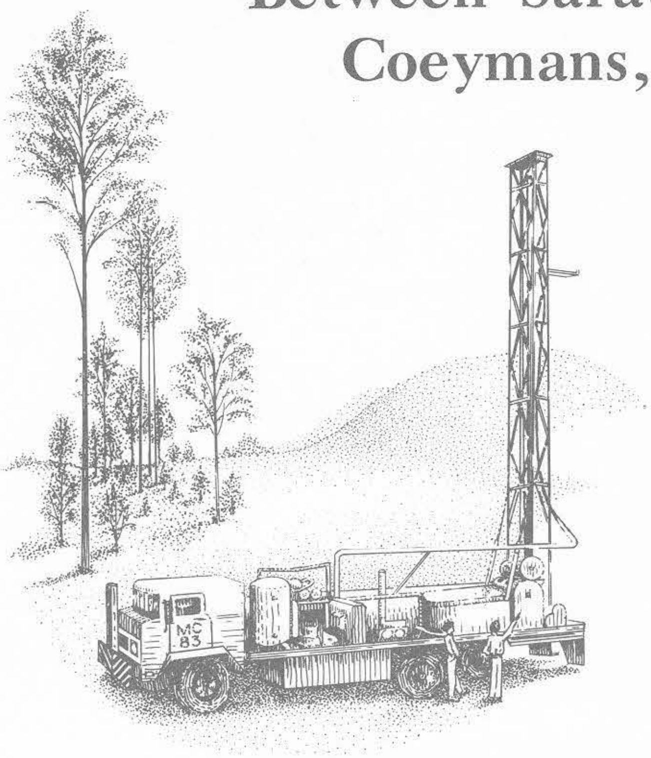
Bedrock Topography and Glacial Deposits of the Colonie Channel Between Saratoga Lake and Coeymans, New York



by

ROBERT J. DINEEN
New York State Geological Survey

and

ERIC L. HANSON
Rensselaer Polytechnic Institute

with a section on the

Ground-Water Potential of the Capital District Buried-Valley Deposits

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Bedrock Topography and Glacial Deposits of the Colonie Channel Between Saratoga Lake and Coeymans, New York

by Robert J. Dineen and Eric L. Hanson

ABSTRACT

The Colonie Channel is a buried, glacially scoured valley with a U-shaped cross section that lies within the Hudson-Champlain Lowlands of east-central New York. The buried valley deepens from 50 to 120 m and widens from 1.6 to 3.2 km from north to south. The valley has a V-shaped inner gorge. The location of the valley is controlled by folded shale and graywacke. The sediments that bury the Colonie Channel are Wisconsinan in age. They were deposited in Glacial Lakes Albany, Quaker Springs, Coveville and Fort Ann as the Woodfordian glacier retreated. Seven units occupy the valley. Till is the oldest Pleistocene deposit in the valley; its thickness ranges from 1 to 30 m, and it is dense, compact, impermeable, bouldery to gravelly clay. Till acts as an aquiclude. Above the till lies outwash and ice-contact sand and gravel, a unit that ranges in thickness from 3 to 15 m, and is permeable stratified sand, silt, and gravel. This sand and gravel aquifier is recharged by discontinuous exposures along the valley sides. The sand and gravel is overlain by lake silt and clay that form a 1 to 60 m thick aquiclude. The silt and clay are impermeable, varved, and grade upward into lake sand and silty sand. The lake sand and silty sand are 15 to 30 m of stratified sand and silt, and form a near-surface aquifer. Delta sand and gravel grade laterally and downward into silty sand. The deltaic unit is 1 to 50 m thick and is permeable and stratified, forming a good aquifer. The lake units are overlain by Woodfordian to Holocene aeolian sand that ranges in thickness from 1 to 30 m and is stratified very fine to fine sand. Holocene floodplain deposits occur along rivers and streams, are 1 to 12 m thick, and are gravelly to silty sand with organic matter. Floodplain deposits are a very good potential aquifer.

INTRODUCTION

The population increase in the Saratoga Lake-Coeymans area has greatly increased the demand for potable water. At present, most municipal water is supplied by such surface reservoirs as the Colonie, Alcove (City of Albany), and Watervliet Reservoirs (Fig. 2) and by wells in the Mohawk River floodplain at Schenectady and Niskayuna. Unfortunately, these water sources will not meet the additional demand caused by increasing populations or industrialization, and another source will be needed.

Subsurface ground-water reservoirs are not fully developed, even though good ground-water potential exists in the buried preglacial valley system of the upper Hudson Valley between Saratoga Lake and Albany (Simpson, 1949, 1952; Bruehl, 1969). The existence of this preglacial valley system originally was postulated by Woodworth (1905) and Cook (1909), based on the alignment of Saratoga and Round Lakes. Attempts to develop municipal water wells in these valleys failed in some areas (NYS Dept. of Health, 1965), yet succeeded in others (Lanagan and Stoller, 1929; Winslow and others, 1965), suggesting the existence of good, but discontinuous aquifers (Arnow, 1949; Heath and others, 1963; Halberg and others, 1965).

This study of the preglacial valleys incorporates data from water wells and test borings; engineering reports; field interviews with home owners, drillers and engineers; field mapping; and seismic refraction lines in the Schenectady, Round Lake, Niskayuna, Voorheesville, Clarksville, Albany, and Delmar 7½-minute quadrangles. This study includes 2,500 subsurface data points from seismic refraction lines, water wells, and test boring logs. Twenty-two test borings were drilled with a rotary rig using drill-mud in uncased, open holes, and logged using natural gamma, single-point resistivity, and self-potential probes. These data were used to develop maps showing the elevation of the bedrock surface, thickness of ice-contact and lake sand and gravel, and the distribution of glacial deposits. The maps should be useful in water resource planning, geologic hazard and resource inventories, and studies in the glacial stratigraphy of eastern New York.

The gamma ray logs obtained in this study were used with lithologic logs to correlate and subdivide the glacial deposits. The gamma ray logs were not calibrated, consequently the raw gamma ray trace is given without a scale of intensity. The relative gamma ray intensity increases from left to right. Two geophysical logging rigs were used. Bore holes 1 through 14 were logged with one rig, 15 through 22 were logged with the other. The second rig was less sensitive to abrupt changes in gamma ray intensity than the first rig.

Gamma ray units are shown on Plate 5, along with preliminary correlations. The units are based on visual comparisons of gamma ray signature, lithologic logs, elevation, self-potential logs, and resistivity logs. I did not plot the gamma ray units on the detailed bore hole logs in the appendix. The uncalibrated gamma ray "calls" are subjective, and other interpretations of units are possible. I chose the unit boundaries that seemed most likely based on gamma ray patterns and sample lithology. Roger Waller explains the general gamma ray properties of the deposits on page 27.

Acknowledgments

This study was a cooperative project with the United States Geological Survey-Ground Water Branch. The U.S.G.S. provided drilling funds, electric logging equipment, and its collective expertise through the advice of Mr. Roger M. Waller, and we wish to acknowledge him for his major contributions to this report. He was the final decision-maker on the location of the test borings, collected the well samples, and ran the down-hole geophysical probes. We had many stimulating discussions in the field and laboratories with Mr. Waller on the interpretation of the geologic units and bedrock topography. We also wish to acknowledge Donald Fisher, William Rogers, and Donald Cadwell for their editorial and professional comments on the many versions of this manuscript. Jack Skiba and Martha Costello merit special mention for the excellent work they have done drafting the plates and illustrations.

BEDROCK TOPOGRAPHY

The Colonie Channel was the principal valley that drained the Hudson-Champlain Lowlands of eastern New York State during preglacial time (Fig. 1; Simpson, 1949). In the study area, the lowlands are 26 to 35 km (16 to 22 mi) wide and are bordered by the Taconic Mountains to the east, the Adirondack Mountains to the northwest and west, and the Catskill and Helderberg Mountains to the southwest (Fig. 2). The Lowlands are underlain by the folded and faulted Ordovician chert, sandstone, graywacke, and shale of the Schenectady, Mount Merino, Austin Glen, Canajoharie, and Snake Hill Formations. The Colonie Channel was the central valley in a trellis drainage system developed on the lowlands along easily eroded shale zones (Fig. 2). Resistant graywacke and sandstone ridges lie between major valleys (Fig. 3; Pl. 3; Davis and Dineen, 1969). Now the channel is obscured by thick, proglacial meltwater and lacustrine deposits.

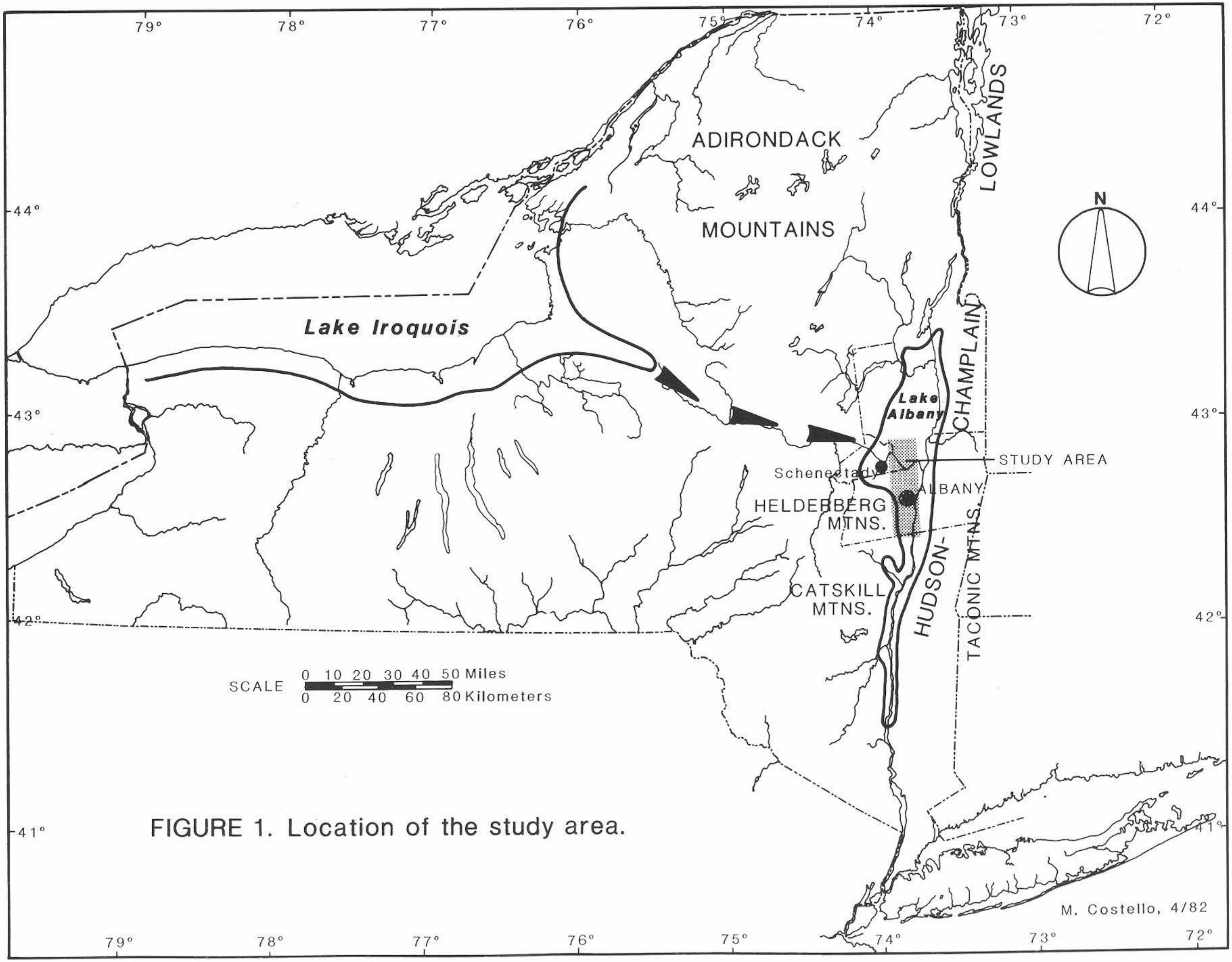

FIGURE 1. Location of the study area.

The channel dissects a series of pre-Wisconsinan strath terraces that slope down and generally widen toward the south (Table 1; Fig. 4). The relief on the individual terraces ranges from 7 to 15 m (20 to 50 ft), making terrace correlation difficult (Fig. 5). The Glenville, Malta, and Elnora terraces are well exposed north of Niskayuna and have gradients of less than 0.3 m/km (1 ft/mi). The Albany terrace has a gradient of 0.3 m/km and is well exposed south of Latham. These low-gradient terraces are incised by many crosscutting valleys. The Guilderland terrace has a gradient of 0.8 m/km (4.0 ft/mi). The 0.3 m/km (1 ft/mi) Castleton terrace underlies the Hudson River between Troy and Coeymans.

The cross section of the Colonie Channel is U-shaped and contains a wide, V-shaped inner gorge between Clifton Park and Karner and south of Karlsfeld (Pl. 4, Cross Sections E, F, G, H, I, J, K, and O). The channel between Elnora and Latham contains ridges that are 15 to 30 m (50 to 100 ft) high (Pl. 4, Cross Sections C, D, E, F, I, J).

Several of the tributaries of the Colonie Channel enter from the northwest and have steep walls and flat floors, particularly the Ballston Creek, Anthony Kill, Jonesville, Elnora, Rexford-Visher Ferry, and Crescent channels (Fig. 2; Table 2). Only the Jonesville and Elnora channels are filled with glacial deposits. Most of the tributaries to the Colonie Channel are hanging valleys, with over 45 m (150 ft) of relief at the confluence with the main channel.

Each of the three major channels contain an area of very high gradient (> 50 ft/mi): at Castleton in the Battenkill-Hudson Channel; at Latham in the Colonie Channel; and at Guilderland in the Mohawk Channel. The Mohawk Channel has an additional high-gradient area at Hoffmans (Simpson, 1949).

Several gaps breach the rock ridges that separate the preglacial valleys. Most of the gaps are occupied by tributary channels (Table 2). Four additional gaps lie between the Colonie and Battenkill-Hudson. These are at Corning Hill, Wemple, Selkirk, and Patroon Creek. These gaps are all U-shaped, hang on the main valleys, and are filled with glacial sediments.

Bedrock is exposed along the valley walls of the Colonie Channel. It consists of Ordovician shale, sandstone, graywacke, and chert. Bedrock appears as a distinct gamma ray high in the geophysical well logs. The bedrock generally is a poor aquifer, and controls ground-water flow by impeding or directing water movement. Rock, unless it is highly fractured, tends to have good bearing strength.

EXPLANATION OF FIGURE 2

PREGLACIAL VALLEYS

- ***A.*** Schagticoke Channel
- ***B.*** Hoosic Channel
- ***C.*** Delphus Kill Channel
- ***D.*** Guilderland Center Channel
- ***E.*** Patroon Gap
- ***F.*** Voorheesville Channel
- ***G.*** Corning Gap
- ***H.*** Vloman Channel
- ***I.*** Corning Connection
- ***J.*** Wemple Gap
- ***K.*** Onesquethaw Channel
- ***L.*** Selkirk Gap

POST GLACIAL VALLEYS

- **A.** Ballston Creek Channel
- **B.** Anthony Kill Channel
- **C.** Jonesville Channel
- **D.** Elnora Channel
- **E.** Dwaas Kill Channel
- **F.** Rexford Reach
- **G.** Crescent Reach

HIGH GRADIENT AREAS

1. Guilderland
2. Latham
3. Castleton

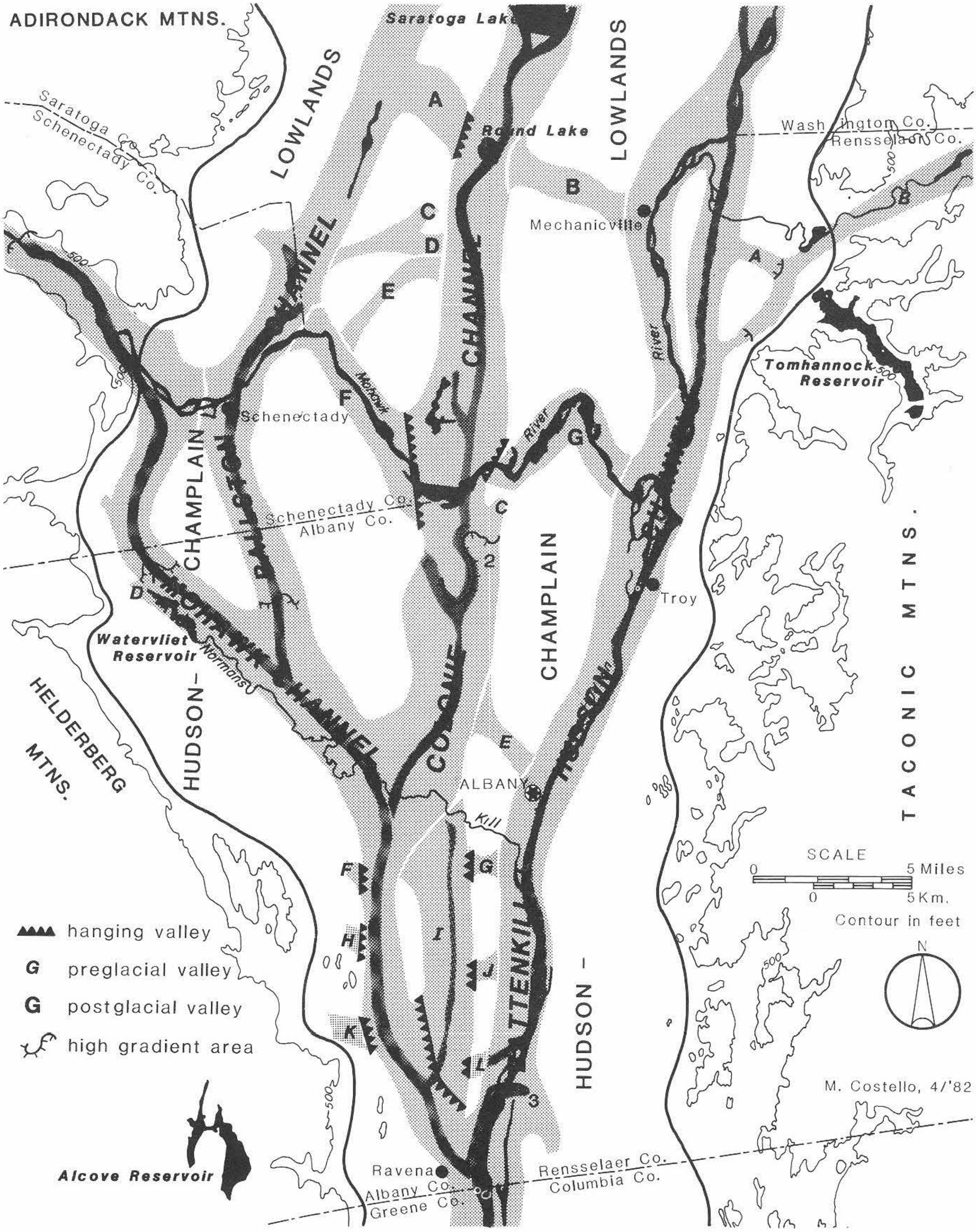

FIGURE 2. Buried valleys in the Albany area.

GLACIAL GEOLOGY

The glacial geology of the Hudson-Champlain Lowlands has been studied by Woodworth (1905), Stoller (1911, 1919, 1922), Fairchild (1917, 1981), Chadwick (1928), Cook (1930), LaFleur (1965a, 1965b, 1969 and 1979), Connally and Sirkin (1973), Dineen (1975, 1977, 1979), Hanson (1977), and Dineen and Rogers (1979). The lowland was occupied by the Hudson Lobe of the Laurentide Ice Sheet during the Woodfordian Stage of the Wisconsinan Glaciation. The Hudson Lobe generally flowed southward, parallel to the bedrock structure and topographic grain of the region. As the glacier scoured the bedrock surface, it picked up large quantities of debris that eventually was deposited as till on the underlying rock surface, as sand and gravel masses at or near the glacial margin, or as clay and silt in the proglacial lakes that filled the low-lying preglacial valleys. The sediment sequence varies systematically, both vertically and horizontally, beginning with till, that grades into sand and gravel, that grades upward into fine silt and clay, which then coarsens upward into sand or silty sand. The valleys are filled with lake sediments that are fine-grained in the valley centers and coarse-grained along the valley margins (Dineen and Rogers, 1979).

Six Pleistocene units and one Holocene unit have been mapped. The oldest unit is till, possibly of Woodfordian age; the youngest Woodfordian unit is dune sand. The dune sand might be interbedded with Holocene floodplain deposits. All the Woodfordian units are interbedded to some extent.

Till

The compact, dark gray, bouldery to gravelly clay till is 1 to 31 m (3 to 100 ft) thick. Till usually has a broad, jagged, moderately intense gamma ray curve with a distinct low gamma ray reading at its top. Flow till and a very clayey till occur in the lake deposits between Delmar and Saratoga Lake. Till generally is a poor aquifer because it is impermeable although some yield is possible from gravel or ablation (washed) till zones within, at the top, and/or at the bottom of the unit. Thick masses of till, such as drumlins and moraine ridges, act as dams that impede or redirect ground water flow (Fig. 6; Dineen, 1975). Till has good bearing strength when confined.

Outwash and Ice-Contact Sand and Gravel

The loose to compact, well sorted to poorly sorted, brown outwash and ice-contact sand and gravel have varying proportions of silt and clay. This unit has a low-intensity gamma ray signature. Sand and gravel masses are well sorted near their centers and poorly sorted toward their edges where they grade vertically and laterally to clays or deltaic sand and gravel. Ice-contact sand and gravel is up to 15 m (50 ft) thick. Permeability decreases with poor sorting, and compactness increases with increasing silt and clay content.

EXPLANATION OF FIGURE 3

- HG — Helderberg (carbonates) and Hamilton (sandstone and shale) Groups
- Osc — Schenectady Formation (sandstone and shale)
- Oc — Canajoharie Shale
- Osh — Snake Hill Shale
- Oag — Austin Glen Graywacke (sandstone and shale)
- BG/TG — Black River and Trenton Carbonates
- TS — "Taconic Series"-metamorphic rocks
- Omi — Mount Merino Chert

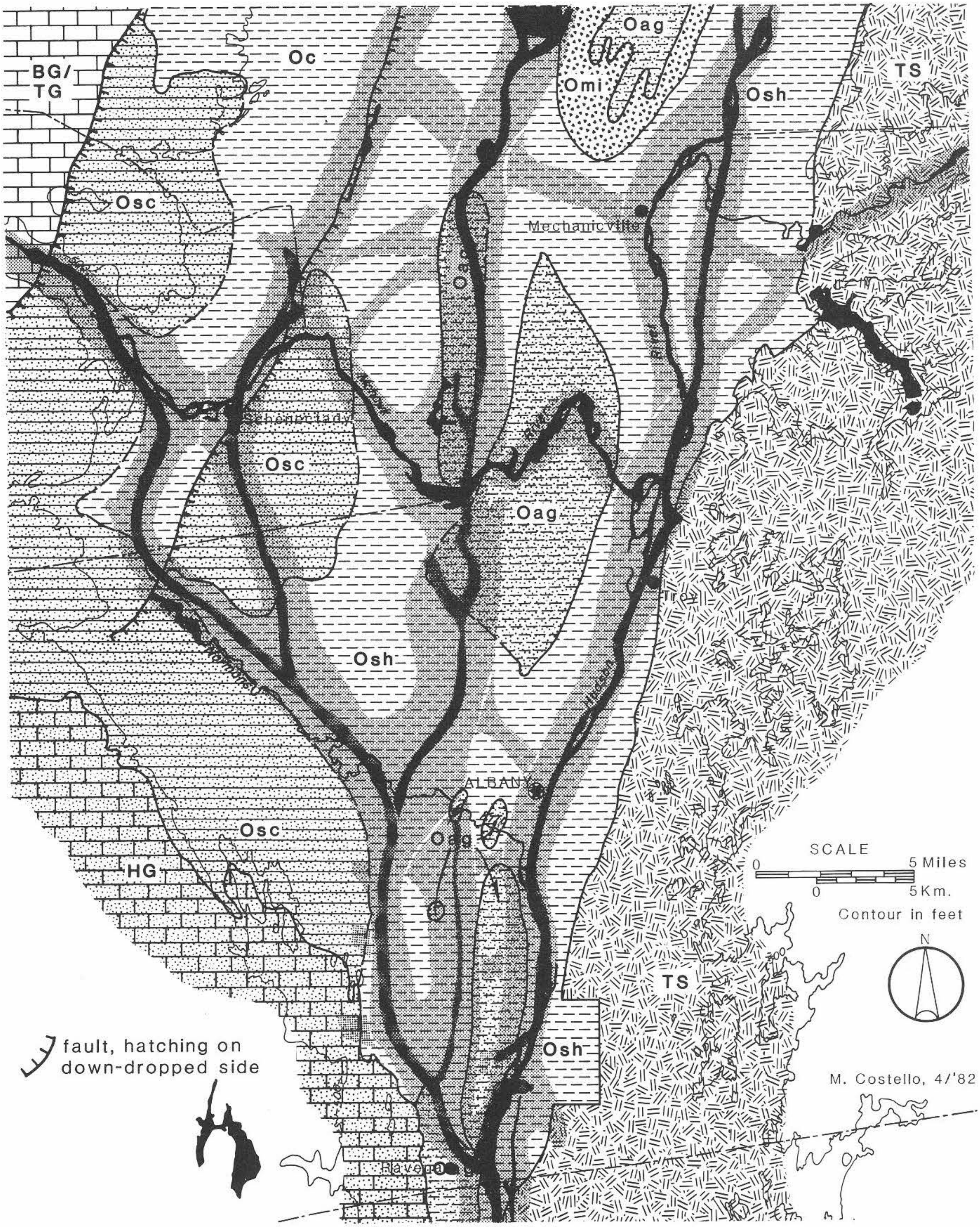

FIGURE 3. Generalized bedrock geology (after Fisher et al., 1970).

TABLE 1 BEDROCK TERRACES

Terrace	*Elevation**		*Relief*	*Gradient*		*Age*[1]	*Remarks*
	North	*South*		*ft/mi*	*cm/km*		
Glenville	380 ft 115 m	370 ft 112 m	50 ft 15 m	0.5	10	Miocene (?)	Very highly dissected, well developed in the Hudson-Champlain Lowlands (Pl. 4, Cross Sections K, M).
Malta	320 ft 98 m	300 ft 90 m	30 ft 9 m	1.0	20	Pliocene (?)	Absent north of Round Lake, moderately dissected, weaker toward the south (Pl. 4, Cross Sections B, C, D, J, K(?), L).
Elnora	280 ft 85 m	260 ft 80 m	30 ft 9 m	1.25	24	Pliocene (?)	Absent north of Round Lake, moderately dissected, weaker toward the south (Pl. 4, Cross Sections B, C, D, G, J, K(?), O, P).
Albany	240 ft 73 m	210 ft 65 m	30 to 50 ft 9 to 15 m	1.25	24	Late Pliocene or Early Pleistocene	Very well developed; can be traced north to Fort Ann, (Pl. 4, Cross Sections A, B, G, I, J. K(?), O, P).
Guilderland	200 ft 60 m	120 ft 35 m	20 to 30 ft 6 to 9 m	4.0	76	Middle Pleistocene	Weak, highly dissected (Pl. 4, Cross Sections A(?), B, C, D, G, I, N, P).
Castleton	25 ft 8 m	−35 m −10 m	10 to 20 ft 3 to 6 m	1.0	20	Late Pleistocene	Well developed.

