"MIDDLE ORDOVICIAN STRATIGRAPHY AND SEDIMENTOLOGY - SOUTHERN LAKE CHAMPLAIN VALLEY"

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Introduction:

The Middle Ordovician strata (Chazy, Black River and Trenton Groups) of the Champlain Valley record the latter stages of passive margin deposition on the early Paleozoic continental margin of eastern North American. The onset of foredeep development, in response to loading of this portion of the continental margin during the late Medial Ordovician Taconic orogeny, in also recorded in the this section by development of generally deepening-upward facies patterns in the Black River and Trenton Groups. The goals of this trip are to examine these units in the Southern Champlain Valley, interpret the depositional environments represented, and to assess the importance of tectonic controls upon regional facies patterns.

Regional Stratigraphic Framework:

The bedrock geology of the Lake Champlain Valley is dominated by Cambrian and Ordovician platform strata. The abundance of exposure in the area, the relative ease of access and early settlement account for the long history of geological study in the region. Early workers recognized that the Paleozoic rock units in northern and eastern New York consisted of basal sandstones (Potsdam Sandstone of Emmons, 1842) overlying highly deformed metamorphic basement (Grenvillian metamorphic terrain). Basal sandstones are succeeded by mixed quartz sandstones and dolostones (Calciferous Sandrock of Emmons, 1842 and Mather, 1843; later included in the Beekmantown Group by Clarke and Schuchert, 1899). The Beekmantown Group is overlain by younger calcite limestones (Chazy of Emmons, 1842; Black River of Vanuxem, 1842 and Trenton Group of Conrad, 1837). The stratigraphy of the Cambrian and Ordovician of New York has been recently reviewed by Fisher, 1977, whose nomenclature we generally follow in this paper.

In the past two decades, the evolution of the Cambrian and Ordovician platform sequence has been interpreted within the context of the plate tectonic history of the northern Appalachians. In general, basal non-marine clastics of the Potsdam Sandstone (Ausable Member) are thought to represent deposition in fault-bounded basins that formed during late Proterozoic-medial Cambrian rifting of the continental margin as the Proto-Atlantic opened (Fisher, 1977). Marine sandstones and carbonates of the Beekmantown Group document the development of the passive margin phase. Chazy Group strata indicate continued carbonate platform deposition, although regional stratigraphic and facies patterns suggest that the platform underwent localized faulting and minor uplift prior to, and during, Chazy Group deposition. Black River and Trenton Group strata are interpreted as an overall deepening upward sequence, documenting the onset of platform subsidence and foredeep development during the initial stages of the Taconic Orogeny. Calcareous argillites and deepwater limestones of the Cumberland Head Formation represent the "last gasp" of carbonate deposition prior to black shale and flysch facies of the late Ordovician foreland basin (Mehrtens, 1984). Latest Ordovician and Early Silurian units in central New York record the infill of the foreland basin. These units are not present in the Champlain Valley.

Chazy Group: Stratigraphy and Sedimentology

The regional stratigraphy of the Chazy Group has been most recently investigated by Oxley and Kay (1959) and Hoffman (1963) and is presently under study by one of us (BWS). Fisher (1968) provides descriptions of the Chazy Group in the northern Champlain Valley.

In the northern Champlain Valley, the Chazy Group is subdivided into three formations, the Day Point, Crown Point and Valcour. In the southern Champlain Valley, these subdivisions are difficult to apply. Oxley and Kay (1959) assigned the entire sequence at Crown Point, New York to the Crown Point Formation, whereas Raring (1973) recognized both Crown Point and Valcour Formations.

The Chazy Group overlies upper Beekmantown Group strata throughout the Champlain Valley. At Westport, New York, the contact is an angular unconformity, with tilted and truncated Bridport Formation dolostones onlapped by basal shales and sandstones. Elsewhere in the outcrop belt, the basal contact is apparently disconformable, although Speyer (1982) has suggested that the contact exposed on Isle La Motte (northern Champlain Valley) is conformable. The maximum thickness of the Chazy is estimated at 235 meters in the Valcour-Valcour Island sections (Oxley and Kay, 1959), however this section is characterized by numerous normal faults and incomplete exposure. Recent work by one of us (BWS) suggests that the thickness is less than 200 meters in the Valcour section. The Chazy Group generally thins to the south in the Champlain Valley, with 95 meters present at Crown Point, and less than 25 meters at Ticonderoga, New York. Chazy Group strata are absent from the platform stratigraphy

Stratographic Nomenclature of Ordovician Strata - Southern Lake Champlain Valley

MEDIAL ORDOVICIAN	MOHAWKIAN	TRENTON	GLENS FALLS
		BLACK RIVER	ISLE LA MOTTE
	CHAMPL.	CHAZY	VALCOUR CROWN POINT DAY POINT
L. ORD.	CANAD.	BEEKMAN-TOWN	BRIDPORT FORT CASSIN WHITEHALL

south of Whitehall, New York. Chazy rocks are present beneath the Taconic thrust sheets south and east of the Whitehall area, based upon the occurrence of Crown Point strata in fault slivers at the base of the Taconic Frontal Thrust near Granville, N.Y. (Selleck and Bosworth, 1985).

