SELECTED TILL AND STRATIFIED DRIFT DEPOSITS BETWEEN GLEN'S FALLS AND AMSTERDAM, NEW YORK

by
Donald T. Rodbell, Geology Department, Union College, Schenectady, NY 12308-2311; rodbelld@union.edu

INTRODUCTION

This trip is intended to provide participants with a review of the glacial stratigraphy of the portion of eastern New York State between Glenn's Falls on the northeast and Amsterdam on the southwest (Fig. 1), and to correlate the regional stratigraphy with the better dated sequences of central New York. All of the data presented here were gathered by students in four different classes of *Glacial and Quaternary Geology* (Geo 52) at Union College between 1995 and 2002.

The region covered by this field trip contains a wide variety of glacial deposits—from subglacial till to subaqueous fan deposits to varves to eolian sands. Perhaps what is most interesting about this region is the evidence present for a dynamic history of ice marginal advances and retreats, and the numerous glacial lakes that occupied much of the region during the latter third of marine isotope stage 2 (Martinson *et al.*, 1987). While there has been a plethora of prior work conducted in the area, a near absence of numerical age control coupled with stratigraphic uncertainties generated by a laterally discontinuous and variable lithostratigraphy provides us with considerable room for debate over the details of the glacial history of the region.

BEDROCK GEOLOGY

The bedrock underlying the field trip area comprises diverse lithologies. The Hudson Valley portion of the area is underlain by the Canajoharie shale, and carbonates of the Beekmantown, Trenton, and Black River Formations. The northern third of the Sacandaga Basin is underlain mostly by granitic and syenitic gneiss, with lesser amounts of hornblende-biotite gneiss, and quartzite. The southeastern part of the Sacandaga Basin extending southward to the Mohawk Valley is underlain by calcareous shale of the Dolgeveille Formation, sandstone of the Galway Formation, and oolitic dolomite of the Beekmantown Group. Finally, the eastern Mohawk Valley is underlain by the Canajoharie shale in western portions and sandstone, siltstone and shale of the Shenectady Formation in eastern portions.

PREVIOUS STUDIES ON GLACIAL HISTORY

There have been numerous published works on the Quaternary stratigraphy of this region; here, I summarize some of them. Woodworth (1905) first coined the term *Lake Albany* for the post glacial lake that occupied the portion of the Hudson Valley from Albany south to Kingston, and he was also the first to recognize an avulsed reach of the Mohawk River, which he termed the *Ballston Channel,* located between Schenectady and Ballston Spa. Stoller (1911) focused on the origin of the Ballston channel, the stratigraphic relationship between lacustrine and glacial deposits, and the economic potential of sediment deposited in Glacial Lake Albany. He also noted the presence of widespread eolian deposits, which he attributed to Holocene deflation of Lake Albany shorelines (Stoller, 1911). In later papers, (Stoller, 1918, 1919, 1922) rejected the notion advanced by Fairchild (1918) of a marine strait between the Champlain Sea and the lower Hudson Valley. Cook (1924) asserted that deglaciation of eastern New York did not involve the steady northward retreat of discrete ice margins; instead, he proposed that regional deglaciation generated large regions of dead ice, which he viewed as consistent with the absence of large moraines and the abundance of glacial meltwater features. This is not consistent, however, with observations made by Stoller (1916) of well-defined recessional moraines near Saratoga, NY or with a moraine(s) from a late glacial readvance in the Luzerne region (Connally and Sirkin, 1971). Chadwick (1927) envisaged clear northward-retreating ice margins that enabled the progressive northward development of numerous postglacial lakes in the Hudson Valley. Cook (in Ruedemann, 1930) picked up on observations made by Stoller (1922) and others in focusing on the evolution of the region's surface hydrology. He concluded that there must have been more than one lake level associated with Lake Albany and asserted that Round Lake and Saratoga Lake owe their origin to the existence of local ice blocks.

