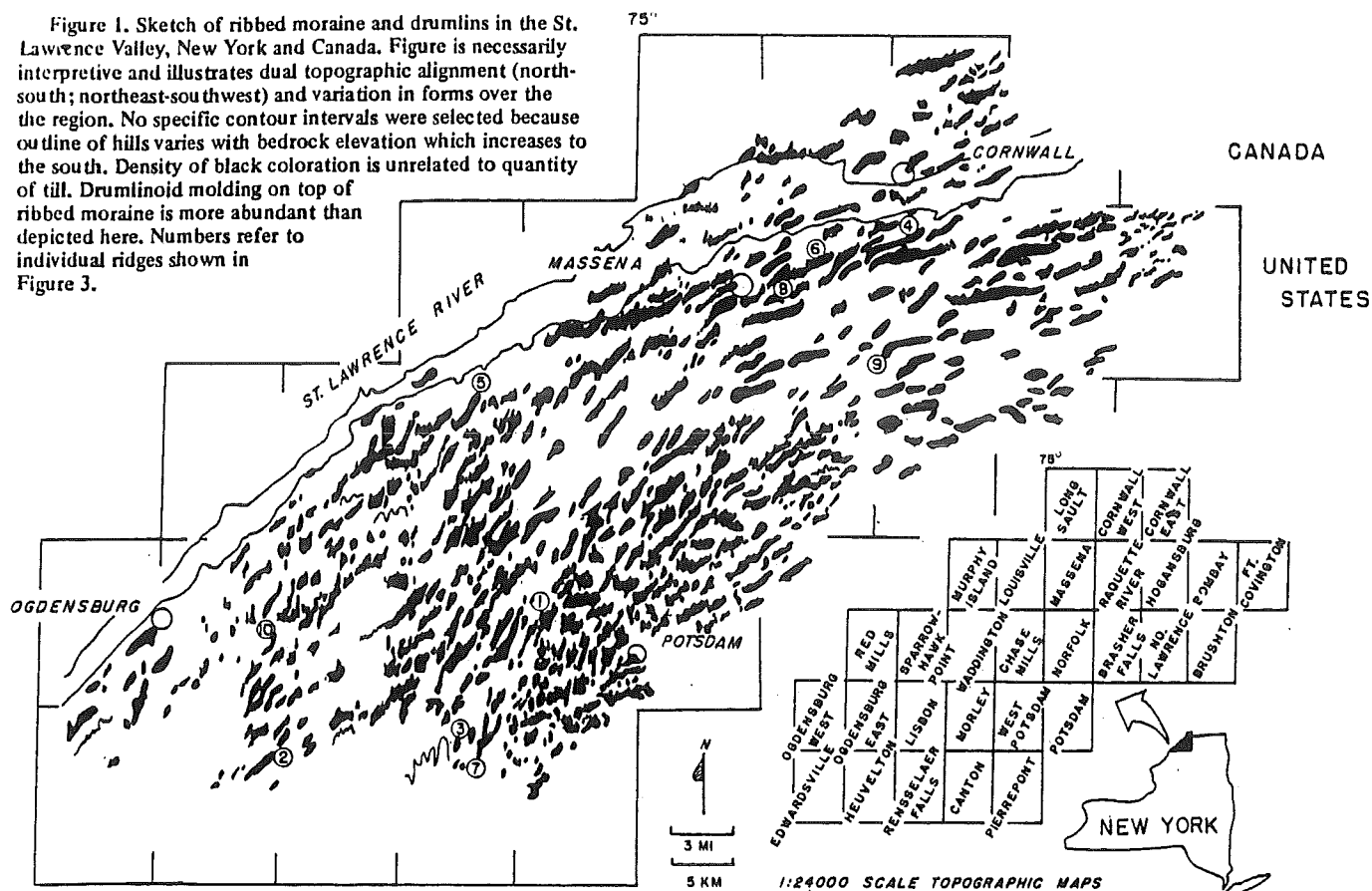


Figure 2. Location of St. Lawrence Valley ribbed moraine belt relative to 100-ft contour interval. Subdivisions are as follows: area 1, ribbed moraine with pronounced drumlinoid molding; area 2, ribbed moraine with little drumlinoid molding; area 3, large drumlins and drumlin-transitional features. Note belt of elongate ribbed moraine extending N80°E toward Covey Hill.

I noted in my 1978 paper the resemblance of ridges to features produced by flowage. I proposed an hypothesis whereby the ridges formed as metastable megaripples induced into dilatant till by glacial over-riding. The ripples gave way to drumlins as the subglacial regime changed during uphill movement toward the Adirondack highlands. The concept proved as slippery to comprehend as the behavior of the till it attempted to describe. I abandoned the surface stuff and returned to work on Precambrian metamorphic rocks.

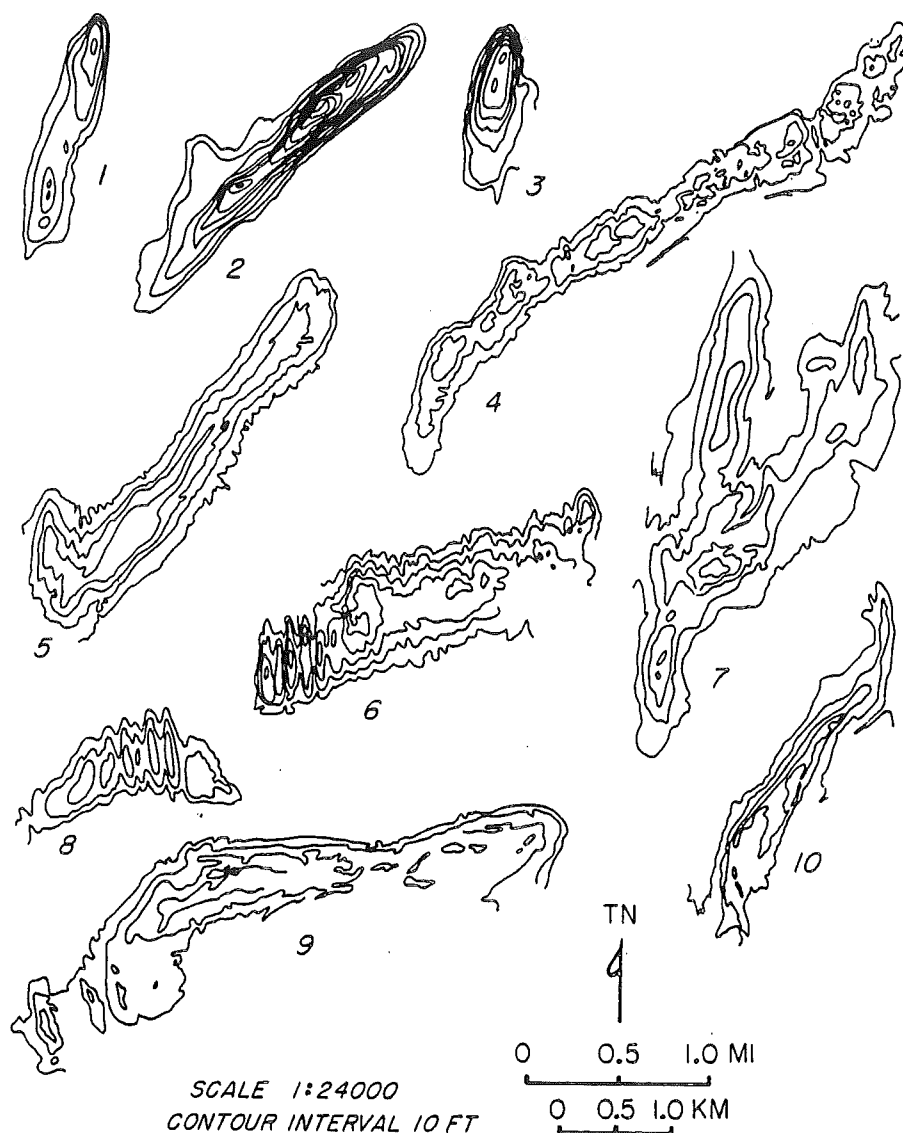


Figure 3. Sketches of various types of morainal ridges in the St. Lawrence Valley (keyed to location in Fig. 1). Contour interval 10 ft.

A different view of origin for ribbed moraine is given by Michel Bouchard (1981) who examined the interior of Temiscamie (Quebec) ribbed moraine in roadcuts. A glacier with a basal till sheet flows over a bedrock basin. The hump or rise encountered when ice leaves the basin causes the basal layer to shear. A slice of till-laden ice is thrust forward. It is followed by another slice that is made, more or less, to overlay the first. Thrusting continues until the succession of slices nearly fills the bedrock basin. The rise is no longer an obstruction to glacial flow, and interstitial ice within the thrustured slabs has become stagnant.

The upper ice becomes detached from basal ice and continues to flow along a sub-horizontal plane of décollement. Stagnant ice beneath the plane may undergo fluting, grooving and drumlinoid molding. Slabs are deformed in the direction of flow to form the ripple-like pattern observed in plan view. Till within the slabs acquires drag and disharmonic folds.

The final stage in ribbed moraine development involves stagnation of upper ice which insulates the basal ice. Melting of basal ice is slow and occurs in response to geothermal heat. The stagnant upper ice also protects basal ice from disturbances other than settling. The thrust and flow-modified slabs are exhumed. Meltwater is evacuated through channels, and ablation deposits may be let down upon the emerging ridges.

Bouchard (1981) believes that ribbed moraine form subglacially as far as 3 to 5 km back from the ice margin. Spacing between ridges depends upon factors such as the angle of inclination of the shear plane, the thickness of the debris-laden basal sheet, and the rate of glacial flow at the base. Spacing between successive ridges has no chronological significance for the rate of recession of the ice sheet.

Do these ideas apply to the formation of ridges as large as those in the St. Lawrence Valley? Many ridges are separated by broad stretches of bedrock thinly veneered by layers of till, varved clay, sand and peat. If each ridge is shaped from a single thrust slab, then little of the overlap or pile-up of slabs has occurred in the manner described by Bouchard (1981) in his Figure 67, p. 246. Selective but locally extensive modification of slabs is suggested by the transition of ridges to large drumlins and by the side by side occurrence of smooth-sided and drumlinoid-molded ridges. Subglacial flowage may not have produced the ridges in ribbed moraine, but it seems to have greatly modified their shapes in the St. Lawrence Valley.

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SOME SOILS AND LANDSCAPES OF THE ST. LAWRENCE LOWLANDS

By

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Introduction

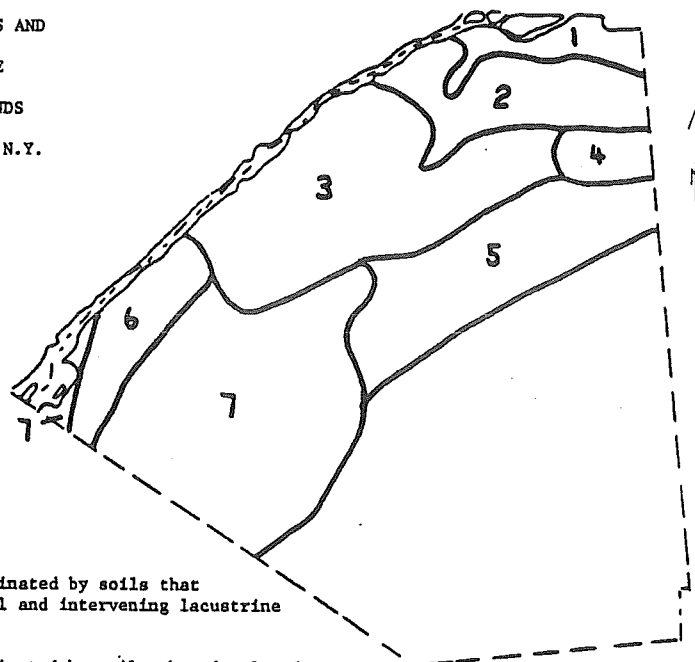
The soils that carpet the low relief of the St. Lawrence Lowlands are of interest to people in a wide variety of disciplines, not the least of which is the Pleistocene geologist. While these soils formed largely in the Holocene, they are so youthful that the stamp of their Pleistocene parent materials remains largely intact and undissembled by soil formation processes. Another reason that these soils of the St. Lawrence Lowlands are of interest to Pleistocene geologists is that these soils are intimately and inextricably related to Pleistocene landscapes. This is because soils as they occur in the field, and are mapped and used are three dimensional creatures of the landscape. Pedologists expose two dimensions of a soil and remove its essence, to be pored over, characterized and classified in the laboratory. The soil that they classify and speak of in such esoteric terms is not the three dimensional soil that is spoken of in the utilitarian sense. It is a two dimensional model that can serve to increase our understanding of a type of soil. The soil that is known in the utilitarian sense is a three dimensional entity. The third dimension, the transverse dimension, is largely inscrutable, and it is the very obscurity of this third dimension that welds soils to land forms or surficial geology—Pleistocene geology in the St. Lawrence Lowlands. How else can one stand on the Earth's surface and visualize the margins of soil lying beneath one's feet, except to correlate changes in soil to changes in landscape? In fact a soil map, as they are usually compiled in the United States, is in reality an interpretative surficial geology map (with some reservations). It is made by first determining parent material, form, and slope of a repeating landscape segment, and then empirically relating a soil to that landform. During the mapping process, once this soil - landform model is time tested and proven for an area, determination of the soil becomes subordinate to and dependant on the identification of the landform or surficial geology.