* Above Sea Level
[1] The ages are uncertain because of the lack of datable pre-Wisconsinan deposits.

TABLE 2 TRIBUTARY VALLEYS

Tributary	*Depth 2 km From Confluence*	*Width 2 km From Confluence*	*Relief of Confluence*	*Width at Confluence*	*Trend*	*Remarks*
Ballston Creek[1]	100 ft 30 m	3,200 ft 1,000 m	100 ft 30 m	4,600 ft 1,400 m	NW	Contains little or no till or lacustrine deposits. Has several rock-floored terraces. Very steep-walled hanging valley.
Anthony Kill[1]	150 ft 45 m	2,000 ft 600 m	150 ft 45 m	4,000 ft 1,200 m	SE	See Ballston Creek remarks (above). Hanging valley.
Jonesville[1]	50 to 60 ft 15 to 18 m	2,000 ft 600 m	300 ft 90 m	2,000 ft 600 m	SSW	Poorly developed, filled with till and lake clay. Hanging valley.
Elnora[1]	40 to 50 ft 12 to 15 m	2,000 ft 600 m	250 ft 75 m	2,000 ft 600 m	SW	See Jonesville remarks (above). Hanging valley.
Dwaas Kill[2]	50 ft 15 m	1,500 ft 500 m	250 ft 75 m	2,000 ft 600 m	SW	See Jonesville remarks (above). Hanging valley,
Present Mohawk-Rexford[1]	130 ft 40 m	3,400 ft 1,000 m	200 ft 60 m	6,600 ft 2,000 m	NW	Very steep-walled. Hanging valley, no glacial deposits in channel.
Present Mohawk-Cresent[1]	130 ft 40 m	3,000 ft 900 m	200 ft 60 m	6,000 ft 1,800 m	NE	See Mohawk-Rexford remarks (above). Hanging valley.
Delphus Kill[2]	100 ft 30 m	4,800 ft 1,500 m	300 ft 90 m	5,000 ft 1,500 m	NNE	Contains an esker complex. Makes Fort Ferry-Mohawk View hill into an umlaufberg. Hanging valley.
Preglacial Mohawk[2]	450 ft 140 m	8,000 ft 2,400 m	at grade	10,000 ft 3,100 m	NW	Contains thick glacial deposits.
Voorheesville[2]	50 ft 15 m	2,000 ft 600 m	150 ft 45 m	2,500 ft 800 m	W	Buried by glacial Lake Albany deposits and till.
Vloman[2]	50 to 75 ft 15 to 23 m	2,000 ft 600 m	150 ft 45 m	2,000 ft 600 m	NW	See Voorheesville remarks (above).
Onesquethaw[1]	150 ft 45 m	1,500 ft 500 m	350 ft 110 m	2,000 ft 600 m	W	Contains till and the Onesquethaw delta complex.
Corning Connection[2]	400 ft 122 m	7,500 ft 2,300 m	at grade	12,000 ft 3,700	NE	Contains Lake Albany deposits, till, and statified sand and gravel.

[1] Steep-walled and flat-bottomed
[2] U-Shaped

The ice-contact sand and gravel deposits occur as large masses that include many en echelon, southeast-trending, elongate esker complexes, particularly between Albany and Round Lake. These complexes cut across the Colonie Channel in the area between Round Lake and Albany. Fan-shaped kame deltas lie at the southeast (downstream) ends of the esker complexes. Large tabular kame terraces occur along the bases of uplands and along the margins of the preglacial valleys. Outwash fills the tributary valleys of the Colonie Channel and may grade into lake deltas. Table 3 summarized the sizes and locations of these gravel masses.

All of these sand and gravel masses are good aquifers although they are discontinuous. Yield is variable because the degree of sorting is not consistent within each gravel mass. Recharge of these aquifers comes from the edges of the buried valleys or along the contacts with adjacent or overlying deltaic gravel or lake and wind-blown sand. Confined gravels have good bearing strength.

Lake Silt and Clay

These soft to hard, gray, reddish-gray, yellow, or brown lake silts and clays are 1 to 60 m (5 to 200 ft) thick. They consist of 0.1 to 15 cm (0.03 to 6 in) thick varves of clay, grading down to silt. The lower 3 m (10 ft) and upper third of the silt and clay sequence are dominated by sandy silt (Dineen, 1975, 1977, and 1979; Dineen and Rogers, 1979). Turbidite sand and gravel occur in the lake sequence where some turbidites can be traced for more than 16 km (10 mi). Contorted silt and clay are exposed in many places north of Delmar and often are overlain by till.

The gamma ray logs, electric logs, and sediment samples suggest that four subdivisions of the lake silt and clay can be traced from north to south (Pl. 5; Table 4). The basal lake silt and clay unit, gamma ray unit A, fills the deepest areas of the Colonie Channel and disappears north of Latham. Where exposed, unit A shows contorted clay, ripple-laminated silts, turbidite beds, and flow till (Dineen, 1977; Dineen and Rogers, 1979; La Fleur, 1979). This unit is absent in the Mohawk Channel.

The contact between gamma ray units A and B usually is gradational. Unit B thins to the south, tends to be coarser to the north, and does not extend north of the Mohawk River. Unit B is overlain by unit C, which is discontinuous north of test hole 17. Unit C does not extend north of Round Lake. The contact between units C and D is sharp. Unit D contains many turbidites and shows an abrupt change in gamma ray pattern and lithology at its top. It extends north of the study area and becomes sandy in that direction.

Ground-water tends to flow slowly in the lake silt and clay unit because of its low permeability. Lateral water movement is concentrated mostly along bedding planes, and vertical movement is concentrated along joints and tension cracks. Permeability and yield are high in the thicker turbidite beds. The silt and clay unit has low bearing strength and is susceptible to landslides, especially on slopes greater than 12°.

TABLE 3 ICE-CONTACT SAND AND GRAVEL MASSES

Body	*Location*	*Width*	*Length*	*Thickness*	*Notes*
South Bethlehem/Coeymans Kame Terrace	In Colonie-Mohawk-Corning Channels between South Bethlehem and Coeymans. Outcrops at Powell-Minnock claypit and South Bethlehem Delta.	5,000 ft 1,500 m	25,000 ft 7,600 m ~15 m ave.	20-100 ft ~50 ft ave. 8-30 m	Channel fill, mostly silty gravel.
Wemple Kame Delta	Just south of Wemple, outcrops along bluff south of Wemple.	4,000 ft 1,200 m	4,500 ft 1,400 m	25 ft ave. 8 m ave.	Mostly silty gravel.
Corning Kame Delta	In Corning Connection. Underlies Corning Hill about 6,000 ft southeast of the Normans Kill.	1,000 ft 300 m	2,500 m 800 m	25-50 ft 25 ft ave. 8 m ave.	Mostly silty gravel.
Meadowdale Moraine-Outwash Complex	Lies west of Voorheesville.	3,000 ft 900 m	22,000 ft 6,700 m	50-150 ft 75 ft ave. 15-45 m 20 m ave.	Mostly silty gravel.

New Salem Kame Delta	Southwest of Voorheesville, connects with Meadowdale Moraine.	5,000 ft 1,500 m	24,000 ft 7,300 m	25-125 ft 50 ft ave. 8-40 m 15 m ave.	Mostly silty gravel.
New Scotland Esker Complex	Lies southeast of Voorheesville and northeast of New Scotland.	8,000 ft 2,400 m	14,000 ft 4,300 m	25-75 ft ~25 ft ave. 8-20 m 8 m ave.	Series of sinous ridges, largely poorly sorted gravel.
Elsmere Gravel Blanket	Lies between Latham and Houcks Corners.	8,000 ft 2,400 m	20,000 ft 6,100 m	3-15 ft 10 ft ave. 1-6 m 3 m ave.	Thin blanket.
Guilderland Kame-Fullers Gravel Terrace	Lies north of Guilderland Center, extends from Guilderland to west Schenectady, in Mohawk Channel.	4,000 ft 1,200 m	44,000 ft 13,400 m	25-150 ft 50 ft ave. 8-45 m 15 m ave.	Poor quality gravel to east and west and good gravel to center.
Schenectady Esker Complex	South of Maywood.	1,000 ft 300 m	5,000 ft 1,500 m	5-30 ft 20 ft ave. 1-10 m 6 m ave.	Gravel quality is unknown, although sorting is good toward the north.
Loudonville Esker Complex	In Colonie Channel between Vischer Ferry and West Albany.	9,000 ft 2,700 m	46,000 ft 14,000 m	25-75 ft 50 ft ave. 8-20 m 15 m ave.	Good quality gravel to south and east, silty gravel in deep part of channel.
Pollack Road Kame Delta	On Pollack Road 5,000 ft southwest of Dunsbach Ferry in Colonie Channel.	5,000 ft 1,500 m	6,000 ft 1,88 m	150-25 ft 50 ft ave. 45-8 m 15 m ave.	Good quality gravel, siltier to north.
Halfmoon Kame Deltas	10,000 ft southwest of Gray's Corners in Colonie Channel.	1,000 ft 300 m	8,000 ft 2,400 m	25-75 ft 50 ft ave. 8-20 m 15 m ave.	Fair to good quality gravel.
Grooms Kame Delta	At Grooms Church in Colonie Channel.	6,000 ft 1,800 m	8,000 ft 2,400 m	25-100 ft 50 ft ave. 8-30 m 15 m ave.	Good quality gravel in center, less satisfactory to edge.
Scotia Esker Complex	West of Glenridge.	1,000 ft 300 m	3,000 ft 900 m	20-50 ft 30 ft ave. 6-15 m 10 m ave.	Quality of gravel is not known. Gravels are in contact with the Schenectady delta.
Usher's Esker Complex	South-southeast of Usher's along east wall of Colonie Channel. Spur to northwest near Bruno Road.	24,000 ft 7,300 m	2,000 ft 600 m	25-100 ft ~30 ft ave. 8-30 m ~10 m ave.	Gravel is good quality in center, poor to ends.

TABLE 4 GAMMA RAY UNITS

Unit	Lithology	Thickness	Gamma Ray Pattern	Notes
G	Silty sand, gravel to sandy silt.	5 to 6 ft 1.5 to 2 m	Medium to high intensity, jagged, decreases in intensity upward.	Coarsens upward, thins to south. This unit underlies many small deltas. It was deposited as delta foreset beds by catastrophic floods into Lakes Quaker Springs, Coveville and Fort Ann.
F	Gravelly silt to gravelly clay.	2 to 15 ft 0.6 to 5 m	Very jagged, intensity decreases upward.	Fines upward, thins to south. Unit F was deposited as till and ice-contact sand and gravel during the Delmar Readvance into Lake Albany.
E	Sandy silt to silty sand with clay beds.	5 to 24 ft 1.5 to 8 m	Low intensity, decreasing upward with strong peaks to the north.	Coarsens upward and to the north, thickens to the north. Unit E is folded between Delmar and Round Lake. It was deposited as bottomset toeset beds in Lake Albany and folded by the Delmar Readvance.
D	Silty clay to sandy clay with turbidite beds.	10 to 30 ft 3 to 10 m	Low intensity to south with strong, broad, lower peak to north.	Coarsens upward and to the north, thins to the south. The contact between units D and E is marked by abrupt lithologic and gamma ray changes. Unit D was deposited as bottomset beds in Lake Albany.
C	Silty clay with turbidite beds.	15 to 18 ft 5 to 6 m	High intensity with few peaks, wide peak at top.	Turbidites are common in this unit. The turbidites are very coarse-grained and more numerous to the north. Unit C was deposited in Lake Albany as deep-water bottomset beds.
B	Silty clay to clayey silt with turbidite beds.	9 to 15 ft 3 to 5 m	High intensity with few peaks, intensity increases upward.	This unit coarsens to north, disappears north of the Mohawk River. It was not deposited west of McKownville. Turbidites are less numerous in this unit than in units A and C. These are Lake Albany bottomset beds.
A	Gravelly, sandy varved silt to silty clay with flow tills and turbidites.	3 to 18 ft 1 to 6 m	Medium intensity with many sharp, low intensity peaks, increases in intensity upwards, "notch" at top.	Fines upward, with contorted bedding. Unit A fills deep areas in the Colonie Channel. It does not occur north of Latham or west of McKownville. This unit was deposited by meltwater in Lake Albany at the face of the retreating ice front.

TABLE 5 GLACIAL LAKE DELTAS

Delta	*Lake*	*Location*	*Thickness feet/meters*		*Notes*
Malta	Quaker Springs	Between Saratoga and Round Lakes	75	25	Ice-contact delta that thins to south and east, deposited by meltwater from ice block in Saratoga Lake Basin and Glacial Mohawk drainage through Drummond and Ballston Lake Channels into +270 ft Lake Quaker Springs. See Pl. 1, Cross Section A.
Shenendahowa	Quaker Springs	Between Jonesville and Shenendahowa Central School	100	30	Thins to east and south, deposited either by meltwater from Round Lake Ice Block (Hanson, 1977) or by Glacial Mohawk drainage through Jonesville Channel into +270 ft Lake Quaker Springs. See Pl. 4, Cross Sections B, C, D, E.
Vischer Ferry	Quaker Springs	East of Vischer Ferry	20	6	Thins to east, deposited by Glacial Mohawk drainage over Rexford Channels into +270 ft Lake Quaker Springs. See Pl. 4, Cross Section I.
Schenectady	Albany	North of Guilderland	150	50	Thins to east and south, deposited by Glacial Mohawk into +335 ft Lake Albany. See Pl. 4, Cross Sections K and M.
Guilderland Center	Albany	North of Guilderland	50	15	Ice-contact delta that thins to south, deposited by Glacial Mohawk drainage flowing across ice to early, expanding +335 ft Lake Albany (see Dineen, 1977).
Albany	Coveville	Pine Hills Section of Albany	30	10	Thins to east, very sandy, deposited by Glacial Normans Kill drainage into +190 ft Lake Coveville.
Voorheesville	Albany	East of Voorheesville	30	10	Thins to east, deposited by meltwater drainage from ice block in Guilderland Center area draining through Meadowdale channels into early, ice-contact +335 ft Lake Albany (see Dineen, 1977).
South Bethlehem	Albany and Quaker Springs	South Bethlehem	60	20	Thins to east, deltaic complex built by Helderberg meltwater flowing through Onesquethaw Channel into +310 ft Lake Albany, +250 and +210 ft Quaker Springs, and Lake Coveville. Earlier delta (+325 ft) was deposited next to the ice.

Delta Sand and Gravel

The delta sand and gravel unit is dark to light brown, cross-bedded to horizontally bedded sand and gravel with some silt that is 1 to 46 m (3 to 150 ft) thick. Deltas are common along the edges of the valleys where tributary streams entered Lake Albany (Table 5; Fig. 7). These deposits grade lakeward into silt and clay, and grade shoreward into outwash. The deltas are good potential aquifers because of their high permeability and significant thickness of sand and gravel.

Lake Sand and Lake Silt and Sand

The lake sand (Pl. 1) and lake silt and sand (Pl. 4) are very light yellow brown to light gray, ripple-laminated to horizontally laminated fine to medium sand with thin (0.3 to 1 m, 1 to 3 ft) silt and clay lenses. They vary in thickness from 1.5 to 30 m (5 to 100 ft). The sand contains up to 30 percent silt, with the higher percentage occurring with greater depth.

These units grade laterally and vertically into delta sand, and are thickest in the Elnora and Guilderland regions and the Schenectady area (Winslow and others, 1965). Springs are common in valleys at the contact between the lake sand and underlying silt and clay, causing valley wall erosion and landslides.

The lake delta sand and gravel and lake sand contain several gamma ray units. Gamma ray unit E contains widespread, thin clay beds, especially to the north, It is folded in exposures between Delmar and Round Lake (Fig. 8). Unit E has an abrupt gamma ray and lithologic contact with unit F. Unit F is till and ice-contact sand and gravel that was deposited by the Delmar Readvance. Unit F grades up into unit G. Unit G underlies the deltas at Milton, Shenendahowa, Vischer Ferry, and South Bethlehem (Fig. 7). Many shallow wells are developed in unit G between Clifton Park and Guilderland.

Wind-Blown Sand

This unit is fine-grained sand that is light yellow brown and cross-laminated. It usually is 1.5 to 15 m (5 to 50 ft) thick, thickens towards the east as dune hills 8 to 23 m (25 to 75 ft) high, and overlies the lake sand and silt. The wind-blown sand also overlaps the ice-contact sand and gravel on the eastern edge of the Colonie Channel. This sand is part of an extensive near-surface aquifer (Arnow, 1949; Dineen, 1975).

Floodplain Deposits

The floodplain deposits are brown to dark brown, highly oxidized cobble to silt that fine upward, are deposited in lenticular beds, and contain many truncation surfaces. They contain variable quantities of organic matter. The floodplain deposits are 6 to 12 m (20 to 40 ft) thick along the Mohawk and Hudson Rivers and less than 3 m (10 ft) thick along the smaller streams. These deposits are good aquifers where they are thicker than 3 m (10 ft).

TABLE 6 GLACIAL LAKE LEVELS

	North		*South*	
Glacial Lake Albany (335 ft)	380 ft*	117 m**	320 ft	98 m***
Glacial Lake Albany (310 ft)	355 ft	109 m	300 ft	92 m
Glacial Lake Quaker Springs	280 ft	86 m**	240 ft	74 m***
Glacial Lake Coveville	220 ft	86 m**	240 ft	74 m***
Glacial Lake Coveville	190 ft	58 m**	180 ft	55 m***
Glacial Lake Fort Ann	170 ft	51 m**	160 ft	49 m***

* Above sea level
** From LaFleur, 1965b; Hanson, 1977
*** From Dineen, 1977

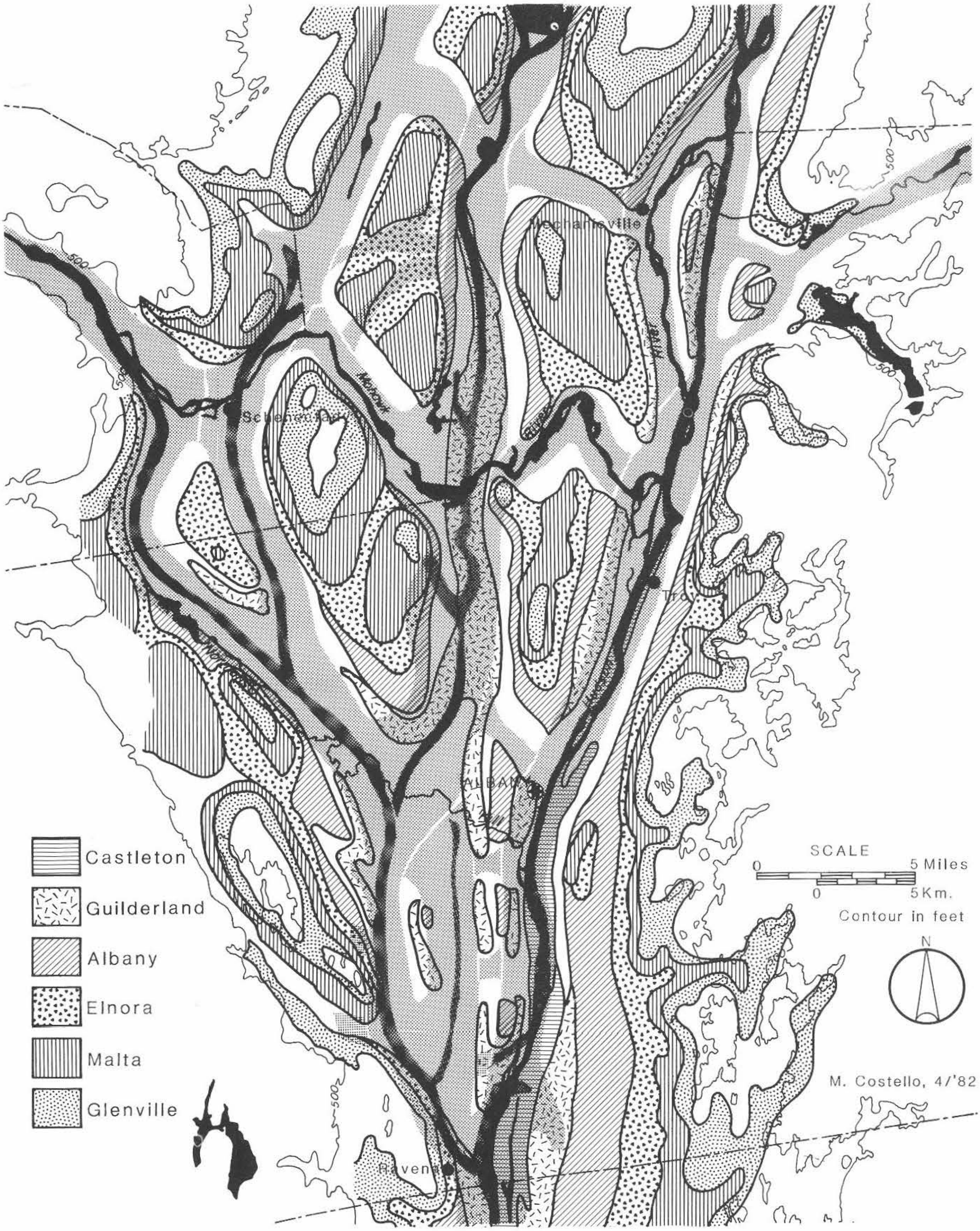

FIGURE 4. Bedrock terraces.

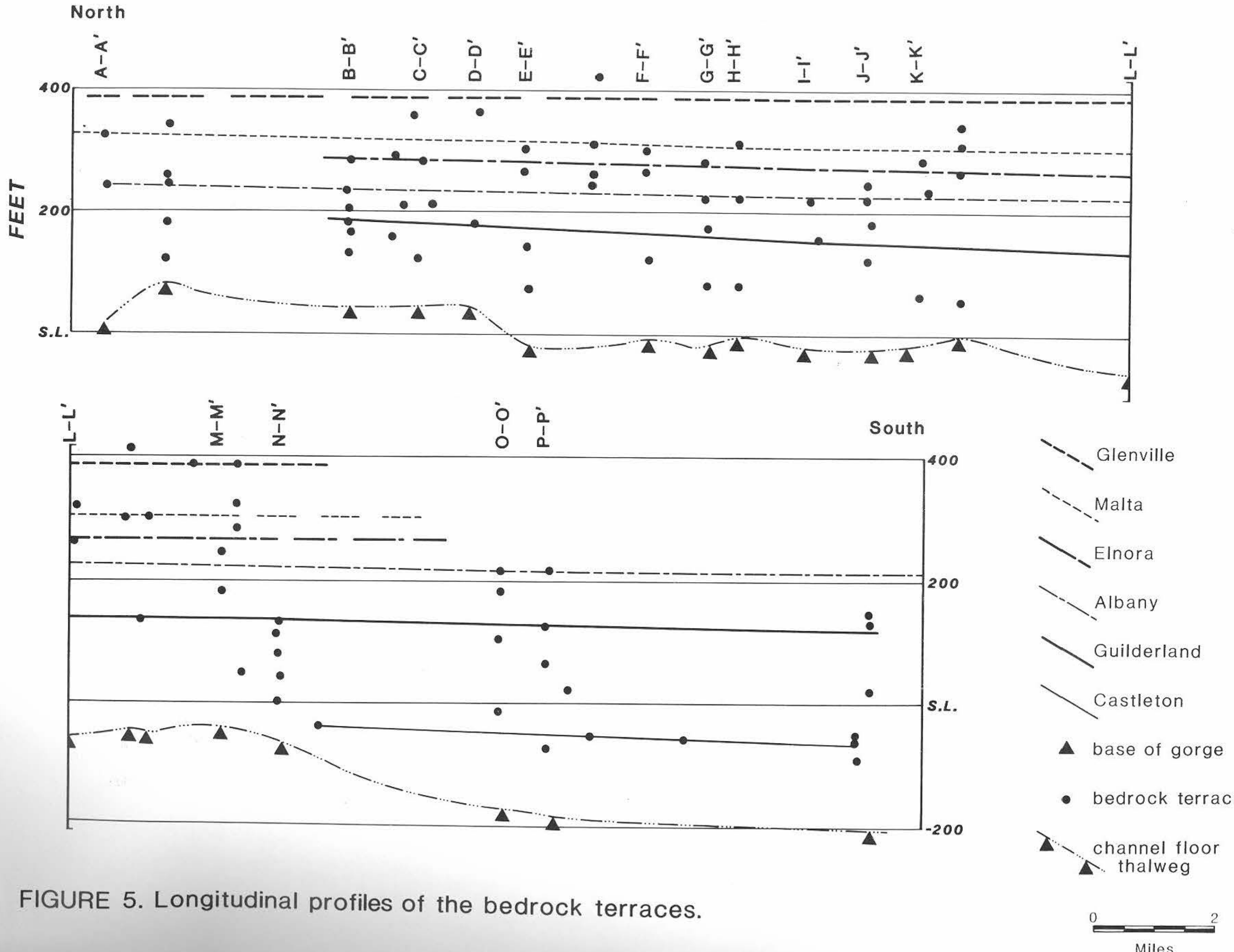

FIGURE 5. Longitudinal profiles of the bedrock terraces.

INTERPRETATION

Bedrock Topography and Preglacial Drainage

The preglacial valleys and terraces are products of many stages of erosion, and have been modified by interglacial, subglacial, and proglacial fluvial and ice erosion. The Glenmont, Malta, Elnora, and Albany terraces were formed during the late Cenozoic, during the Miocene to late Pliocene when the proto-Hudson drainage flowed south to a stable Atlantic Ocean base level.

The Guilderland and Castleton terraces are incised into the low-gradient terraces by rejuvenated drainage that flowed south during an interstadial episode of low sea level. The preglacial valleys are the youngest pre-Woodfordian features and were eroded by proglacial and subglacial drainage that also was graded to a lower sea level. These valleys have been modified by ice scour, as is indicated by their U-shaped profiles and hanging tributaries, so they are older that the last major (Woodfordian) ice advance and probably are early to middle Wisconsinan in age. Base level fell several times as indicated by the inner gorges and the high gradient areas at Guilderland, Latham, and Castleton. These sharp increases in gradient are extinct waterfalls whose locations were controlled either by faults or resistant rocks (Figs. 2 and 3). The incision of the inner gorges occurred when water flowed through the channels to a lower sea level during the waning stages of earlier glaciations or when meltwater flowed under the glacier and eroded subglacial valleys. The bedrock ridges within the valleys are folded, resistant graywacke or chert beds.