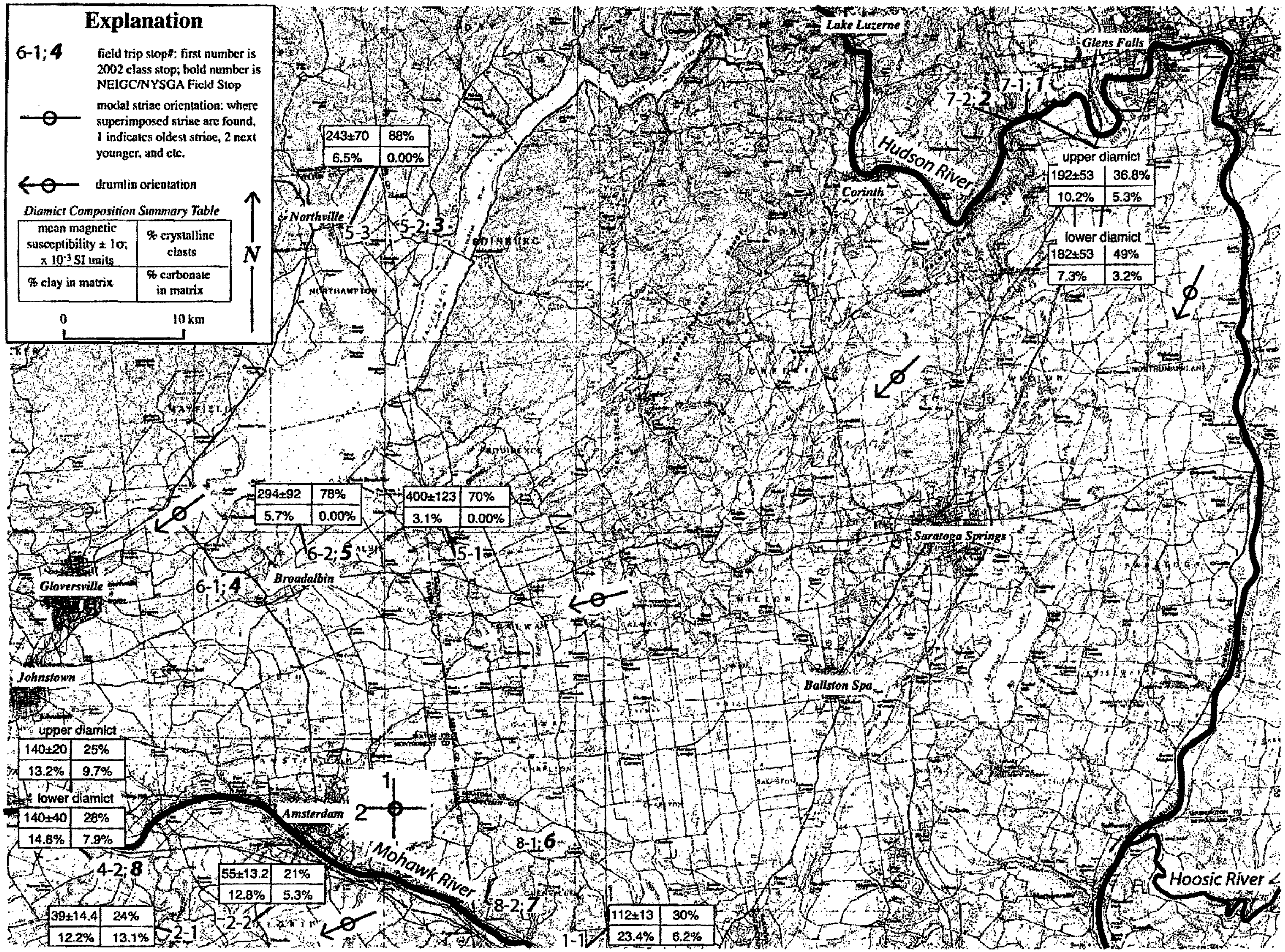

Figure 1. Paleoglacier flow indicators and composition data for diamicts derived from the Adirondack and Hudson-Mohawk lobes of the Laurentide Ice Sheet.

More recent work has focused on the chronology of glacial lakes in the eastern Mohawk and central Hudson Valleys (e.g., LaFleur, 1965; DeSimone, 1985; Wall and LaFleur, 1995 and references therein), and on the age and significance of glacial deposits in the region. Of the latter studies (summarized in Dineen and Hansen, 1995), much emphasis has been placed on determining the history of lobes of the Laurentide Ice Sheet during the last deglacial cycle. The area of this field trip encompasses the border between two principal ice lobes: the *Adirondack Lobe*, which flowed over the Adirondacks, and the *Hudson-Mohawk Lobe*, which flowed down the Hudson Valley and westward up the Mohawk Valley. Deposits from these two lobes can be distinguished according to their texture and composition (Dineen and Hansen, 1995).

