FIELD TRIP NO. 2

GEOLOGIC TRAVERSE FROM POTSDAM TO THE THOUSAND ISLANDS

by

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Introduction

The Lowlands Adirondacks, or northwestern part of the Adirondack Mountains Province, contains a record of extremely ancient seas that predate the Grenville Orogeny by hundreds of millions of years, and in which limestones, various detrital sediments, and volcanic materials were deposited. The orogeny, now dated at 1100 m.y. in the Adirondacks, produced severe metamorphism, intense deformation, igneous activity, and a mountain range of Himalayan scale extending for thousands of miles along the eastern side of North America as it existed then. These mountains are referred to as the Ancestral Adirondacks. The Grenville-age rocks we see today, in the Adirondacks, the Thousand Islands, and in the Grenville Province of Canada, are but remnants of the core of that great mountain range, where orogenic processes were most severe (Fig. 1A). There ensued a period of erosion that lasted approximately 600 million years and left a landscape of low relief with karsts developed in the marbles. Flooding by shallow seas that advanced from the east, set the stage for deposition of shelf sediments in late-Cambrian Potsdam time, that continued until the beginning of the Taconic Orogeny in late Ordovician time. This once continuous cover of sedimentary rocks has been largely removed from the Adirondacks and Frontenac Arch in the last few million years by erosion accompanying the still-continuing rapid uplift of those regions (Figs. 1B, 2) (Isachsen, 1975).

The principal purpose of this field trip is to examine the Precambrian and lower Paleozoic rocks exposed in a traverse from Potsdam to Alexandria Bay, with special regard for the nature of the unconformity itself. The trip will be highlighted at midday by a boat trip through the lovely Thousand Islands. The route and stops are shown on Figure 3.

Road Log

The trip begins from the campus of the State University College of Arts and Sciences at Potsdam and proceeds on U.S. 11 to Canton, a distance of approximately 12 miles. In the Village of Potsdam, the route passes over Fall Island in the Raquette River, where the new $5 million hydro-electric and water treatment plant is located. The island is underlain by highly resistant, Grenville-age, metagabbro exposed just below the two dams. The Julia Anderson Park on the island near the second bridge was built upon this tough bedrock in 1981 as a

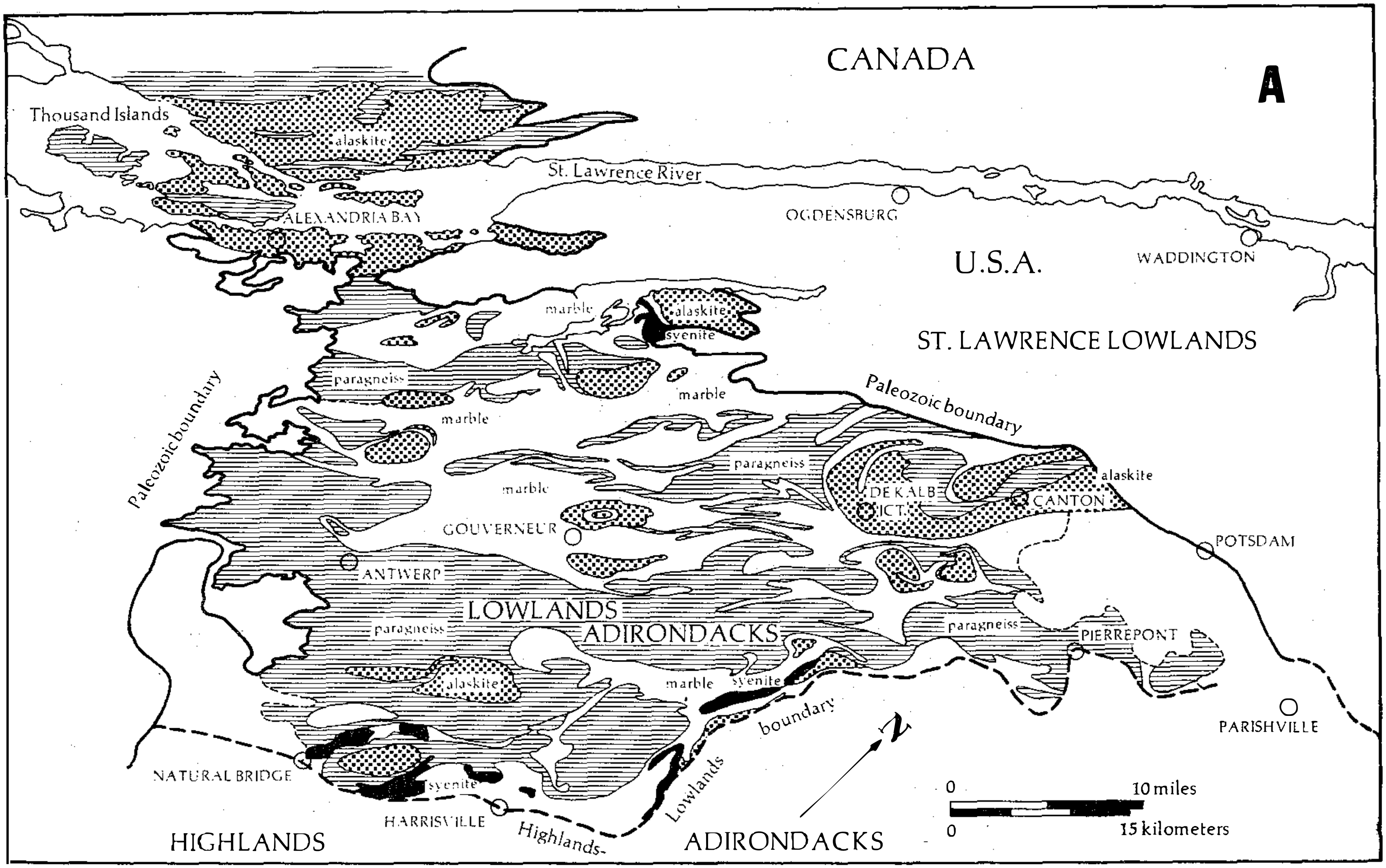


Figure 1A. Generalized Precambrian geology of the Lowlands Adirondacks and Frontenac Arch, ignoring lower Paleozoic outliers. Modified from Isachsen and Fisher (1970), in Van Diver (1980).