The gaps and tributary valleys are not necessarily the same age nor were they cut by the same mechanisms as the major valleys. The Ballston Channel, Mohawk Channel, Battenkill-Hudson Channel, and Corning Connection all meet the Colonie Channel at grade, all are U-shaped, and all contain glacial deposits (Pl. 1; Table 2; Fig. 2), implying that they are the same age as the Colonie. The Jonesville, Elnora, Dwaas Kill, Delphus Kill, Voorheesville, Vroman, and Onesquethaw valleys all hang on the Colonie Channel, contain glacial deposits, and have been modified by glacial scour so they are likely to have been pre-Woodfordian proglacial or subglacial meltwater valleys. The Anthony Kill, Ballston Creek, and modern Mohawk Channels do not contain glacial deposits and have not been modified by glacial scour so they are probably post-Woodfordian. The Ballston Creek and Anthony Kill channels contain underfit streams so they are early Holocene (Stoller, 1919); the Mohawk River is middle to late Holocene to Recent in age.

Glacial History

Bedrock topography controlled the initial glacial retreat. Ice-margin positions occurred most frequently at abrupt changes in the gradient of the bedrock channels such as at Niskayuna, Round Lake, and Saratoga Lake (Figs. 2, 5, 8). Recessional ice-margin positions developed where the Hudson Lobe was grounded on bedrock and faced a deep lake basin such as at Round Lake and Niskayuna. At such locations the glacier flowed on rock north of the change in gradient, but floated in Lake Albany. Floating ice rapidly backwasted by iceberg calving. The rapid backwasting ceased when the grounded ice was met.

The ice margin at Saratoga Lake was caused by a southward rise in rock elevation. Here the glacial movement was impeded by friction caused by the narrowing gorge and rising rock surface. The thick deposits of sand and gravel that lie between Lake Lonely and Round Lake were deposited against large, stagnant ice blocks while active ice was lying north of Lake Lonely. Lakes Lonely and Saratoga formed as kettle hole lakes after the ice blocks melted. The sandy phase of gamma ray units F and G were deposited between Saratoga Lake and Round Lake by the Saratoga Ice Margin.

Till was deposited by the glacier during both advance and retreat. The till fabrics depended on the mode of deposition. Till that was deposited at the base of the glacial lobe, under high pressure, was compact, unsorted lodgment till such as drumlins. The drumlins were deposited during the Hudson Lobe's advance southward down the Hudson Lowlands and were oriented with their long axes parallel to the ice movement. The drumlins tended to be deposited in clusters or drumlin fields on the lee (relative to ice movement) bedrock slopes such as the Hartmans-Schenectady Drumlin Field between South Schenectady and Westmere (Fig. 6). These thick, drumlinized till masses are called till-shadow hills. Drumlins usually were absent on the stoss (up-glacier) side of terraces where the ice was moving upslope. The till that was released from within or on the melting ice was sorted by meltwater to some degree and formed loose ablation till. Many of the permeable zones at the top and base of the till are ablation tills. The tills and muddy, poorly sorted gravels of gamma ray unit A were deposited by rapid backwasting of the ice margin caused by melting of the glacier by Glacial Lake Albany water. Thus, gamma ray unit A records the interaction between the active, retreating Hudson Glacial Lobe and proglacial Glacial Lake Albany. The ice margins were in contact with the northward-expanding Glacial Lake Albany and decreased in age from south to north. The thick ice-contact deposits that were associated with ice margins represented readvances and/or hesitations in lobe retreat (Fig. 8). As Glacial Lake Albany expanded northward, the deepest lake water lay in valleys. These deep, elongate basins were separated by the valley walls and influenced the deposition of Lake Albany sediments. The thickest sections of lake deposits overlie the buried preglacial valleys. Beaches, deltas, and sand plains recorded several levels of Lake Albany; these levels decreased in elevation to the south because of glacial isostatic rebound (Table 6; Fig. 8; Woodworth, 1905).

The ice margins (Fig. 6) were recorded by ice-contact deposits that were deposited in the +335 ft Lake Albany. The Meadowdale-Hampton Ice Margin extended from Amsterdam to Hampton Park and reached as far south as Coeymans. Mohawk Valley drainage from Glacial Lake Amsterdam flowed along the southwestern edge of this ice margin, depositing parts of the Meadowdale Moraine and Voorheesville Delta, part of the New Scotland Esker Complex, and the South Bethlehem/Coeymans Kame Delta. The Voorheesville Delta was deposited in a small, ice-marginal lake that was connected to, and at the level of, the +335 ft Lake Albany. Meltwater from the upper Hudson Valley flowed southeast in a large, englacial river, built the Loudonville Esker Complex, and entered the +335 ft Lake Albany at the Hampton Kame Delta. As the ice margin retreated to its Guilderland position, Lake Amsterdam drainage built part of the Guilderland Kame, and the upper Hudson meltwater built the Hampton Kame Delta and part of the Loudonville Esker Complex. The Wemple and Corning Kame Deltas were deposited as subaqueous cones along the edge of a stagnant ice block that occupied the Battenkill-Hudson Channel between Glenmont and Kingston. The ice then retreated to the Rensselaer Ice Margin; the overflow from Lake Amsterdam deposited the rest of the Guilderland Kame, the Schenectady Eskers, and Guilderland Delta. The McKownville Till Ridge was deposited at the ice margin. Upper Hudson drainage continued building the Loudonville Esker (including a delta at an elevation of +400 ft), the Rensselaer Delta, and Elsmere Gravel Blanket. The lower part of the gamma ray unit A was deposited in deep (>100 m, > 300 ft) water, in close proximity to the Rensselaer Ice Margin, as suggested by the presence of contorted beds, flow tills, and turbidites in Unit A, and by its fining-upward trend. Deposition of the Fullers Gravel Blanket and gamma ray unit A continued as the ice retreated to the Niskayuna Ice Margin. The Pollock

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EXPLANATION OF FIGURE 6

ICE-CONTACT GRAVEL MASSES

1. South Bethlehem /Coeymans Kame Delta
2. Wemple Kame Delta
3. Corning Kame Delta
4. Meadowdale Moraine-Outwash Complex
5. New Salem Kame Delta
6. New Scotland Esker Complex
7. Elsmere Gravel Blanket
8. Guilderland Kame /Fullers Gravel Terrace
9. Loudonville Esker Complex
10. Pollock Road Kame Delta
11. Schenectady Esker Complex
12. Scotia Esker Complex
13. Grooms Kame Delta
14. Halfmoon Kame Deltas
15. Usher Esker Complex
16. Newtown Road Kame Delta
17. Waterford Kame Deltas
18. Rensselaer Kame Delta
19. Hampton Kame Delta
20. East Greenbush /Schodack Kame Deltas
21. Willow Glen Kame Delta
22. Ballston Spa Kame Delta
23. Voorheesville Delta

ICE MARGINS

A. Meadowdale-Hampton [1]
B. Guilderland [1]
C. Rensselaer [1]
D. Niskayuna [2]
E. Round Lake [2]
F. Saratoga Lake [2]

from: 1. LaFleur, 1979, 1965.
2. Hanson, 1977.

TILL MASS

a. Hartman's-Schenectady Drumlin Field
b. Mckownville Till Ridge

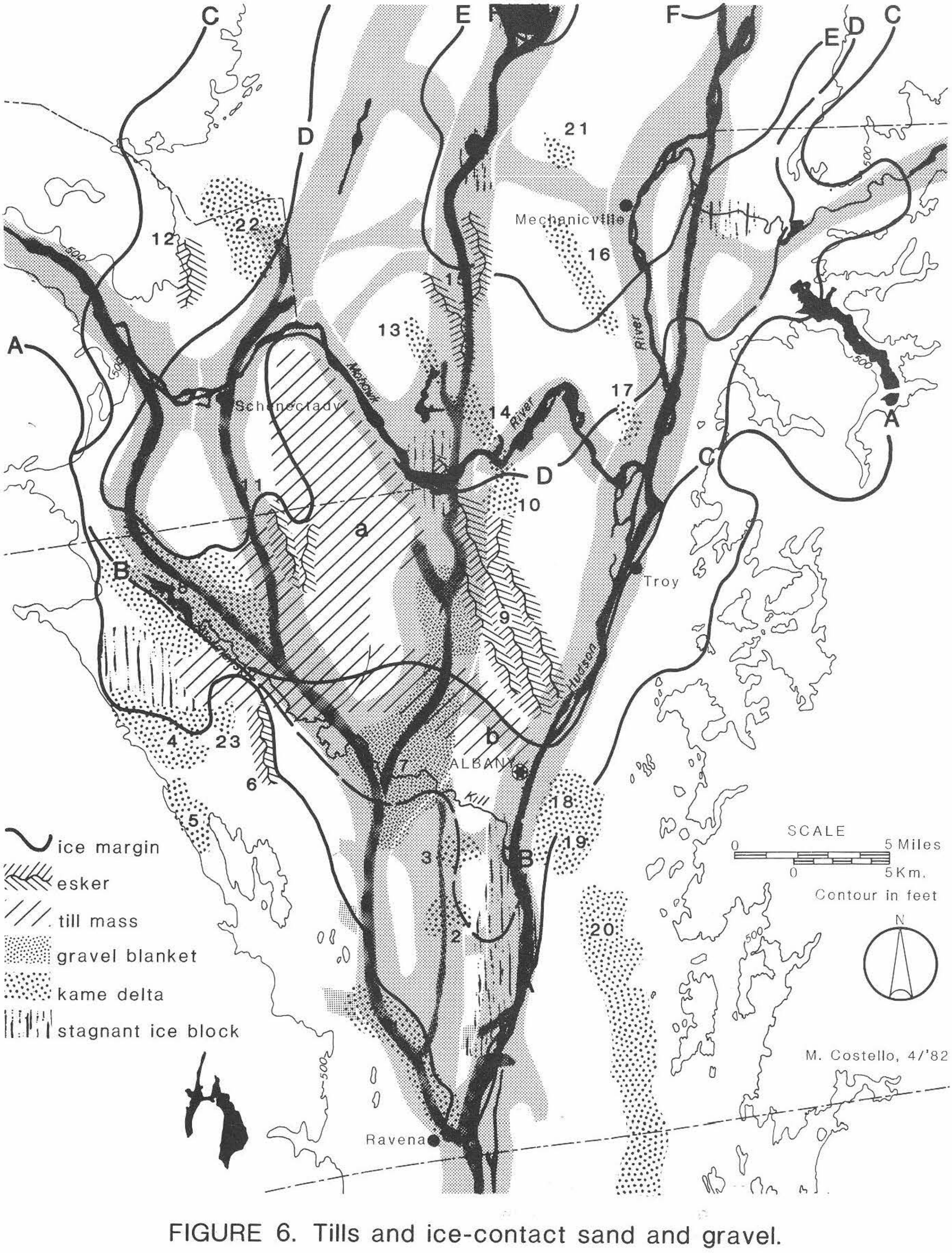


FIGURE 6. Tills and ice-contact sand and gravel.

and Ballston Spa Kame Deltas were deposited at the Niskayuna Margin. The deposition of gamma ray units A and B ended when the ice retreated from Niskayuna (units A and B are absent north of that margin). The Niskayuna Ice Margin did not persist very long and only small kame deltas and thin gravel blankets were deposited. Retreat from the Niskayuna Margin was apparently rapid because only small, discontinous esker segments and kame deltas were built between Niskayuna and Clifton Park (Figs. 6 and 8).

Gamma ray unit C was deposited after the ice margin stabilized at Round Lake. Unit C is thin and becomes finer grained towards the south. It grades into thick esker gravels in the Round Lake-Bruno Road area and contains many turbidites that increase in number to the north and also increase upward in the section. Unit C was deposited by meltwater flowing from the ice margin into water that was 80 to 60 m (250 to 200 ft) deep. Portions of the Ushers and Newton Road Esker Complexes were deposited during this phase. The Schenectady, East Greenbush, upper South Bethlehem, Poestenkill, and Hoosic Deltas also were deposited at this time: all but the Schenectady Delta were deposited next to glacial ice (Figs. 6 and 8).

The ice retreated to Saratoga Lake and a large delta was deposited at Malta by upper Hudson meltwater drainage. At that time, gamma ray unit D was deposited in water that was 15 to 30 m (50 to 100 ft) deep. The shoaling of the lake was the result of sediment filling the basin. Unit D's silty sand to sandy silt represents delta bottomset/toeset beds that rapidly migrated across the lake. Deposition at the Schenectady Delta ended at the demise of unit D deposition as the water fell to the +310 ft Lake Albany level and the Mohawk River was deflected northward up the Ballston Channel (Stoller, 1919, 1922; LaFleur, 1979). Only local deposition of lake clay and silt occurred north of the present Mohawk River after deposition of gamma ray unit D.

Gamma ray unit E was deposited in water that was 10 to 15 m (30 to 50 ft) deep. Its source was the Saratoga Ice Margin. It thins and becomes finer toward the south. This unit usually coincides with the Lake Silt and Sand and Lake Sand map units although clay was deposited locally. The Malta, middle south Bethlehem, and Hannacroix Deltas are underlain by unit E. The unit contains extensive interbedded sand and clay and wind-blown, lake-deposited sand. The sand was recycled from the exposed Schenectady Delta by northwest winds. Sand and gravel between Round Lake and Jonesville were deposited as turbidites that were brought into the lake by catastrophic floods from the Mohawk Valley.

The top of unit E was folded, then unit F was deposited when ice readvanced into the +310 ft Lake Albany as far south as Delmar. Most of the till deposited by the Delmar Readvance was well mixed with ice-contact sand and gravel (gamma ray unit F) and was deposited by rapid downwasting and backwasting of the thin Delmar Readvance ice tongue. The Delmar Readvance deposited the Meadowdale Moraine and the thick gravel just below an elevation of +200 ft in the Albany area, the upper gravel in the Karner area, the thick gravel and sand between Saratoga Lake and Crescent, and folded clay and silt between Delmar and Round Lake (Fig. 8; Pl. 4, Cross Sections A, L, M and N). The ice rapidly wasted back as the lake level dropped, depositing gamma ray unit F as outwash in Lake Quaker Springs. Unit G was deposited in Lake Quaker Springs by catastrophic floods from the Mohawk River. Unit G underlies the Shenendahowa Deltas (Figs. 7 and 8).

The water fell to the Lake Coveville and Lake Fort Ann levels and a thin layer of sand and sandy silt was deposited in the shallow (3 to 10 m, 10 to 30 ft) water in the Vischer Ferry, Albany, lower South Bethlehem, and Hannacroix Deltas. The drop in water level to Lake Coveville was recorded by the layer of gravelly sand on top of unit F in bore hole 5, by the sheet of silty sand deposited by offshore bars in the Bethlehem area, and by silty gravel in bore holes 10 and 11 (Pl. 5; Figs. 7 and 8). The stagnant ice block that lay in the Battenkill-Hudson Channel persisted until the end of Lake Fort Ann.

EXPLANATION OF FIGURE 7

DELTAS

1. Malta	**5.** Guilderland Center	**9.** Hoosic
2. Shenendahowa	**6.** Albany	**10.** Poestenkill
3. Vischer Ferry	**7.** Voorheesville	**11.** East Greenbush
4. Schenectady	**8.** South Bethlehem	**12.** Hannacroix

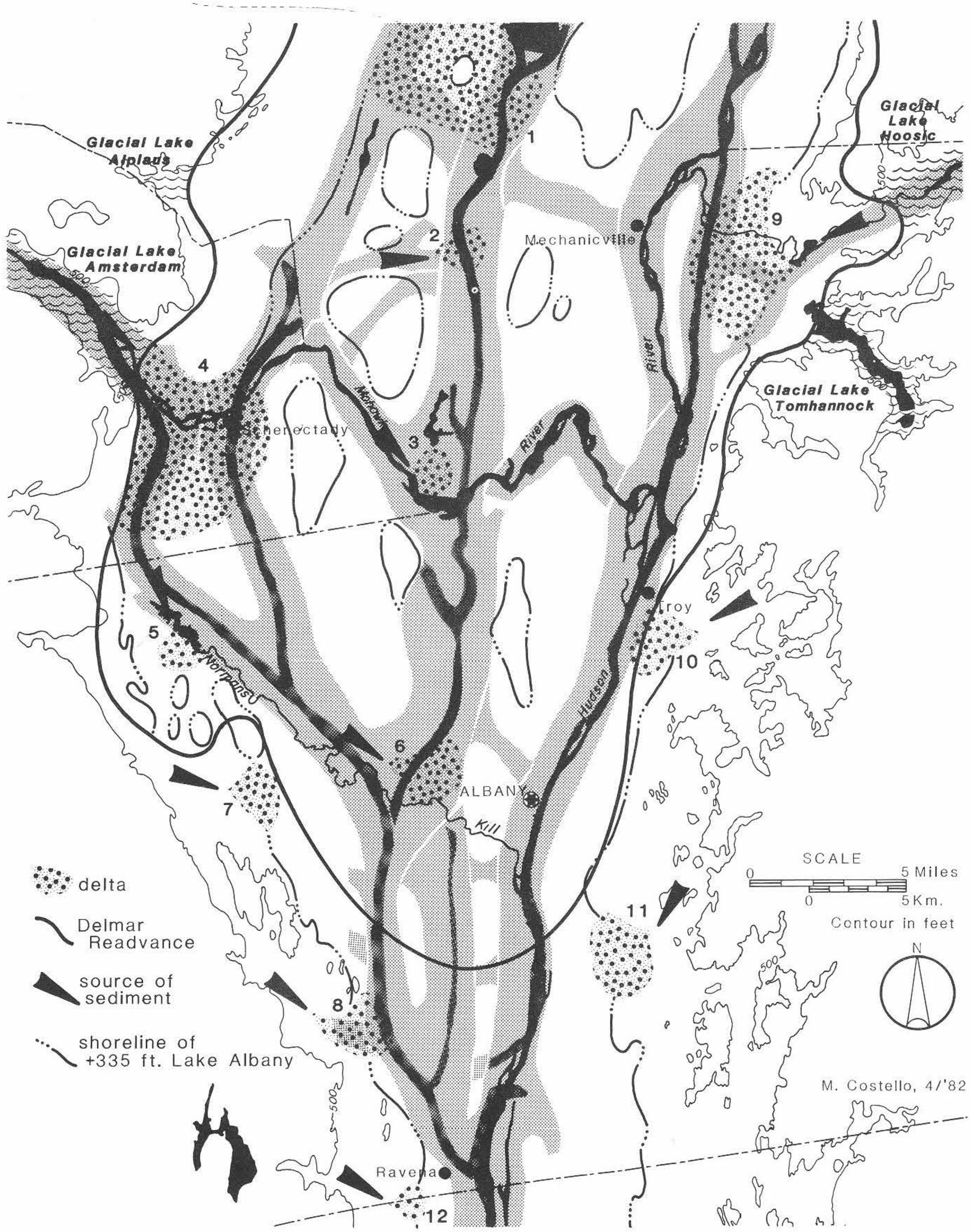


FIGURE 7. Deltas.

CONCLUSIONS

The glacial deposits in the Colonie Channel reflect the influence of an active glacial margin on depositional environments in an expanding proglacial lake. Basal Lake Albany deposits are very silty and commonly contain flow tills, gravel, and turbidite beds. Bottomset beds, consisting of fining-upward silty clay to clay, have fewer turbidite beds and flowtills; these lower beds were deposited in deep water when the ice front was at Latham. The upper Lake Albany beds coarsen upward from silty clay to sandy silt that were deposited in a shallow phase of Lake Albany. The lake became shallower as its basin filled with sediment and as the water drained to lower levels. Either just before or just after the level of Lake Albany fell to +310 ft, the Hudson Lobe readvanced at least 32 km (20 mi) from Saratoga Lake to Delmar. Very soon after the Delmar Readvance the lake level dropped 70 ft to the +250 ft Lake Quaker Springs. Meanwhile, catastrophic floodwaters were diverted north from the Mohawk Valley by the great Schenectady Delta to overflow the Ballston Channel complex and deposit deltas between Clifton Park and Malta. Channel margins and interfluves underlay shallow water, high energy depositional environments. Thick wedges of wind-blown lake-deposited sand were deposited in the shallowing lakes as sand was blown off the newly emergent lake plains to the west. Storms and seasonal, wind-driven waves produced longshore and bottom currents in the shallow lakes, resulting in thick deposits of ripple-laminated sand. The shallow water environments migrated eastward across the lake basins as the lake level fell.

Holocene erosion has deeply trenched the lake deposits. Floodplain deposits are up to 12 m (40 ft) thick in the postglacial valleys.

Till and bedrock are aquicludes. They direct ground-water flow by acting as dams. Two major types of aquifers occur in the area. The first, a shallow aquifer, consists of Holocene floodplain deposits and Woodfordian wind-blown sand, lake sand, and delta sand and gravel. The water in this aquifer commonly is close to the surface. The water is recharged over the wide area of exposure of the component units. The second type is a deep aquifer consisting of ice-contact sand and gravel; it is recharged through exposures along valley walls. The water is under artesian pressure.

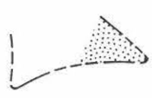
EXPLANATION OF FIGURE 8

• exposures or wells with till

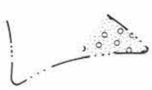
▲ contorted lake sediments

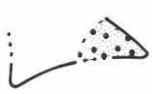
drumlinized lake clay and kames

margin of the Delmar Readvance


delta and margin of +210 ft. Lake Coveville


delta and margin of +250 ft. Lake Quaker Springs


delta and margin of +310 ft. Lake Albany


delta and margin of +335 ft. Lake Albany

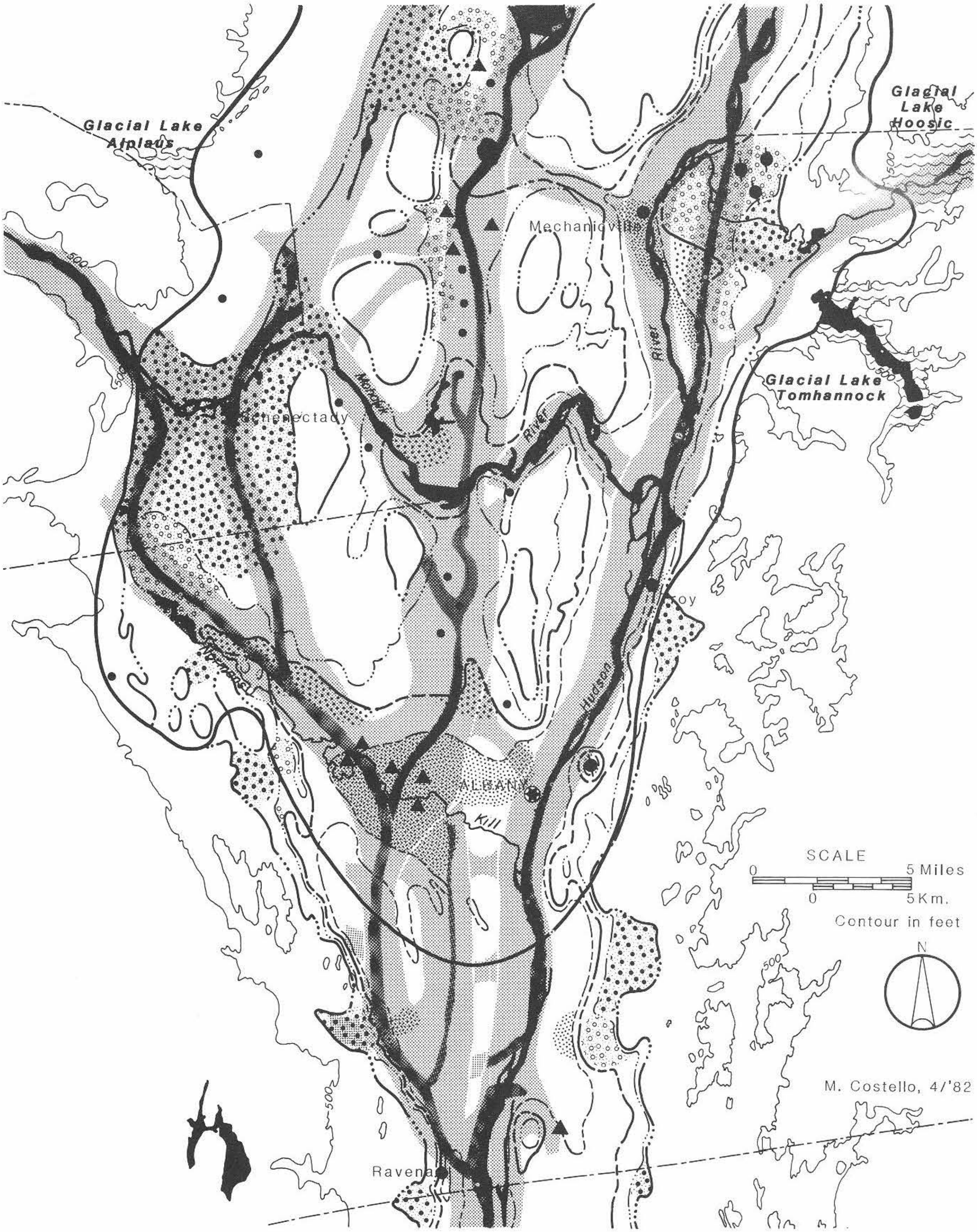


FIGURE 8. Lake Albany stages.

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Ground-Water Potential of the Capital District Buried-Valley Deposits

by

Roger M. Waller

ABSTRACT

Twenty-two test holes were drilled into the preglacial buried-valley system in the Capital District area and penetrated deep confined aquifers. Yields of several thousand gallons per minute are estimated to be feasible from properly constructed wells tapping these aquifers.

The test holes were drilled open hole and logged by natural-gamma, resistivity, and self-potential probes. Gamma logging proved adequate to distinguish sand and gravel units beneath the thick glaciolacustrine clay and silt; electric logs aided in determining water-bearing potential of the units.

Data from most sites extended knowledge of the deep-aquifer system, and many sites were found to contain coarse, permeable zones that show promise of high water yields. Most sand and gravel units probably are continuous with adjacent surficial glacial ice-contact, outwash, or deltaic deposits. Hydraulic conductivity along the preglacial valley is not consistent, but sand and gravel is present within most of the inner gorge. Seismic profiles can aid in refining knowledge of the areal extent and cross-sectional details of the relatively narrow gorge within much of the valley system.

INTRODUCTION

A deep aquifer system within the Colonie Channel of the buried valley system probably was first discovered by the City of Cohoes in the 1920's during the drilling of several artesian flowing wells near the present site of Albany County Airport (Keis, 1933). Subsequently, the first large-production wells, which yielded as much as 60 gal/min, were drilled east and southeast of that site in the early 1930's for the Latham Water District. The latter wells apparently were the first to tap the deep part of the channel. No continued or successful attempts are known to have been made to locate other large wells within the channel. Simpson (1949, p. 720) recognized the buried channels in the area to be potential sources of extensive water-bearing sand and gravel deposits. At the same time, Arnow (1949, p. 31) noted that the three Latham Water District wells in the airport area, which were pumping about 2 mgal/d by 1942, had reduced the potentiometric (water-table) level to a noticeable degree. By 1953, these wells had been relegated to standby use after a surface-water system was put into operation (Malcolm-Pirnie, 1968, p. 26).