Relatively few radiocarbon ages have been reported from diamicts in the study area. One important radiocarbon age constrains the timing of a late glacial readvance in the Hudson Valley near Glens Falls, NY. Connally and Sirkin (1971) reported the glacial stratigraphy exposed along the north side of the Luzerne Gorge of the Hudson River. Here are exposed two diamicts that stratigraphically bound laminated sands and silts. The two tills are similar in composition but yield different fabrics (Hansen *et al.*, 1961). The age of the upper till is constrained by basal radiocarbon dates from Pine Log Camp bog, which is located ~3.2 km north of the village of Lake Luzerne, NY and ~15 km north of the Luzerne Gorge. The basal-most age from this bog of ~13,150 ± 150 ^{14}C years B.P. provides a minimum-limiting age for the upper till, which is attributed to the Luzerne readvance as first recognized by Woodworth (1905). Connally and Sirkin (1971) map the southern limit of the readvance to approximately the latitude of Wilton, NY, ~ 7.25 km south of the Luzerne Gorge.

STOPS FOR THIS FIELD TRIP

There are 8 stops for this field trip. The first two focus on the stratigraphy of the Luzerne Gorge and the possible correlation of stratigraphic units there with the chronology of events in the central Mohawk Valley. Stops 3-5 focus on the Sacandaga basin and evidence there for a large postglacial lake dammed to the south by the Broadalbin Interlobate Moraine (BIM). Finally, Stop 6 and 7 are focused on postglacial lakes in the eastern Mohawk Valley, and Stop 8 provides an excellent exposure of stacked diamicts separated by glacial fluvial deposits.

Table 1.
Summary of Field Trip Stops

STOP #	LOCATION	FEATURES NOTED
1	Luzerene Gorge	diamict typical of till deposited by western side of Hudson Mohawk lobe
2	Luzerne Gorge	varves with drop stones- sandwiched between upper and lower tills
3	Sand and Gravel Pit near Edinburg	climbing ripples, foreset beds with southern paleocurrent directions
4	Herba Gravel Pit	climbing ripples, foreset beds, cut and fill channel
5	Broadalban Town Garage	sand and gravel, cross stratification, climbing ripples, drop stones, diamict stratigraphically on top of section
6	Gravel Pit, North Road West Glenville	foreset beds of kame delta
7	Hoffmans delta	high elevation delta in eastern Mohawk Valley
8	Auriesville Stream Cut	stacked diamicts separated by glacial fluvial gravels

Stop 1

This stop is on the north side of the Luzerne Gorge, in sight of the Hudson River. Exposed along the north side of the Gorge are a thick sequence of diamicts, sand, gravel, and varves (Stop 2). At this stop we will examine the basal till of the Gorge. In addition to a strong NNE-SSW fabric (Fig. 2), this till yields composition indicators that reflect a provenance in the Hudson-Champlain lowlands and from regions underlain by crystalline rocks.

Magnetic susceptibility, carbonate content, texture, and percentage crystalline clasts provide a means to distinguish till deposited from Hudson-Mohawk ice from that deposited by Adirondack ice. Tills deposited by Hudson-Mohawk ice contain >3% carbonate, whereas Adirondack tills are devoid of carbonate (Fig. 1). Similarly, the matrix of tills deposited by Hudson-Mohawk ice contain >10% clay and yield relatively low magnetic susceptibility values (<200 x 10^{-3} SI units). These trends are most obvious when comparing tills in the eastern

Mohawk Valley (e.g., Stops 1-1, 2-1, 2-2 in Fig. 1) with tills in the Adirondacks (e.g., Stops 5-1, 5-3 in Fig. 1). The tills of the Luzerne Gorge have compositions that are intermediate between these two end members; nonetheless, these tills are clearly distinguished from Adirondack till.