The discussion that follows is meant as a brief and informal sketch of the soils and landscapes of the St. Lawrence Lowlands as they are manifested in St. Lawrence County, N.Y. It is based on the soil landscape regions that are exhibited on Figure 1.

Some Soils and Landscapes by Regions

Region one. The landscapes in this region are dominated by well-defined NE - SW oriented glacial till land forms and intervening basins of lacustrine and or marine sediments. Central to most of the

FIGURE 1.
SKETCH OF SOME SOILS AND
LANDSCAPES OF THE
ST. LAWRENCE LOWLANDS
In St. Lawrence Co., N.Y.



LEGEND

Region one: areas dominated by soils that developed on deep till and intervening lacustrine or marine deposits.

Region two: areas dominated by soils that developed on areas dominated by sandy deltaic or near shore deposits

Region three: areas dominated by soils that developed on deep till and intervening lacustrine or marine deposits

Region four: areas dominated by soils that developed on wave washed, low lying ridges and intervening lacustrine or marine deposits

Region five: areas dominated by soils that developed in silica rich till and are transitional to Spodosols (Podzols)

Region six: Areas dominated by lacustrine or marine soils that are shallow or moderately deep over flat lying Paleozoic sandstones and dolomites.

Region seven: areas dominated by glacial till or residual soils shallow over Precambrian bed-rock and rock outcrop, and soils that formed in intervening lacustrine basins.

basins are streams or rivers that are bracketed in places by narrow flood plains. Along the St. Lawrence River are extensive areas of man deposited soils.

The glacial till land forms at their crests often feature long narrow areas that show signs of winnowing (copious surface stones, paucity of fines etc). Grenville and Hogansburg, well drained and moderately well drained till soils of high base status (presence of carbonates above 40") and of highly dolomitic lithology, are on the tops, shoulders and steeper side slopes of these landforms. Proceeding perpendicular to the long axis of these glacial till features, the Grenville and Hogansburg soils yield quickly to the somewhat poorly drained, medium and high base status Massena soils that are on gentle middle and lower side slopes and on upper foot slopes. Massena soils often exhibit very stony surfaces. Scattered on the till landform are slight sometimes barely perceptible depressions that retained deposits of lacustrine and or marine materials, and in which areas of the somewhat poorly drained, clayey Rhinebeck soils are found.

Lacustrine and or marine sediments dominate the area between the upper foot slopes of neighboring till landforms. The somewhat poorly drained Swanton soils feature a coarseloamy over clayey stratigraphy and occupy middle and lower footslopes. The somewhat poorly drained, clayey, Rhinebeck and Kingsbury are the major soils of the lower foot slopes and toe slopes; this is especially true where the basins are broad. Where the basins are narrow the Swanton soils become more of a factor. Poorly and very poorly drained clayey Madalin and Lington soils occupy depressions and swales in the broader basins. In places where the streams that course through the basins are deeply incised, moderately well drained Vergennes and Hudson soils have developed on the steeper areas that lead down to the stream or flood plain.

Along the streams that ply the basins natural levees occur in many places. Moderately well drained sandy overy clayey Claverack soils have developed on the levees where they have been stranded by the down cutting of the stream. Swanton soils commonly are found on the landward toe slopes of such stranded levees. Where the levees are contemporarily over topped by flooding or breached, undifferentiated alluvial soils are found on the levee and bracketing it.

Man made landforms are common in the near vicinity of the St. Lawrence River and in the village of Massena. Large quantities of materials obtained from digging the Massena Intake in the early 1900's and from dredging the St. Lawrence Seaway in the 1950's were deposited in convenient areas. In some places clay sediments were deposited in settling lagoons. Some of these landforms, especially in and adjacent to the St. Lawrence River, are easily recognized by raw cut banks and the exposed 10YR 5/3 to 3/3 colors. Most of these areas are calcareous immediately beneath the soil surface.

Region Two. The landscapes in this region are dominated by a matrix of nearly level deltaic sediments that surround well defined and

oriented (NE - SW) glacial till landforms. Lacustrine and or marine deposits are common, but chiefly near the margins of the region. Organic deposits fill large depressions. Exposed bedrock is common in river bottoms.

The deltaic (the term is used loosely to refer to sandy deposits) land forms are generally low lying; the soils consisting mainly of sandy, somewhat poorly drained Junius or Naumburg soils. Poorly drained and very poorly drained sandy, Scarboro and Granby soils occupy wetter, more depressional areas along streams.

Carbondale and Dora mucks are organic soils that formed in the broadest and lowest lying depressions. Scattered on the low lying Naumburg dominated landscape are short discontinuous and often crescent shaped ridges upon which sandy, well and excessively drained Adams and moderately well drained Croghan soils formed.

The till landforms that protrude through the matrix of deltaic sediments are similar in most respects to the glacial till landforms discussed in Region one, the main differences being that clayey soils are usually found on footslopes and toe slopes instead of lacustrine soils (except near the perimeter of the region).

The lacustrine and or marine landforms occur near the margins of this region and are similar in most respects to those discussed in Region one. The major difference is that in places there are large areas of somewhat poorly drained, nearly level, sandy over clayey Naumburg Varian soils that are commonly near by clayey Rhinebeck soils and sandy Naumburg soils.

The bedrock in this region is chiefly Beekmantown Dolostone.

Region three. The landscapes and soils of this region are similar with few exceptions to Region one.

The high base status Grenville and Hogansburg soils that occupy convex areas gradually grade into medium base status (base saturation of greater than 60% within 30" or presence of free carbonates within the soil) Pittsfield and Georgia soils in the southern part of the region.

Swanton and Claverack soils are more prevalent in lacustrine areas than they were in Region one.

Along the St. Lawrence River man made land forms are less prevalent than they were in Region one.

Cambrian and Ordovician bedrock is commonly exposed in stream bottoms and in river channels, occurrences that are rare in Region one.

In the southwestern part of this region bedrock controlled till landforms become commonly cored by flat-lying Ordovician and Cambrian dolomites and sandstones. Such landscapes are similar to those discussed in the section on region 6.

Region four. The landscapes and soils of this region are similar to those of region one with the exception that most of the glacial till landforms have been wave washed to a large degree and are not so well defined and oriented as the till landforms in region one. The landscapes of region four are gentler than those of region one, and more muted.

The sandy skeletal, (sandy, with greater than 35% gravels by volume) well and excessively drained Trout River and moderately well drained Fahey soils dominate the convex areas of the topography. These soils developed in wave worked glacial till fabric and often exhibit very stony surfaces. Sandy over loamy, somewhat poorly drained, and very stony Coveytown soils are on the foot slopes of these landforms or in slight depressional or nearly level areas. The sandy over loamy very poorly drained and very stony Cook soils have developed along streams or in deeper depressions. Perhaps in the nature of a Shibboleth these wave washed landscapes are graced with numerous small gravel pits that are uniformly five or six feet deep; abandoned at that depth probably because of the occurrence of loamy till materials.

In places central to this region, east and west of the village of North Lawrence, the wave washed till landscapes cover large areas to the exclusion of soils representing lacustrine or marine sediments.

The lacustrine or marine soils in this region generally have less clay content than similar soils in region one. Consequently, the silty moderately well drained Collamer and somewhat poorly drained Niagara soils occupy these lacustrine or marine landscapes instead of the clayey soils typical of region 1.

Region five. This is a transition region between soils and landforms of the Adirondacks Highlands and those of the St. Lawrence Lowlands. Not much soil mapping has yet been done in this area, yet there is reason to believe that the till fabric becomes more acid as one proceeds south, accommodating soil regimes of lower base status such as Dystrochrepts, and as one approaches the Adirondack Highlands Spodosols (Podzols).

Lacustrine deposits in this region are characteristically coarse textured, having very fine sandy loam or silt loam subsoils. Also, depth to carbonates in these soils seem to be greater than in lacustrine soils found elsewhere in the St. Lawrence Lowlands. As one proceeds south in this region lacustrine deposits (fine sediments) diminish in size and in frequency to be all but replaced by sandy sediments in the Adirondack Highlands.

Bedrock controlled landscapes complete with suites of soils are common in the region. Typically the bedrock types are Precambrian gneisses and granites, however Grenville marbles and Potsdam sandstones occur in some places.

Deltaic landscapes are locally extensive in this region. Sandy, well and excessively drained Adams and moderately well drained Croghan

soils occupy the higher more convex landscape segments, and the wet Naumburg and Scarboro soils are found on nearly level, low lying depressional areas.

Region six. This is a region of nearly level, bedrock controlled lacustrine dominated landscapes. Bedrock controlled, short steep slopes are occasional in these landscapes and demarcate, also nearly level, areas of raised relief.

The lacustrine or marine landforms are generally nearly level, the topography controlled by the closely underlying bedrock. In wetter, depressional areas, where bedrock is especially close to the soil surface, shallow, poorly and very poorly drained clayey Madalin variant soils have formed. Moderately deep to bedrock, clayey somewhat poorly drained Cahumont and Rhinebeck variant soils are on broad slightly concave flats. In places the deep Kinsbury and Rhinebeck soils are often interdispersed with the Chaumont and Rhinebeck variant soils because of vagaries in the topography of the bedrock.

The glacial till landforms consist mainly of slightly higher areas in the landscape, commonly the sides and edges of wide, shallow trough like basins. Sometimes the advent of the glacial till landform is demarcated by short steep slopes. Shallow, well drained Insula and Benson soils are on the convex areas of these landforms, while the moderately deep to bedrock, somewhat poorly drained Ruse soils formed in concave areas. In some depressions clayey, Madalin variant soils have formed in small pockets of lacustrine sediments.

The rock types that are frequently exposed in this area (particularly on till landforms) are principally flat lying Cambrian and Ordovician sandstones and dolomites.

Region seven. This is a region of abrupt bedrock controlled relief features that are separated by lacustrine or marine basins.

The bedrock in this region is domed and folded granites, gneisses and marbles.

In some places these folds or domes are large and constitute the framework for large broad backed ridges. Bedrock scarps and exposures are common on these large ridges, however shallow, well and excessively drained Benson and Insula soils that formed in residuum or glacial till are on most convex surfaces. Clayey soils such as poorly drained Madalin or somewhat poorly drained Rhinebeck have formed in the lacustrine deposits that fill depressions on the broad backs of the landforms or that were deposited on some of the gently sloping beveled shoulders. Sometimes these depressions are in pock mark groups, with intervening protrusions of bedrock. The rounded bedrock in these cases dot the lacustrine flat.

In other areas of this region, the ridge like folds and domes of bedrock are smaller, more knife edged and closer together. As on the larger ridges, bedrock exposures and scarps are common, and Benson and

Insula soils blanket most surfaces. On these smaller ridges, however, there is no purchase for lacustrine sediments and soils.

Where the folds or bedrock domes are large the intervening valleys are commonly broad with an occasional small bedrock island. In such broad basins the lacustrine deposits are usually deep to bedrock, and with the exception of the occasional bedrock outcrop, these lacustrine areas commonly are similar to lacustrine areas in region one in terms of a landscape-soil sequence.

Where the folds or bedrock domes are smaller and closer together the intervening lacustrine soil sequence commonly consists of poorly drained, clayey, Covington or Madalin soils bracketing an intermittent stream in the center of the narrow basin. In some areas thin bands of clayey, moderately well drained Hudson soils slope up from the Madalin or Covington soils to the margins of the bedrock controlled ridge.

Conclusion.

This article sketches the main soil-landscape "themes" of the St. Lawrence Lowlands as they occur in St. Lawrence County, as the author conceives them. It was not meant to discuss all landforms, landscapes or soils, hopefully it sketched most of the soil-landscape "themes" as they are manifested regionally in St. Lawrence County, New York.

Acknowledgements.

The author gained perspective of the subject through conversations with Luther H. Robinson, Kenneth Van Doren and Keith A. Wheeler, all of whom are SCS soil scientists.

The soils map from the "Soil Survey of St. Lawrence County, New York" compiled by Lounsbury, et al, GPO, 1925 was consulted in demarcating regional boundaries.

Late Quaternary History of the St. Lawrence Lowland, New York

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FIELD TRIP ROAD LOG

Day One: 8:00 A.M.