Interest in obtaining large water supplies was sporadic until the 1960's,when rapid suburban development created additional demand for water. Knowledge of the Colonie (and Mohawk) channels led to renewed drilling in search of a deep aquifer within the suspected location of these channels. In general, success was rare, and the ground-water potential of the channels was considered poor. However, a few successful large-production wells in widely scattered parts of the channels—specifically in the buried valleys containing the inner gorge, or channel, proposed by Simpson (1949)—subsequently were developed in the Towns of Clifton Park, Guilderland, and Bethlehem (see references given in "Capital District Regional Planning Commission" 1969).

Increased water needs and preliminary plans for the costly development of distant surface-water sources stimulated interest in exploring further the aquifer of deposits within the buried bedrock valleys and, in particular, the channel that had seemed so elusive to random drilling ventures. Consequently, the U.S. Geological Survey, in cooperation with the New York State Geological survey, drilled test holes in selected sites within the Colonie Channel of the preglacial valley stream. The principal drilling goals were to (1) delineate more precisely the preglacial channel; (2) extend knowledge of the extent and continuity of the aquifers beneath the glacial-lake deposits; and (3) determine the relation of these aquifers to surface sand and gravel deposits, which are the probable main recharge areas.

Acknowledgments

The author is deeply grateful to the numerous home owners, well drillers and water officials who provided information on wells and access to property for conducting drilling operations and seismic-line profiles.

TEST-DRILLING PROGRAM

Drilling sites were selected on the basis of New York State Geological Survey's preliminary bedrock-contour and geologic maps and on accessibility to desired areas. It was assumed that the most permeable aquifer material would lie in the deepest, or channel, part of the bedrock valley because here the velocity of the glacial melt-water streams (not necessarily of the last glaciation) that carved the "inner gorge" would have been greatest and would have winnowed out the fine-grained material. The coarse deposits left by such streams would subsequently be covered by the glacial-lake deposits.

As drilling progressed, additional sites in the adjacent Mohawk Channel were selected to help interpret the history of deposition in the buried-valley system. A secondary advantage of the additional drilling was that supply needs in these areas recently have become of more concern.

Test-Drilling Procedures

The test holes were drilled by Hanson Drilling Co. of Nassau, N.Y., under the supervision of the U.S. Geological Survey. Most test holes were drilled on private property adjacent to access roads. The test holes were drilled open hole, with no casing, to facilitate geophysical logging and to reduce cost.

The drilling contractor was provided with general information as to the type and thickness of the material to be expected and the estimated depth to bedrock. A mobile hydraulic rotary drill rig was used for the drilling, and a self-propelled scraper-backhoe was used for mud-pit construction and cleanup. The crew at the rig consisted of a driller, a driller's helper, and the author.

At each test site, two interconnected mud pits were constructed to settle the drill cuttings and to circulate the drilling fluid. Drill-mud additives of bentonite and commercial mixtures were used to improve mud properties to maintain the open, uncased holes. Density and viscosity of the drilling mud were determined with a standard mud balance and a Marsh[1] funnel.

During drilling, conventional rotary samples were collected at 5-foot intervals and at major changes in formation, and a driller's log was compiled from these samples. Samples were washed and bagged for later mineralogical and grain-size study by the New York State Geological Survey.

Geophysical logging was run in each test hole as soon as the drill tools were removed. Spontaneous potential (SP), single-point resistivity, and natural-gamma logs were run with U.S. Geological Survey Widco[1] loggers. The logs were used in interpretation of the lithology and water-bearing potential at each site.

Geophysical logging provides an economical aid in interpreting the properties of the material encountered without requiring a well casing or pumping tests. The SP log shows the natural electric potential of formations and thereby helps differentiate clay formations from more permeable zones, the resistivity log characterizes the water in the formation as to chemical quality and distribution, and the natural-gamma log records the emission of gamma rays from disintegration of radioactive material within rocks. Of the rocks in the area, shale emits the highest radiation, clay gives an intermediate amount, and sand gives the least. Thus, gamma logs provide an effective means of distinguishing formation changes and are useful for correlation purposes.

[1] Use of brand names is for identification only and does not imply endorsement by the U.S. Geological Survey.

The 22 test holes were numbered in the sequence drilled. Site locations, gamma ray logs and composite sample logs by Dineen based on driller's logs, samples and geophysical logs are given in the Appendix; site locations are shown on Plate 1. The gamma logs, which were effective in distinguishing thick sand and gravel units and the bedrock contact, have been evened out in Plate 5 for presentation purposes. Distinctive breaks in gamma logs are probably more accurate than driller's logs in depicting formation changes because they avoid the time lag and the mixing of sample material that are inherent in rotary drilling. Because interpretation of the resistivity and SP logs requires experience and judgment, they are not presented in this volume, but are available for inspection at the U.S Geological Survey office in Albany, N.Y.

The results of the drilling, correlation with previous data, and the interpretation of glacial geology by R.J. Dineen and E.L. Hanson (written commun., 1977) were used to describe the buried-aquifer system and secondary aquifers in the sections that follow.

GROUND-WATER HYDROLOGY

Deep Aquifer

The presence of a complex, deep aquifer system in the bottom of the preglacial valleys was confirmed. In about one-third of the test holes, a significant thickness of sand, gravel, or sand and gravel (with silt or clay) is present. The logs indicate in general that further exploration of the channels for large water supplies is warranted. The water-bearing potential in regard to well yield was not tested because pumping tests were not run. However, test holes 9, 13, and 17 involved additional construction that enabled a measure of their yield capabilities. It is concluded that individual well yields ranging from several hundred to 2,000 gal/min are feasible from properly constructed wells in some areas.

Data for each test are presented in the Appendix. These data in correlation with the respective cross section in Plate 4 indicate the relationship of the formations to overlying deposits. From the cross sections (Pl. 4) and the bedrock-contour map (Pl. 3) , the areal extent of the aquifer system can be extrapolated. Although the aquifer is shown in Plates 1, 2, and 4 to be continuous laterally and along the channel system in much of the area, caution is recommended in extending these units for great distances because of lack of supporting data.

As pointed out by Dineen and Hanson in an earlier section of this report, the deep sand and gravel deposits seem to be correlated with adjacent bodies of deltas, kames, and eskers and are probably the collapsed margins of these ice-contact features or were the bottom-set beds of these deposits in the early stages of glacial retreat. The general presence of clay and silt indicate poor sorting and early deposition in the glacial lake. The presence of well-sorted outwash deposits at other sites was indicated by clean sand and gravel and large grain size such as at test holes 9, 11, and 17 (Pl. 2).

Recharge to the deep aquifer cannot occur naturally through the overlying clay unit; it must therefore infiltrate from adjacent permeable high ground. The surficial kames, eskers, and deltas shown in Plate 1 are logical recharge areas. Plate 4, which shows cross sections through the test-hole sites, depicts how buried sand and gravel units may have continuity or contact with surface deposits.

The confinement of the deep aquifer in some areas by the thick clay or till creates artesian conditions whereby the head, or potentiometric level, of water in the aquifer is higher than land surface in most low areas. Thus, in those areas underlain by the clay and silt squence (Pl. 1), discharge of the aquifer by natural means is upward. The largest area of artesian flow is in the airport vicinity which also contains the largest known water-producing part of the aquifer and the highest potentiometric levels.

At about the 200-ft depth in the airport area, the aquifer is under artesian flowing conditions where land surface is below the 320 ft altitude. Basically, the entire Shakers Creek drainage overlies the artesian-flowing area. In more than 10 years of operation of three Latham Water District wells in the airport area, water levels had declined at least 40 ft (Arnow, 1949, p. 31). Concern over the extent of the decline and over possible aquifer limitations let to searches for other water sources and eventual cessation of pumping these wells during the last decade. Since the cessation of pumping, water levels have recovered, and at present the wells are flowing under natural pressure.

The artesian level, or head, at a static level of about 320 ft indicates that recharge to the aquifer comes from an area of higher altitude such as the adjacent sandy hills to the east, (Pl. 4, Cross Section K). These coarse glacial deposits (eskers or kames) readily transmit water from precipitation through sand or gravel to units beneath the lake clays and silt. Some recharge also may come from the till ridge to the west (Pl. 4, Cross Section K), but the till, having a relatively dense silty-clayey texture, does not transmit water as readily. However, a thin layer of sand and gravel that overlies the till could transmit some water. The aquifer probably discharges principally by upward leakage through the lake deposits and sustains numerous wetlands in the area. Shaker Creek forms an additional drain for the aquifer, and some discharge also may occur upward through permeable zones beneath the Mohawk River flood plain.

Continuity of the "airport" aquifer with that of the Latham Water District well three-fourths of a mile to the south, at the airport, was confirmed in test hole 17 where water flowed uncontrolled at more than 300 gal/min at 4-ft/head in a 20-in. temporary surface casing. To reduce this flow, the Latham well at the airport was pumped at about 500 gal/min, and, in about 2 hours, flow began to decrease in test hole 17 and was reduced to about 200 gal/min in less than a day. Although some of the reduction undoubtedly was related to caving of the test hole, pumping of the Latham well is believed to be the main cause of reduced flow. The airport well also is in hydraulic connection with other Latham wells one-half mile farther south, as indicated by reduced flow in these wells during the incident described above.

Another area of significant well yield and artesian conditions is in Clifton Park near test hole 4 (Pl. 1). Two well fields about a mile apart in the Van Patten Homes, Inc. development have well yields of several hundred gal/min (Dick Ferraioli, Inc., Well Contractor, oral commun., April 1976). Test hole 4 was drilled to provide an observation well in this area of significant ground-water withdrawal. However, the hole was evidently too far east to tap the significant part of the channel. The hydraulic connection between these two well fields subsequently has been confirmed by recent pumping tests (D.T. Clark, Dunn Geoscience, oral Commun., April 1978).

The Town of Guilderland wells on Rt. 155, about half a mile north-northwest of test hole 13 (Pl. 1), also tap the deeper sand and gravel of the Mohawk Channel system. Test hole 13 was cased and left as an observation well to determine long-term effects of pumping in this part of the channel system. The record of water levels to date is shown in Figure 9 along with the 1976–78 hydrograph for a shallow well (Alb-636) tapping the surficial lake-sand aquifer at Albany. The hydrograph shows major fluctuations in the early record and an overall decline due to the 1977–1981 drought. The first year's record may reflect the effects of pumping in the Guilderland well field. The subsequent record seems to have settled down. The hydrograph for Alb-636 shows the normal response of the shallow water table to be seasonal recharge and discharge in a nonpumping area.

Shallow Aquifer

The shallow aquifer system is defined herein as the water-table aquifer(s) in the glacial deposits of lake sand, delta sand and gravel, outwash, and ice-contact sand and gravel at the surface, and in postglacial deposits of aeolian sand and the alluvial sand and gravel of the modern Mohawk River. Some of the surficial glacial deposits extend into or beneath the lake silt and clay (see section "Glacial Geology" by Dineen and Hanson). The above units form an areawide shallow aquifer system that provides a few to several hundred gallons per minute of water to domestic, industrial, and small public supply wells. They are described herein to indicate their relation to the deep aquifer system of the buried-valley system. Arnow (1949) reported on these units and their water-bearing capabilities.

The cross sections of Plate 4 illustrate the hydrologic relationship of the shallow and deep aquifer systems. Recharge of the surficial permeable deposits is from precipitation (see hydrograph Alb-636, Fig 9). Ground water moves laterally out of these deposits as streamflow in local streams such as Shakers Creek, Dwaar Kill, Stony Creek, Patroon Creek, Hunger Kill, and Davers Kill. Ground water also recharges the deep aquifers and intermediate zones through interrelated permeable zones such as shown, for example, in Sections G, H, K, and L, on Plate 4. The relatively small pumpage from the deeper aquifers, as discussed earlier, are not known outside the artesian-flow areas such as Shakers Creek. The shallow aquifers are a source of recharge to the deeper aquifers in some areas where the shallow aquifer head is higher than that of the deep aquifer. Thus, contamination of the shallow aquifer or a reduction in recharge to it will affect the deeper aquifer.

The alluvial sand and gravel of the Mohawk River floodplain are perhaps the most available, readily found, and least expensive for drilling of the potential aquifers in the area. Logs of test hole 8 (Appendix) and Cross Section J, Plate 4 show the probable geologic conditions in much of the floodplain. More than 20 ft of clean, water-bearing gravel near the surface, having direct hydraulic contact with surface-water bodies, was found. Large diameter wells protected from flood inundation could easily supply a few thousand gallons per minute from each installation. Quality of water from such wells, in terms of both chemical content and turbidity, will be a key consideration because the water would be induced directly from the Mohawk River. The Latham Water District constructed four such wells in 1965, more than a mile downstream from test hole 13, to depths less than 43 ft and with a combined yield of 5 Mgal/d (Malcolm-Pirnie, 1968, p. 27).

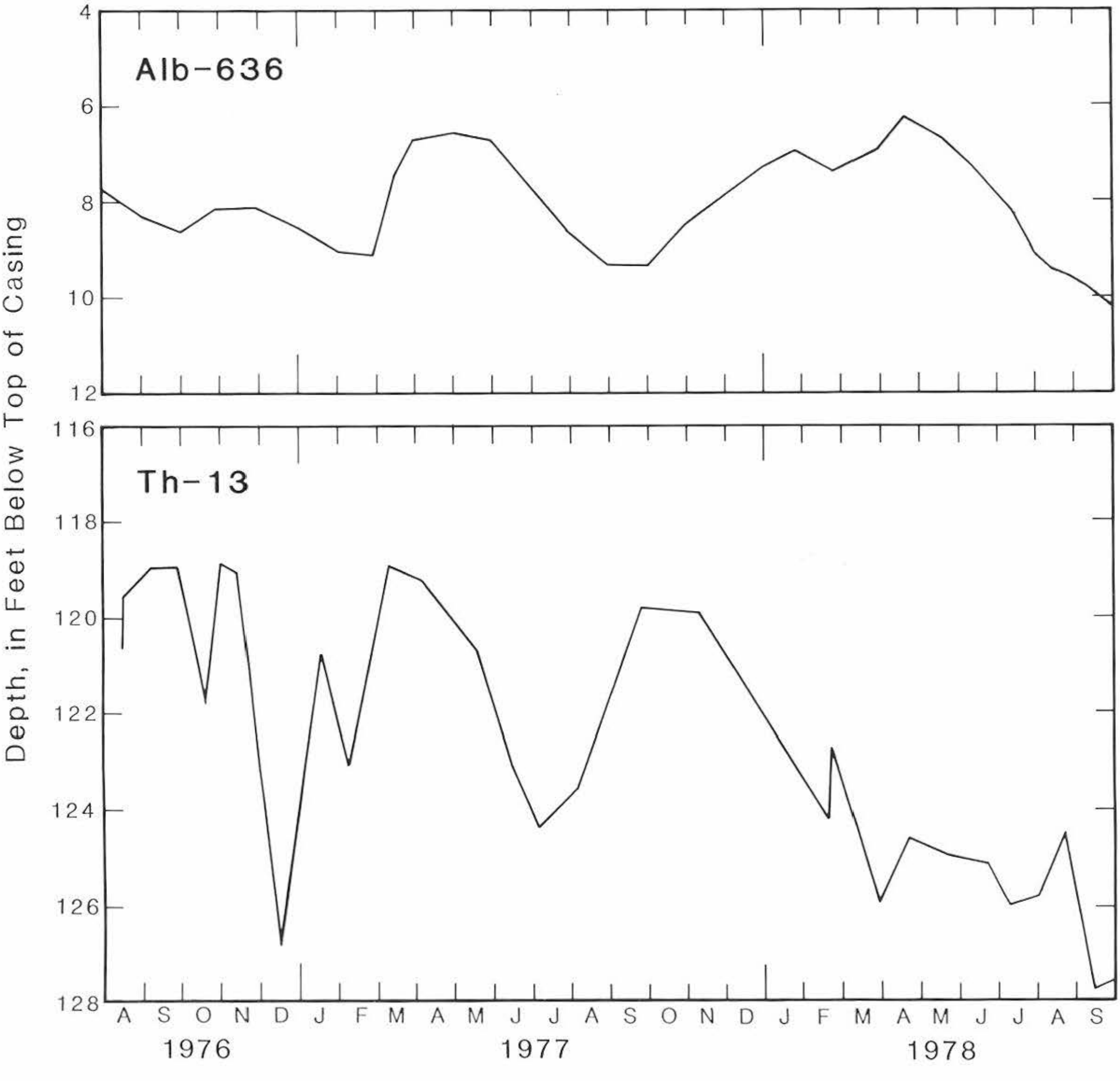

FIGURE 9. Hydrographs of well Alb-636 and Test Hole 13, 1976-1978.

CONCLUSIONS

Test drilling located additional deep sand and gravel aquifers, helped determine their areal continuity in some areas, and provided data on probable areas of recharge. Proper location of drilling sites is critical because the lateral extent of the aquifer is undefined in many areas. Test drilling or refined seismic profiling could help delineate the cross-sectional area to define areas of greatest aquifer potential. Method of well development is critical. Because the aquifer contains much silt and clay, proper screen selection and careful development procedures are essential to obtain maximum quantities of sediment-free water. Because the aquifer systems are in hydraulic continuity in a rather narrow system, the well spacing must be adequate to prevent excessive drawdown interference between pumping wells. If further development is undertaken, pumping tests with water-level observations in nearby wells will be needed to evaluate the hydraulic characteristics of the aquifer.

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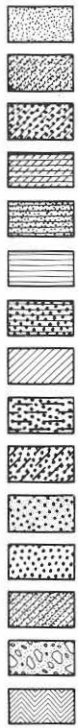
EXPLANATION