Stop 2

Here along this portion of the roadcut are exposed ~10 meters of varves. These are stratigraphically above the basal till of Stop 1 and below the uppermost till, which is exposed along the roadcut several hundred meters up the hill to the southwest of this outcrop. The site has been slumped and colluviated for years, but we have excavated through the colluvium and found varves at nearly all levels of this outcrop. These lake sediments may have been deposited in the southern-most segment of Glacial Lake Warrensburg (Connally and Sirkin, 1971), or in a smaller lake restricted to within the Gorge.

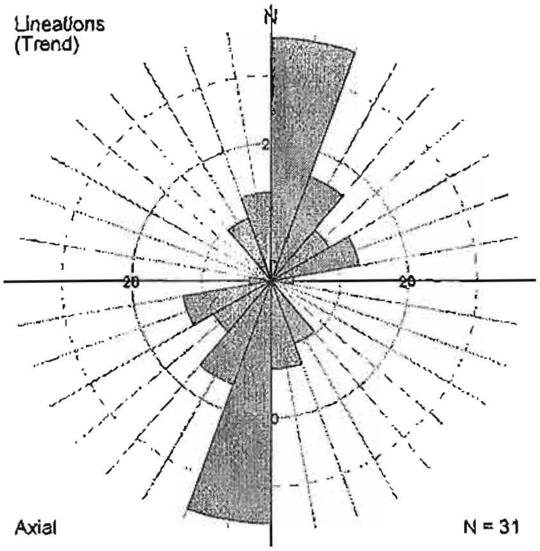

Figure 2. Till fabric for the basal till in the Luzerene Gorge (Stop 1).

The presence of lacustrine sediment between diamicts reflects an interstadial period. In order to estimate the duration of this interstadial in the absence of a clean and continuous outcrop of varves, we have over the years determined sedimentation rate (couplets/cm) for varves in several positions of the outcrop. Typical values are 3.5 couplets/cm. If this rate is representative of the average sedimentation rate for the entire outcrop, then the duration of this interstadial period was ~3500 years. Owing to the presence of several thick sand layers within this varve sequence, the calculated duration is best considered to be a maximum limiting duration.

Correlation of this interstadial period with the regional record of glaciation is tenuous, but it seems likely that the interstadial recorded here correlates with the Shed Brook Discontinuity in the western Mohawk Valley (Ridge, 1997) and thus with the Erie Interstade (14-16 ka). As noted above, the entire sequence here must be older than 13,150 ^{14}C yr BP, and this is consistent with correlation to the Erie Interstade.

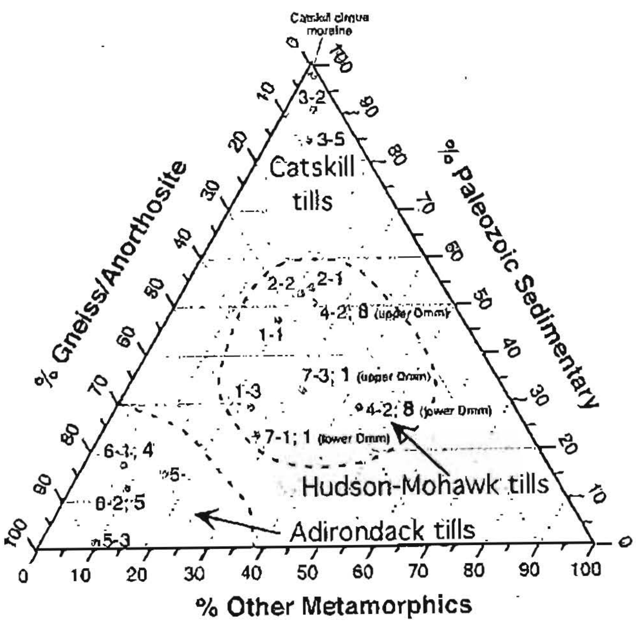

Figure 3. Lithology of clasts in tills from Adirondack and Hudson-Mohawk lobes.

The uppermost till is not very accessible in the Gorge, but a colluviated section of it is exposed about 200 m to the southwest of Stop 2. The till there is compositionally very similar to the basal till, again implying an origin in the Hudson-Champlain lowlands.

Stop 3

This site, which is located on the north side of the Great Sacandaga Lake, exposes more than 10 m of well-sorted sand and some gravel, in discrete foreset beds that dip southward. Superimposed on these beds are well-preserved Type A climbing-ripple cross-laminations (Harms *et al.*, 1982) that are exposed in planes parallel to flow. Both the foreset beds and the climbing ripples indicate a strongly southward paleocurrent direction (Fig. 4); or *into* the Sacandaga Basin. This deposit represents a delta or kame delta sufficiently distant from the ice margin to exclude the coarse fraction of glacial outwash.