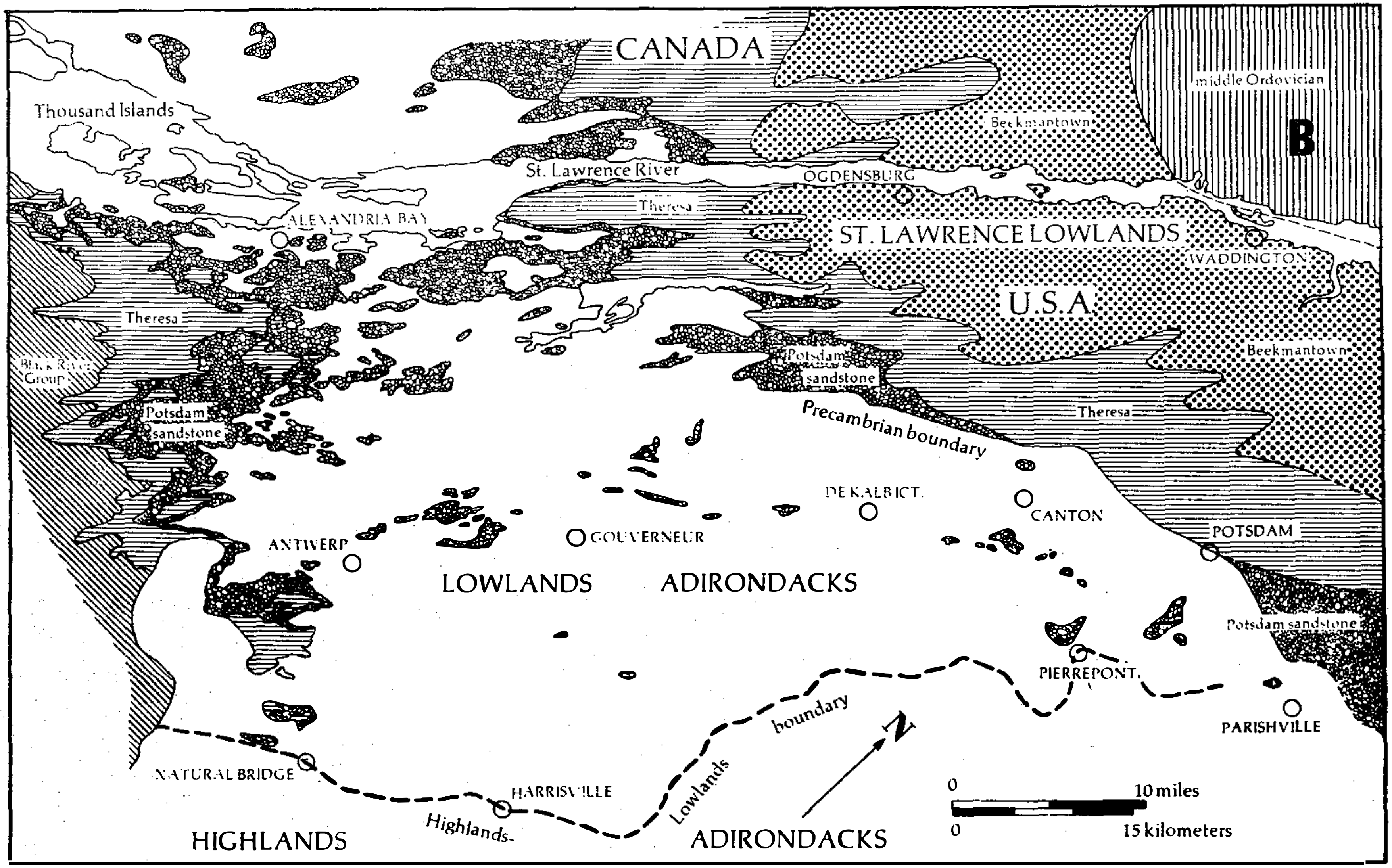


Figure 1B. Generalized Paleozoic geology of the Lowlands Adirondacks, Frontenac Arch, and St. Lawrence Lowlands, ignoring the Precambrian basement geology. Same sources and geographic area as Figure 1A.