Colonie Channel Bore Holes

Robert J. Dineen

New York State Museum
Geological Survey, Map and Chart Number 37



Very fine to medium sand

Silty, very fine to fine sand

Gravelly, silty fine sand

Clayey silt

Clayey sand to sandy clay

Silty clay to clay

Gravelly clay

Coarse to fine silt

Very silty cobbles to boulders

Silty, gravelly sand

Sand and gravel

Gravel

Silty, very fine sand, with organic matter

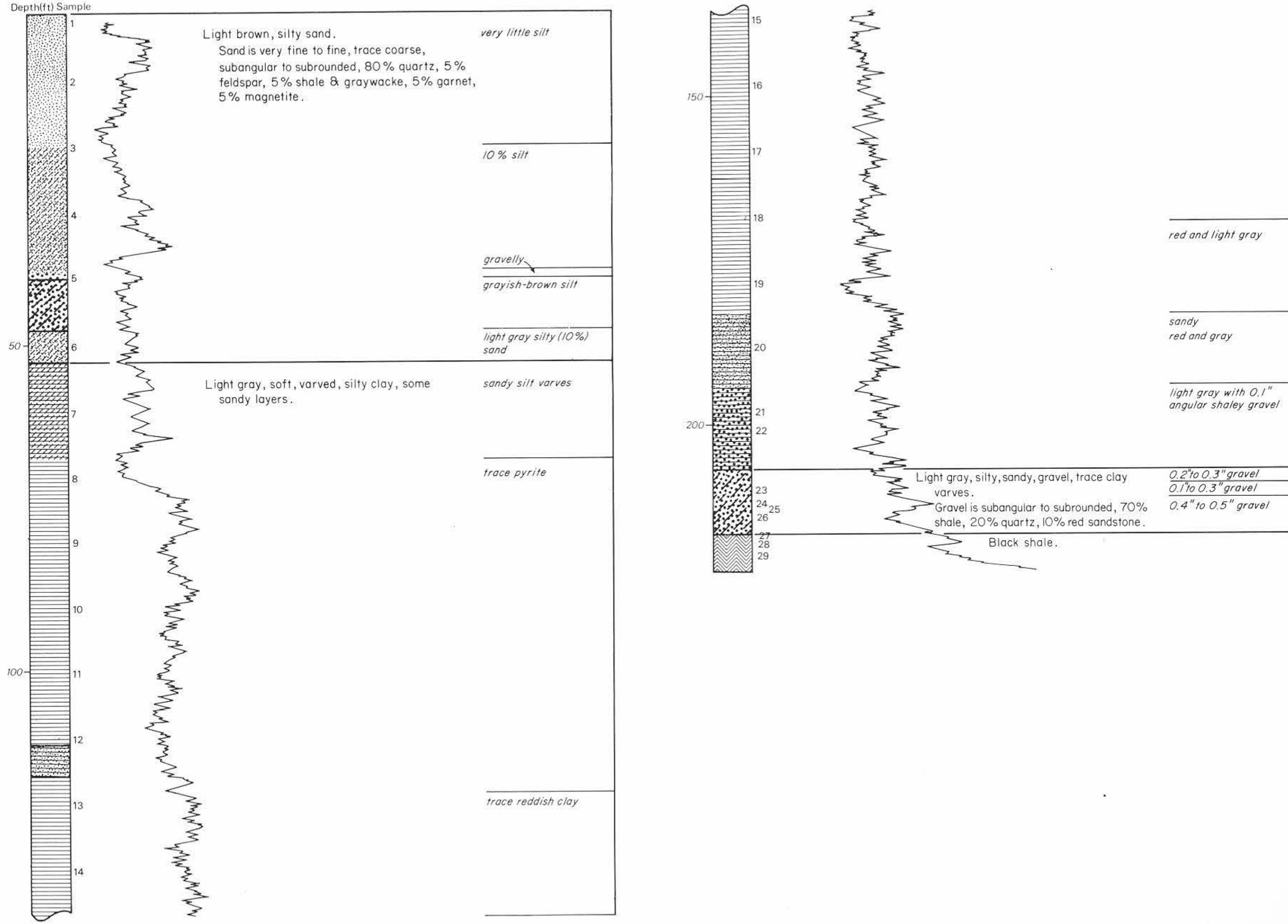
Bouldery, sandy, clayey gravel

Bedrock

COLONIE CHANNEL BORE HOLE 1

Niskayuna Quad — Englemore & Moe Roads

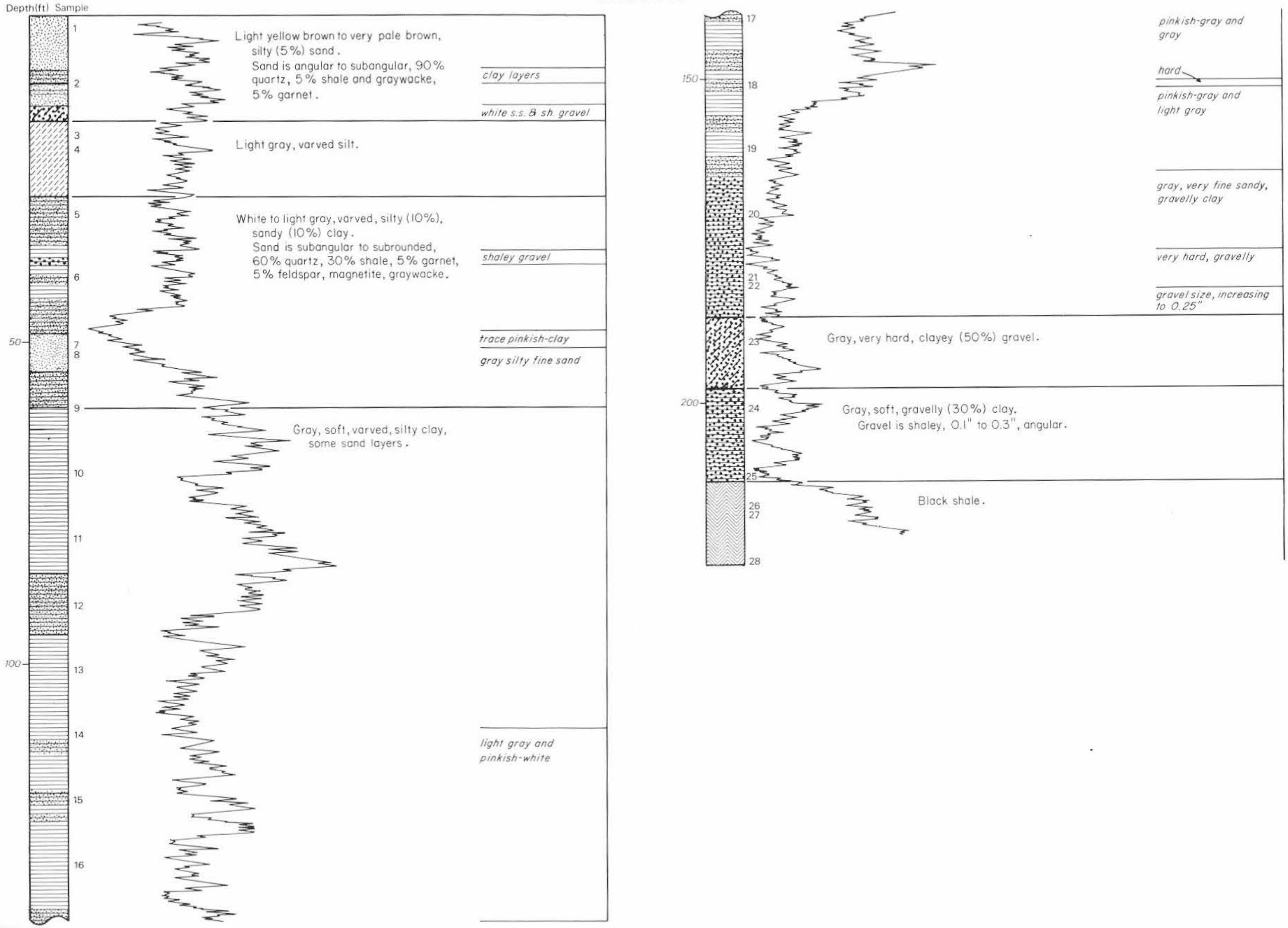
Section F-F′ Drilled 6·9·76



COLONIE CHANNEL BORE HOLE 2

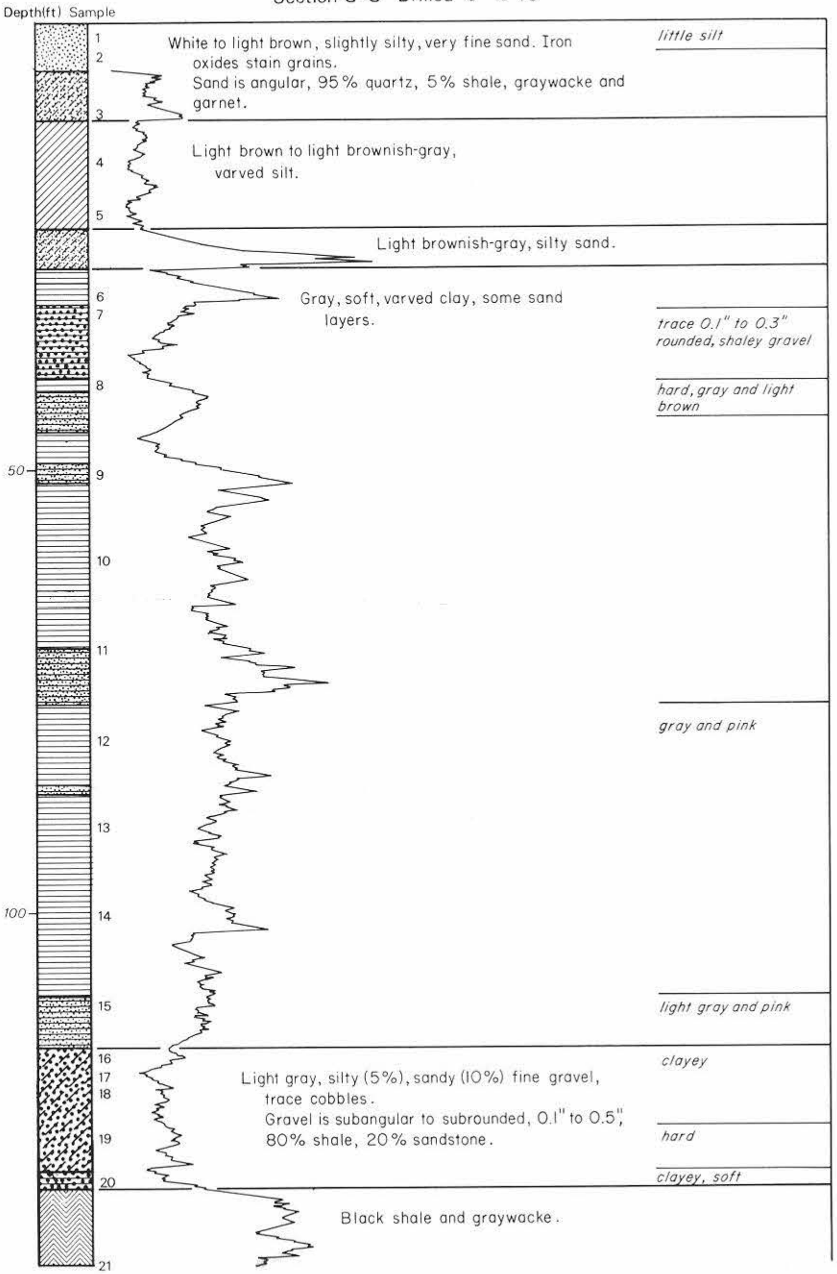
Niskayuna Quad — Bonneau Road

Drilled 6·11·76



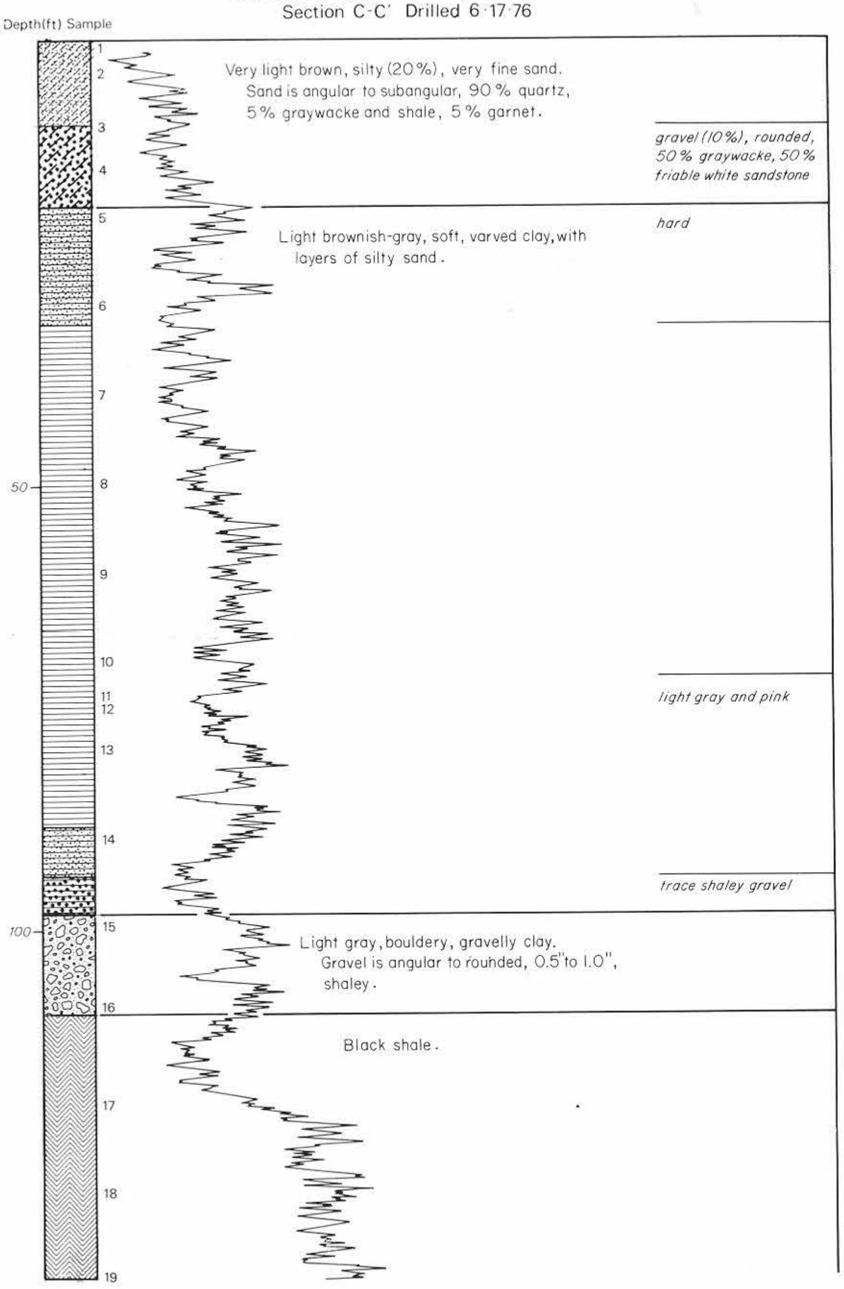
COLONIE CHANNEL BORE HOLE 3

Niskayuna Quad — Bonneau Road
Section G-G′ Drilled 6·15·76



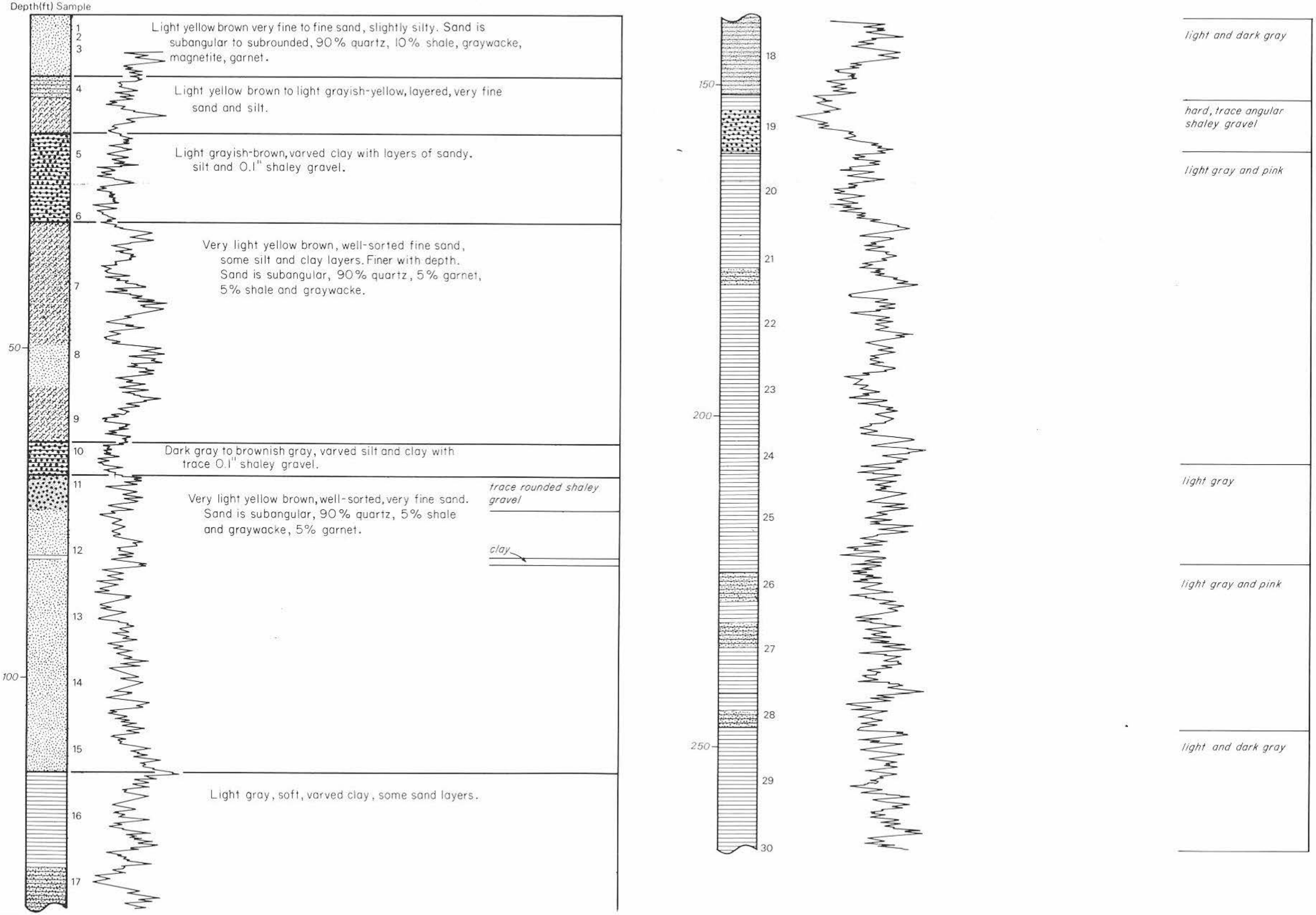
COLONIE CHANNEL BORE HOLE 4

Round Lake Quad — Country Knolls South
Section C-C′ Drilled 6·17·76



COLONIE CHANNEL BORE HOLE 5

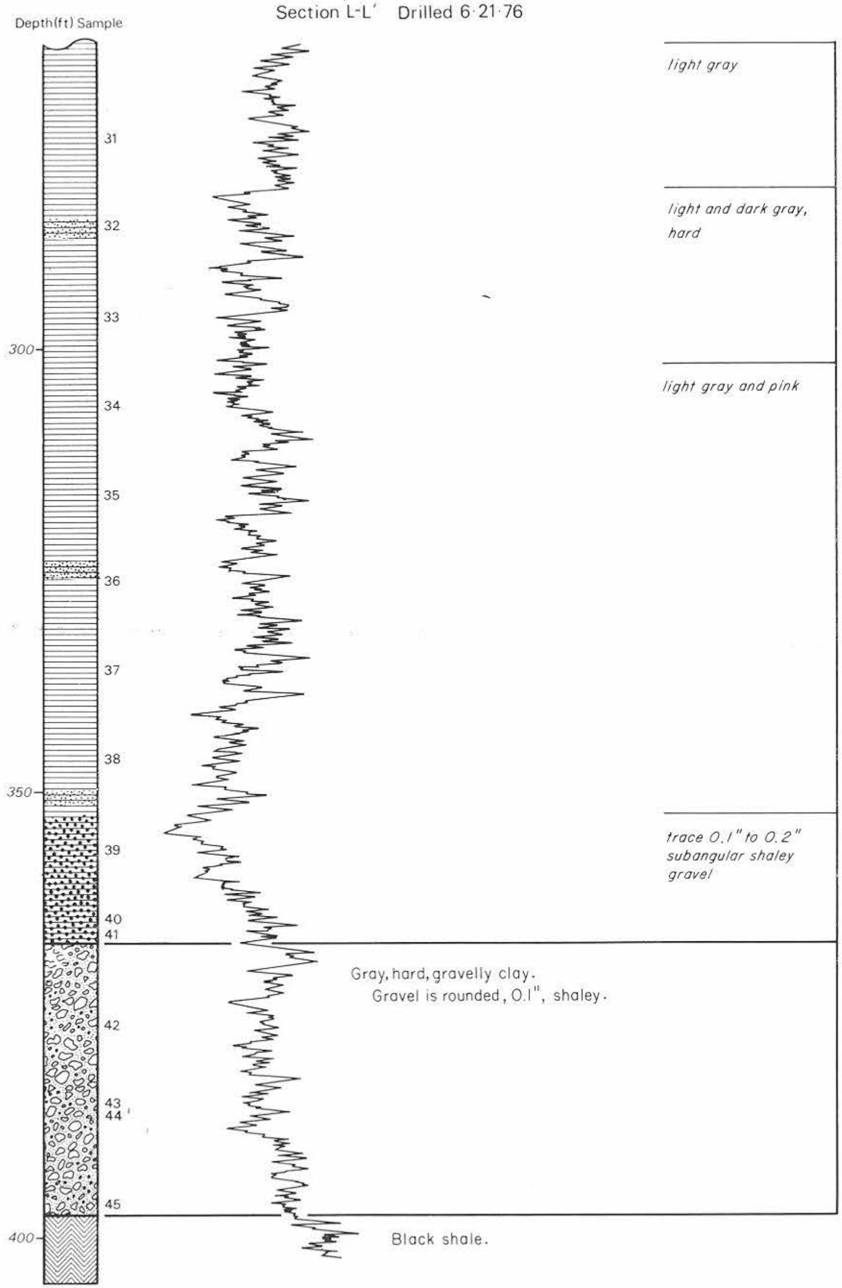
Albany Quad- Wolf Road
Section L-L' Drilled 6-21-76



COLONIE CHANNEL BORE HOLE 5

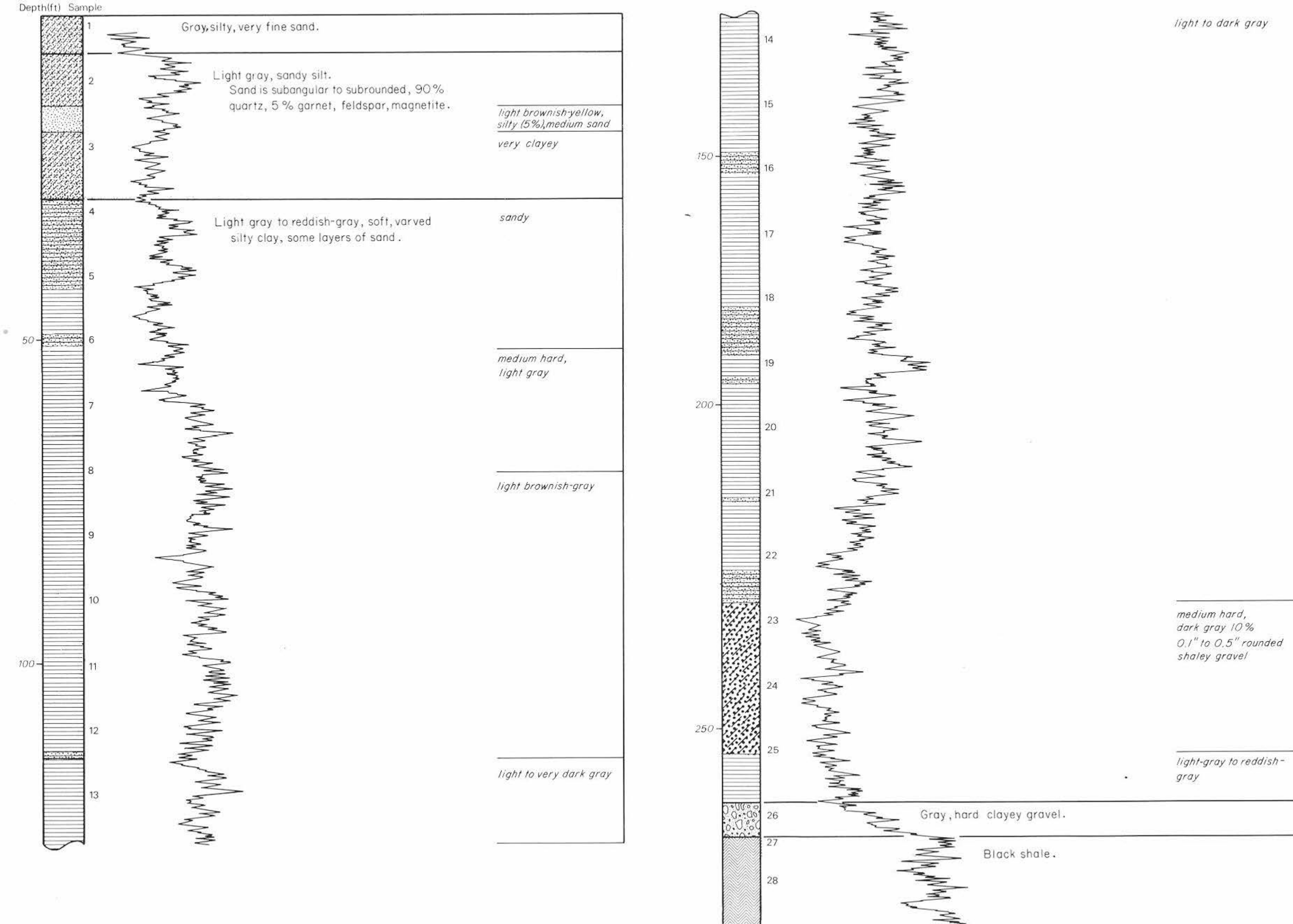
Albany Quad—Wolf Road

Section L-L′ Drilled 6·21·76



COLONIE CHANNEL BORE HOLE 6

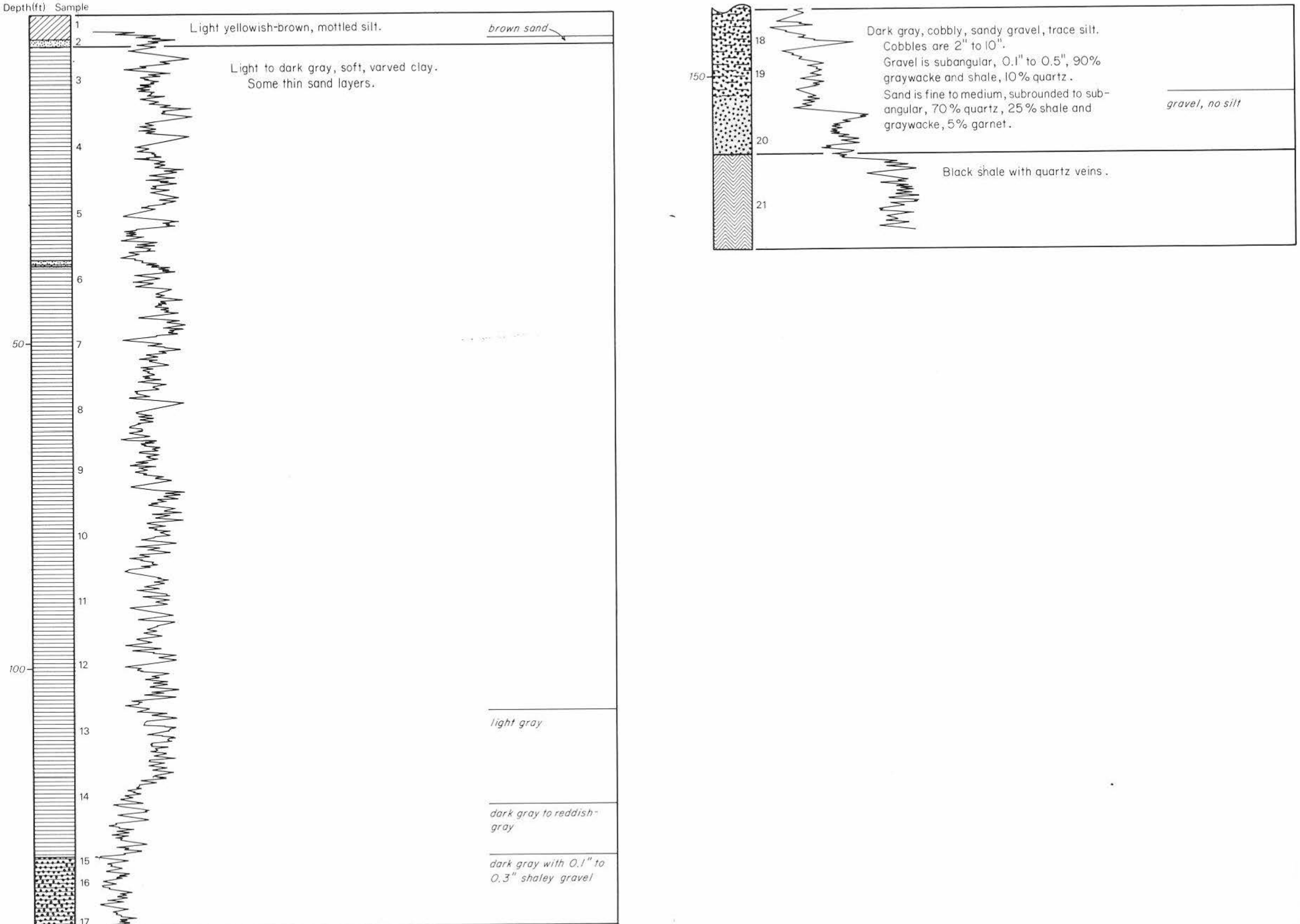
Albany Quad — Tobins
Section M-M′ Drilled 6-24-76



COLONIE CHANNEL BORE HOLE 7

Albany Quad — McCormack Road

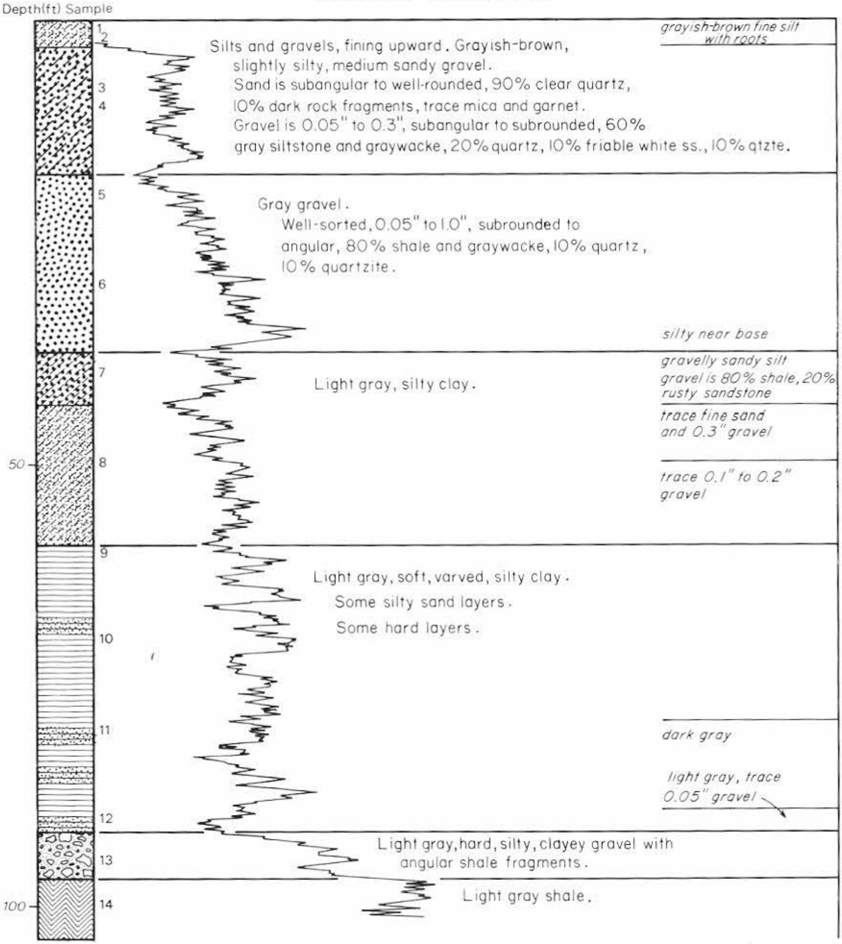
Section N-N′ Drilled 6·28·76



COLONIE CHANNEL BORE HOLE 8

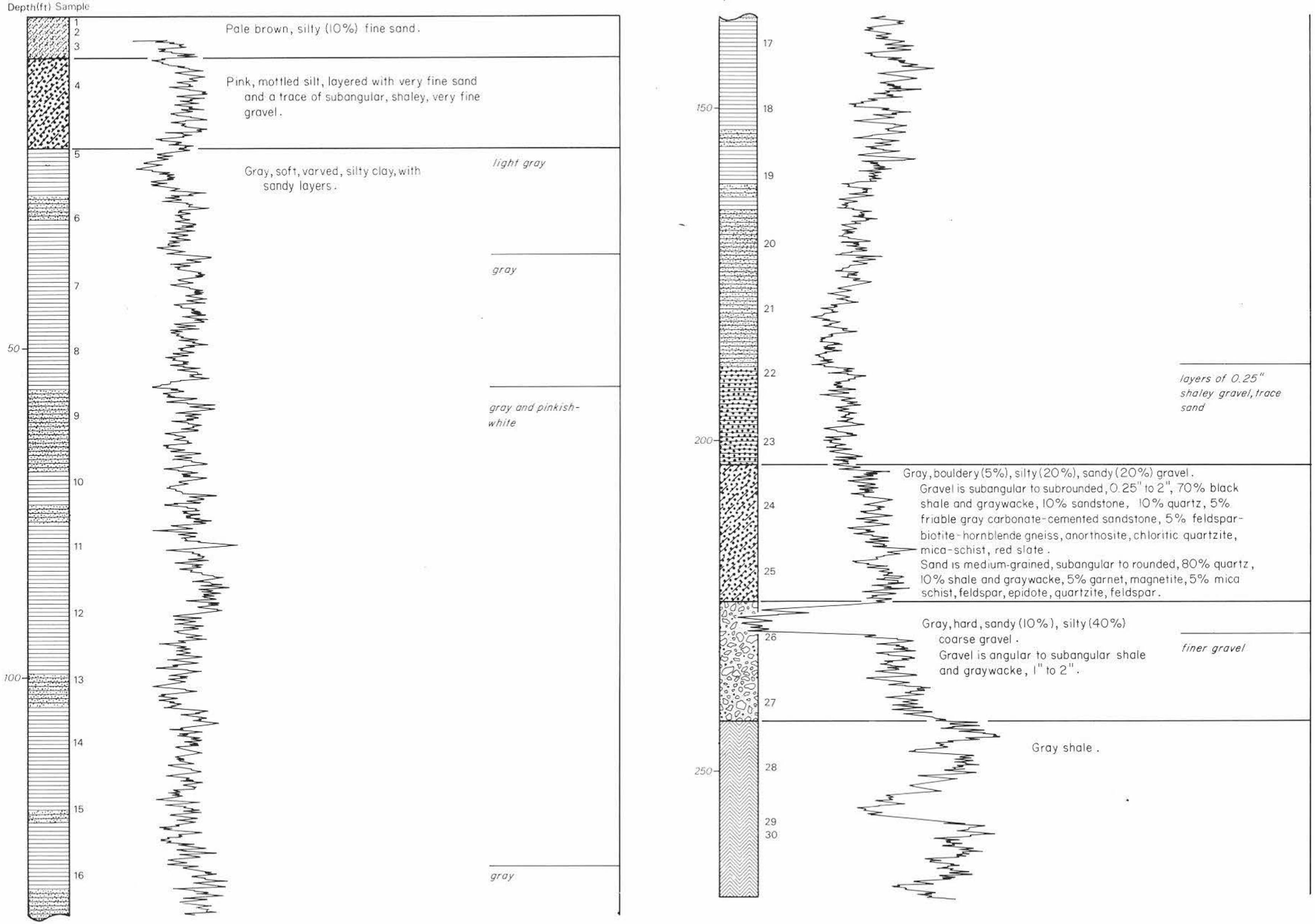
Niskayuna Quad — Mohawk River Flood Plain