A delta with southward paleocurrent directions on the north side of the Sacandaga Basin requires a lake in the basin, much as exists today. The elevation of this lake surface at its highest was 300 masl (~985') based

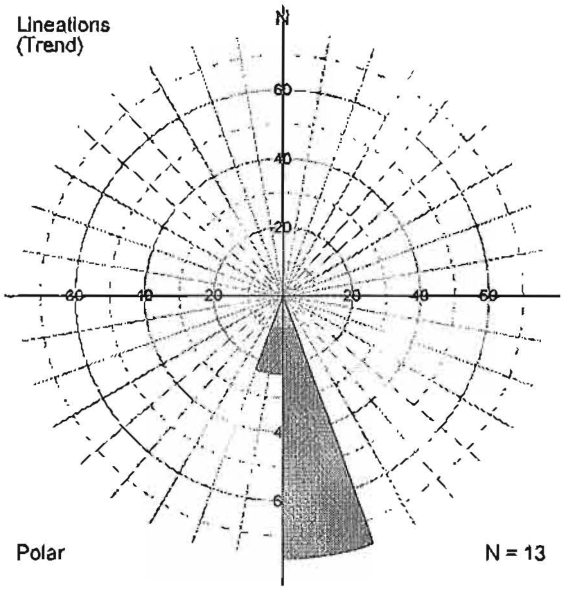

Figure 4. Paleocurrent directions for the foreset beds and climbing ripples exposed in the gravel pit near Edinburg (Stop 3).

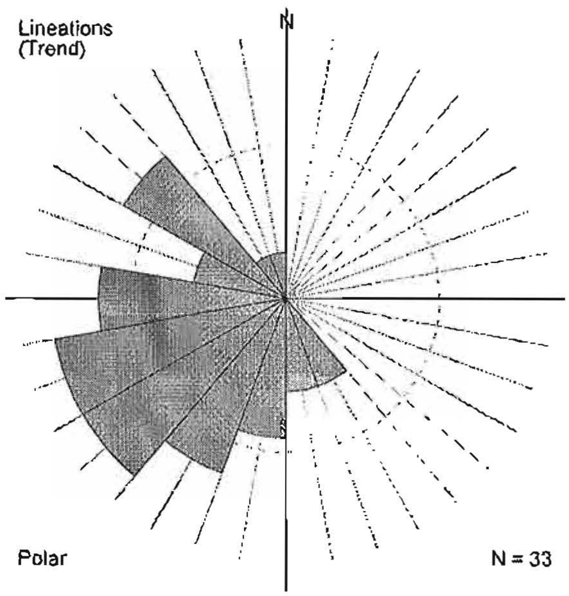

Figure 4. Paleocurrent directions from cross-stratification preserved in the Herba Gravel Pit (Stop 4).

on the elevation of the topset-foreset transition of a large kame delta at the mouth of the Sacandaga River exposed in a gravel pit ~3 km northwest of Northville.

To generate a lake of this elevation in the Sacandaga Basin, the outlet of the Basin near Conklingville or Lake Luzerne must have been dammed by the Hudson-Mohawk lobe. In addition, to generate a lake level of ~300 m, the southern margin of the Sacandaga Basin must also have been dammed by the Hudson-Mohawk lobe. The top of the Broadalbin-Interlobate moraine (Stops 4 and 5; Dineen and Hansen, 1995), which is ~20 km south of the aforementioned highest foreset beds has an elevation of ~260 m. Even a high gradient of isostatic tilting of ~ 1 m/km is insufficient to make the BIM a viable dam for Glacial Lake Sacandaga; the surface of the Hudson-Mohawk lobe must have been at least 20 m higher than the surface of the BIM. The presence of Glacial Lake Sacandaga requires substantial retreat of the Adirondack lobe while the northern side of the Hudson-Mohawk lobe at the BIM remained relatively stationary.