Rapid facies changes occur along the Champlain Valley outcrop belt, apparently in response to irregular topography on the underlying Beekmantown erosional surface and perhaps, syndepositional faulting. Tidal flat, shelf lagoon, shoal sand, reef and reef flank facies are exposed in the Champlain Valley. Terrigenous clastics are present at the base of the Chazy, and are thickest in the Ottawa Valley, where non-marine (braided stream) facies occur (Hoffman, 1963).

In the southern Lake Champlain Valley, reef facies are not present in the Chazy Group, but faunal diversity is generally high. Brachiopods, calcareous algae, bryozoans, gastropods, nautiloids, trilobites and pelmatozoans are abundant in subtidal shelf facies. Tidal flat and sand shoal facies bear a restricted fauna, dominated by the large gastropod Maclurites magnus.

A disconformity caps the Chazy Group in the southern Champlain Valley, suggesting slight emergence of the shelf prior to deposition of the overlying Black River Group. At Crown Point, this interval is marked by a thin arkosic sandstone which contains Adirondack-derived quartz and feldspar. These sands indicate that Proterozoic basement was exposed nearby at the end of Chazy deposition, perhaps in response to uplift along normal faults to the west.

Black River Group:

In the type area of the Black River Group in northwestern New York State, four formations are recognized in the Black River Group; in ascending order, the Pamelia, Lowville, Chaumont and Watertown. Although facies resembling portions of these formations are recognizable in the southern Champlain Valley, the Black River Group is considerably thinner than in the type area, and a single formation name, the Orwell, is generally applied to the entire Black River. Fisher (1984) has suggested two formations, the Isle La Motte and Amsterdam, can be recognized in the Glens Falls region.

In the southern Champlain Valley, the Orwell consists of basal sandy dolostone overlain by poorly fossiliferous lime mudstones. These facies are rapidly succeeded by fossiliferous packstones and wackstones which characterize the Orwell in most exposures. The faunal diversity of typical Orwell is high, with gastropods, nautiloids, rugose and tabulate corals, crinoids, stromatoporoids, bryozoans, brachiopods and trilobites common. This faunal assemblage indicates deposition on a shallow, but relatively quiet subtidal shelf. The sequence is punctuated by bioclastic and intraclastic current-stratified grainstones, suggesting sporadic storm events.

Exposures of the Black River Group in the Champlain Valley are rarely complete, and geographically scattered, limiting correlation from south to north. This unit has received very little detailed study, and we encourage interested workers to pursue study of this unit.

Trenton Group:

In the southern Champlain Valley, the contact between the Black River and Trenton Groups is relatively abrupt and is characterized by increased terrigenous mud content and change in bedding style. The entire Trenton Group in the region is assigned to the Glens Falls Formation, which typically consists of interbedded calcareous shales and limestones. The fauna of the Trenton is diverse, although it lacks the large stromatoporoids, corals and bryozoans of the Black River. Brachiopods, trilobites and smaller bryozoans are particularly abundant. Overall, the Trenton was deposited at depths below normal wave base or on a low gradient ramp-type shelf. The interbedding of limestone and shale is interpreted as resulting from storm deposition, with intervening periods of mud accumulation. Turbidite bedding features are recognized in some exposures.

The Trenton Group in the Champlain Valley becomes progressively shalier up-section, and is overlain by calcareous argillites of the Cumberland Head Formation. This unit gives way to black shales and siltstones of the Canajoharie Shale. This trend resulted from the deepening; of the Trenton shelf to depths sufficient; to reduce biogenic carbonate production, coupled with increasing terrigenous sediment input. This facies transition to deepwater dark muds marks the development of the Taconian foreland basin in New York. Progressive east-to-west deepening was accomplished by normal faulting of the shelf, and was linked to the onset of the Taconic Orogeny. Wedging of the continental margin into an east-dipping subduction zone, followed by loading of the margin by west-direct thrusting of the Taconic accretionary prism accounts for the development of this basin. Cisne, et al (1982) have suggested that the convergent tectonic regime of the Taconic Orogeny and related history of the Ordovician foreland basin of the northern Appalachians is analogous to the modern Timor-Timor Trough-north Australia shelf collisional system. In the Timor analogue, the attempted underthrusting of the northern Australian plate margin has led to progressive deepening and syndepositional normal faulting of the previously shallow water north Australia platform, producing a deep-over-shallow facies pattern that is very similar to the Canajoharie-over-Trenton sequence of the middle Ordovician of New York State.