Total Miles	Miles from Last Point	Description
0.0	0.0	Begin at Flanders Inn, Massena, N.Y. (Massena 7.5' quadrangle). Assemble in parking lot. Turn east (left) out of Flanders Inn parking lot onto West Orvis Street.
0.1	0.1	Intersection of W. Orvis and Main St., 4-way stop sign. Turn south (right) onto Main St., follow to intersection with N.Y. 37.
0.7	0.6	Turn east (left) onto Rte. 37. Follow to Eisenhower Lock Road (St. Lawrence County Hwy. 131). Leave Massena 7.5' quadrangle - enter Raquette River 7.5' quadrangle.
4.4	3.7	Turn north (left) onto Eisenhower Lock Road toward Robert Moses State Park. Cross Grasse River. Approach snack bar and south side overlook parking on right. Pass under Eisenhower Lock. Lake St. Lawrence to left (upstream), Wiley Dondero Canal to right (downstream). Continue ahead to Information Center.
7.6	3.2	Turn east (right) at access road passing Tourist Information Center on right. Road is not numbered nor named but leads toward Hawkins Point Lookout and Snell Lock.
8.5	0.9	Turn left (northeast) on secondary access road to Hawkins Point Lookout. Road is badly pocked in places. Follow road to a point just beyond bend to right. Small copse of sumac on left marks field trip stop in small gully. Power lines are visible ahead (east) crossing road.

STOP ONE

- | | | |
|------|-----|--|
| 9.7 | 1.2 | <p>Gully exposes fossiliferous, gray marine silt and clay. Elevation 200 ft. & a.s.l. Fossils (macro and micro) have been identified by J. Mark Erickson (see accompanying Table).</p> <p>The assemblage of microfauna is similar to an assemblage identified by T. Cronin and discussed in Clark (1980). Cronin interpreted the micro-fauna as suggesting "frigid environments" and, as suggested by Erickson, reduced salinities.</p> <p>Kirkland and Coates (1977) reported a radiocarbon date of 12,000 + 200 years BP "from Champlain Sea clay in downtown Massena" (p.501).</p> <p>Proceed ahead (east) to intersection with paved primary access road to Hawkins Point Lookout.</p> |
| 10.2 | 0.5 | <p>Turn north (left) at primary access road. Proceed to turn-around at Lookout.</p> |
| 10.4 | 0.2 | <p>Drive vehicles around loop at Lookout. U.S. and Canadian portions of the newly named Franklin D. Roosevelt Power Dam, between Barnhart Island (U.S.) and Canadian side are visible to the north.</p> <p>Return to primary access road, turn south (left) and proceed ahead.</p> |
| 10.9 | 0.5 | <p>Turn west (right) on access road, proceed toward Information Booth and Eisenhower Lock Road (County Highway 131).</p> |
| 13.4 | 2.5 | <p>Turn south (left) on Eisenhower Lock Road and retrace route under Lock to Rte. 37.</p> |
| 16.6 | 3.2 | <p>Turn west (right) on Rte. 37 toward Massena. Continue west past Main St., Massena, to intersection with Rte. 56. Leave Raquette River 7.5' quadrangle, enter Massena 7.5 quadrangle.</p> |
| 23.5 | 6.9 | <p>Intersection with Rte. 56. Turn south (left) on Rte. 56 South. Road runs along crest of ridge with small (0.2 - 0.5km) N-S trending drumlinoid features developed on ridge flank (see discussion by J. Carl). Valley floors are filled with Champlain Sea and fluvial sediments.</p> |
| 26.4 | 2.9 | <p>On west (right) side of road, numerous boulders on surface probably mark wave action by Champlain Sea on till ridge, resulting in winnowing of fine</p> |

TABLE 1.
Summary of Paleontological Data
From Massena "Clay" Locality

Prepared by J. Mark Erickson
assisted by Ronald Metzger
and Richard O'Connor

A grab sample of approximately 200 cc volume was washed in water and dispersant in preparation for standard micropaleontological examination of sand and silt fractions. The coarse fraction of silt and very fine, angular and subangular quartz sand (with an accessory complement of micas and tourmaline) comprised approximately 35% of the sample. It included fossil material in the form of mollusk shell fragments, foraminiferid tests, and ostracode carapaces.

Examinations of fossil material were made at magnifications up to 100X using standard reflected-light microscopy. The taxa identified are listed in Table 1. Relative abundance data are presented in the same table.

TABLE 1
LIST OF TAXA PRESENT IN MASSENA
CLAY SAMPLE FROM HAWKINS POINT SITE

<u>TAXON</u>	<u>RELATIVE ABUNDANCE</u>
Mollusca (Bivalvia)	
<u>Macoma</u> cf. <u>M. baltica</u>	Common
Protista (Foraminiferida)	
<u>Elphidium</u> sp.	Abundant
<u>Cassidulina</u> <u>crassa</u>	Common
<u>Guttulina?</u> sp.	Very Rare
Arthropoda (Ostracoda)	
<u>Candona?</u> sp.	Very Rare
<u>Cyprinotus?</u> sp.	Very Rare
Unidentifiable fragments	Very Rare

Composition of the faunal assemblage here recognized ensures a marine origin for this deposit but is not sufficient to permit significant detail for paleoenvironmental reconstruction. Abundance of Elphidium and presence of the ostracodes Candona? and Cyprinotus? may suggest a brackish water condition.

sediments and leaving a boulder lag (see discussion by S. Carlisle).

27.7	1.3	Sand deposits exposed in road cuts. Reworked Champlain Sea deposits by eolian processes into dunes. Strong dune development apparent on topographic maps 1-2km west.
28.3	0.6	Road again on crest of oriented till ridge, with wave washed boulder lag on surface. We have crossed onto the Norfolk 7.5' quadrangle. The area covered by this map sheet displays well-developed oriented till ridges and drumlins 60-70 ft. high.
29.7	1.4	Intersection. Stay on Rte. 56.
29.9	0.2	Cross Raquette River.
30.0	0.1	Entering town of Raymondville.
30.6	0.6	Two large drumlins on east (left) side of road trending N10°E - S10°W, ice flow towards south.
33.1	2.5	Entering town of Norfolk. Stay on Rte. 56S. Kirkland and Coates (1977) reported radiocarbon dates of 11,000 ± 160 yrs. BP and 11,225 ± 200 yrs. BP "from reworked sand overlying winnowed till north-east of Norfolk" (p. 501).
34.2	1.1	Barrett's Quarry on west (right) side of road. They are quarrying the Ogdensburg Formation (Ordovician dolostone). Quarry excavations of "overburden" have exposed thick till sequences, but operators have not allowed access.
35.7	1.5	Entering village of Norwood. Stay on Rte. 56S.
36.6	0.9	Cross railroad tracks. Leaving Norfolk 7.5' quadrangle onto Potsdam 7.5' quadrangle.
41.1	4.5	Entering village of Potsdam, town where the milk bottle was invented. Stay on Rte. 56S through town.
41.9	0.8	Junction with Rte. 345. Stay on Rte. 56S.
42.2	0.3	Bear left at light on Rte. 56S and Rte. 11N.
42.4	0.2	Turn south (right) on Rte. 56S. Passing by part of Clarkson College campus.
42.8	0.4	State University of New York at Potsdam campus on left.

44.0 1.2 Junction with Rte. 72. Bear right - stay on Rte. 56S.

45.1 1.1 Country Club entrance on left.

STOP TWO

45.25 0.15 Sand pit into delta on west (right) side of road. Exposures into delta display variety of sedimentary structures, including thick (3-4m) beds of contorted bedding resulting from soft sediment deformation.

This delta was built by the Raquette River into a late Pleistocene lake. The delta was unidentified in earlier field work. The break in slope between the gently sloping top surface and steeply sloping frontal surface occurs at 530-540 ft. (161-164m) a.s.l.

The delta is 23km (14.4 miles) east-northeast of strandline #19 or the delta constructed by the Grasse River into lake level IV at 152-155m, and 7.4km (4.6 miles) southwest of strandline #20, a delta built by the West Branch of the St. Regis River into level IV at 166-169m. Plotting the elevation of the delta at this stop on the distance-elevation diagram places it on the tilted water plane of level IV, and thus correlates with strandline #'s 19 and 20.

According to regional correlations proposed by Clark and Karrow (1984), this water level (IV) was confluent with glacial lake Belleville in the Ontario basin and lower Fort Ann in the Champlain Lowland.

Continue south on Rte. 56.

45.7 0.45 Large sand and gravel pit on east (left) side of road.

45.9 0.2 Town line of Pierrepont. Have crossed onto Colton 7.5' quadrangle. Warning: left turn coming up.

46.3 0.4 Jog left off of Rte. 56 onto narrow road.

46.45 0.15 Turn left onto Keener Road.

46.6 0.15 Townline of Parishville.

47.2 0.6 Large sand and gravel pit (Bicknell Bros.) into glacio-fluvial ice contact sediments. Ice contact sediments are widespread along the northern flanks

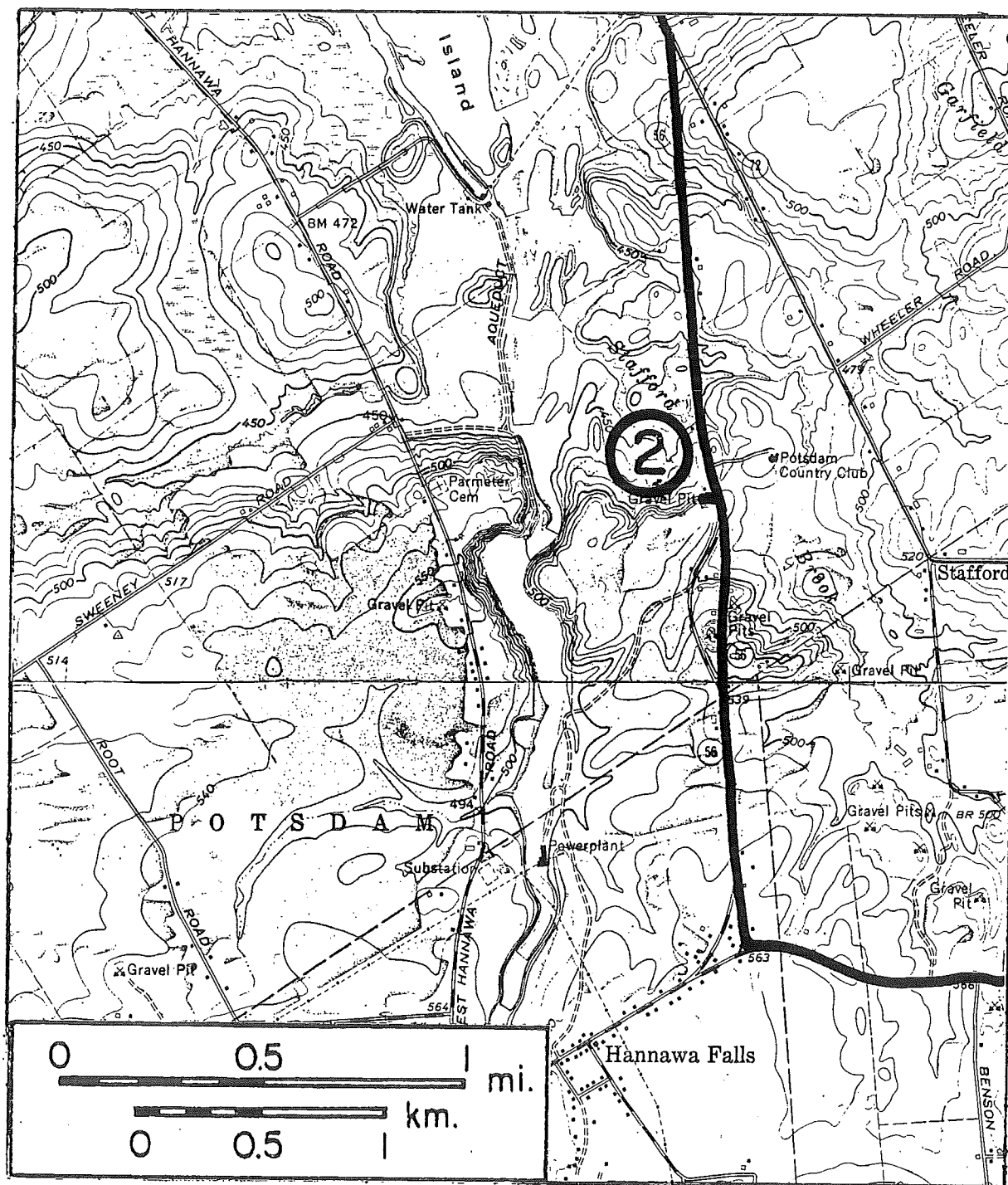


FIGURE 1. Location of Stop 2. From Potsdam and Colton 7.5' quadrangles.

of the Adirondack Mountains, often choking valley floors. They are interpreted as indicating stagnation of the retreating ice sheet in this high relief area.