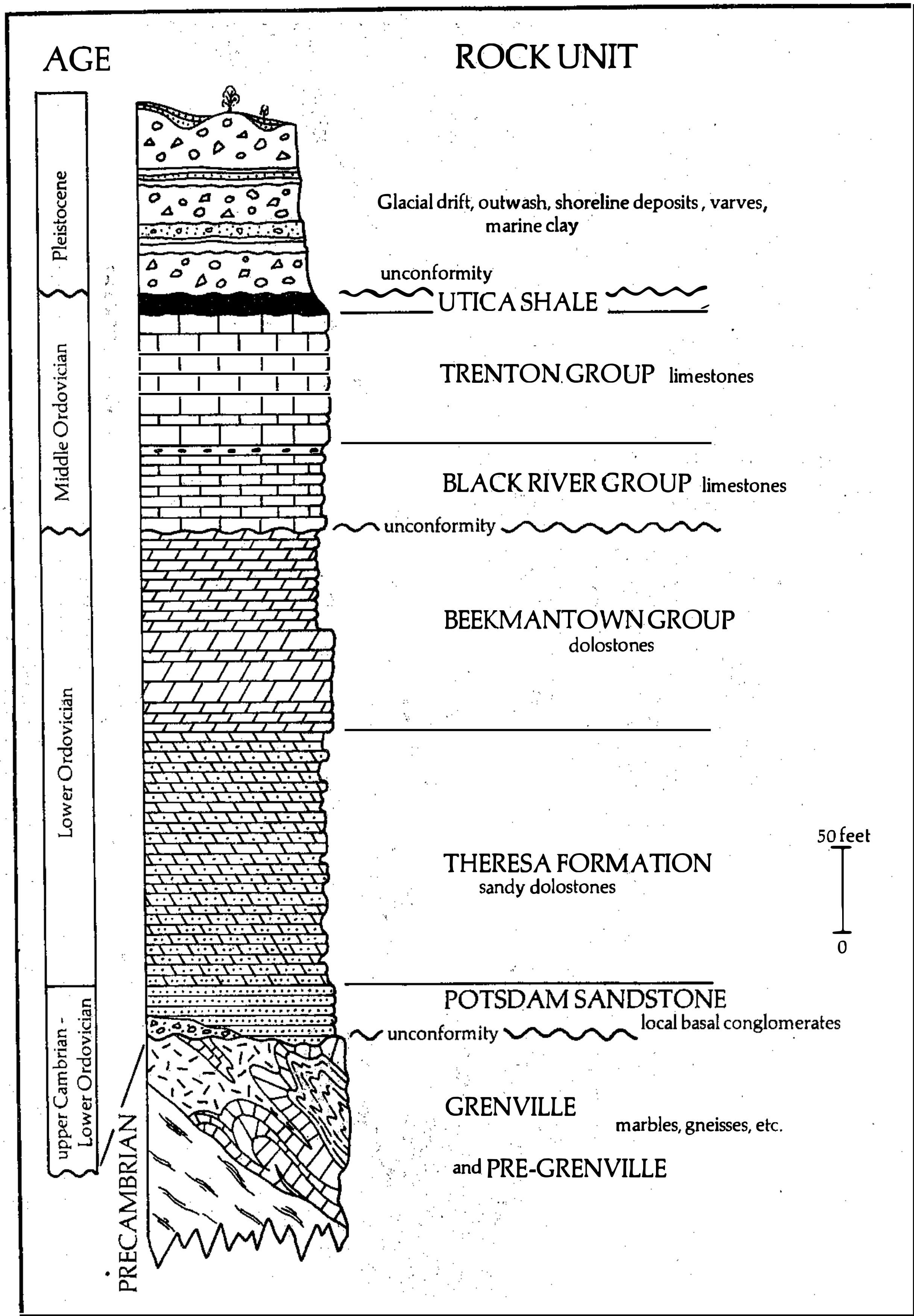


Figure 2. Composite Stratigraphic column for the Adirondacks and bordering lowlands of northwestern New York. From Van Diver (1980).

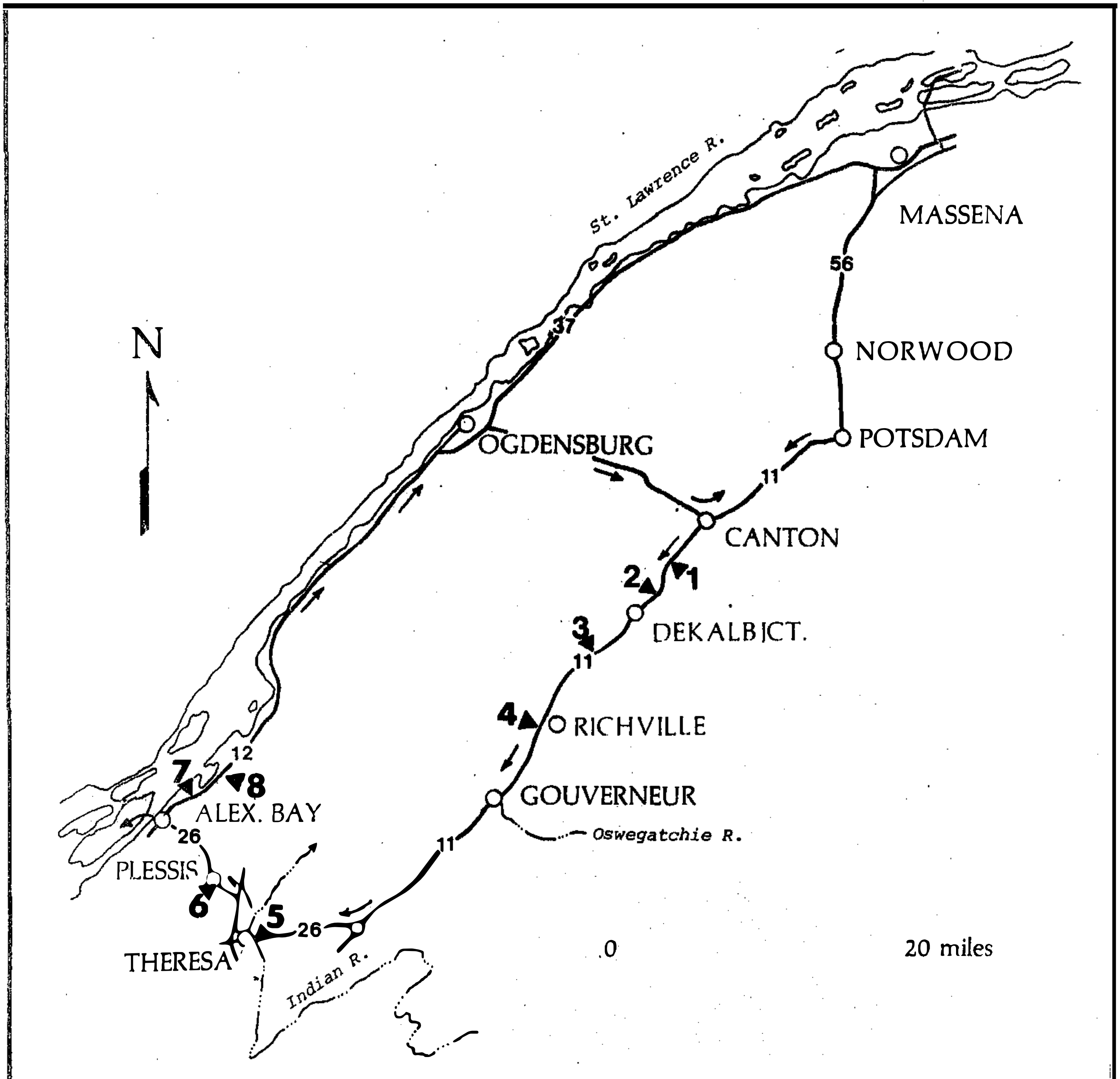


Figure 3. Trip map, with stops.

replacement for the park lost to the construction of the Potsdam Bypass in that same year. To lower the surface 17 inches to the level prescribed by the New York State Department of Transportation plans, workmen had to resort to drilling and blasting of the bedrock.