Stop 4

This site is located on the northern edge of the BIM, ~5 km west of Broadalbin. It exposes more than 25 m of stratified drift, which ranges in grain size from sand-cobble. Dineen and Hansen (1995) reported the presence of lodgement and flow till at this site. The dominant lithology here is metamorphic—mostly granitic gneisses.

Much of the BIM is underlain by stratified drift, and it seems likely that the BIM was deposited as a kame into standing water between the Adirondack lobe to the north and the Hudson-Mohawk lobe to the south. The distance between these lobes must have increased as Adirondack ice retreated northward and the northern edge of the Hudson-Mohawk lobe remained more-or-less stationary to the south of the BIM. This scenario is supported by paleocurrents which vary widely but which are dominantly southwestard (Fig. 4), along the axis of the BIM—thus meltwater was apparently transporting sediment off the sides of both lobes, but these currents were eventually shunted southwestward toward what must have been an outlet to Glacial Lake Sacandaga.

Stop 5

Located near the center of the BIM, this site exposes a complex stratigraphy of outwash sands and gravel, horizontally laminated lacustrine sands, all of which is overlain by a diamict. This latter has many of the hallmarks of Adirondack till; namely, a high magnetic susceptibility, an absence of carbonate, low % clay, and high % crystalline rocks (Fig. 1). In addition, this till yields NNE-SSW till fabric (Fig. 5), consistent with Adirondack ice.

The stratigraphy appears to record an advance of the Adirondack lobe from N-S over the BIM. However, Dineen and Hansen (1995) have interpreted the stratigraphy here to

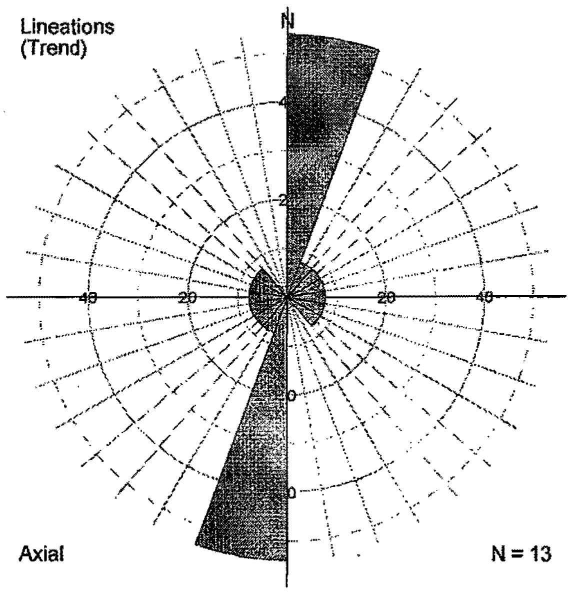

Figure 5. Till fabric from the diamict at the Broadalbin Town Pit (Stop 5).

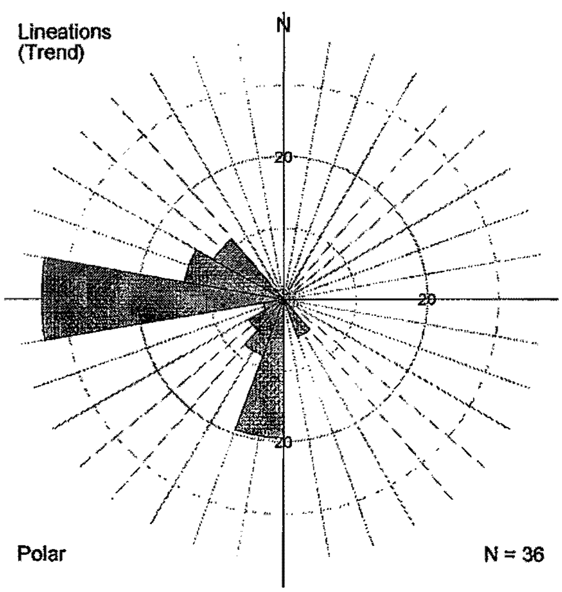

Figure 6. Paleocurrent directions from foreset beds and cross-stratification preserved in the West Glenville gravel pit (Stop 6).

reflect an advance of the Hudson-Mohawk lobe (Yosts Readvance). The presence of rotten shale clasts supports their interpretation, and it is possible that the apparent Adirondack composition reflects Hudson-Mohawk flow lines that overtopped the Kayaderorseras Range ENE of this site. In this case the, it is possible that this till is correlative with the upper till in the Luzerne Gorge (Stop 1), and reflects a Luzerne Readvance that was considerably larger than envisaged by Connally and Sirkin (1971). If so, then the Mt. McGregor moraine of Connally and Sirkin (1971) either represents a younger readvance or a recessional ice position during deglaciation from the Luzerne Readvance.