5.5 miles (8.8km) south of this site is a delta constructed by the Raquette River (strandline #1) into lake level I at 274-277m (910-920 ft.). Clark and Karrow (1984) proposed that level I was confluent with Lake Iroquois and marks the first incursion of Lake Iroquois into the St. Lawrence Lowland.

47.4	0.2	Turn north (left) onto Willisville Road.
48.0	0.6	Sand and gravel pits on west (left) side of road - continuation of pits driven by earlier.
48.55	0.55	Turn east (right) onto Rte. 72.
51.6	3.05	Town of Parishville Center.
53.3	1.7	Drainage divide between West Branch St. Regis River (east) and Raquette River (west).
55.0	1.7	Intersection. Stay on Rte. 72. Going up hill - road cut through delta sands.
55.3	0.3	Good view to north (left) of eroded delta remnant.
55.4	0.1	Enter town of Parishville.
55.6	0.2	Cross West Branch St. Regis River.
55.8	0.2	Turn north (left) onto County Highway 26. Parishville School on right.
56.2	0.4	Bear left at fork.
56.6	0.4	Bear left at fork.

STOP THREE

56.8	0.2	We are on the surface of a delta constructed by West Branch of the St. Regis River (strandline #5) into lake level II at 267-270m (880-890 ft.). The delta has been extensively eroded by the river, but remnants such as we saw from the road and that we are standing on clearly demonstrate the existence of a raised delta.
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According to our reconstructed water level, this glacial lake drained through Covey Hill Gap, which we'll visit on our last stop tomorrow. Clark and Karrow (1984) proposed that lake level II was con-

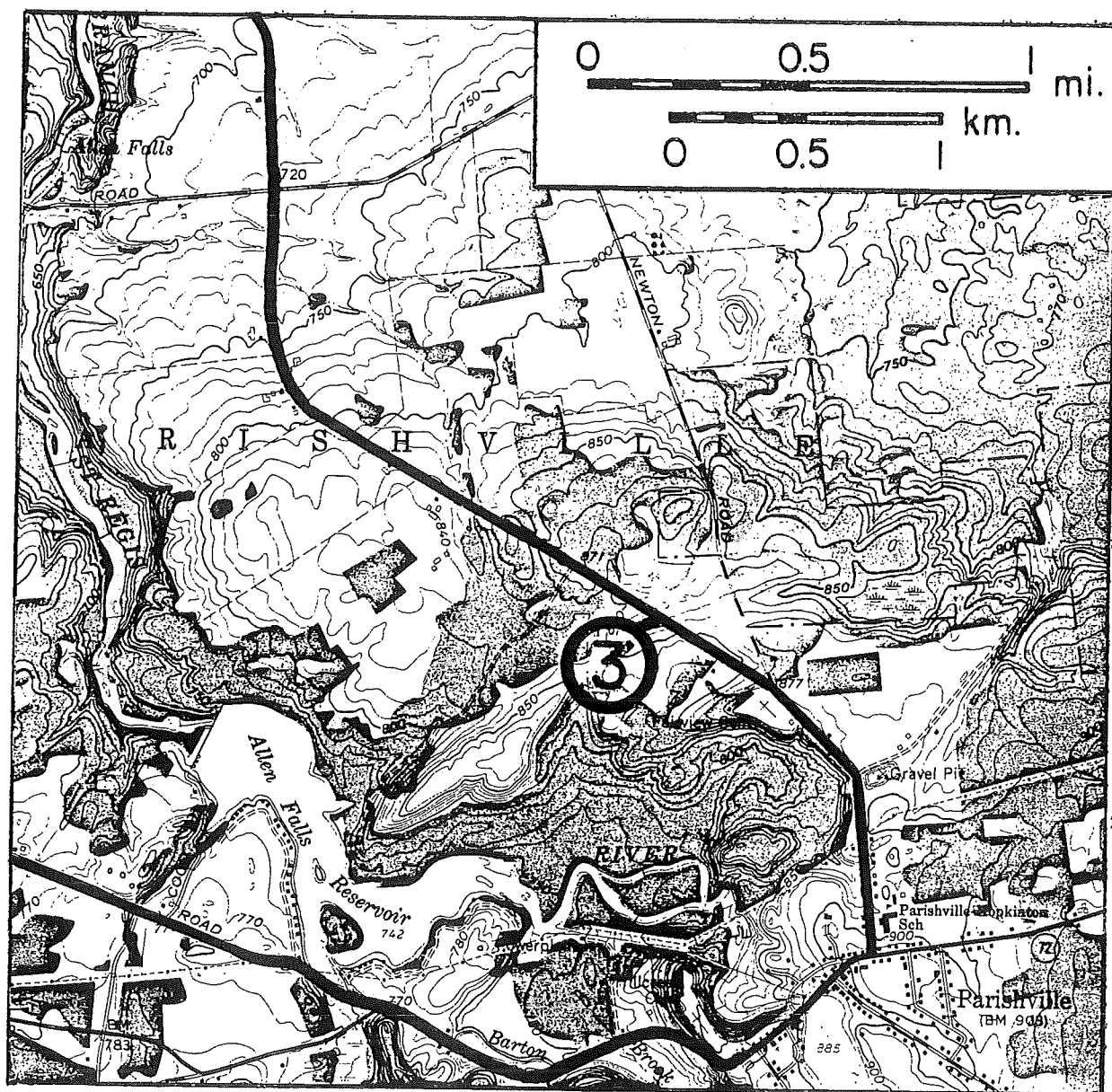


FIGURE 2. Location of Stop 3. From Parishville 7.5' quadrangle.

fluent with Lake Iroquois. Relative lowering of lake levels from I to II in the St. Lawrence Lowland occurred as a result of differential isostatic uplift, with greater uplift in the Covey Hill region than in the Lake Ontario basin. The Iroquois level

was maintained in the Lake Ontario basin, but a lower outlet (Covey Hill Gap) became available due to differential isostatic uplift, and the result we see on the "extended" diagram is a "splitting" of strandlines.

We will walk onto sand surface ("erg") to discuss Iroquois relationships. Watch for well-polished vertifacts.

Another delta was constructed downstream into lake level IV at 166-169m (550-560 ft.) (strandline #20). A possible candidate for a delta is located between strandline #'s 5 and 20 at 185m which would correspond to lake level III.

Continue north on county highway.

56.9	0.1	Precambrian bedrock on road side.
57.9	1.0	Boulder surface concentration on right - washed till?
59.5	1.6	Crossing sand and gravel which may be deposit of delta corresponding to lake level III.
59.6	0.1	Entering town of Southville.
59.65	0.05	Intersection with Rte. 11B. Turn east (right) onto Rte. 11B.
63.1	3.45	Townline of Hopkinton.
66.9	3.8	Village of Hopkinton. Continue on Rte. 11B.
67.1	0.2	Intersection with Rte. 72. Continue on Rte. 11B.
68.0	0.9	Road crossing over till plain with thin mantling of lacustrine clay.
69.0	1.0	Entering village of Nicholville.
69.3	0.3	Turn south (right) onto Rte. 458 East.
69.7	0.4	Turn east (left) onto Days Mills Road - a narrow, partly paved road.
70.2	0.5	Sand pit on right side of road. Excavations into delta (strandline #6) constructed by the St. Regis

River into lake level II, or the same level as delta at Stop 3. Further downriver (7 miles, 11.2km), a delta (strandline #21) was constructed into lake level IV at 171-174m (560-570 ft.).

73.1	2.9	Turn left onto Rte. 72.
73.15	0.05	Cross Lake Ozonia outlet.
75.4	2.25	Bear left on Rte. 72.
76.7	1.3	Entering village of St. Regis Falls.

LUNCH

77.1	0.3	Turn left into campsite-picnic area for lunch.
		Return to Rte. 72, turn left towards village of St. Regis Falls.
77.0	0.1	Stop sign. Turn left into town.
77.2	0.1	Turn east (right) onto County Road 14 across from St. Regis School.
78.1	0.9	Turn north (left) onto Conger Road (small dirt road) across from plant nursery.
78.9	0.8	Bear left onto Niles Road. Refer to topographic map - figure.

We have crossed over a recessional moraine underlain by ice contact stratified sediments. A well-developed esker up to 80-90 ft. high leads northward out of the moraine. Sediment comprising the esker is coarse gravel.

This esker - kame moraine - outwash plain complex is interpreted as representative of the style of deglaciation of the northward - retreating ice sheet. Relief exceeds 300m (1000 ft.) in this region of the northern Adirondacks. Deglaciation of the region was characterized by progressive ablation of the ice, initially by downwasting. Ice remained active in the low regions while stagnation occurred over high areas. Eventually, backwasting became the primary mode of deglaciation as the ice front assumed the configuration of lows (valleys) and became lobate in form. Ice proceeded to retreat out of the valleys, intermittently stabilizing to produce the esker - kame - outwash complexes in major valleys.

81.0	2.1	Turn west (left) onto Church Road. Entering town of Dickinson Center.
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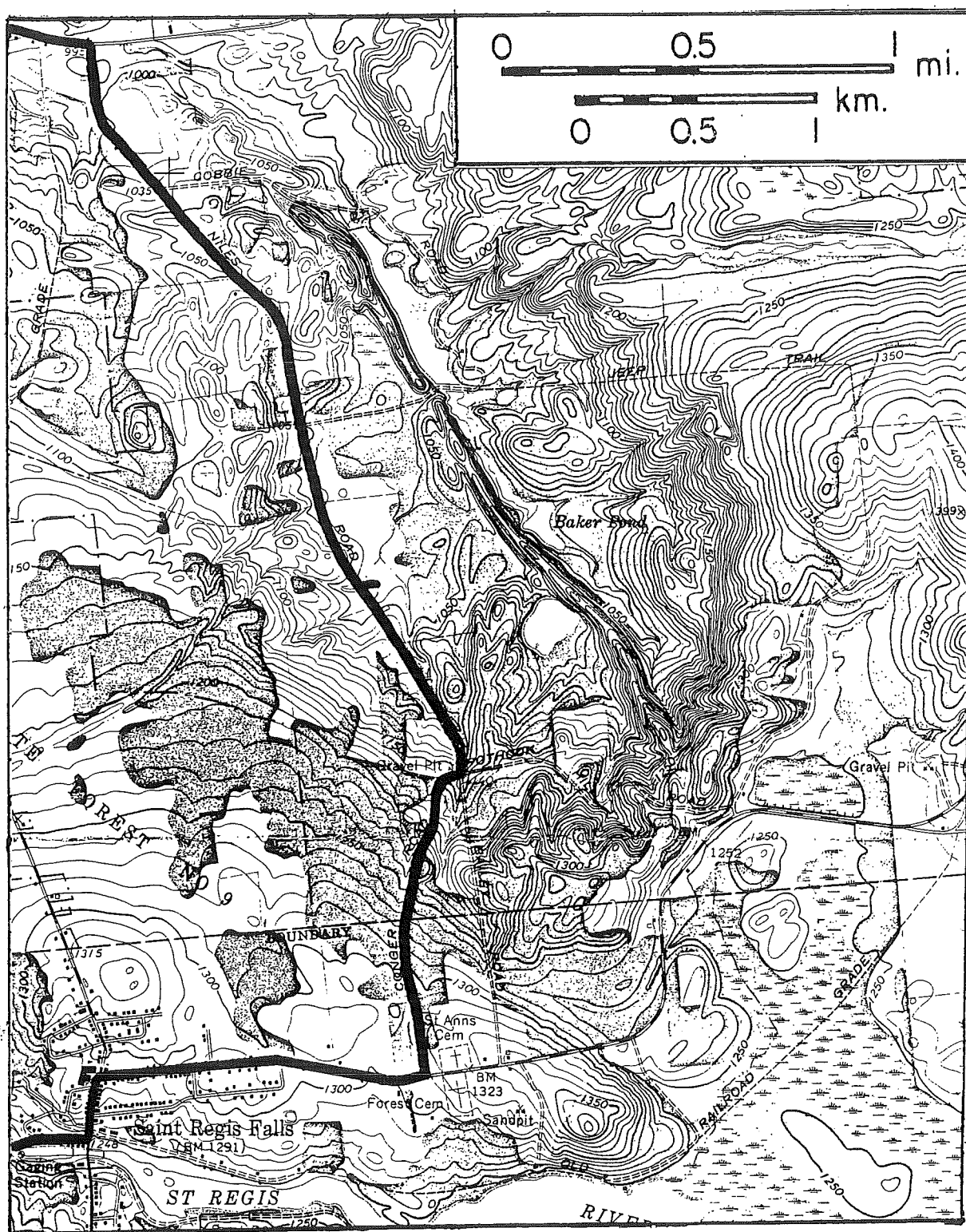


FIGURE 3. Detail of esker-kame moraine-outwash plain complex near Saint Regis Falls, N.Y. From Saint Regis Falls 7.5' quadrangle.