Potsdam is located only three miles downstream from the type locality for the Potsdam Sandstone near Hannawa Falls, but no exposures of this formation are found in the Village.

En route to Canton, the road traverses rolling pastureland developed by differential erosion of Proterozoic rocks of variable resistance, and modified by glacial scour and deposition. Till deposits take the form of ground moraine, and low drumlinoid hills resulting in an attractive "swell-and-swale" topography. Nearing Canton, a high point of the road affords a panoramic view southward that incorporates the moderately corrugated profile of the Adirondack foothills in the distance and an occasional drumlinoid prominence in the foreground.

The roadlog mileage count begins just beyond the Grass River bridge in Canton, at the traffic light.

Road Log

cumulative miles	miles from last stop	
0.0	0.0	Intersection N.Y. 68 and U.S. 11. Turn left on U.S. 11 toward Gouverneur.
0.6	0.6	Railroad underpass. Exposures of dark, migmatitic gneiss with pink granitic veining.
3.1	2.5	Small marble cut, right, with whitish banded marble below and marble thinly interleaved with rusty calc-silicate rock above. Folding here reflects the ductility contrast between these two rock types that is characteristic of the Adirondack region in general. Flow banding in the marble displays a remarkable fluidity, whereas the calc-silicate, though also intensely folded, has been extensively ruptured and displaced. The result is a chaotic "marble stew," which resembles what might be seen if strips of crisp fried bacon were swirled in smooth peanut butter. More of this will be seen at Stop 1.
3.5	0.4	Low, long roadcut in dark greenish-gray calc-silicate rock with subordinate marble interlayers, right side of road. Tight recumbent folding.

3.9 0.4 STOP 1. This is the now-famous and graffiti-ed Snake Roadcut; the name for which was first published in the guidebook for the 1971 NYSGA meeting at Potsdam (Fig. 4). The cut is a large and outstanding example of the plastic deformation of the Grenville marbles. The "Snake," itself, is a nearly continuous, thin band of microcline-rich rock on the SE cut (left) that has been sinuously infolded with the marble. Despite its thinness and obvious stretching, the Snake has survived nearly unbroken over much of its length. A good example of a refold can be seen at the NE end, where F_1 isoclinal folds have been openly folded around an F_2 hinge surface. The deformation shown by the Snake is deceptively simple. Greater complexity, perhaps with as many as four separate folding events, can be observed above the Snake on top of the cut (DANGEROUS!), where thin, infolded layers of rusty calc-silicate rock have been exposed in three dimensions by solution of the enclosing and interleaved marble. A less dramatic, but safer, example can be observed at the right end of the opposite cut, near road level.

In the marble adjacent to the Snake, note the dark green, concentric banding of diopside, the product of metamorphic reaction between the dolomitic marble and siliceous parent rock of the Snake. Diopside concentration diminishes rapidly away from the band. Also found in this reaction zone are fine-grained brown sphene, copper-colored phlogopite, yellowish metallic pyrite, green actinolite, black tourmaline, and very minor quartz.

Carl and Van Diver (1971) proposed a subaqueous ashfall origin for the parent material of the Snake, interrupting a shelf limestone sequence. This is suggested both by the composition, and the thin, blanket shape of the layer. Other snakes of similar material, and some of phlogopite may be seen on the opposite cut.

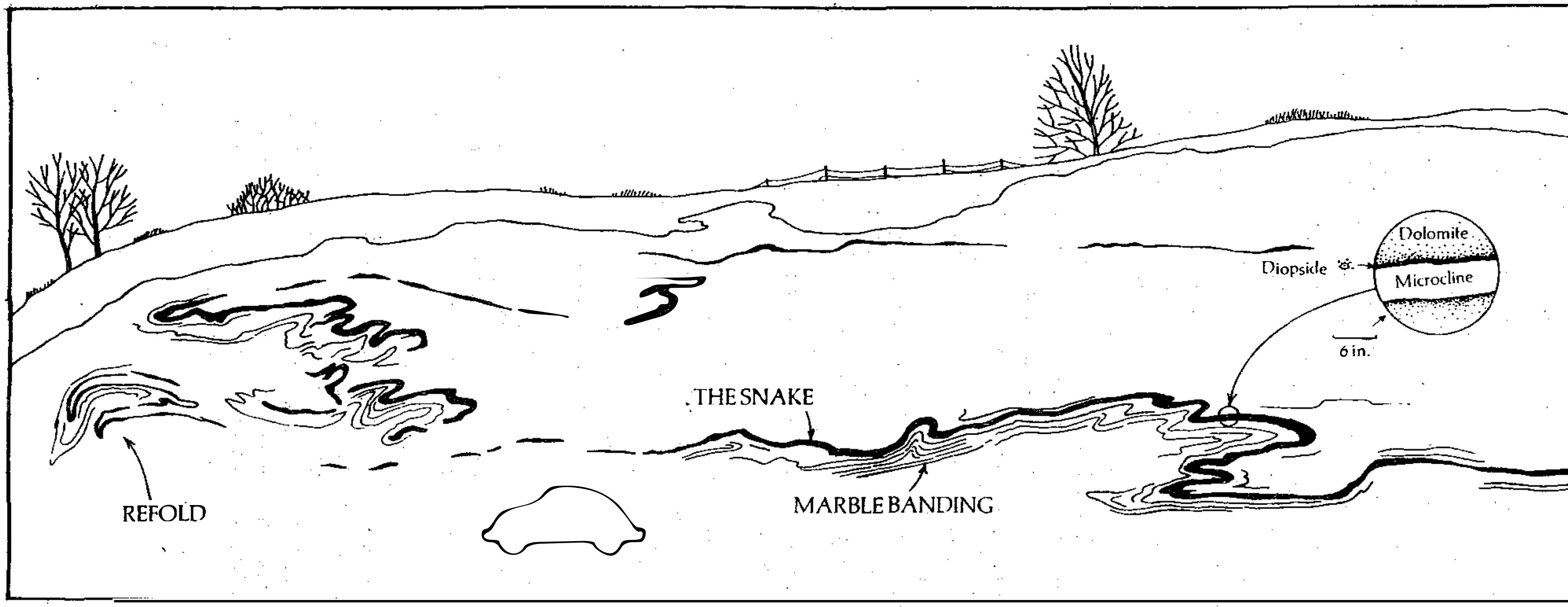


Figure 4. The Snake roadcut.