Following the deposition of the black muds atop the foundered carbonate platform, synorogenic sands and muds were shed from the rising Taconic accretionary prism. In some areas, these deposits are deformed by later thrusting. Molasse deposition is recorded in deltaic and marine shelf facies of the upper Ordovician Lorraine group and Oswego Sandstones in west-central New York. These units are not exposed in the Champlain Valley.

FIELD TRIP STOP DESCRIPTIONS

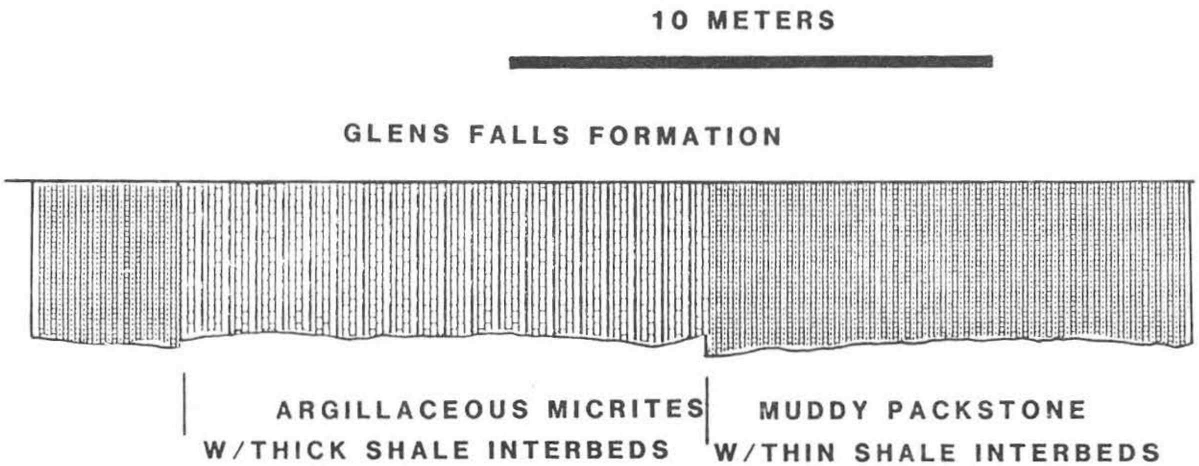
Since this trip consists of two major stops, we have not included a detailed trip log. From Plattsburg, we will proceed south on I87 to the Westport exit, continue south on Rt. 9N through the village of Westport. Our first stop is located approximately 3 miles south of Westport on Rts. 9N and 22 at roadcuts immediately south of the railroad overpass. Please exercise extreme caution - traffic is heavy and visibility poor!