81.4	0.4	Turn north (right) and cross the Deer River.
81.6	0.2	Turn east (right) at sharp bend in road onto Cemetary Road.
82.1	0.5	Possible photo stop, if we have time. This is not the largest erratic that exists, but it is the largest seen in northern New York, and warrents its own contour line on the St. Regis Falls 7.5' quadrangle map.
83.4	1.3	Intersection with Church Road. Continue straight on Cemetary Street.
84.0	0.6	Intersection. Turn north (left) onto Conservation Road.
84.8	0.8	Good view straight ahead of St. Lawrence Valley.
85.1	0.3	Exposure on right into steeply dipping foresets of gravel. MacClintock and Stewart (1965) interpreted this deposit as a delta built into glacial lake Fort Covington (=Iroquois). Presently, no stream exists anywhere near this delta. Ice marginal channels are graded to it, however, and combined with its location in an ablation complex of sediments, suggests that it is a glaciofluvial ice contact deposit. State Forest Headquarter on left.
85.7	0.6	Intersection. Continue straight on Conservation Road.
86.7	1.0	Stop sign. Turn east (right) onto Rte. 11B. 3.6 miles (5.8km) north, the limit of the Champlain Sea is marked by strongly developed beach ridges at 460-470 ft. (140-143m) (strandline #33).
87.4	0.7	Village of East Dickinson. Cross onto Bangor 7.5' quadrangle. Beach ridges corresponding to lake level III are found near East Dickinson at 204-207m (670-680 ft.).
88.4	1.0	Cross Stony Brook. This stream constructed a small delta (strandline #24) at 180-183m (600-610 ft.) into lake level IV.
90.5	2.1	Road cut on right side of road, site of till fabric reported in Clark and Karrow (1983) measured in red till (fabric 13A).
90.9	0.4	Village of West Bangor, N.Y.
91.2	0.3	Cross Little Salmon River. This river built a small delta downstream at 181-184m (600-610 ft.) into lake level IV.

The area south of here contains large volumes of ablation sediments, mapped by MacClintock and Stewart (1965) as Fort Covington terminal moraine. Clark (1983a) interpreted deposition of these sediments as recessional moraine by northward retreating ice that stabilized along the northern margin of the Adirondack

Mountains while lobes of ice projected southward up the valleys of the Salmon, St. Regis, and Raquette rivers. Further northward ice retreat in the St. Lawrence Valley allowed the incursion of Lake Iroquois, first marked in this area by lake level I.

- | | | |
|------|-----|---|
| 92.8 | 1.6 | Village of Bangor, N.Y. |
| 93.2 | 0.4 | Cross East Branch of the Little Salmon River. Upstream from crossing, the river constructed a delta (strandline #8) into lake level II (=lake Iroquois) at 285-288m (940-950 ft.). The delta is developed on ablation sediments. |
| 94.2 | 1.0 | Top of ridge. Ridge is underlain by Precambrian rocks and projects northwards into St. Lawrence Valley. It is flanked by Potsdam Sandstone to the west, north, and east. |
| | | A well-developed beach ridge (strandline #2) was mapped on the north flank of the ridge at 302-305m (1000-1010 ft.), and corresponds to lake level I, or the highest and oldest lake level identified in the St. Lawrence Lowland. |
| 97.7 | 3.5 | Enter village of Malone, N.Y. |
| 98.2 | 0.5 | Blinking red light, intersection with Rte. 30. Continue straight through intersection. |
| 98.4 | 0.2 | Intersection with Webster Road. Turn south (right) onto Webster Road. |
| | | MacClintock (1958) described Malone Till as "exposed in many places in and near Malone, so it has been named the Malone till" (p. 6). MacClintock and Stewart (1965) described the type locality for the Malone Till as "a good exposure of the red-brown till in the excavation for Webster Avenue in Malone" (p.69). We have not been able to locate this exposure. |
| 99.2 | 0.8 | View from road to east (left) of Salmon River Valley which contains large volumes of ice contact stratified sediment. The hills seen at the bottom of the valley are kames. |

STOP FOUR

99.6

0.4

Two excavations into till which were not exposed in 1979 when the surficial geology of the Malone area was mapped. Consequently, no sedimentological, compositional, or fabric data is available. However, one sample had been collected 0.15 mile north of this stop in a road cut of Webster Avenue (sample #11, Table 2). Furthermore, six additional samples (Table 2) had been collected within a two mile (3.2 km) radius of this stop. In addition, two till fabrics (9A, 10A) were measured 1.8 miles (2.9km) northwest of of this stop, and another fabric (12A) was measured 2.1 miles (3.4km) south of the stop.

TABLE 2*

Sample No.	Texture (%)			Pebble Lithology (%)				Carbonate Mineralogy (%)	Color
	Sd	St	Cl	PC	SS	Sh	Carb.		
7	60	30	10	26	37	35	0	0	Red brown
10	59	34	7	70	25	5	0	0	Red brown
11	72	25	3	80	15	5	0	0	Red brown
25	52	41	7	2	48	42	8	3.0	Brown
26	69	26	5	48	52	0	0	0	Red brown
27	70	26	4	70	25	5	0	0	Red brown
30	59	35	6	0	42	39	19	5.0	Red brown

*From Clark (1980)

Red brown surface till in the Malone area was termed Malone Till by MacClintock and Stewart (1965), and they correlated it with the lower till exposed in Seaway excavations. Clark and Karow (1983) interpreted red brown surface till as part of a continuous till sheet (Fort Covington Till) extending north to the Seaway excavations and south into the Adirondack Mountains. Spatial differences in color and composition within the till sheet were attributed to the influence of underlying bedrock. These relationships are indicated in the data from samples collected nearby (Table 2). The two samples containing carbonate content in matrix and clast components were collected furthest north of the seven samples, and still reflect an influence of carbonate bedrock up-ice on till composition. The remaining samples, however, are devoid of carbonate content, which we interpret to reflect deposition south of carbonate bedrock influence.

We interpret red brown till exposed at this stop to correspond to till samples nearby. Consequently, we argue that this till correlates to Fort Covington Till, and that a separate surface till sheet (Malone) does not exist in this area. The surface till further correlates with the upper till exposed in Seaway excavations.

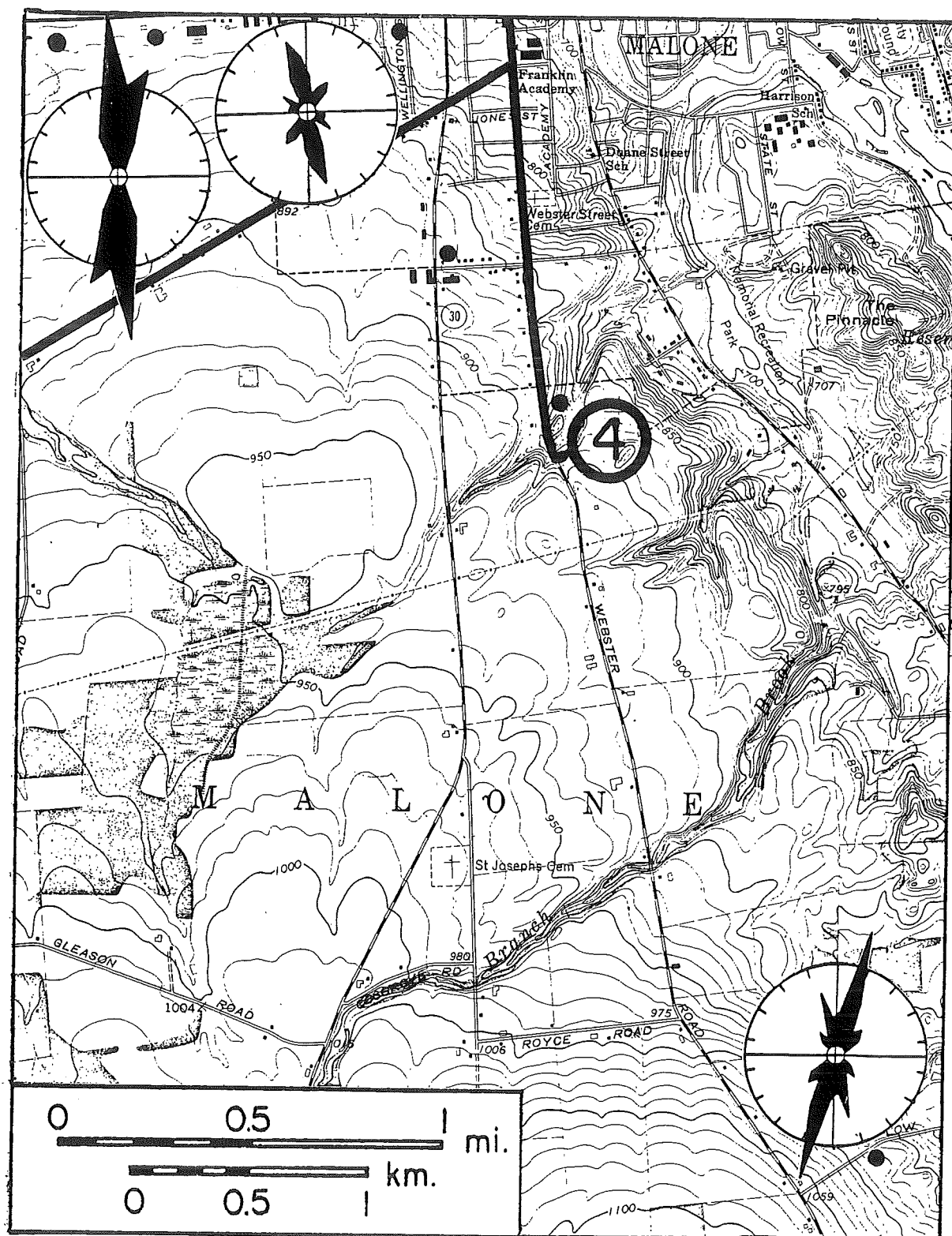


FIGURE 4. Location of Stop 4. Till fabrics (clockwise from upper left) 9A, 10A, and 12A from Clark and Karrow (1983). Malone 7.5' quadrangle.

Upper outcrop: Vertical face 12-15 ft. (3.6-4.5m) high, 100-150 ft. (30-45m) long, exposing red brown till. On several faces, pebble fabric can be observed.

Lower outcrop: Vertical face over 20 ft. (6m) high, exposing two units. The lower unit is massive red brown till 12-15' (3.6-4.5m) thick; the upper unit is buff brown - brown, stratified diamicton (4.7-6 ft.; 1.4-1.8m). Contact is abrupt and planar.

As mentioned earlier, these are "new" outcrops, and we encourage discussion, particularly about the lower outcrop.

Turn around and return north on Webster Road to Malone.

- | | | |
|-------|-----|---|
| 100.9 | 1.3 | Turn west (left) onto Rte. 11. |
| 101.1 | 0.2 | Intersection of Rtes. 11 and 37. Turn north (right) onto Rte. 37. |
| 102.0 | 0.9 | View to east (right) - evergreen trees growing on surface of Malone delta. |
| 102.5 | 0.5 | Turn right onto Bear Hill Road. |
| 103.2 | 0.7 | Stop sign. Continue straight on Bear Hill Road. We have left the Malone 7.5' quadrangle and crossed onto the Constable 7.5' quadrangle. |

We are now driving on the surface of the Malone delta (strandline #27). Immediately after the stop sign, the road descends into a depression over 9.1m (30 ft.) deep. Several other depressions are found on the delta surface and are interpreted as recording the former presence of ice blocks (bergs?) that may have been stranded in shallow water after higher lake levels dropped.

MacClintock and Stewart (1965, p.69) described the Malone delta as "one of the striking topographic features of the St. Lawrence Lowland." The large delta was constructed by the Salmon River into lake level IV, and has a present elevation of 189-192m (620-630 ft.). This is the same lake level into which the delta we examined at Stop One was constructed.