4.7 0.8 STOP 2. DeKalb Anticline, located 100 feet from the right side of the road (Fig. 5). This is an overturned anticline in dark brown garnet biotite schist, with interlayered light greenish gray, calc-silicate rocks, altogether a rather unusual rock for the Lowlands Adirondacks. The fold is interrupted near its hinge surface by a two-foot pinkish pegmatite dike. As at the "Snake," the deformation here appears deceptively simple. Contoured point diagrams of minor fold axes prepared by several generations of Structural Geology students at Potsdam, indicate refolding (this is nearly identical to similar diagrams prepared for the Snake). Furthermore, there are a few puzzling S-shaped folds at the right side of the dike that suggest renewed deformation after pegmatite emplacement. Study the texture of the dike from side to side, and see if you can find evidence for this interpretation.

A small cut directly across the highway displays a rusty basaltic (diabasic?) dike that intrudes the biotite schist, with contacts that zig and zag alternately along schistosity and jointing. At the left end, there is a small xenolith of granitic rock incorporated in the basalt. Diabasic dikes like this are common in the Lowlands Adirondacks. They intrude the Grenville-age rocks but not the Potsdam Sandstone, and are considered to be of late Proterozoic to early Cambrian age.

7.1 2.4 Junction Co. 17 in DeKalb Junction.

11.7 4.6 STOP 3. Red-and-White Roadcuts. This is one of the most dramatic series of new cuts opened by road construction in 1976-77. The first cut on the right (lowest) exposes highly contorted grayish marble in sharp, irregular, discordant, contact with a chaotic mass of friable pinkish to dark brick red sandstone, sandy intraformational breccia, and conglomerate, with assorted inclusions of marble. A wedge-shaped conglomerate dike is located at the top of the marble just to the right of the sedimentary contact.

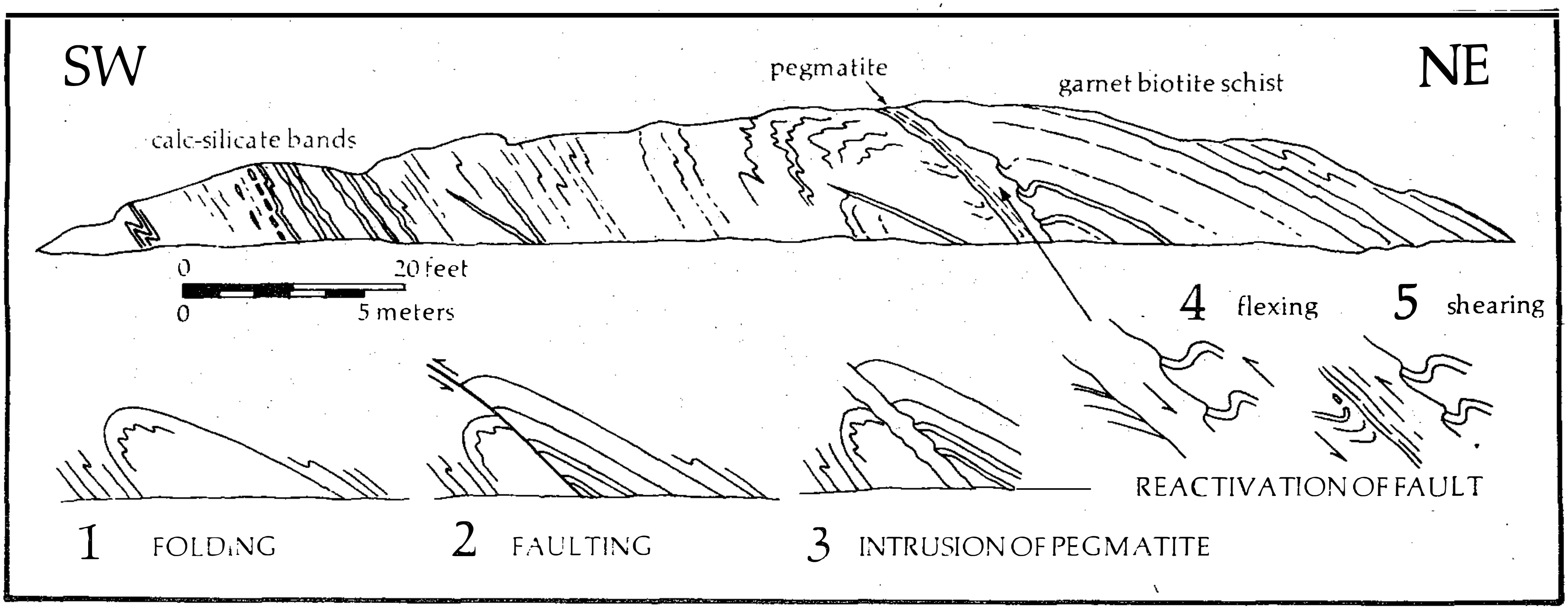


Figure 5. DeKalb Anticline roadcut, with proposed sequence of deformation and emplacement.

All of these features undoubtedly result from the infilling of a sinkhole developed in the marble prior to and possibly continuing during marine transgression in Potsdam time. The contact represents an unconformity spanning about 600 million years. Similar features may be observed at numerous places in the northwestern part of the Lowlands Adirondacks, most notably in the Rock Island Road cut 4 miles north of Gouverneur (Carl and Van Diver, 1971).