Section J-J' Drilled 7·1·76



COLONIE CHANNEL BORE HOLE 9

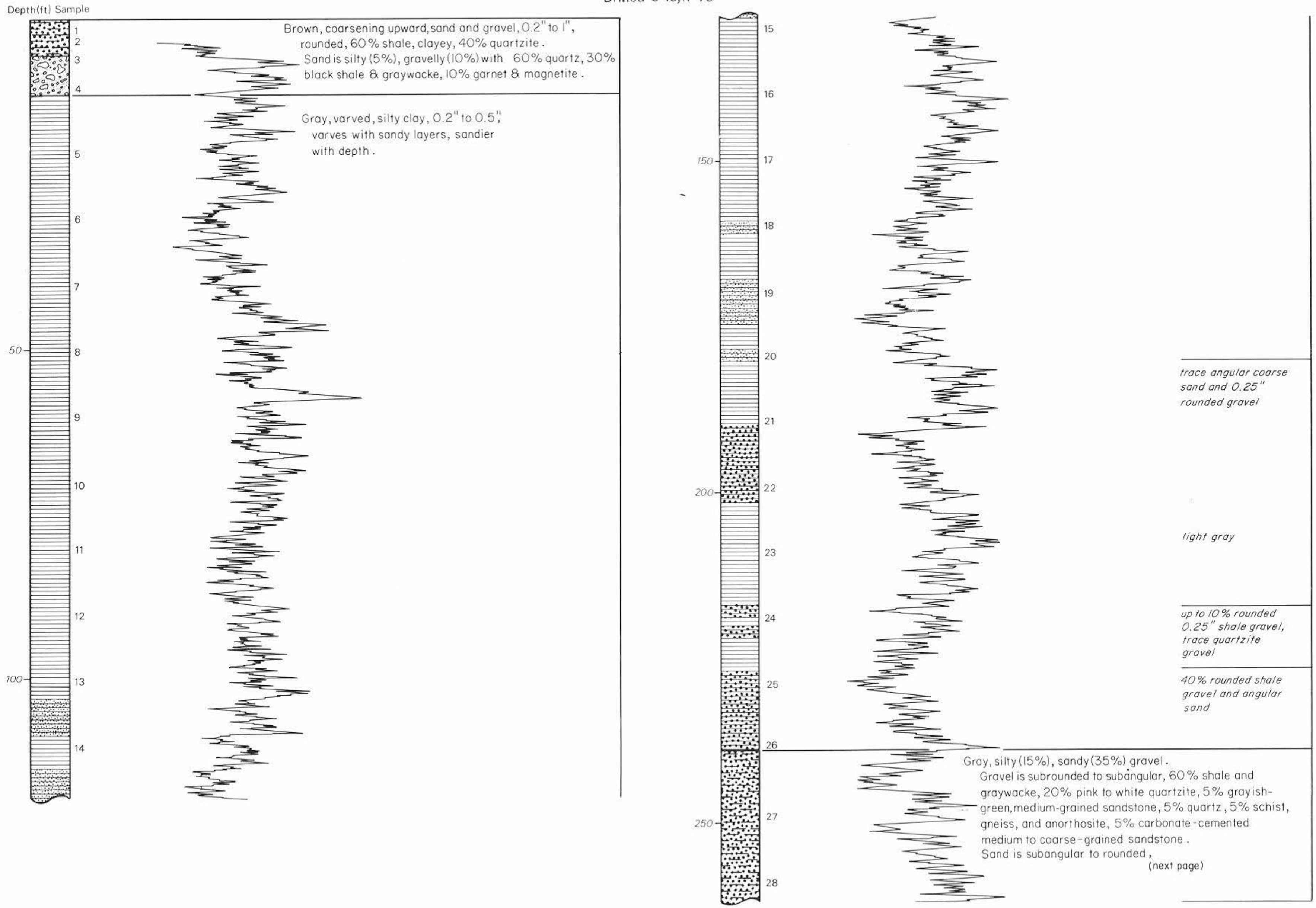
Delmar Quad – Houck's Corners
Section O-O′ Drilled 8-11,12-76



COLONIE CHANNEL BORE HOLE 10

Delmar Quad — South Bethlehem

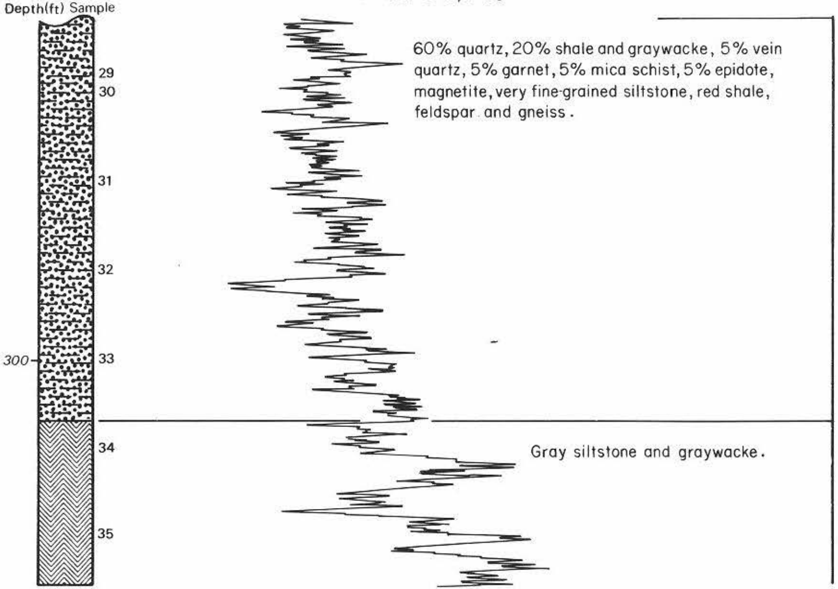
Drilled 8·16,17·76



COLONIE CHANNEL BORE HOLE 10

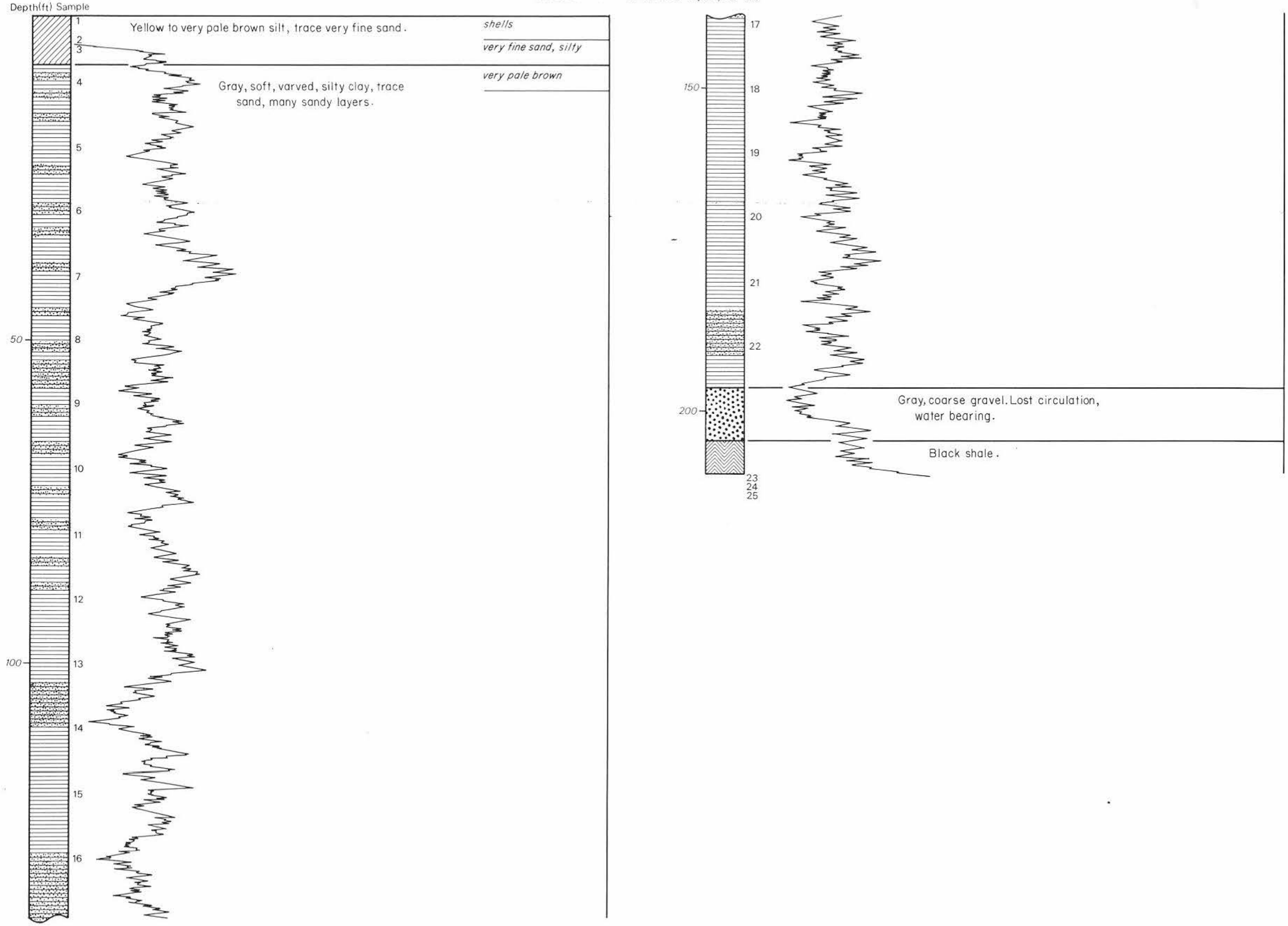
Delmar Quad South Bethlehem

Drilled 8·16,17·76



COLONIE CHANNEL BORE HOLE 11

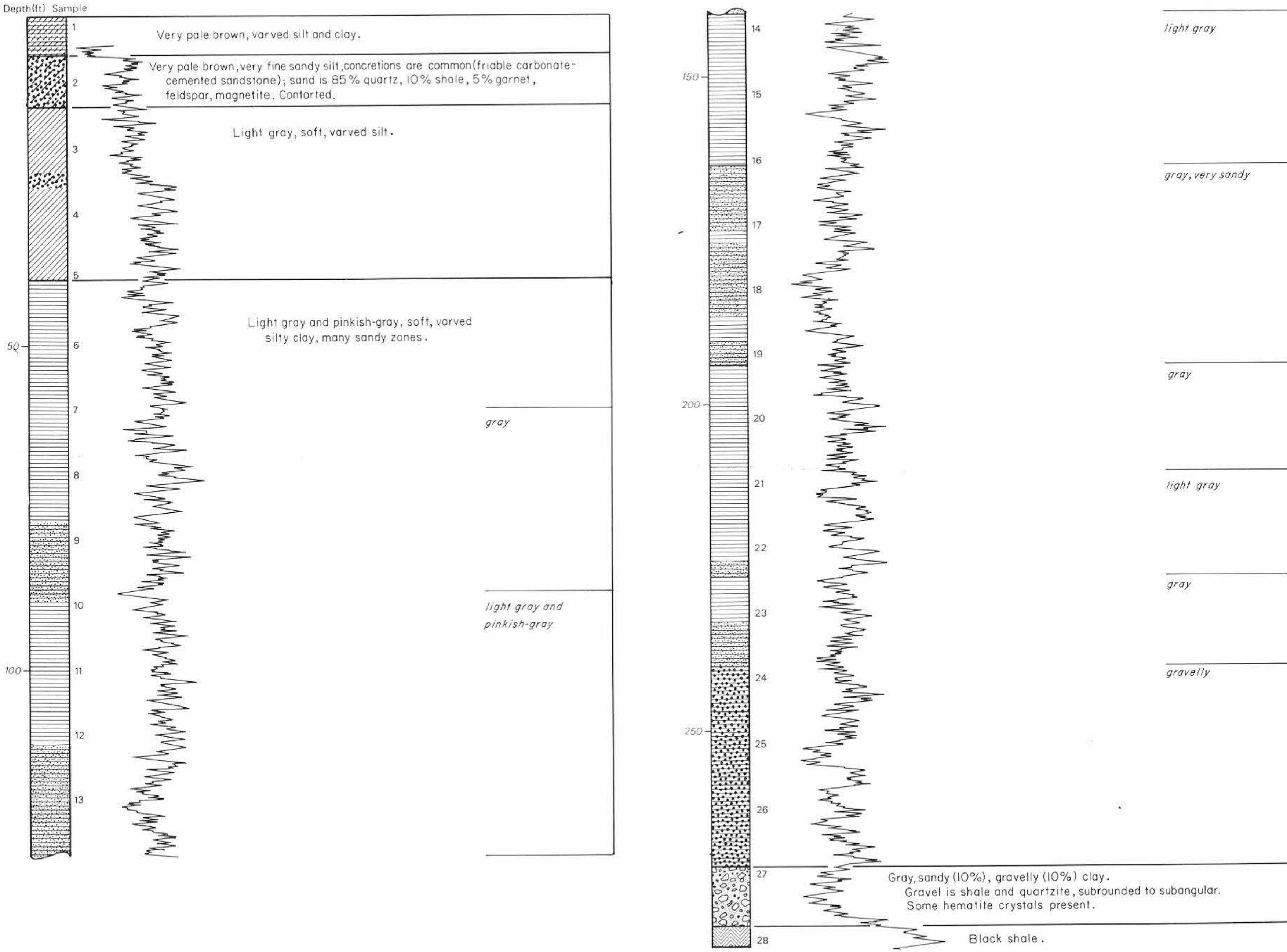
Delmar Quad—Elmwood Cemetery
Section P-P′ Drilled 8-19, 20, 23-76



COLONIE CHANNEL BORE HOLE 12

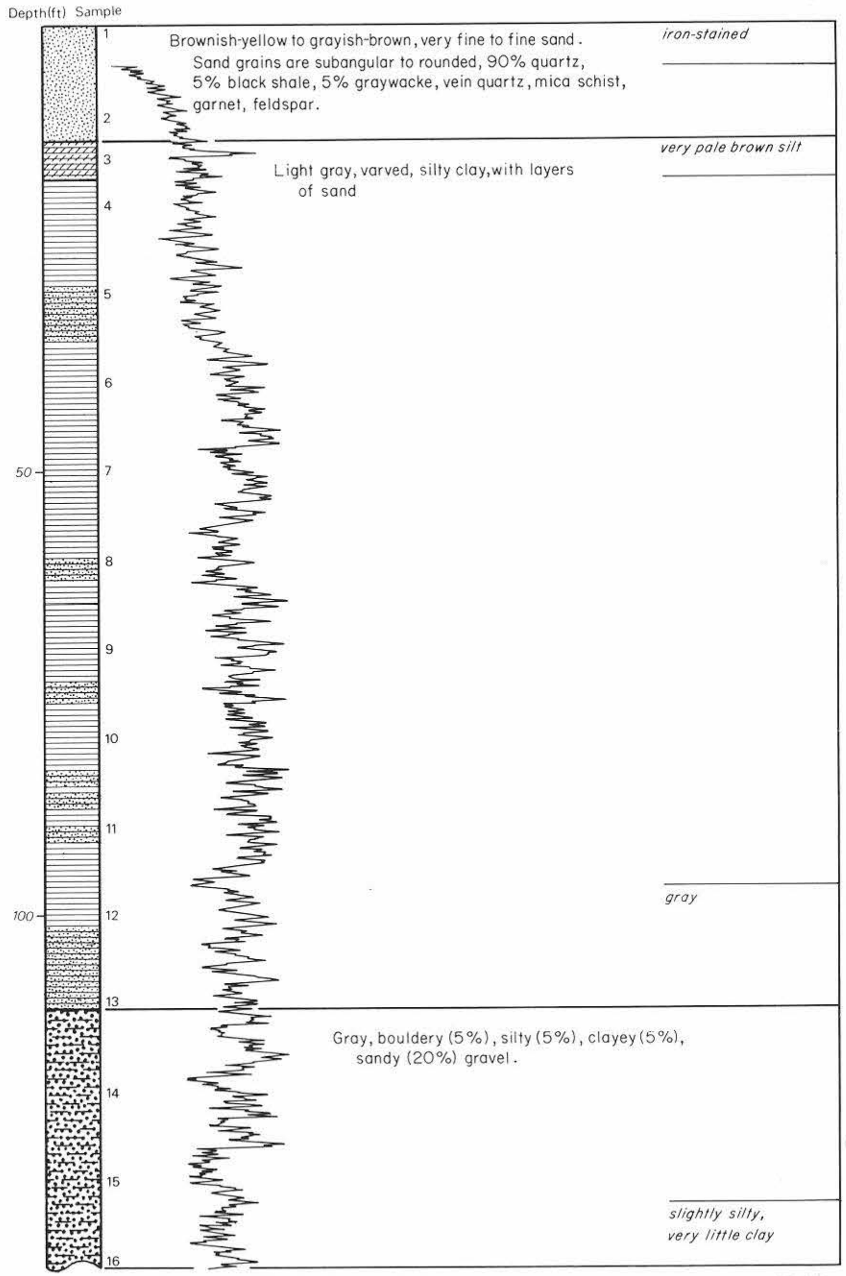
Albany Quad — Delmar

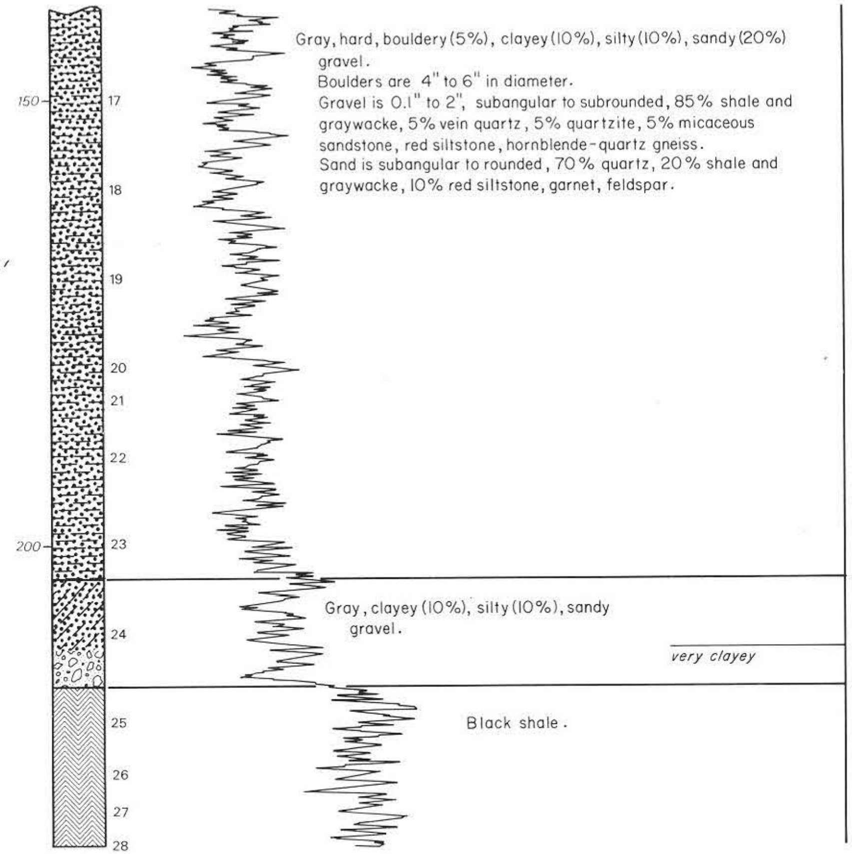
Drilled 8-25-76



COLONIE CHANNEL BORE HOLE 13

Voorheesville Quad — Dr. Shaw Road
Drilled 8·27, 28·76





Notes: Screened and pump-tested

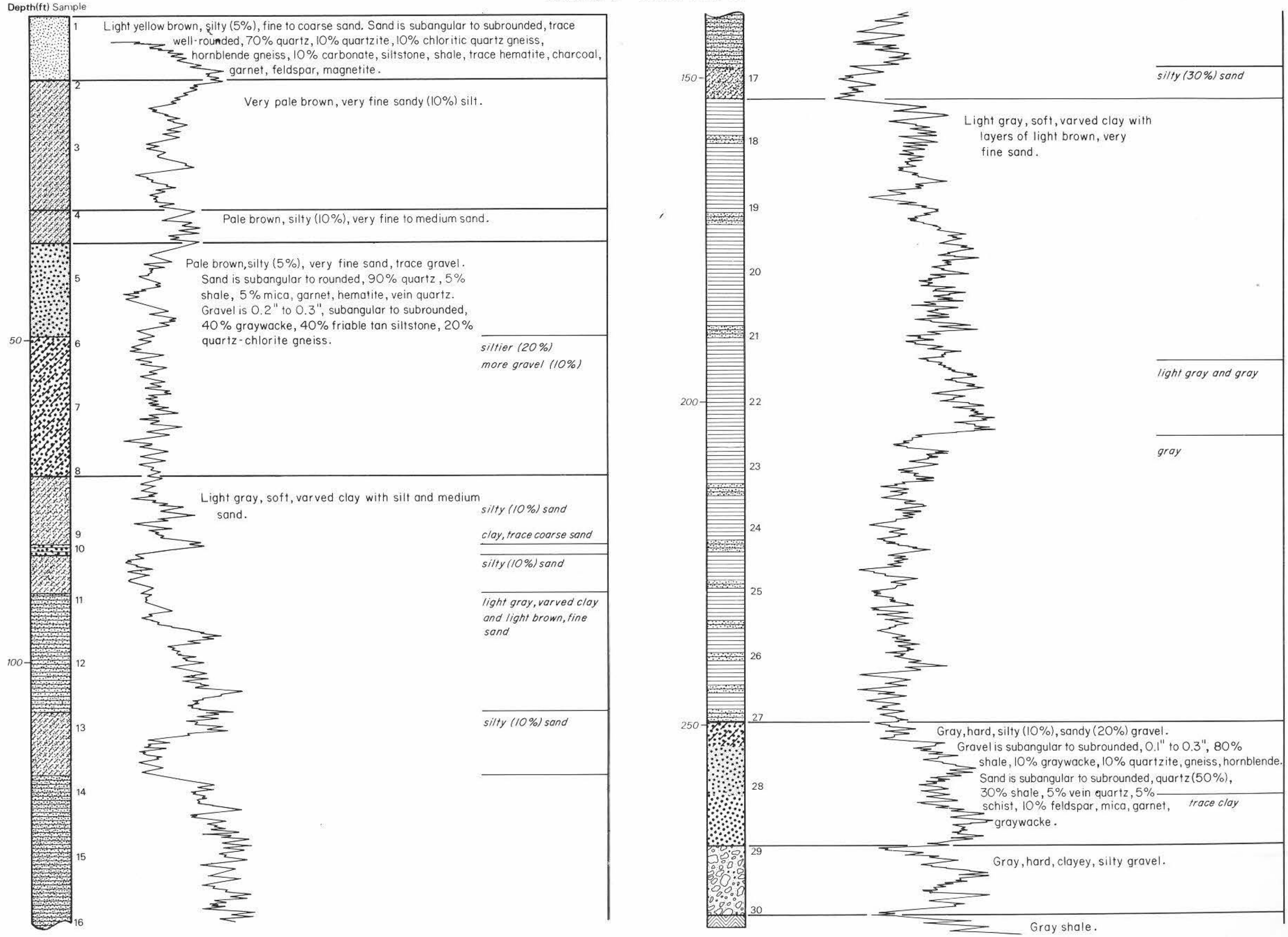
Depth	Pump test
124 ft.	2 gpm
139 ft.	15 gpm
148 ft.	17 gpm
169 ft.	25 gpm
184 ft.	35 gpm

Screen was plastic 0.03", slotted, and set 193-198 feet.
Well was developed for 4 hours and pumped with air lift.
Static level was approximately 118 feet.