- | | | |
|-------|-----|--|
| 104.0 | 0.8 | Beginning to drive down steep frontal slope of delta. |
| 104.6 | 0.6 | Stop sign. Turn west (left) onto Cargin Road. View to south (left) of front of Malone delta. |

Beach ridges nearby record the limit of the Champlain

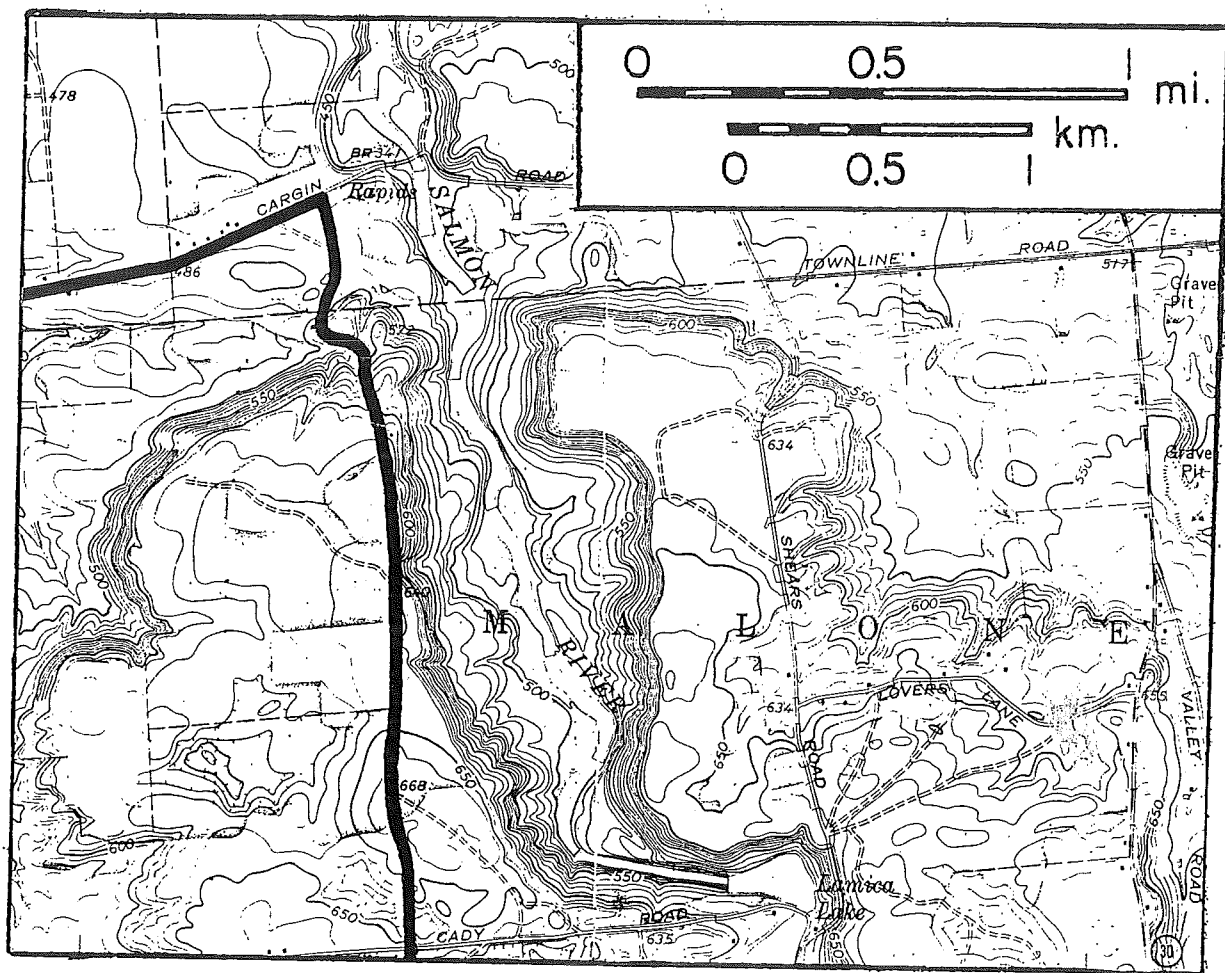


FIGURE 5. Detail of Malone delta constructed by the Salmon River into level IV. From Constable 7.5' quadrangle.

Sea at 480-490 ft. (146-149m) (strandline #35), which is approximately the elevation here. Therefore, although no strandline features are found here, our elevation suggests we are at the marine limit.

- 105.6 1.0 Stop sign. Continue straight through town of Fay.
- 105.8 0.2 Stop sign. Turn south (left) onto Rte. 37S.
- 107.1 0.3 Turn west (right) onto County Road 8. Crossing a till plain overlain by lacustrine sand to the south and marine sand and gravel to the north.
- 110.2 3.1 Intersection - continue straight.
- 111.1 0.9 Passing by well-developed beach ridges immediately north of road. These mark the limit of the Champlain Sea at 470-480 ft. (143-146m) (strandline #34). Individual beach ridges here can be traced up to 5km on air photos.
- 112.2 1.1 Turn north (right) onto County Highway 3. Crossing onto Fort Covington 7.5' quadrangle.
- 113.4 1.2 Intersection in town of Cooks Corners. Turn west (left) onto County Highway 32.
- 114.4 1.0 Bear right at fork - stay on paved road.
- 115.8 Crossing onto Bombay 7.5' quadrangle.
- 115.9 Turn north (right) onto Townline Road.

STOP FIVE

- 116.1 0.2 Exposure of till just upstream from bridge over West Branch Deer Creek.

Gray till (6-8 ft., 1.8-2.4m) overlain by buff brown till (0.6-0.9m) overlain by sand (1.8-2.4m).

Two samples of gray till were analysed by Clark (1980):

Sample No.	Texture (%)			Pebble lithology (%)				Carbonate Mineralogy (%)
	Sd	St	Cl	PC	SS	Sh	Carb.	
40	52	37	11	3	48	1	48	8.1
41	52	37	11	0	54	2	44	8.8

A till fabric (5A) was also measured here.

Underlying bedrock is the Theresa formation (interbedded sandstone and dolostone), thus accounting for the high percentage of sandstone pebbles.

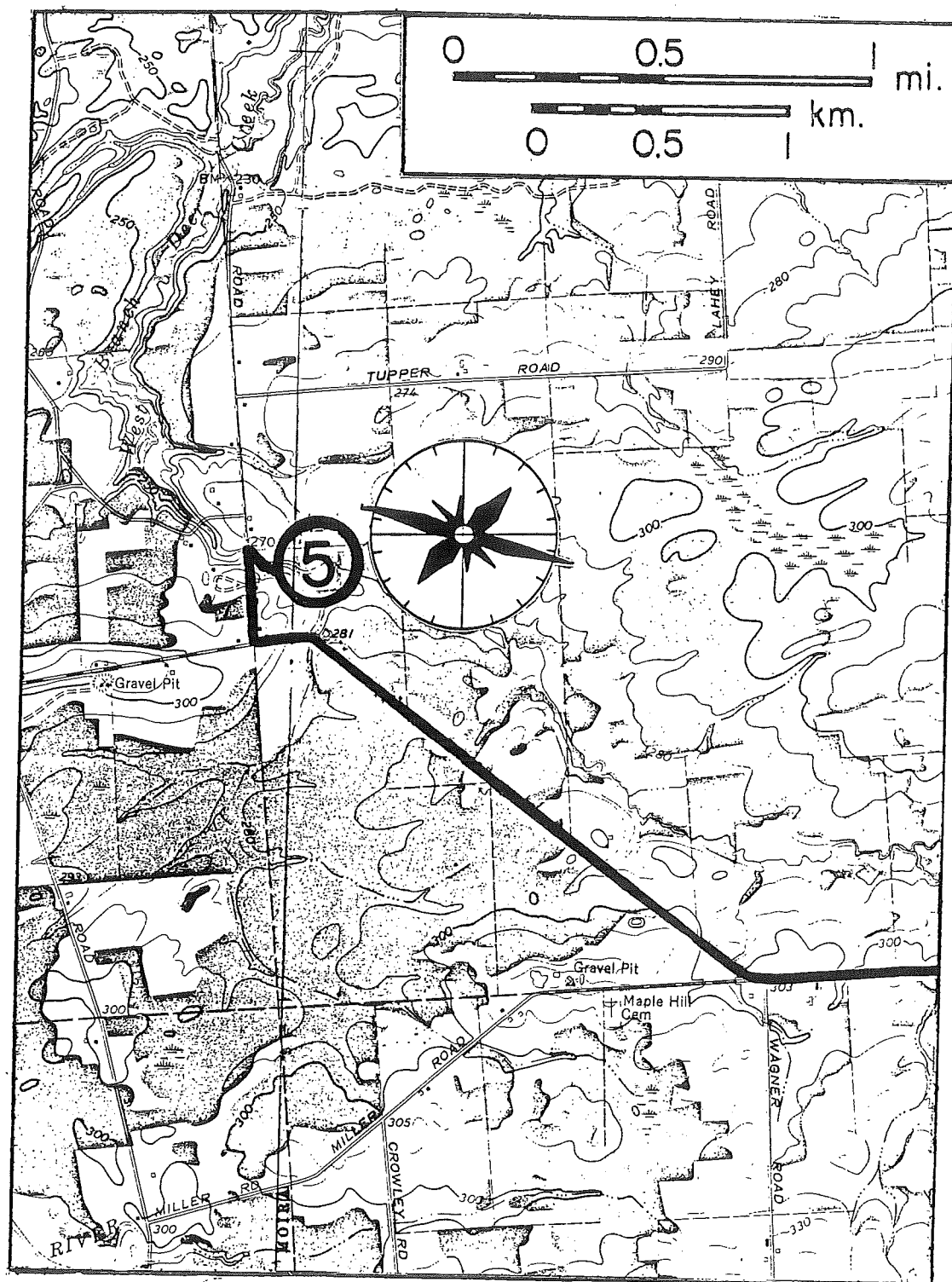


FIGURE 6. Location of Stop 5. Till fabric 5A from Clark and Karrow (1983).
Bombay and Fort Covington 7.5' quadrangles.

The gray till exposed here is Fort Covington Till. The buff-brown color of the upper 0.9m is the weathered counterpart of gray till. Overlying sands are non-fossiliferous but are interpreted to be marine.

The north-south difference in distance between Stop 4 and this stop is 5 miles (8km), yet the two till exposures we have observed at these two stops have significantly different compositions. This suggests rapid petrographic facies changes in till resulting from rapid subglacial deposition (cf. Clark, 1983b).

Turn around and return to intersection with County Highway 32.

116.3 0.2 Stop sign. Turn east (left) onto County Highway 32.

118.8 2.5 Intersection in town of Cooks Corners. Turn north (left) onto County Highway 3.

119.1 0.3 Cross West Branch of Deer Creek.

123 3.9 Intersection in town of Fort Covington Center. Turn east (right) onto County Highway 4.

Road follows crest of till ridge which is southernmost ridge of belt of oriented till ridges (see discussion by J. Carl).

125.5 2.5 Cross Salmon River.

125.6 0.1 Stop sign - intersection with Rte. 37. Turn north (left) onto Rte. 37.

126.3 0.7 Town of Westville. Turn east (right) off Rte. 37, stop sign within 100 ft. Continue bearing right at stop sign onto County Highway 20.

127.6 1.3 Turn north (left) onto County Highway 40.

128.9 1.3 Fork in road - continue due north (bear left at fork).

STOP SIX

129.0 0.1 Gravel pit exposing marine and glaciofluvial sediments.

Coarse, gravelly, fossiliferous marine sediments (0.5-1.0m) overlying ice contact, glaciofluvial stratified sand and gravel. Marine sand and gravel contains abundant fossils of Hiatella artica and Macoma sp. (balthica?), and rare fossils of Balanus and Mytilus. Marine sediments were derived from reworking of underlying glaciofluvial sediment. The contact between marine and glaciofluvial sediments is uniformly horizontal. Glaciofluvial gravel is imbricated, with paleoflow from north to south.