On a regional scale, remnants or outliers of sandy and conglomeratic sediments like this become smaller and less frequent southeastward from the continuous Paleozoic boundary near the St. Lawrence River, and they are largely confined to areas of marble. Because of their lack of fossils, often chaotic nature, and discoloration, their assignment to the Potsdam Sandstone is uncertain, but many exposures display upward gradation to clean, pinkish to white or brown, orthoquartzitic, well-bedded arenites typical of the Keeseville member of the unit in this region. Such an upward progression may be seen in the second large roadcut on the right, up the hill. The large, reddish-brown cut opposite this consists of well-stratified, quartz pebble conglomerates, with thin ortho-quartzitic sandstones on top. A small knob of marble occurs at road level near the lower end of the cut, where clayey sediment has been found (cave floor?).

Studies by the New York State Geological Survey indicate that the Potsdam Sandstone and the overlying Theresa and younger units dip away from and do not pinch out toward the Adirondack Dome. It is assumed, therefore, that these units once formed a continuous blanket over the region, which has been largely denuded during the geologically recent, and continuing doming of the mountains. It is mainly in thick karst fillings like this near the edge of the Precambrian terrain, that the basal Potsdam, or pre-Potsdam, sedimentary rocks have been preserved.

15.7	4.0	Dark gneiss left.

16.2	0.5	Begin Richville Bypass. Dark gneiss, perhaps meta-turbidite, with apparent preserved small-scale graded bedding.
17.3	1.1	STOP 4. End of Richville Bypass. Dark red cut at right is puzzling, and it is hoped discussion will be generated among field trip participants. The material is similar to, but much more hematitic and voluminous than that of the unquestioned sinkhole fillings. More "normal" Potsdam sandstone may be found at the top of the cut. Conglomeratic sandstone dikes in marble may be found at the upper end of the opposite cut. The left half of that cut, however, consists of a whitish feldspathic (metapegmatite) rock outwardly resembling the marble, and containing several thin, diopsidic marble sills or dikes. What do you suppose is the origin of this rock? See if you can find the contact with the marble.
17.6	0.3	Begin several marble cuts with abundant small reddish conglomeratic sandstone infillings. From here to Gouverneur the road traverses rolling countryside with predominantly NE-trending ridges underlain by gneiss, and marble valleys.
22.6	5.0	Enter Gouverneur. Note the several buildings in town constructed of Gouverneur marble, essentially the same as the marbles we've been looking at.
		Continue on U.S. 11 through the Village.
29.9	7.3	Begin several marble cuts.
32.7	2.8	Potsdam Sandstone cut right, with bowl-shaped structure at top. These structures are commonly found intermingled with cylindrical structures near the base of the Potsdam over marble. They have long been thought to result from the rearrangement of sand by sifting into underlying small solutional pockets in marble. They are copiously developed along the Cream of the Valley Road north of the Rock Island Road cut.
33.0	0.3	Begin several marble cuts, some with dark calc-silicate layers.

33.6	0.6	Marion Construction Materials sand and gravel quarry in kame, right. Well rounded cobbles, abundant cross-bedding.
34.2	0.6	Pinkish alaskite gneiss at x-road, with glacial grooves at top.
34.9	0.7	Optional stop. Begin several cuts of marble with infolded and segmented calc-silicate layers, in direct contact with biotite granite gneiss.
38.1	3.2	Intersection N.Y. 411 in the Village of Antwerp, with cuts in migmatitic gneiss. Pass over Indian River. Turn right to Theresa. The road along the way (about 10 miles) passes by numerous outcrops of gneiss and marble. The gneiss tends to form rounded, elongate, barren knobs, with streamlined, glacially smoothed forms.
48.9	10.8	<u>STOP 5</u>. <u>Theresa Reservoir</u>. The cliff on the left side of the road near the reservoir, again, is a reddish conglomerate and breccia similar to those you have seen in sinkhole deposits. Massive and poorly bedded, it is but one of a wide variety of conglomerates and breccias occupying the interval between Proterozoic rocks and "normal" Potsdam Sandstone in the Lowlands Adirondacks. In this one, pebbles are sparse except near the center base of the cliff. Upwards in the section, the rock becomes sandier, better stratified, and cross-bedded. The underlying rocks are concealed by the cliff, but can be seen just below the Niagara Mohawk dam nearby. The rocks are all steeply-inclined gneiss and metaquartzite. The Indian River drops more than 80 feet here. The dam was built in 1929 on the site of the original, 65-foot "High Falls" - almost certainly a fault scarp. Raising the water to its present level eliminated the 15-foot "Upper Falls" that were located a short distance upstream.
49.3	0.4	Stop sign in Village. Turn right, and continue to junction with N.Y. 37.

50.9	1.6	Junction N.Y. 37. Turn right. Theresa lies close to the Paleozoic boundary, and here the road climbs onto an extensive tableland capped by flat-lying, durable Potsdam Sandstone and occasional outliers of Theresa sandy dolostone perched on top of it.
52.5	1.6	Y-junction. Continue left on N.Y. 26, past several cuts in Theresa Formation.
56.0	3.5	STOP 6 at Plessis. The clean surface of the Potsdam Sandstone here offers a remarkable display of well-preserved glacial scour features, including polish, striae, chatter marks, and large grooves. Also visible on the smooth surface are abundant arcuate cross-bed laminae. The gentle undulation of the Potsdam surface seen here is barely concealed beneath thin soil cover between here and Alexandria Bay. Continue north on N.Y. 26 past cuts of light gray, thin-bedded Theresa Formation.
58.3	2.3	Browns Corners. The flatness of the tableland is most evident here, when viewed across open pastureland with less than 10 feet of relief. Continue left to Alex Bay.
62.3	4.0	Junction N.Y. 12 at Alex Bay.
		Continue straight ahead through the Village to Uncle Sam's Boatrides, and park for a two-hour boat trip.

BOAT RIDE. The purposes of the boat ride are: 1) to give us a welcome relief from bus travel; 2) to allow time to eat lunch; 3) to view some of the magnificant Thousand Islands, and 4) to view, from the boat, exposures of flat-lying Potsdam Sandstone over granitic gneiss at the southern tip of Wellesley Island.