COLONIE CHANNEL BORE HOLE 14

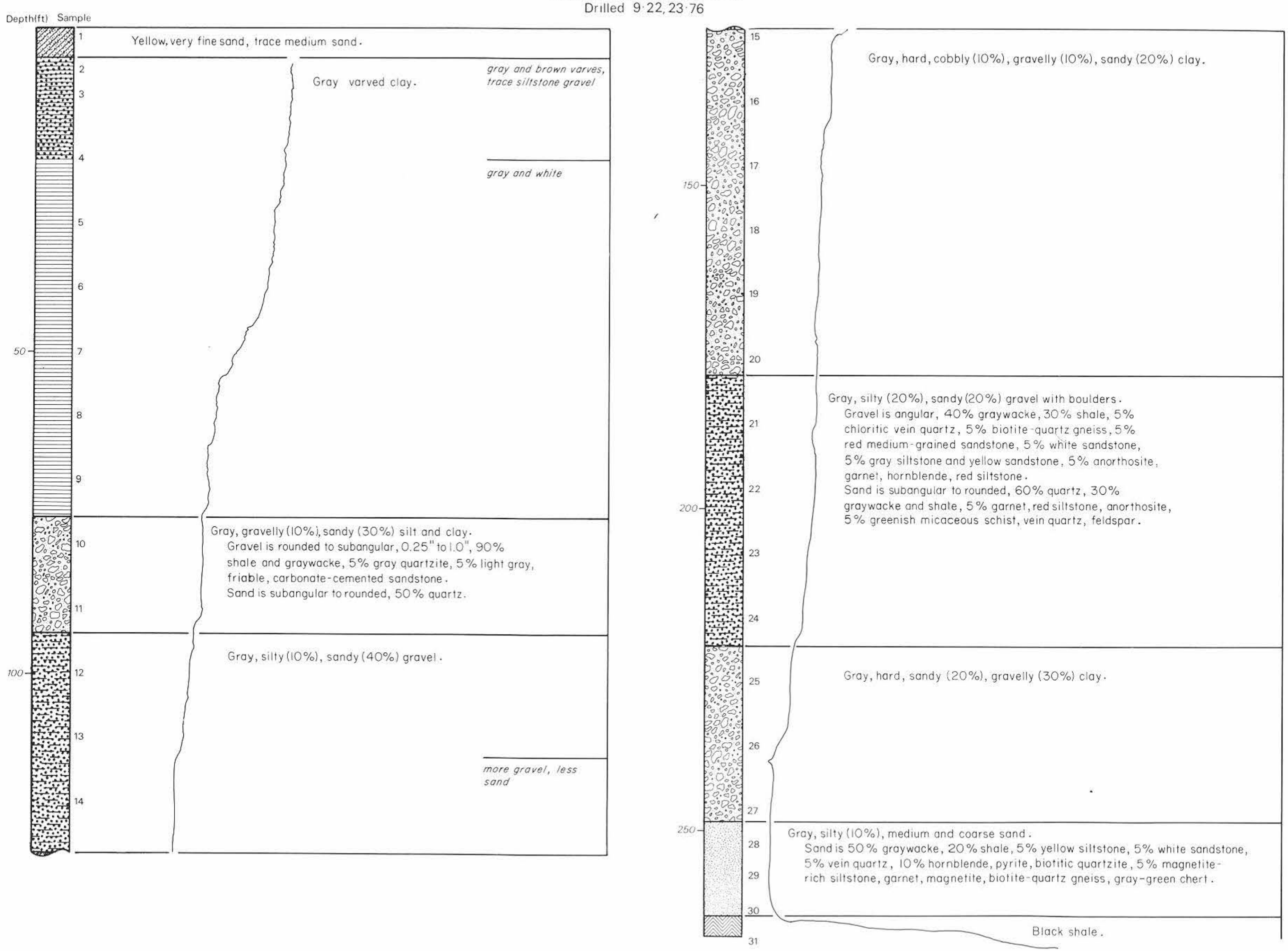
Round Lake Quad — Malta Test Site

Section A-A' Drilled 9·2,3·76



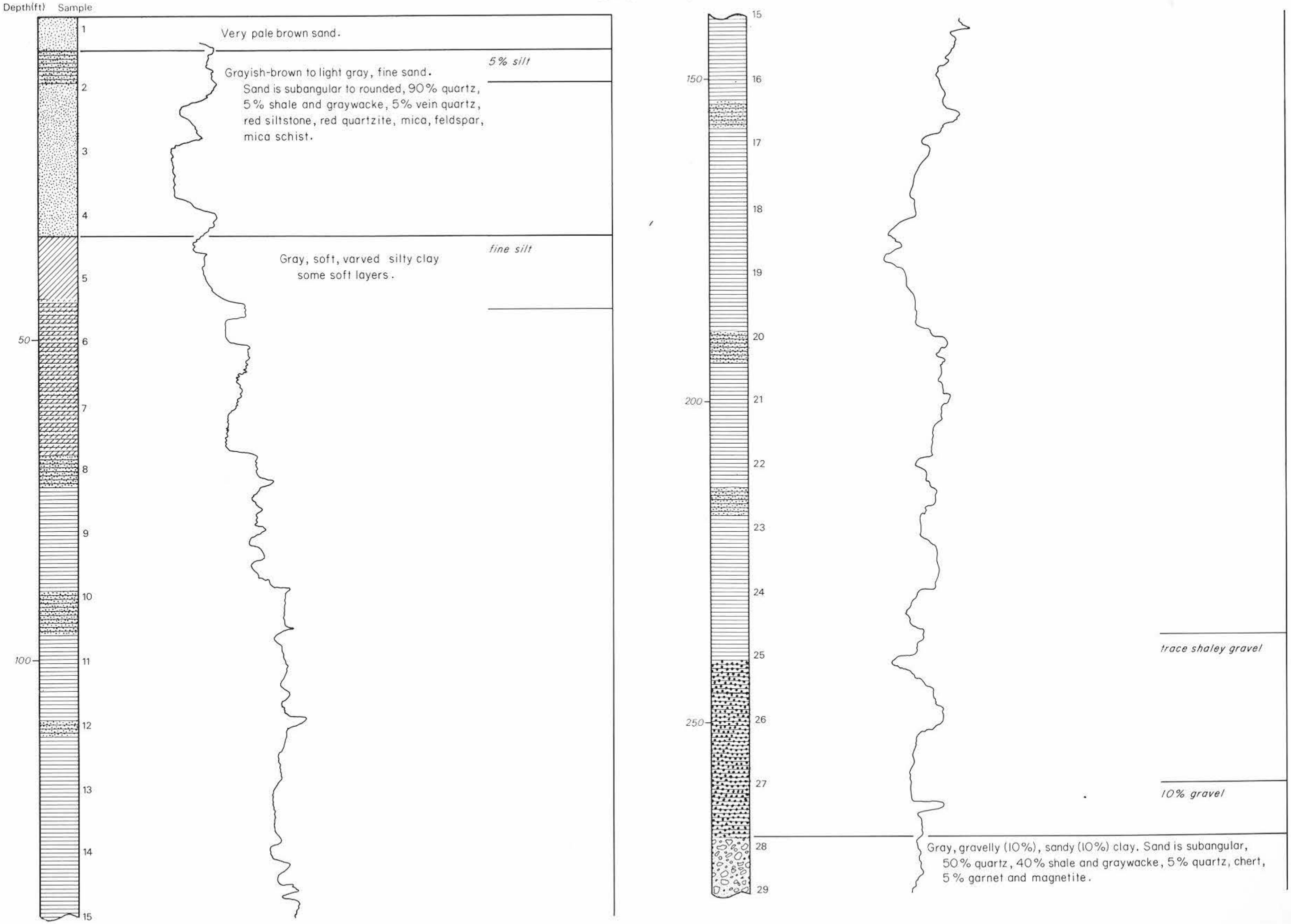
COLONIE CHANNEL BORE HOLE 15

Voorheesville Quad — Route 20
Drilled 9·22, 23·76



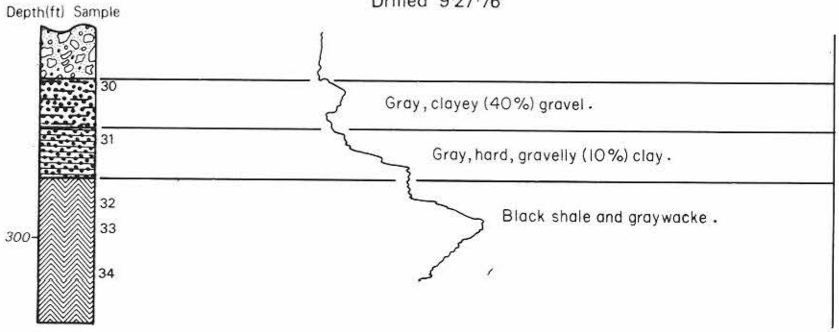
COLONIE CHANNEL BORE HOLE 16

Voorheesville Quad — Spawn Road
Drilled 9·27·76



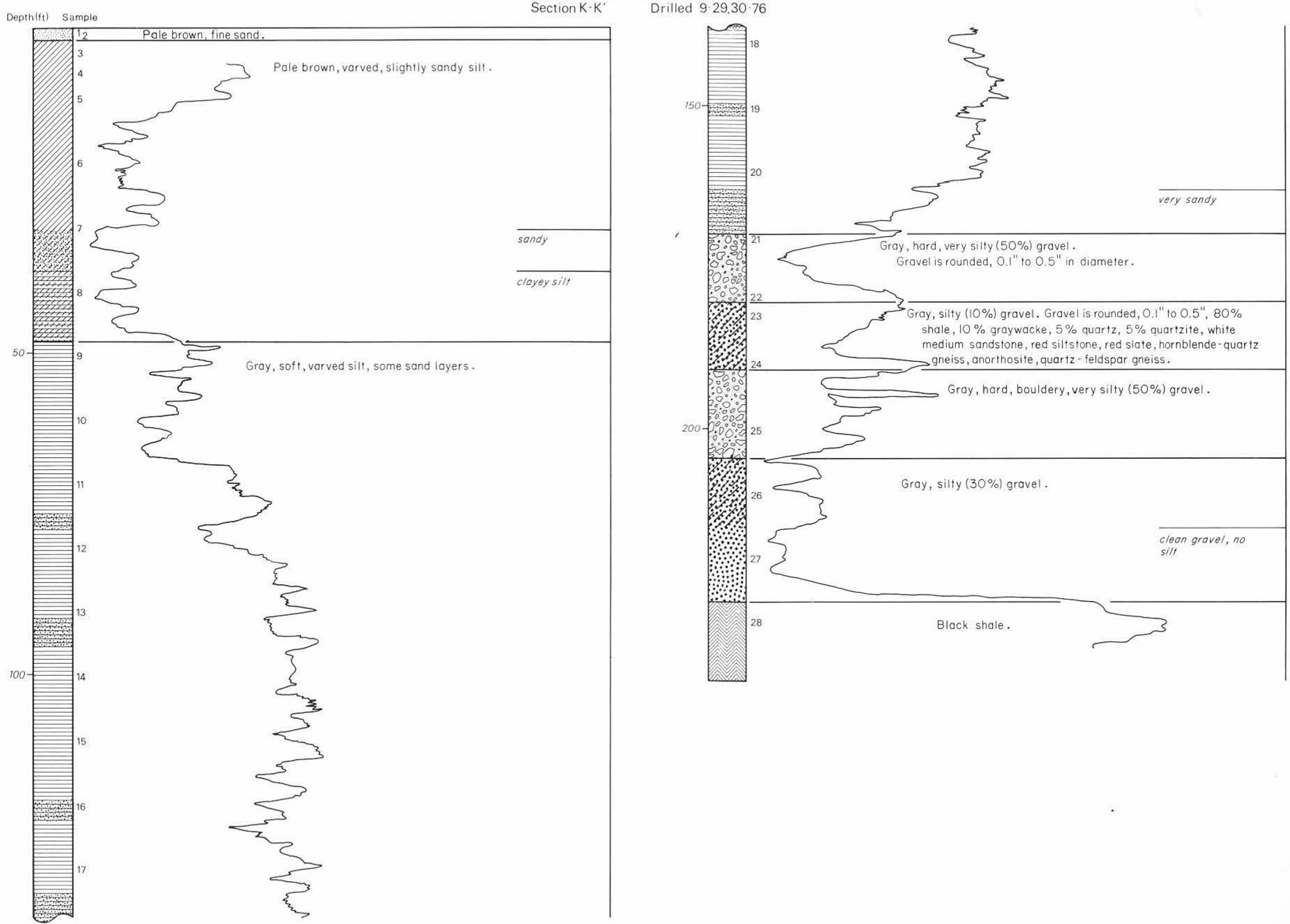
COLONIE CHANNEL BORE HOLE 16

Voorheesville Quad — Spawn Road
Drilled 9·27·76



COLONIE CHANNEL BORE HOLE 17

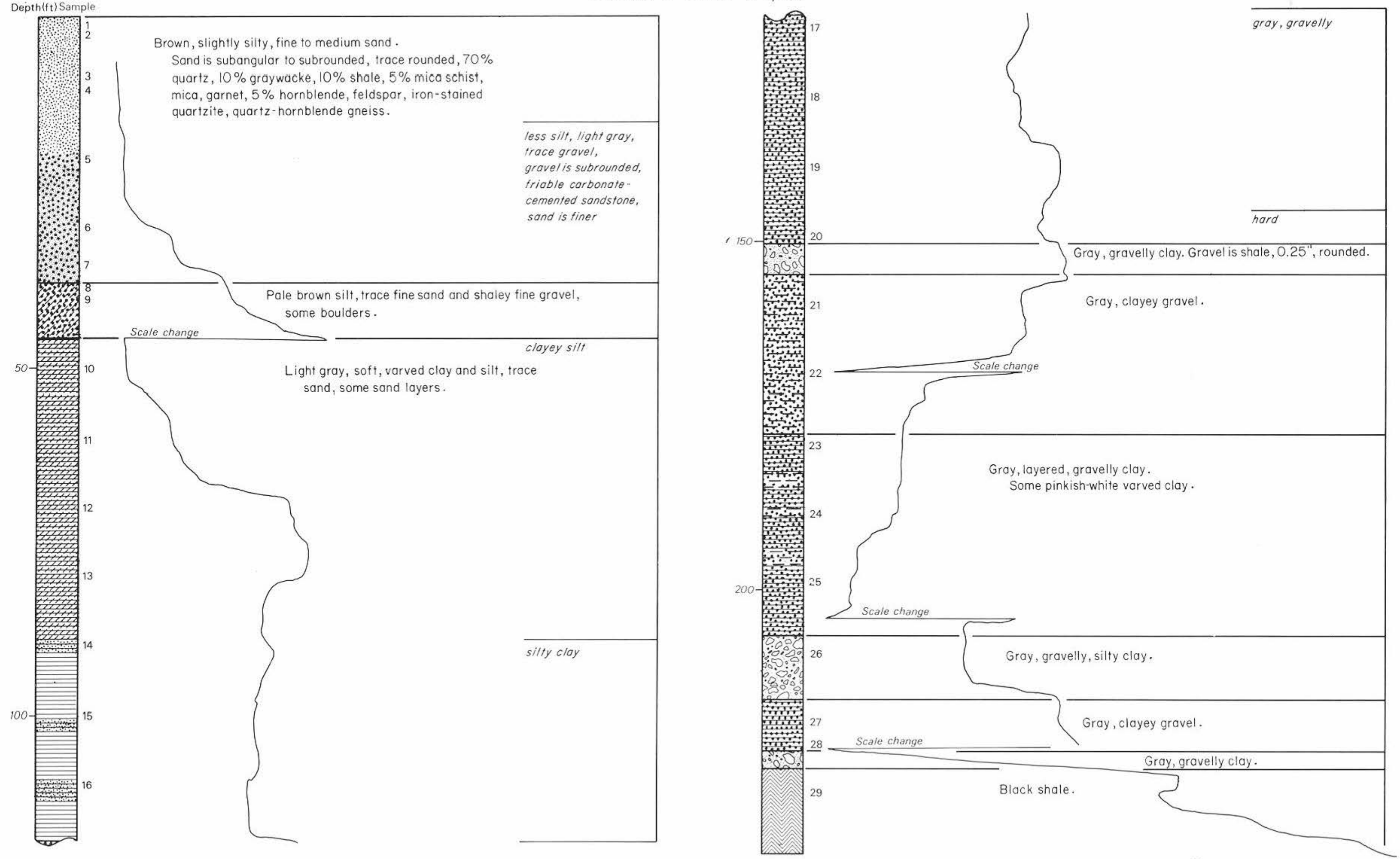
Niskayuna Quad — Old Niskayuna Road
Section K-K' Drilled 9-29,30-76



COLONIE CHANNEL BORE HOLE 18

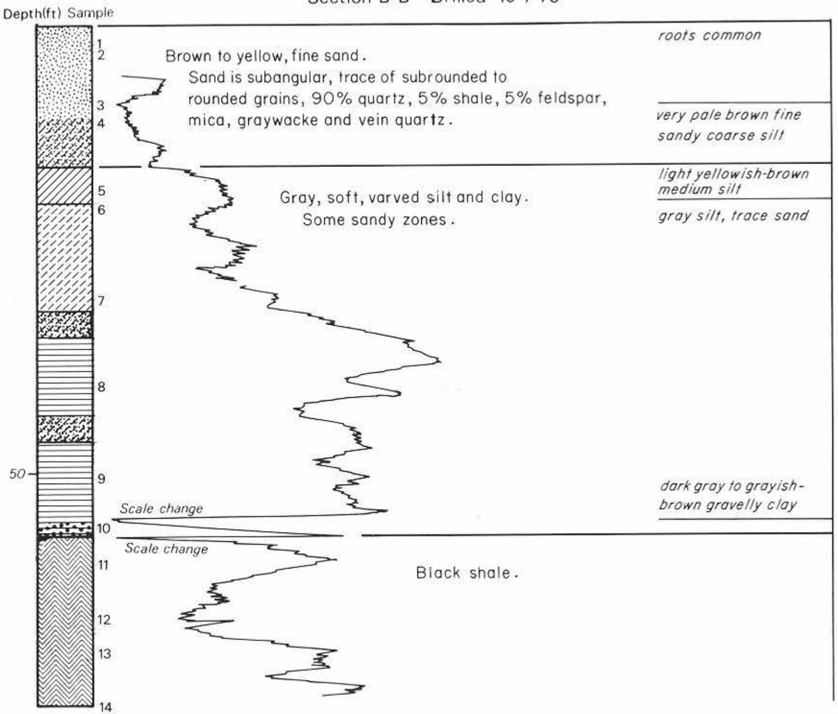
Niskayuna Quad

Section D-D′ Drilled 10·4,5·76



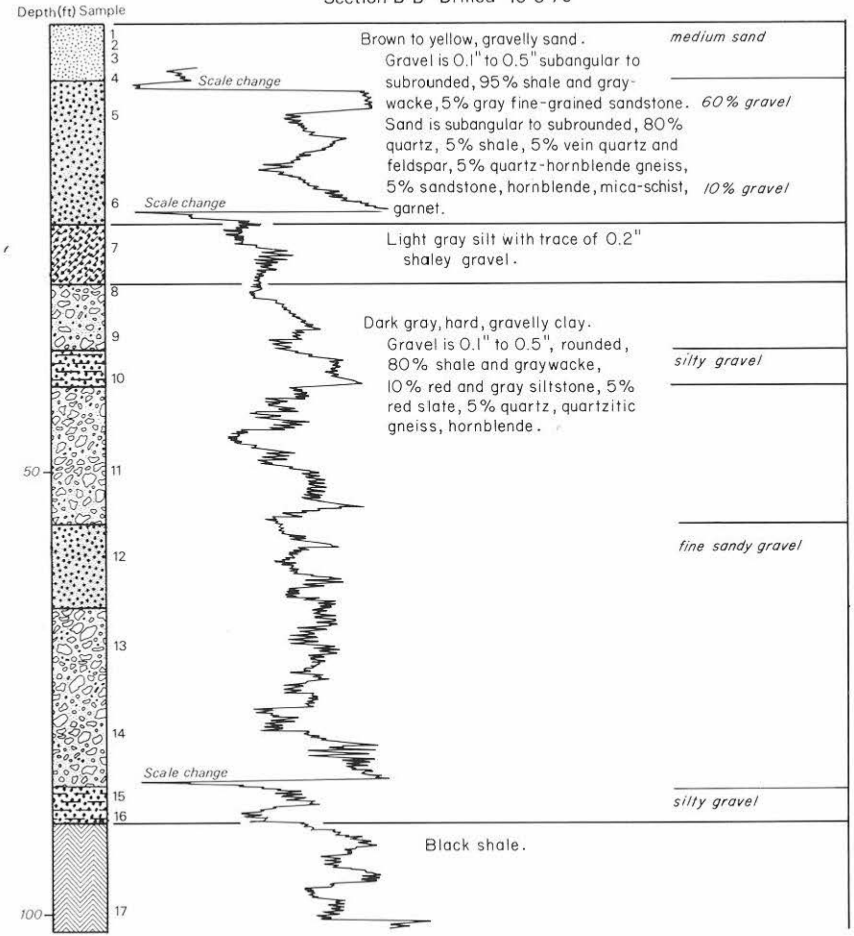
COLONIE CHANNEL BORE HOLE 19

Round Lake Quad—Elnora
Section B-B′ Drilled 10·7·76



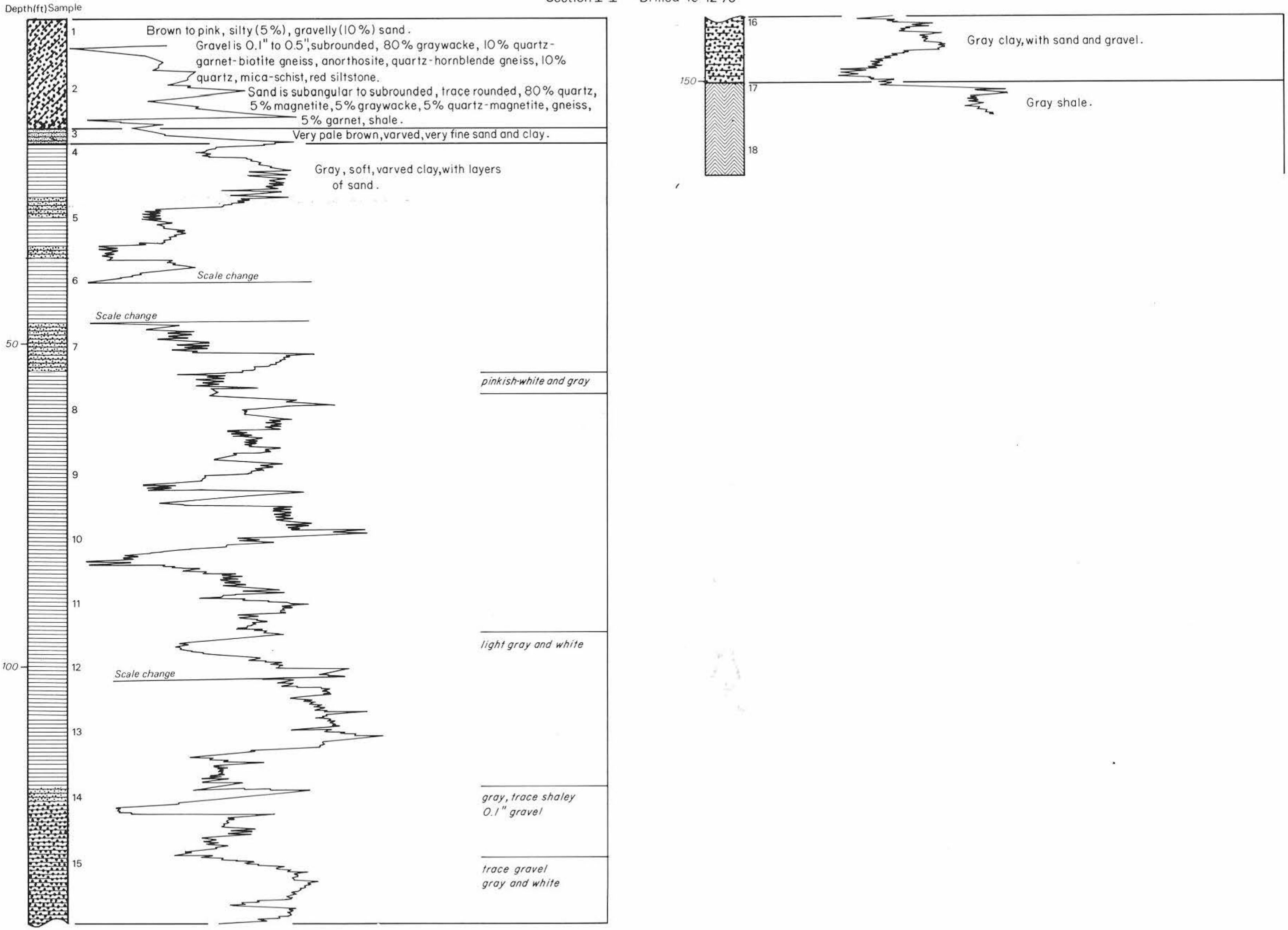
COLONIE CHANNEL BORE HOLE 20

Round Lake Quad — Pierce Road
Section B-B′ Drilled 10·8·76



COLONIE CHANNEL BORE HOLE 21

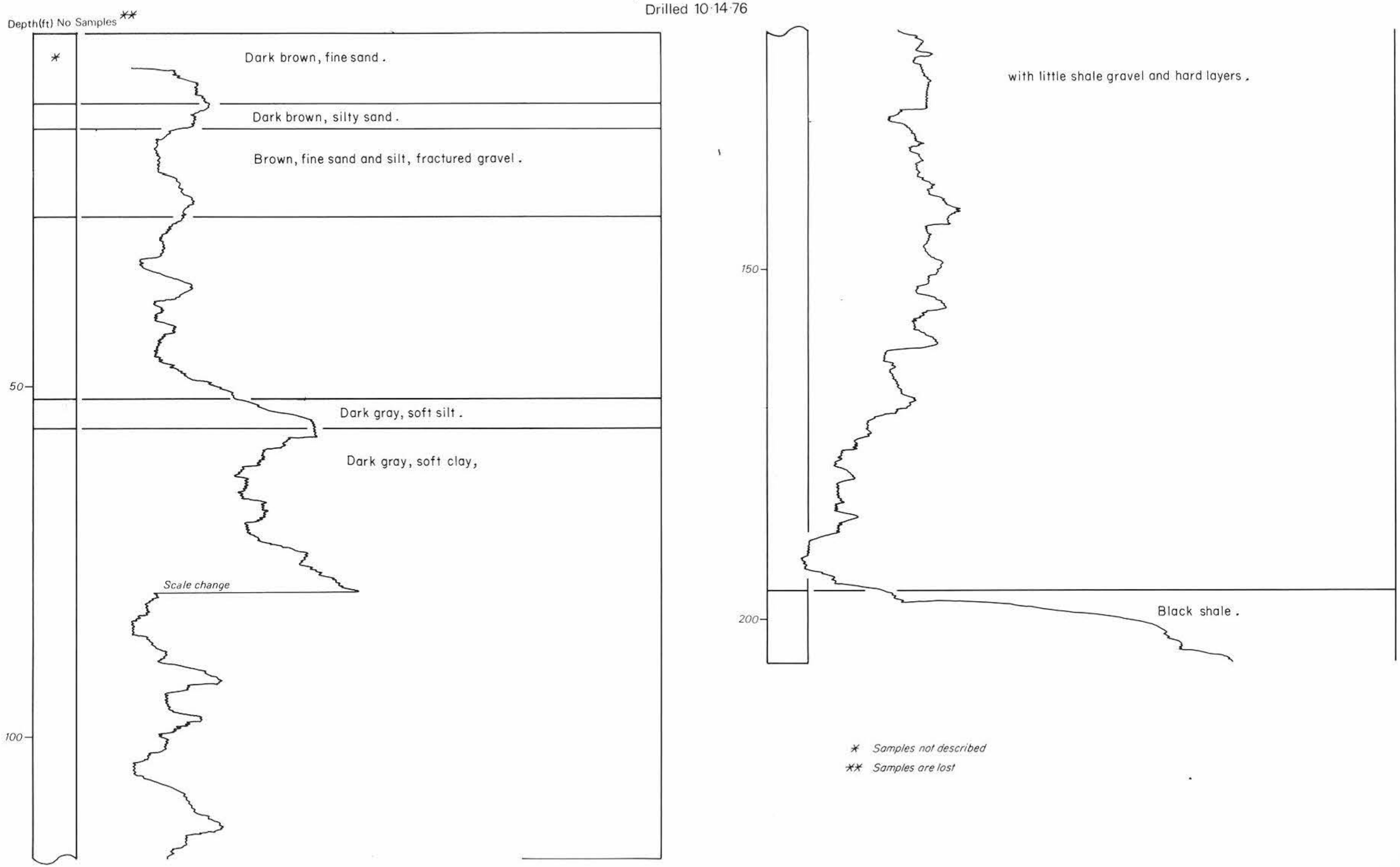
Niskayuna Quad — Vischer Ferry
Section I-I′ Drilled 10·12·76



COLONIE CHANNEL BORE HOLE 22

Niskayuna Quad — Plank Road

Drilled 10·14·76



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Richard H. Monheimer, Director

THE NEW YORK STATE EDUCATION DEPARTMENT

GEOLOGICAL SURVEY
Robert H. Fakundiny, State Geologist

PLATE 1. COLONIE CHANNEL SURFICIAL GEOLOGY

Robert J. Dineen

1983

SCALE 1:48000

2 1 0 2 MILES

2000 0 2000 4000 6000 8000 10000 12000 14000 FEET

2 1 0 2 KILOMETER

EXPLANATION

Hf **Floodplain:** light dark brown, fining upward cross-bedded to trough cross-bedded gravel to silt, moderately to poorly sorted. Grains are sub-angular to rounded. *Moderately permeable, yields from 5 to 50 g.p.m., variable water quality. Floodplains flood often, scour and excessive deposition are common.*

Qu **Aeolian Sand:** very light yellow brown cross-laminated fine to medium sand, well-sorted trace silt. Grains are subrounded to rounded. Thickness ranges from 3 to 100 ft. (1.3 to 3m). Relief ranges from 10 to 100 ft. *Yield can be as large as 500 g.p.m. Water table tends to be close to surface. Subject to wind scour if devegetated.*

Qs **Lake Sand:** light gray to very light brown fine to coarse sand, ripple to horizontally laminated. Contains thin silt lenses or laminae, can contain up to 30% silt. *Moderately permeable, yields from 3 to 100 g.p.m. Subject to wind erosion. Can be unstable on slopes, particularly when wet.*

Qd **Delta Sands and Gravels:** dark to light yellow brown cross-bedded to horizontally bedded sand and gravel with some cobble lenses. Grades into lake sand and silts. Thickness ranges from 10 to 15 ft. (3 to 50m). *Good to fair permeability, yields from 5 to 100 g.p.m.*

Qc **Lacustrine Silts and Clays:** reddish gray to dark gray, weathering to yellow brown, varved. Varves are 0.3 to 2.5 in. (0.1 to 6 cm.) thick. *Permeability in poor, yields rarely exceed 3 g.p.m. Slopes are unstable.*

Qi **Outwash and Ice-Contact Sand and Gravels:** dark brown to very light brown, well to poorly sorted, locally significant quantities of silt, clay, and flowtills. *Permeability very good to poor, yields 3 to 500 g.p.m.*

Qt **Tills:** dark gray to dark brown, compact mixture of gravel, boulders, and clay. *Permeability is poor, yields rarely exceed 5 g.p.m.*

Or **Bedrock:** black to light gray sandstones, limestones, and shales. Joints and fractures are well developed. *Permeability is moderate to poor, yields rarely exceed 10 g.p.m.*

— 25 — Isopach (thickness) of upper lacustrine and wind-blown sand and/or gravel.