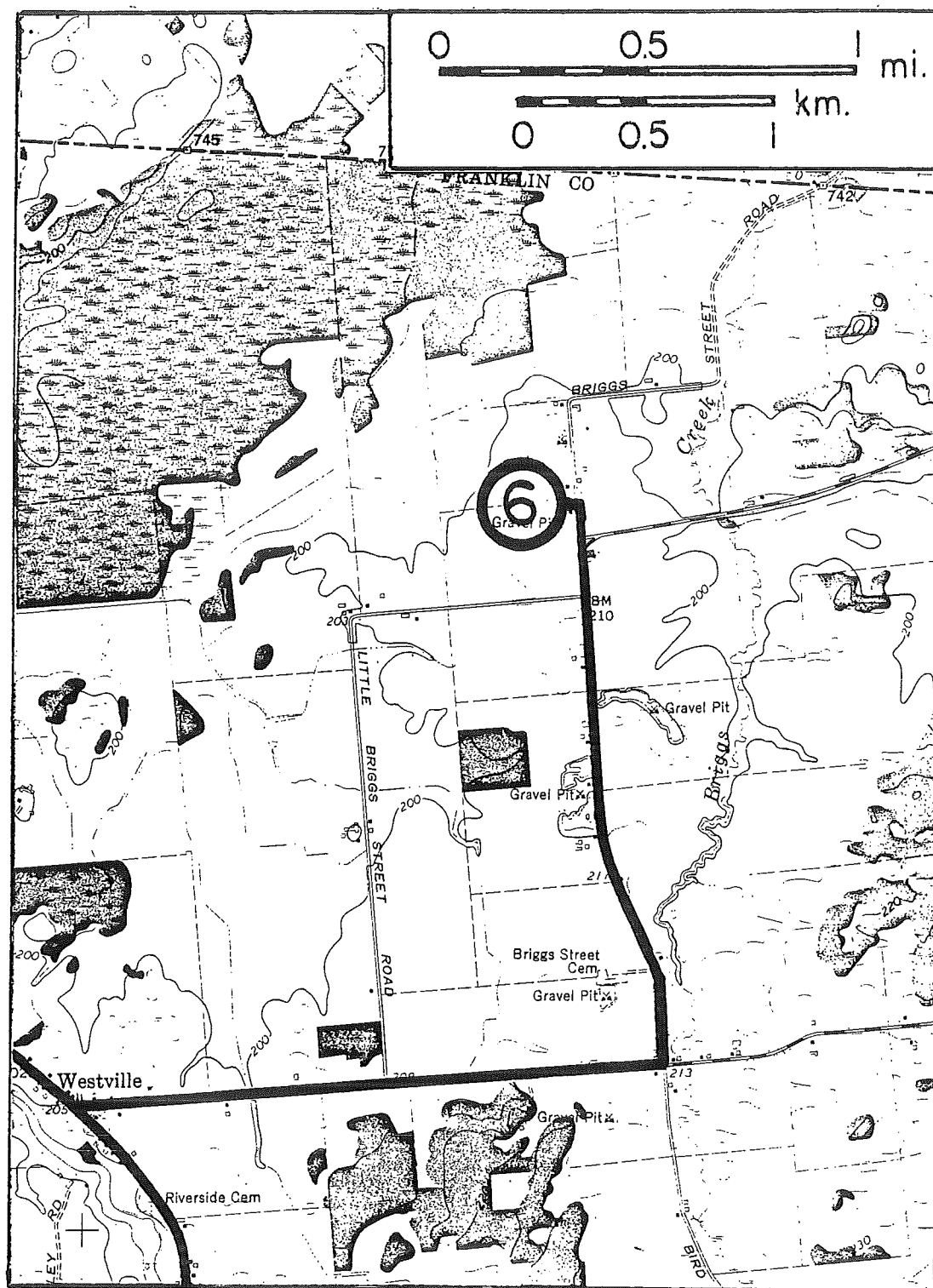


FIGURE 7. Location of Stop 6. From Fort Covington 7.5' quadrangle.

Shells from this locality have been dated at 10,970 + 110 yrs. BP (WAT - 626).

Turn around and return to County Highway 20.

- 130.4 1.4 Turn west (right) onto County Highway 20.
- 131.7 1.3 Bear right at fork in road.
- 131.8 0.1 Stop sign. Turn north (right) onto Rte. 37.

Entering area of oriented till ridges. MacClintock and Stewart (1965) interpreted these ridges as "one broad moraine", and "because the gray-buff drift forms a major moraine whose axis passes through Fort Covington, it is designated Fort Covington Till" (p. 6). Therefore, we are entering the type area of Fort Covington Till. MacClintock and Stewart (1965) never designated a type locality for this till.

- 132.4 0.6 Salmon River on left. River bed is floored on Ogdensburg Formation.
- 134.5 2.1 Till fabric (1A) and samples (56 and 56) (Table 3) collected in road cut on right.
- 134.8 0.3 Pass under 765 Kv power line.
- 135.2 0.4 Till fabric (3A) and till samples (54 and 55) collected in road cut on right (Table 3).
- 135.5 0.3 Till fabric (2A) and till samples (52 and 53) collected in road cut on right (Table 3).
- 135.8 0.3 Entering village of Fort Covington, N.Y.

End of Day One. Return to Massena on Rte. 37.

TABLE 3*

Sample No.	Texture (%)			Pebble Lithology (%)				Carbonate Mineralogy (%)
	Sd	St	Cl	PC	SS	Sh	Carb.	
52	54	36	10	0	15	5	80	12.6
53	50	42	8	0	36	2	62	10.2
54	63	32	5	0	42	7	51	10.0
55	65	30	5	1	24	2	73	11.0
56	54	40	6	0	27	8	65	16.2
57	48	44	8	5	35	0	60	15.6

*From Clark (1980)

DAY TWO

8:00 A.M. - Leave Flanders Inn, go directly to Malone, N.Y. on Rte. 37.

0.0	0.0	Intersection of Rte. 37 and Rte. 11 in Malone, N.Y. Turn east (left) onto Rte. 11. Follow Rte. 11 through Malone.
1.1	1.1	Franklin County Fairgrounds on south (right).
2.8	1.7	Turn east (right) off Rte. 11 onto County Highway 23 toward Burke.
4.0	1.2	Cross steel bridge over Collins Brook.
6.8	2.8	View to south (right) of Burke delta (strandline #10) built by the Little Trout River into lake level II, which drained across Covey Hill through Covey Hill Gap. Elevation of delta is 294-297m (970-980 ft.).
7.4	0.6	Entering village of Burke.
7.5	0.1	Cross Little Trout River. Aside from the delta constructed upstream into level II, the Little Trout River also constructed a delta in level IV at present elevation of 192-195m (630-640 ft.).
7.65	0.15	Turn south (right) onto County Highway 36 across from Fire Department.
8.1	0.45	Fork in road - go straight (left at fork). Burke delta can be seen on right.
8.9	0.8	Turn east (left) onto Cook Road.
9.9	1.0	Ridge on south (right) side of road is a small (0.5km long) esker.
10.1	0.2	Road crosses esker. Exposure of esker sediments on right.
10.7	0.6	We are crossing an underfit stream valley presently occupied by an intermittent stream. The channel is floored with boulders. We have crossed onto the Chateaugay 7.5' quadrangle.
11.1	0.4	Stop sign. Continue straight on Hartnett Road. Another underfit stream channel is on south (right) side of road.
11.3	0.2	Road crosses channel, and now channel is on north (left) side of road.

STOP ONE

12.05 0.75

Good view of underfit channel on north side of road.

The underfit channels we have been driving past were termed the "Chateaugay Channels" by MacClintock and Stewart (1965, p. 64), and they described them as: "generally fairly straight trenches in the drift, 25 to 75 feet deep, 300 to 400 feet across and floored with a mosaic of boulders. . . . These depressions trend east-west, diagonal to the general northward slope of the land" (p. 64).

The system of channels, now mostly abandoned, spans the regional slope from approximately 400m (1300') to 315m (1040'). The channels are graded to the west, therefore suggesting that drainage was to the west. MacClintock and Stewart (1965) and Denny (1974) concluded that the channels were eroded along a retreating ice front, an interpretation followed by us. The channels are eroded primarily in till.

This region has low relief (less than 15m (50 ft.) and is characterized by the slope of the St. Lawrence Valley to the north. The influence of this low relief on the style of deglaciation is suggested by the Chateaugay ice-marginal channels. Whereas high relief (i.e. northern Adirondack Mountains) resulted in downwasting and lobation of the ice margin, marginal retreat in this region of low relief was by an active ice front, with erosion of ice-marginal channels and relatively little deposition of ice contact sediments.

We interpret cessation of ice marginal channel erosion as a result of encroachment of a glacial lake (level I) eastward. The lowest altitude to which the channel network developed, therefore, is an indication of the altitude of the highest lake level, and this altitude is used as a strandline (strandline #3).

Continue east on Hartnett Road.

12.5 0.45

Bear left (north) at intersection.

12.8 0.3

Crossing another abandoned channel. Immediately east of us, the Chateaugay River has eroded a deep gorge.

13.3 0.5

Bear east (right) at fork. Cross Chateaugay River - good view of gorge excavated by river into Potsdam Sandstone.

The Chateaugay River constructed deltas into lake level (strandline #11, altitude 296-299m) and lake level IV (strandline #30, altitude 195-198m).

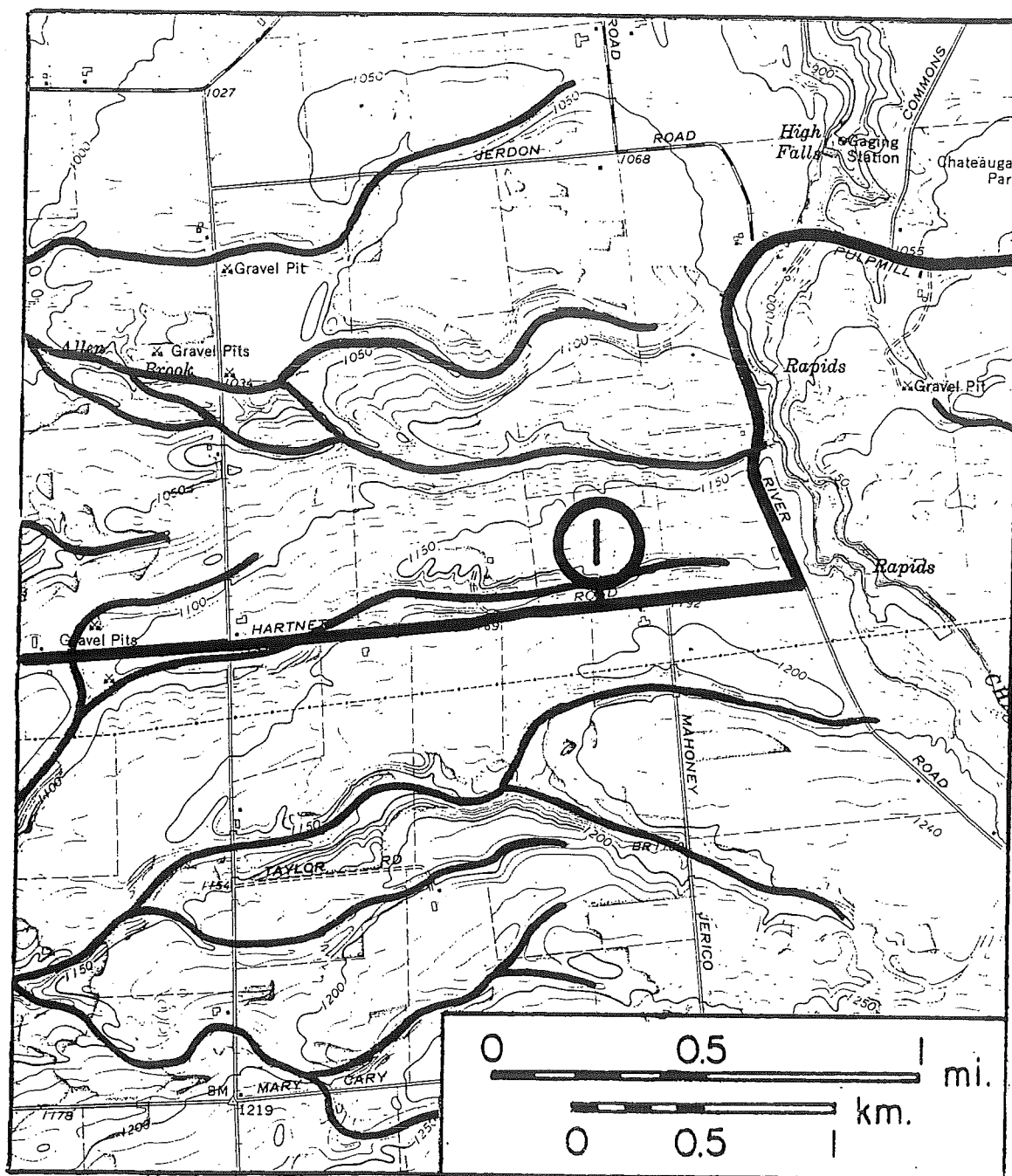


FIGURE 8. Location of Stop 1. Chateaugay channels are outlined. From Chateaugay 7.5' quadrangle.

14.2	0.9	Stop sign. Turn north (left) onto Rte. 374, proceed into Chateaugay.
15.1	0.9	Entering village of Chateaugay.
15.7	0.6	Stoplight. Turn east (right) onto Rte. 11.
17.5	1.8	Marble River to the north (left) of road. This river constructed deltas into lake level II (strandline #12, 299-302m) and lake level IV (strandline #31, 198-201m).
18.8	1.3	Leaving Franklin Co., entering Clinton Co.
23.6	4.8	Intersection with road to Churubusco, continue east on Rte. 11.
24.0	0.4	Drainage divide between waters flowing via the Chateaugay River and Marble River to the St. Lawrence, and waters flowing via the Chazy River to Lake Champlain.

Abandoned stream channels or cols, interpreted as spillways for ice-dammed lakes (MacClintock and Stewart, 1965; Denny, 1974), cross the drainage divide (cf. Figure). "The altitudes of these spillways are progressively lower from south to north, as follows: 3 1/4 miles south of Churubusco at 1,305 feet; 2 miles south of Churubusco at 1,290 feet; 1 mile northeast of Churubusco at 1,150 feet; 3 miles northeast of Churubusco at 1,090 feet" (MacClintock and Stewart, 1965, p. 60).

Denny (1974, p. 9) interpreted the three highest cols as having "carried water from east to west, perhaps into ice-marginal streams that cut some of the abandoned stream channels west of Churubusco and south of Chateaugay", or the Chateaugay channels. The fourth channel "at an altitude of about 1,085 feet . . . hangs at both ends and could have carried water either east or west" (Denny, 1974, p. 9).