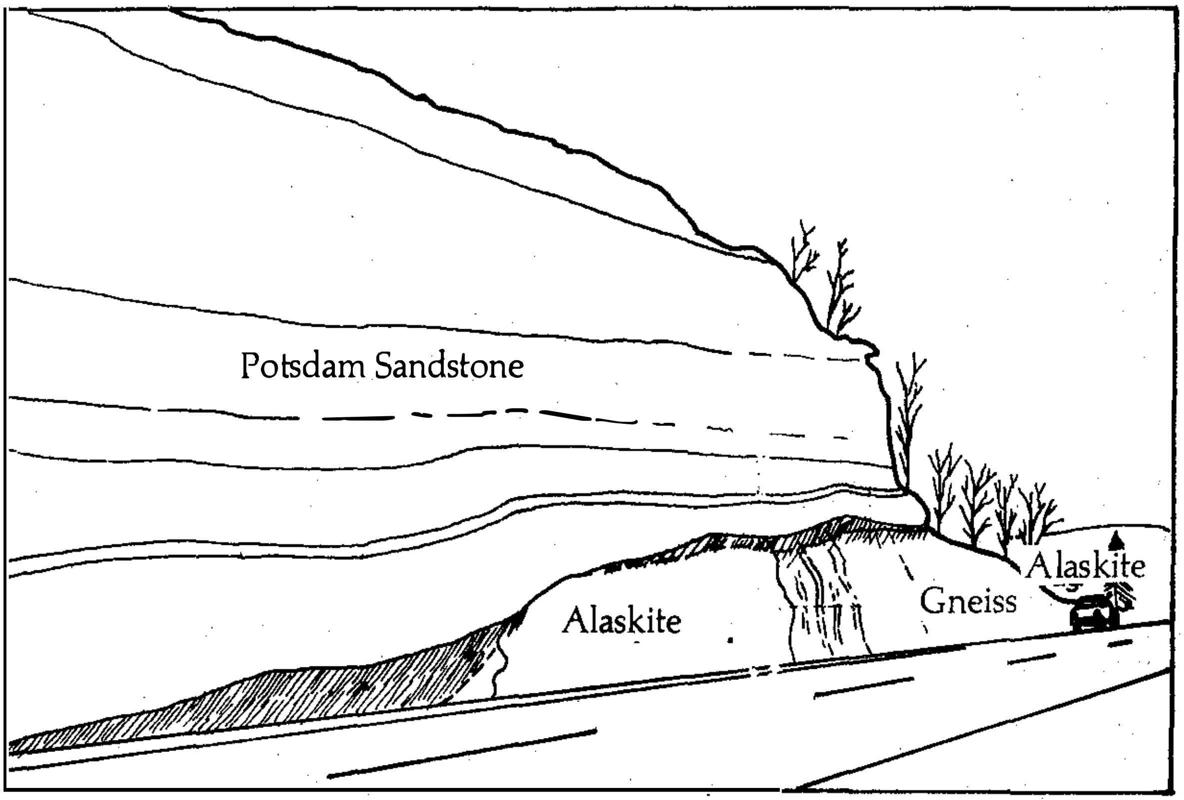
The boat trip will take us first through open water under the beautiful Thousand Islands suspension bridge to the end of Wellesley Island. Then we will wend our leisurely way back through the cluster of scenic islands near the American shore.

It is now believed that the Proterozoic terrain of the Thousand Islands was once blanketed with flat-lying Potsdam Sandstone and younger Paleozoic units, as was that of the Adirondack Mountains. In historical perspective, the Himalayan-sized Ancestral Adirondacks, resulting from the Grenville Orogeny approximately one billion years ago, had by Potsdam time, been worn down to a peneplain, leaving the region vulnerable to marine submergence. Transgression of the so-called "Potsdam Sea" beginning in late Cambrian(?) time (ca. 525 m.y.a.), set the stage for shallow marine deposition of sand, carbonates and clays, the parent materials for the lower Paleozoic units that now rim the Adirondacks and Frontenac Arch. Erosional decimation of these once continuous deposits has been accomplished only in the last 10 million-or-so years as a result of the still-continuing doming of the Adirondacks and concurrent uparching of the Frontenac Arch. Presently, only a few scattered remnants of Potsdam Sandstone remain on the flanks of the Arch in the Thousand Islands region, and on its northwestward and southeastward extensions into Canada and New York, respectively. We will view one of these patches from the boat at the southern tip of Wellesley Island. Farther upstream toward Lake Ontario, a much larger remnant has survived erosion on Howe Island, and still farther, Wolfe Island, the largest of the Thousand Islands, is completely blanketed with limestones belonging in the medial Ordovician Black River and Trenton Groups (the lower Ordovician Theresa and Beekmantown are missing). An exposure of the Proterozoic/ Potsdam unconformity that is essentially similar to that of Wellesley Island will be examined at close range at Stops 7 and 8 later.

The Proterozoic rocks of the Frontenac Arch have also been deeply eroded as a result of the ongoing uplift, leaving only the more resistant knobs projecting as islands or shoals. The islands are generally elongated parallel to their strong northeasterly structural grain, a trend that is even more evident in the marble-gneiss outcrop patterns of the Lowlands Adirondacks. For the most part, the islands are lovely, forested, projections of attractive, pink leucogranitic (alaskitic) Alexandria Bay Gneiss (visible mainly along the shores). Most of them take the form of glacier-polished sheepbacks, with gentle stoss sides facing northeastward and steep cliff sides opposite, indicating a southwestward upvalley ice advance. The islands are largely devoid of glacial debris, except for some minor till hills, and thin ground moraine. This scarcity probably reflects, at least in part, the severe erosion resulting from rapid drainage of Lake Iroquois through the St. Lawrence Valley, after that outlet was opened by recession of the Wisconsin ice sheet.

Following the boat ride, we will return to N.Y. 12, and proceed 2 miles from the Church Street intersection toward Ogdensburg to Stop 7, a very large cut on both sides of the road. This is the Alexandria Bay Roadcut, a unique geologic site that has been nominated for inclusion in the DNAG Centennial Field Guide Project.