Stop 6.

This site exposes a kame delta on the northern edge of the Glenville Hills. The deposit is about 20 m thick and contains sand and gravel beds that are inclined at about 20° to the west. This west-southwest flow direction (Fig. 6) likely reflects glacial meltwater off the western side of the Hudson-Mohawk lobe after it had shrunk to open a basin to the west. The elevation of this lake was ~215 m (700') based on the elevation of the top of this kame delta, and on the elevation of numerous sand and gravel pits that demarcate the southern extent of the lake along West Glenville Road to the west of this locality.

Although LaFleur (1965) maps this kame delta at the eastern edge of his "Early Lake Amsterdam", it seems more plausible that this kame was deposited into a much smaller, restricted lake. This smaller lake would have been dammed to the east by the Hudson Mohawk lobe, to the south by the Glenville Hills and to the west and north by bedrock hills within 2 km of this locality. The most likely outlet for this lake was southward down Wolf Creek Hollow and Hoffman's Delta (Stop 7) to the Mohawk River. This is consistent with the elevation of the outlet to Wolf Creek Hollow (~215m), and explains: 1- why Wolf Creek Hollow is devoid of till, and 2- why Hoffman's Delta is so much larger than other deltas in the eastern Mohawk Valley. Proglacial lake drainage down Wolf Creek Hollow would have stripped the valley of drift and induced considerable down cutting. Much of this drift would have been deposited in Hoffman's delta.

Stop 7.

Hoffman's delta is the largest delta in the Mohawk Valley east of Amsterdam. It was deposited at a lake level of ~130 m (~420 '), and according to LaFleur (1965) it was deposited into a late phase of Lake Amsterdam, when the Mohawk Valley was plugged to the east, at approximately Scotia, NY, by the eastward retreating front of the Mohawk lobe.

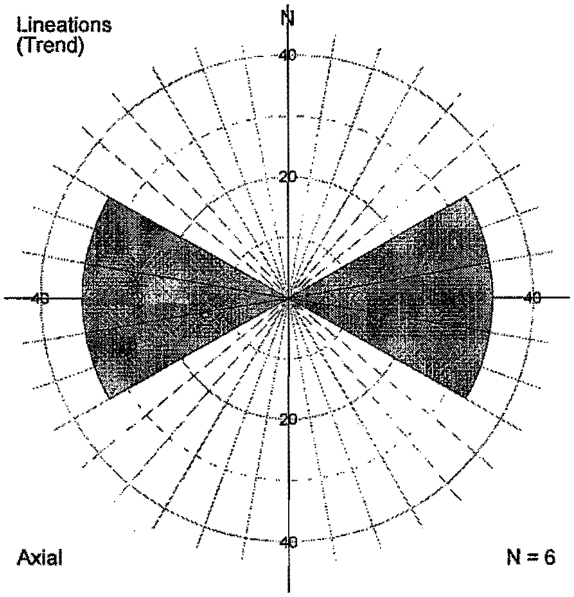

Figure 7. Till fabric from the basal diamict at the Auriesville exposure (Stop 8).

Stop 8.

Here are exposed 40 m of diamicts, gravel and sand. The base of the exposure is marked by a typical lodgement till from the Mohawk lobe that is at least 12 m thick. It contains several lenses of gravel, which may reflect intervals of meltout till. This till is overlain by at least 12 m of sandy colluvium, which appears to be derived from a sand and gravel unit that is at least 4 meters thick. This gravel unit possesses strata that dip northward at ~ 20°. The top of the exposure is marked by a second till, at least 6 meters thick, which is oxidized at its surface, and which is, in turn, overlain by well-sorted fine-medium sand. The sequence appears to reflect multiple ice advances over the site. The two tills are nearly identical in composition, and clearly reflect a Hudson-Mohawk source (Fig. 1). What few fabric data we have from the lower till indicate that it was deposited along an E-W (or W-E) flow path (Fig. 7). . The sand and gravel unit separating the tills appears to be deltaic and indicates the presence of a glacial lake in the Mohawk Valley at an elevation of ~85 m (280').