Geologic contact; dashed where inferred

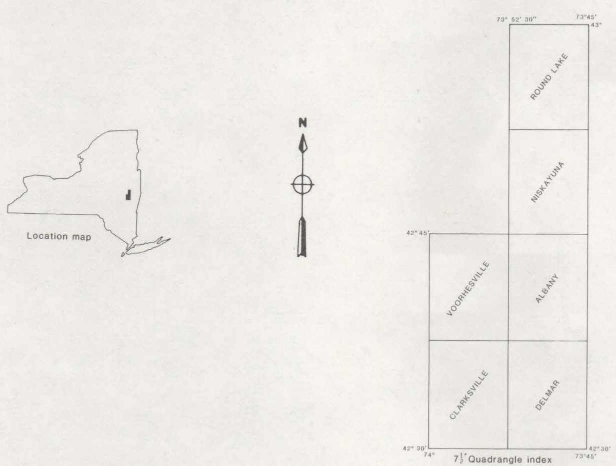
● Test boring or seismic control point

▲ Bore hole without till

■ Bore hole with till

◉ Engineering bore hole with till

A—A' Location of cross sections shown on Plate 4.



Geologic compilation 1976-78

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Geological Survey, Map and Chart 37


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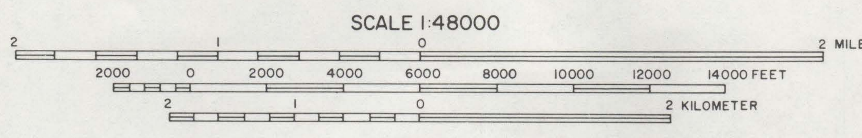
PLATE 2. COLONIE CHANNEL ICE-CONTACT SANDS AND GRAVELS

Robert J. Dineen

1983



EXPLANATION

- 250 — Elevation of the top of the ice-contact sands and gravels
- 50 — Isopach (thickness) of the ice-contact sands and gravels
- • Test boring or seismic control point

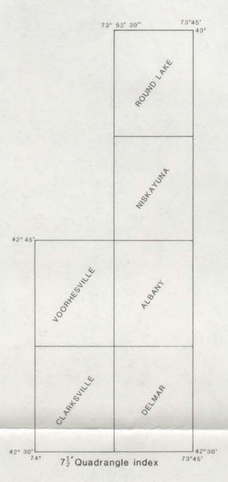


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PLATE 3. COLONIE CHANNEL BEDROCK TOPOGRAPHY

Robert J. Dineen

1983

SCALE 1:48000

2 1 0 2 MILES

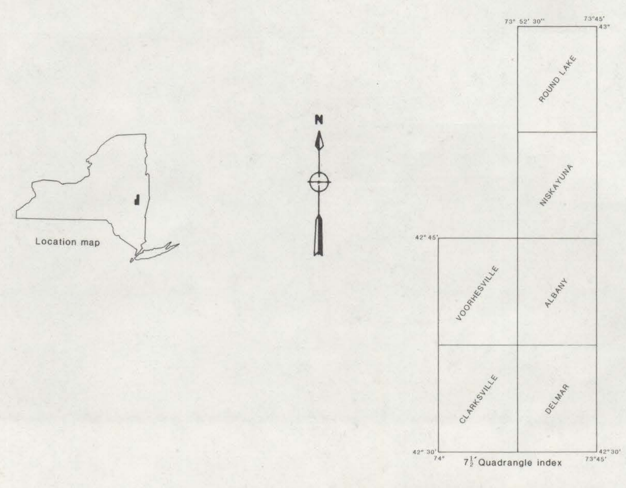
2000 0 2000 4000 6000 8000 10000 12000 14000 FEET

2 1 0 2 KILOMETER

EXPLANATION

—250— Elevation of the top of the bedrock surface

• Test boring or seismic control point



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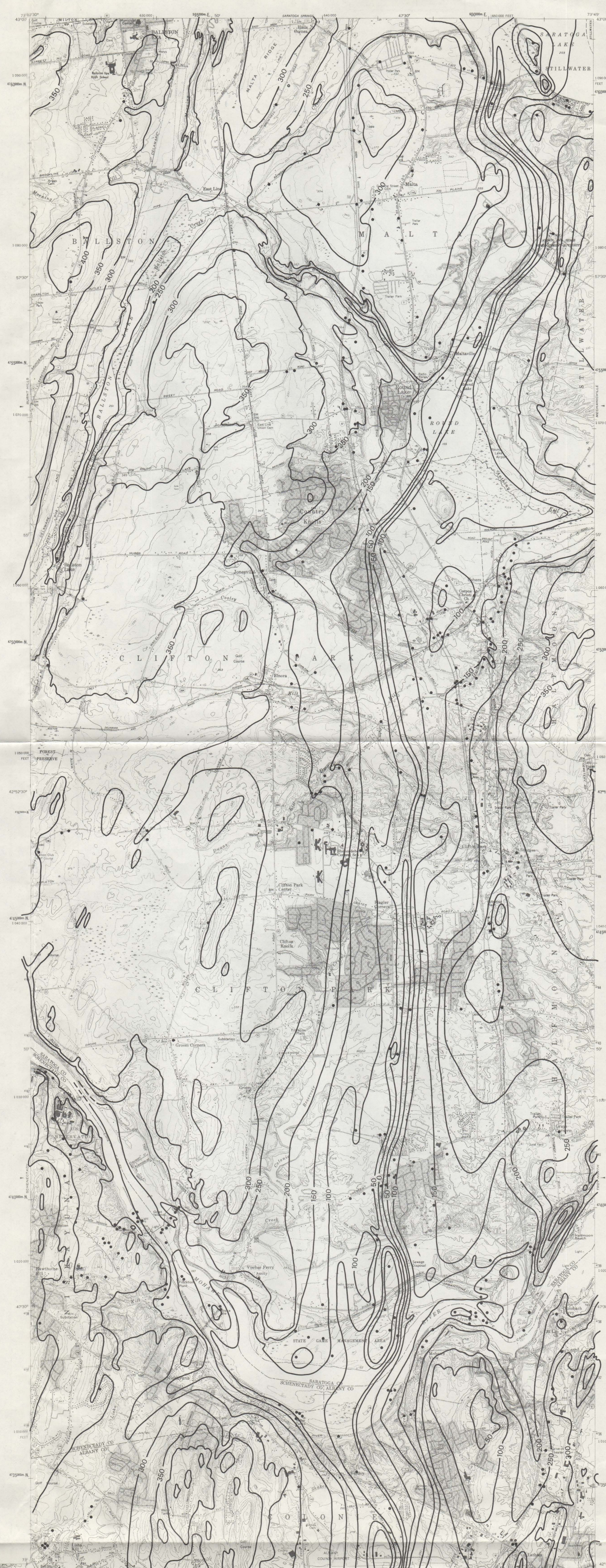


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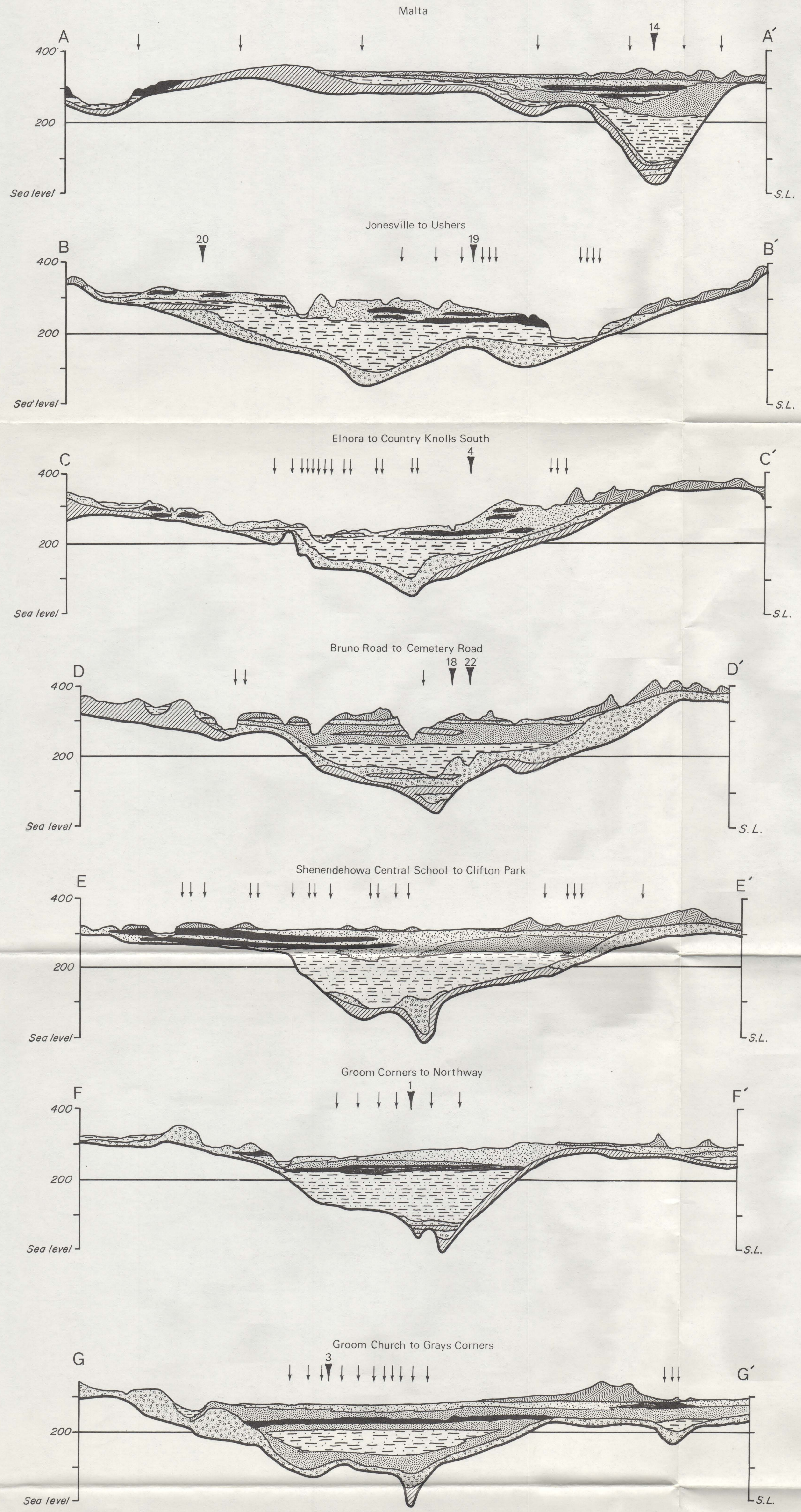
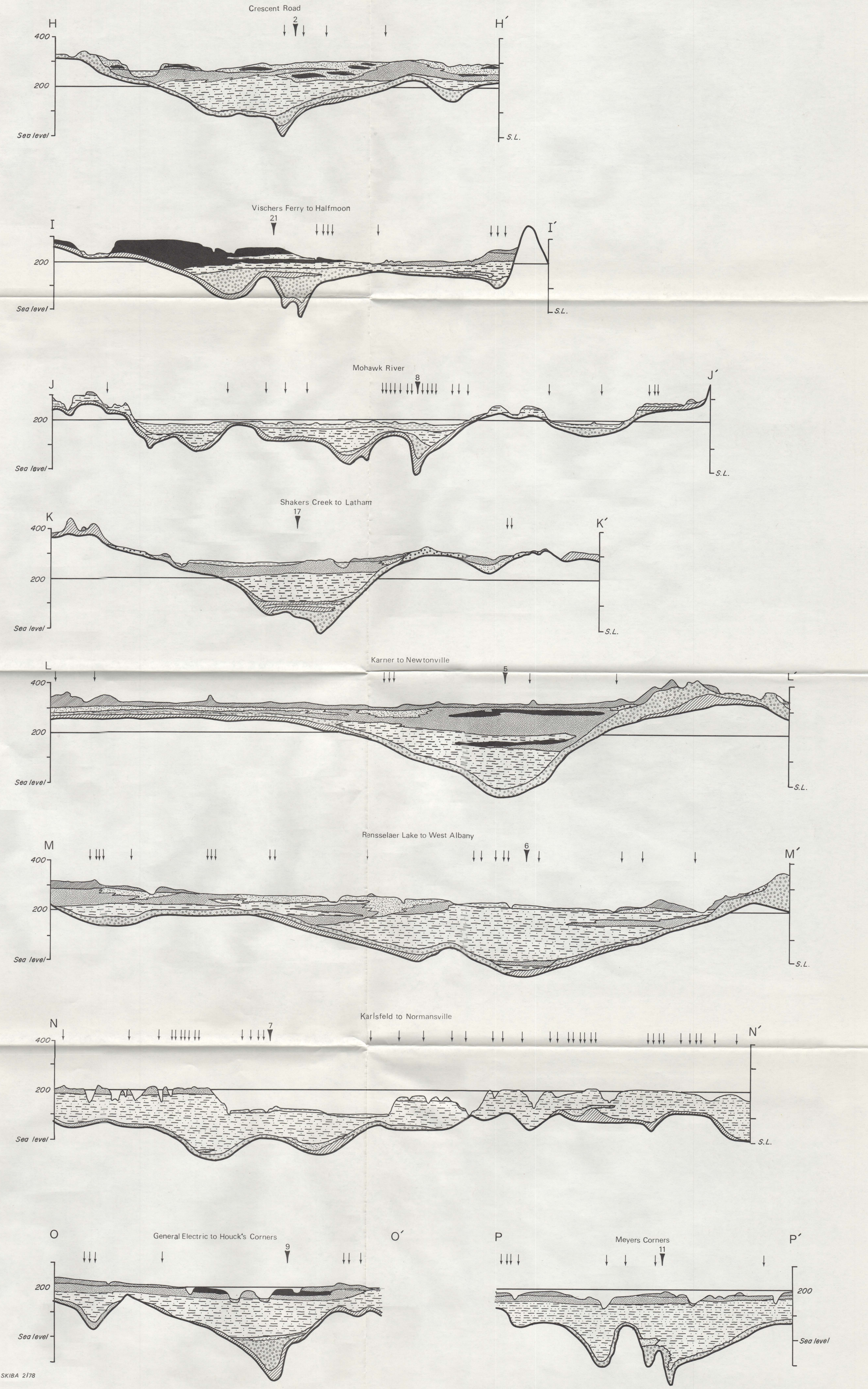
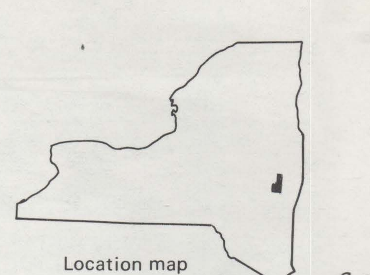




EXPLANATION

- Flood plain
- Wind-blown sand
- Lake sand
- Gravelly lake sand
- Lake silt and sand
- Lake clay and silt
- Lake beach gravel
- Ice-contact gravel and sand
- Till
- 14 U.S. Geological Survey – N.Y.S. Geological Survey bore hole
- N.Y.S.G.S. control point; well, test boring or seismic line, open file data
- Top of bedrock

0 1 2 Kilometers
0 1 Mile



Exact location of cross sections shown on Plate 1

Vertical exaggeration 10X

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PLATE 4. COLONIE CHANNEL CROSS SECTIONS

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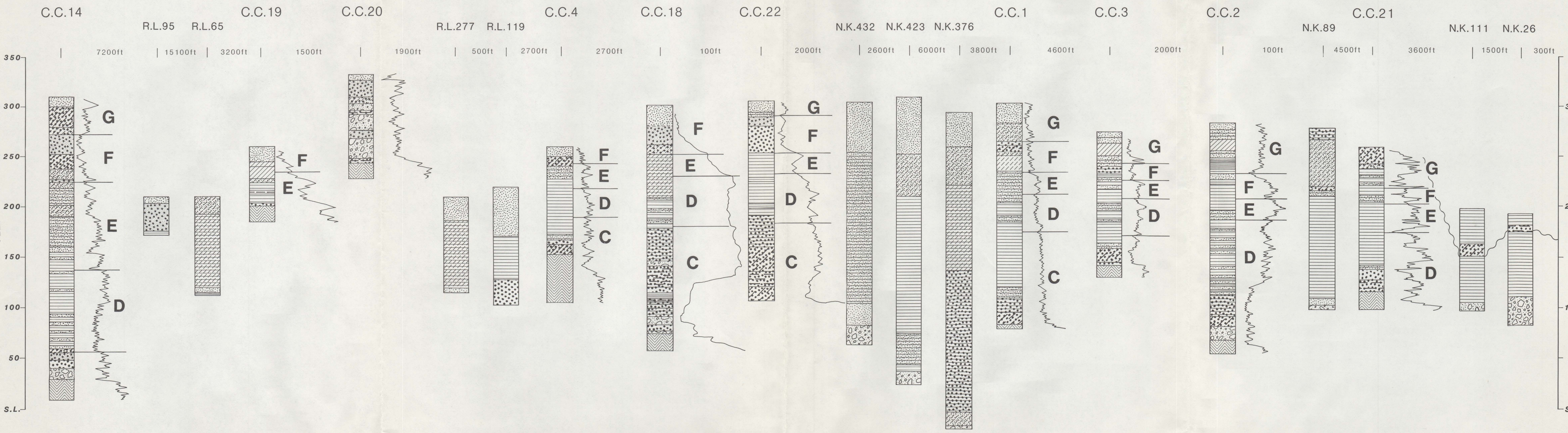
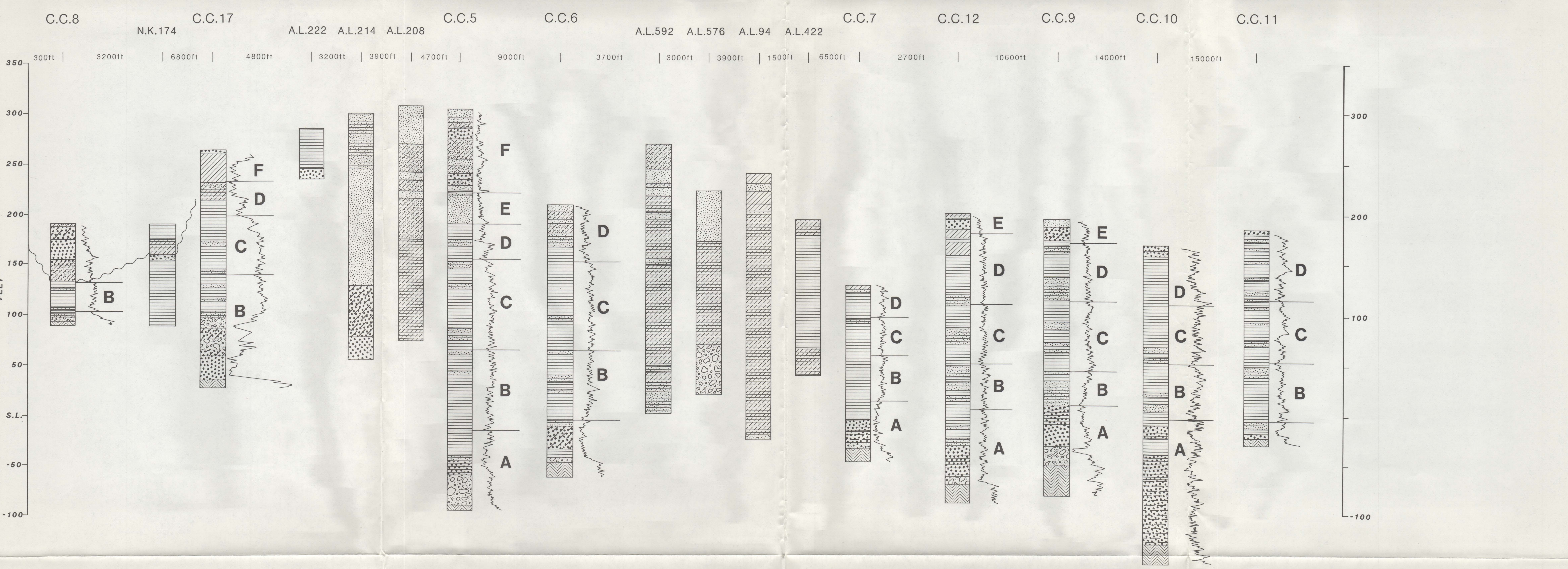
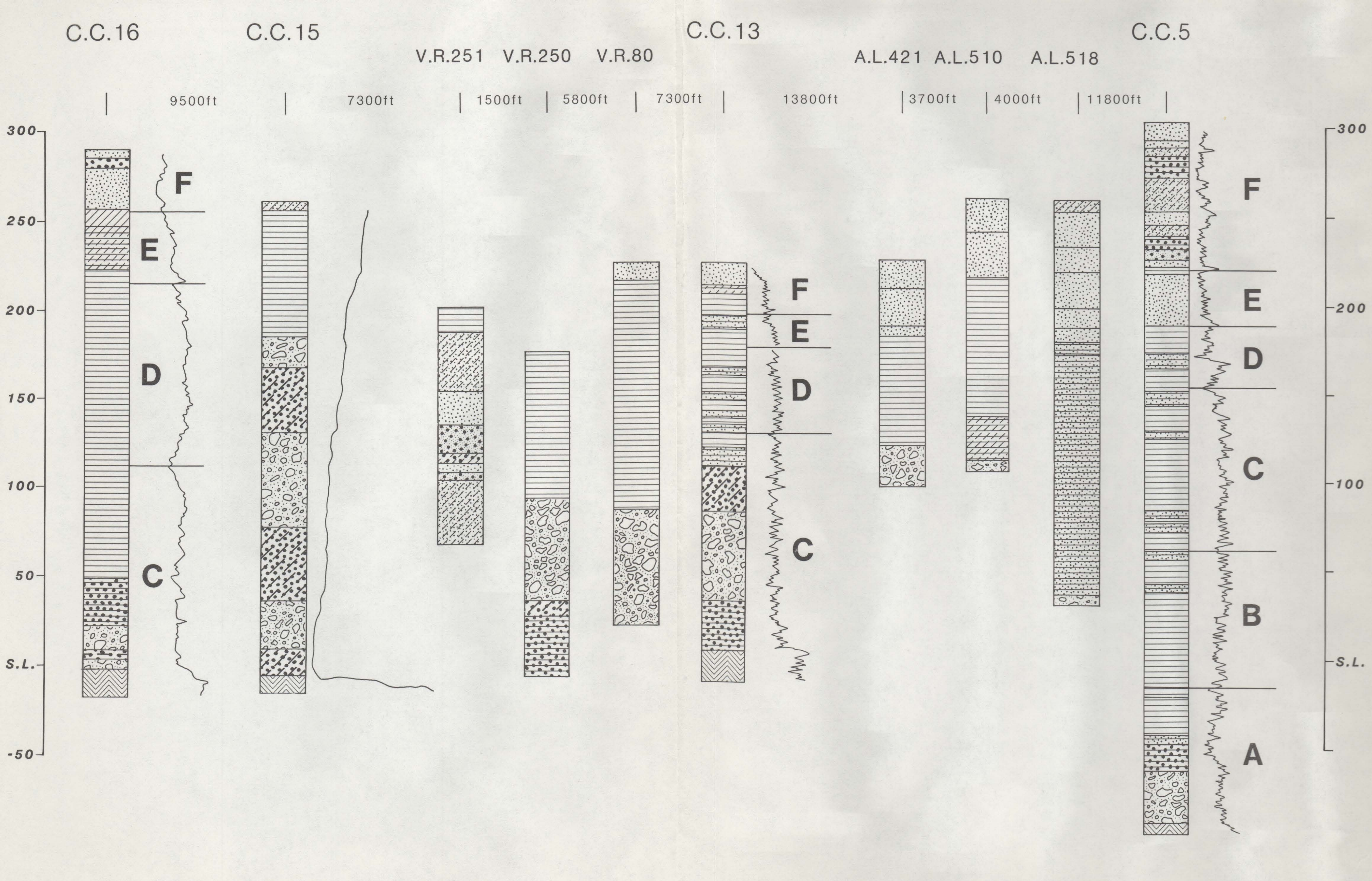






EXPLANATION

- Very fine to medium sand
- Silty very fine to fine sand
- Gravelly silty fine sand
- Clayey silt
- Clayey sand to sandy clay
- Silty clay to clay
- Gravelly clay
- Coarse to fine silt
- Very silty cobbles to boulders
- Silty gravelly sand
- Sand and gravel
- Gravel
- Silty very fine sand with organic matter
- Bouldery sandy clayey gravel
- Bedrock

C.C.16 Colonie Channel Bore Hole and Identification Number

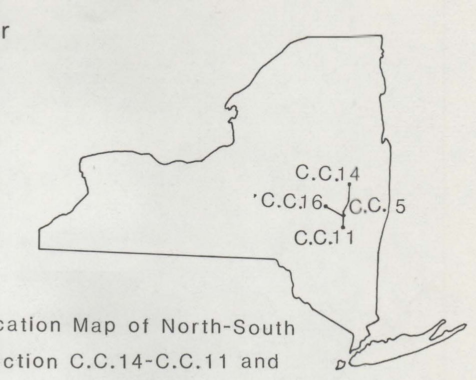
QUADRANGLE ABBREVIATION AND IDENTIFICATION NUMBER OF WATER WELL OR TEST BORING

R.L.119 Round Lake
N.K.26 Niskayuna
A.L.222 Albany
V.R.251 Voorheesville

Pleistocene-Holocene Unconformity

Uncalibrated Gamma Ray Log

D Gamma Ray Unit



Location Map of North-South Section C.C.14-C.C.11 and West-East Section C.C.16-C.C.5.

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PLATE 5. COLONIE CHANNEL LONGITUDINAL PROFILE
Correlation of Gamma Ray Units

Robert J. Dineen

1983

J.Skiba/M.Costello, 4/82