66.3	4.0	<u>STOP 7</u>. <u>Alexandria Bay Roadcut</u>. (Fig. 6A, B) The northeastern (downhill) end of this cut exposes an angular unconformity of profound dimensions, encompassing a time gap of approximately 600 million years between Proterozoic gneisses and basal Potsdam Sandstone. It enables comparison



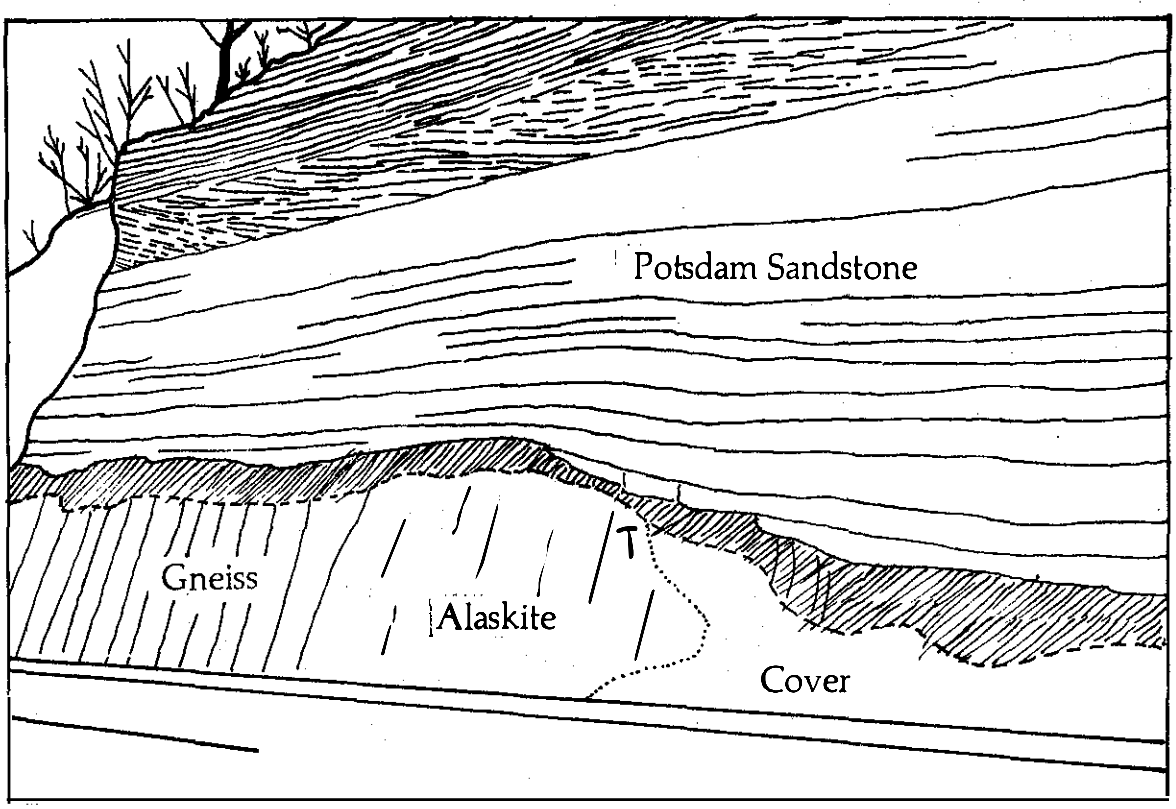


Figure 6. Sketch map of the Alexandria Bay Roadcut, northwest side (A) (above) showing gross features as discussed in the text, and (B) (below) showing the same section on the other side of the road, with considerably more detail.

between the contemporaneous erosional surfaces developed on gneisses and those of the marbles seen earlier.

The Proterozoic rocks beneath the unconformity consist of massive, pink, alaskitic gneisses and darker, banded gneisses with steeply dipping foliation. These are extensively weathered, especially in a narrow zone directly beneath the base of the Potsdam. Note, also, that the upturned edges of the gneiss bands are buckled below the contact. This zone may represent a fossil inorganic soil developed on the pre-Potsdam erosional surface, or preferential, post-depositional, groundwater leaching along the contact (which may also explain the extreme friability of the basal sandstone beds). Can you suggest any other possibility?

Features nearly identical to these have been reported on the other side of the Adirondacks near Putnam Center, N.Y. by Van Diver (1980). The pre-Potsdam erosional surface appears to be structurally intact and rises slightly to the northeast (downhill on the road), forming a boss, or knoll preserving the original relief of the depositional surface. Basal sandstone beds drape over the southwestern slope of the knoll, and pinch out against it, while proximal younger beds thin out over the top of it. Upwards in the section, the bedding becomes increasingly horizontal and uniformly thick. Cross-bedding, in general, is poorly developed, but is more prevalent in the upper part of the section.

The basal Potsdam beds at this roadcut have been described by Kirchgasser and Theokritoff (1971), as mature orthoquartzites with scarce clasts of Precambrian rocks, suggesting an origin by reworking of fluvial sands by an encroaching sea. On a regional scale, marine transgression set the stage for leveling of the irregular Proterozoic surface by filling in all of the karst depressions like those seen earlier, and covering over projections in gneisses such as that of the Alex Bay Cut.

		Continue northeastward toward Ogdensburg.
67.5	1.2	Cross-bedded Potsdam Sandstone cut.
67.9	0.5	Cross-bedded Potsdam Sandstone cut.
68.6	0.7	STOP 8. Proterozoic/Potsdam unconformity. This cut shows features similar to the Alex Bay cut, but here the basal sandstones display better-developed, low-angle, cross-bedding. The purpose of this stop is to allow comparisons between these two exposures of the unconformity, as developed on gneiss. From here, we will proceed directly to Ogdensburg, and then to Potsdam.
69.1	0.5	Begin several excellent exposures of gneiss.
72.8	3.7	Cuts in lower Potsdam Sandstone with distinct lower and upper lithofacies (see Selleck, this volume).
		Continuing northeastward, the cuts along the highway expose progressively higher stratigraphic sections of the Potsdam and Theresa Formations. Contact between the two units is exposed at Chippewa Bay (Selleck, Stop 3, this volume; Kirchgasser and Theokritoff, 1971).
		A good overlook to view the river is located at 78.5 miles, at Cedar Point.
101.3	28.5	Ogdensburg, at traffic light intersection with N.Y. 68. Proceed right to Canton and Potsdam.
130.3	29.0	Arrive Potsdam. End of trip.

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