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ROAD LOG

The starting point is the McDonald's parking lot on the Corinth Road where it crosses I87- The Northway (Exit 18). The parking lot is immediately west of I87, at Exit 18. Reset trip odometers

Total (miles)	Distance from Last (miles)	
0.0	0	Start at McDonald's Parking Lot- Exit 18 of Northway (I87) northwest corner of intersection of I87 with Corinth Road. Proceed west on Corinth Road.
2.4	2.4	Pass West Mountain Road on right; continue straight (west).
3.5	1.1	Park on right side of road; shoulder is narrow; leave 4-way hazard lights blinking.

STOP 1. (Fig. 1- 15 minutes) BASAL TILL OF THE LUZERENE GORGE AND STEEP EXPOSURE OF MULTIPLE DIAMICTS.

3.5	0.0	Continue west on Corinth Road.
4.1	0.6	Park on right side of road; shoulder is narrow; leave 4-way hazard lights blinking; walk up hill along road to out crop on right hand side of road that exposes slumped glacial varves.

STOP 2. (Fig. 1- 15 minutes) VARVES BETWEEN THE UPPER AND LOWER TILLS OF THE LUZERENE GORGE.

4.1	0.0	Continue west on Corinth Road.
9.5	5.4	Turn right on East River Road.
14.3	4.8	Turn left on Bridge Street in the village of Lake Luzerne (this become Rt. 4).
35.4	21.1	Turn right in Edinburg (stay on Rt. 4).
35.8	0.4	Park on right side of road; shoulder is narrow; leave 4-way hazard lights blinking.

STOP 3. (Fig. 1- 30 minutes) DELTA ON NORTH END OF SACANDAGA BASIN.

35.8	0.0	Continue west on Rt. 4 (becomes Fulton County Rt. 113).
37.0	1.2	Route 4 becomes Fulton County Rt. 113.
38.5	1.5	Turn left on Main Street (Northville)
39.8	1.3	Turn left on Bridge Street (Northville)
40.5	0.7	Turn left (south) on Route 30
50.7	10.2	Turn left on Route 30
54.5	3.8	Turn right on Sand Hill Road
55.3	0.8	left into the Herba sand and gravel pit

STOP 4. (Fig. 1- 40 minutes) HERBA SAND AND GRAVEL PIT.

55.3	0.0	Turn right out of the gravel pit onto Sand Hill Road.
56.1	0.8	Turn right onto Route 30.
57.1	1.0	Turn left onto Fulton County Route 155
58.6	1.5	Turn right onto Union Street.
59.7	1.1	Turn left into Broadalbin Town Gravel Pit.

STOP 5. (Fig. 1- 40 minutes) BROADALBIN TOWN GRAVEL PIT.

59.7	0.0	Turn left onto Union Street.
64.0	4.3	Turn right onto Fishhouse Road.
66.7	2.7	Turn left onto Route 29.
68.8	2.1	Turn right onto Route 147.
77.0	8.2	Turn right onto North Road
78.5	1.5	Turn Right into West Glenville Gravel Pit

STOP 6. (Fig. 1- 20 minutes) WEST GLENVILLE GRAVEL PIT.

78.5	0.0	Turn right out of gravel pit onto North Road.
78.8	0.3	Turn right onto West Glenville Road.
79.9	1.1	Turn left onto Wolfe Hollow Road.
80.3	0.4	Stay right here.
81.6	1.3	Park on right side of road; shoulder is narrow; leave 4-way hazard lights blinking.

STOP 7. (Fig. 1- 20 minutes) HOFFMAN'S DELTA.

81.6	0.0	Continue down Wolfe Hollow Road.
82.1	0.5	Turn Right on Route 5.
88.8	6.7	Turn left on Route 30 (follow signs to Route 5S to Auriesville).
89.7	0.9	Turn left onto Route 5S heading west.
96.3	6.6	Turn left onto Ingersoll Road.
96.9	0.6	Park on right side of road; shoulder is narrow; leave 4-way hazard lights blinking.

STOP 8. (Fig. 1- 60 minutes) Auriesville Exposure.