Prest (1970) interpreted retreat of the ice margin from the vicinity of Ellenburg, N.Y. (east - southeast of divide) as opening an outlet lower than the Rome, N.Y. outlet of Lake Iroquois, creating a lower water level that he named the Ellenburg phase of post-Iroquois lakes. Further northward ice retreat uncovered lower outlets, initiating other post-Iroquois lake phases.

Plotting the col at 1080-1090 feet described by MacClintock and Stewart (1965) and Denny (1974) on the distance - elevation diagram (see discussion by Clark) suggests that it was the drainage outlet for level I, which we have suggested was confluent with Lake Iroquois. Consequently, we agree with Denny's interpretation of cols at higher altitudes as representing drainage of local, ice-dammed lakes to the west.

24.7	0.7	Good view to south (right) of Adirondacks.
28.0	3.3	Entering village of Ellenburg.
28.4	0.4	Bear left at fork. Continue on Rte. 11. North Branch of Great Chazy River on side of road.
30.1	1.7	Entering village of Ellenburg Depot. Large ridge south of road is a north-south trending moraine built by ice which lay to the east. Denny (1974) traced this moraine six miles (9.6km) northwards, where it then bends nearly 90° and continues toward the west. The col at 1080-1090 ft. (329-332m), which we have correlated with lake level I and Lake Iroquois, is immediately distal (south) of this moraine, suggesting that drainage of Lake Iroquois across Covey Hill began following ice retreat to this position.
30.9	0.8	Road crosses North Branch of the Great Chazy River.
33.9	3.0	Turn north (left) onto Cannon Corners Road.
34.15	0.25	Cross North Branch of the Great Chazy River.
36.2	2.05	Entering Cannon Corners. Chapman (1942) and Denny (1974) reported Lake Fort Ann beach features at Cannon Corners at an altitude of 720-730 ft. (218-221m). An extensive area of exposed bedrock (Potsdam Sandstone) about 3 miles long and 1 mile wide was mapped by Denny (1974) 0.5 miles west of the road north of Cannon Corners. Denny (1974) mapped a recessional moraine just east of the bare rock. Denny (1974) interpreted the origin of exposed bedrock by "water flowing in spillways along the ice edge [which] removed the drift that overlay the bedrock" (p. 15).
36.9	0.7	Crossing the English River.
37.0	0.1	Intersection with White Road (Cannon Corners). Continue north (straight).
39.1	2.1	Exposed Potsdam Sandstone on left and right, probably by water draining through Covey Hill Gap.
39.9	0.8	Canadian Border. Bienvenue au Canada.
41.0	1.1	Stop sign. Village of Covey Hill, Quebec. Turn west (left).
41.7	0.7	Terrace feature. Altitude approximately 750 ft. (227m), so this could be a Lake Fort Ann feature.

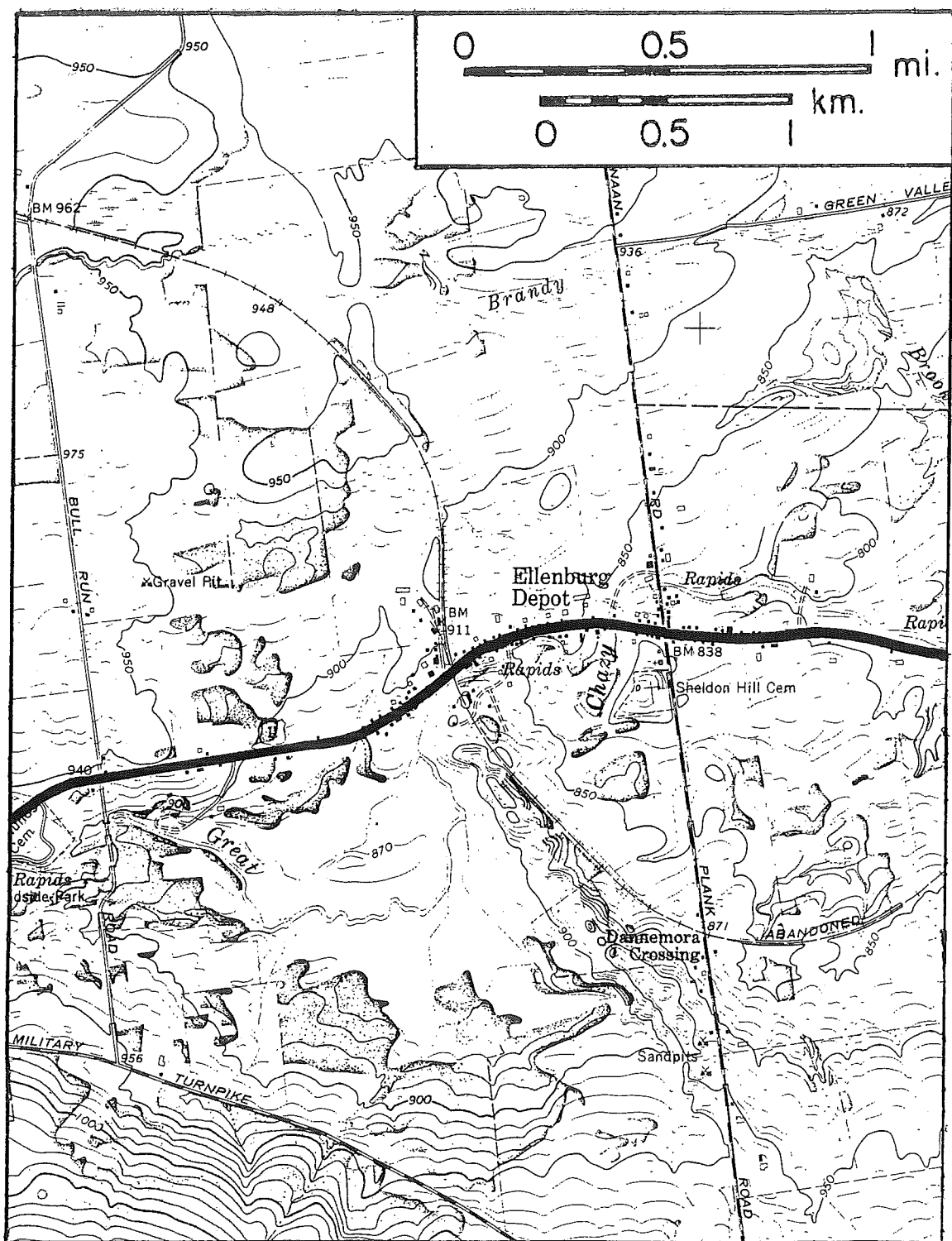


FIGURE 9. Detail of large moraine south of Ellenburg Depot. From Ellenburg Depot 7.5' quadrangle.

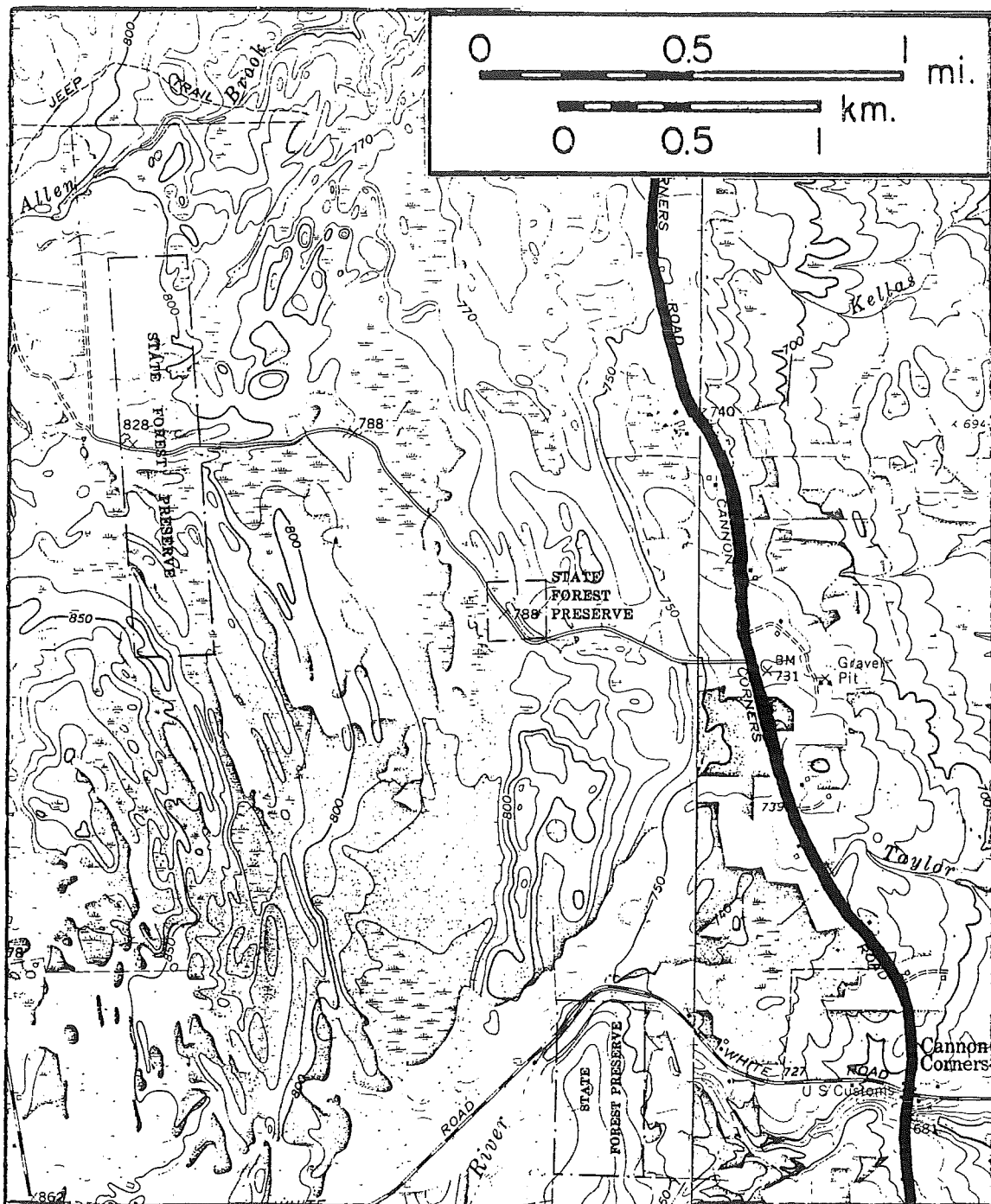


FIGURE 10. Detail of washed bedrock surface (west of Cannon Corners Road), immediately south of "the Gulf", or part of Covey Hill Gap. From Ellenburg Depot and Altona 7.5' quadrangles.

We are driving up the eastern flank of Covey Hill. The following description of Covey Hill is from MacClintock and Terasmae (1960). "Covey Hill has long been a spectacular landmark in the glacial history of North America. It is the bold northern terminus of the Adirondack upland where this latter, projects northward, as a 'bastion', from New York State across the border three miles into Quebec Province. The hill rises 900 feet from the St. Lawrence lowland, on the north. . . . Its summit is separated from the upland in New York by a gentle flat-bottomed col a half-mile wide and a mile long of altitude 1,010 feet, known as Covey Hill Gap" (p. 232).

- | | | |
|------|-----|---|
| 42.9 | 1.2 | Radio tower on south (left) side of road is highest point on Covey Hill at an altitude of 1400-1500 ft. (424-454m). |
| 43.9 | 1.0 | Turn south (left) into Blueberry Farm. Check with farm foreman for permission. |
| 44.2 | 0.3 | Park vehicles and walk to Covey Hill Gap. |

STOP TWO - also lunch stop.

Covey Hill Gap. The following description is from MacClintock and Stewart (1965) and Denny (1974).

This abandoned stream channel was first described in 1842. "The east end of the col is the site of an abandoned waterfall, plunge pool, and steep-walled canyon. The waterfall was about 63 feet high. . . . The water in the lake is 70 feet deep at its western end, and shoaling to 35 feet midway toward the eastern end. The 'canyon' extends a mile eastward from the lake. Midway, where the walls are about 85 feet high, is a second stagnant pool known locally as 'the gulf'. . . . The waters of this ice age 'Niagara' rushed down the steep eastern slope of the divide from 1,000 feet to 820 feet and excavated the gulf and lake, as cascades sapped the horizontal layers of sandstone" (MacClintock and Stewart, 1965, p. 62).

Prest (1970) argued that Covey Hill Gap drained the post-Iroquois Frontenac phase. Denny (1974) suggested that Lake Iroquois first drained across Covey Hill through the Gap. Clark and Karrow (1984) also suggested that Lake Iroquois drained through Covey Hill Gap, but that a higher outlet (1080-1090 ft.) was first used by Iroquois.

End of Day Two.

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