Stop #1: Westport, New York

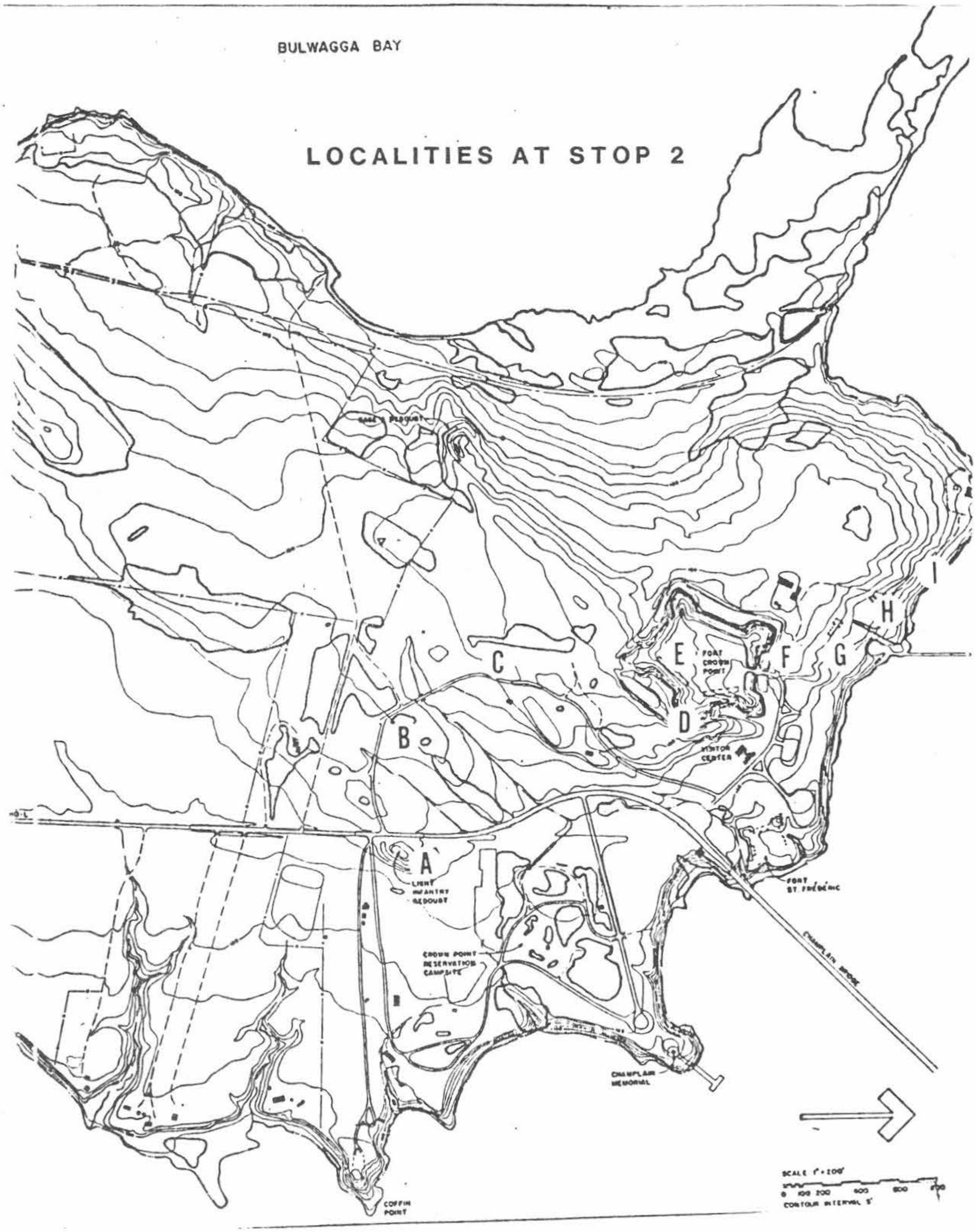
These roadcuts expose approximately 24 meters of the Glens Falls Formation of the Trenton Group. Stratigraphically, we are located in the middle and upper portion of the Glens Falls, within the zone of *Cryptolithus tesselatus*. The Glens Falls at this exposure consists of two major facies. The lowermost three meters, and the uppermost ten meters of the section are characterized muddy packstone beds, often capped by *Chondrites* burrows. The limestone beds are separated by thin calcareous shale interbeds. Each limestone bed consists of a couplet, with the basal portion of the bed characterized by whole-shell and fine bioclastic grainstones, and the upper portion consisting of slightly fossiliferous mudstones. This facies is interpreted as a storm surge ebb current deposit, resulting from the turbidity current-like flows generated as storm wave surge resuspended mud and shell debris on shallower portions of the shelf. Fossils are relatively abundant in this facies, and include the typical Trenton brachiopods, bryozoans and rare trilobites.

The middle ten meters of the exposure consists of somewhat more regularly bedded argillaceous micrites, with relatively thick (2-20 cm.) shale interbeds. The argillaceous mudstone beds show limited size grading, and are often highly bioturbated. Fossils are scarce in the limestone beds, but interbedded shales may contain bryozoans and other bioclasts. This facies is interpreted as a hemipelagite, resulting from deposition of suspended lime and terrigenous mud in a setting unaffected by wave and storm driven currents. The abundant shales in this facies indicate a sudden increase in the influx of terrigenous sediment to the shelf at this time. Insoluble residues from the limestone beds often contain abundant silt-size euhedral quartz, plagioclase and sanidine crystals, suggesting that volcanic ash was supplied, perhaps from the Taconian island arc system to the east. This facies is traceable to the east in sections on the Vermont side of Lake Champlain.

Route to Stop #2: Continue south on Rts. 9N and 22, through the village of Port Henry. Turn left (east) approximately 4 miles south of Port Henry, following signs for Bridge to Vermont. Continue northeast toward Crown Point Bridge, turning left onto entrance road for Crown Point Historic site. Continue on entrance road and park at Picnic Pavilion. Note: NO COLLECTING OR HAMMERING ALLOWED AT THIS SITE!!!



SECTION AT WESTPORT (STOP 1)


BULWAGGA BAY
LOCALITIES AT STOP 2
A
B
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I
FORT CROWN POINT
VISITOR CENTER
FORT ST. FRÉDÉRIC
CHAMPLAIN BRIDGE
LIGHT INFANTRY REDOUBT
CROWN POINT RESERVATION CAMPSITE
CHAMPLAIN MEMORIAL
COFFIN POINT
SCALE 1" = 200'
0 100 200 400 800
CONTOUR INTERVAL 5'

Crown Point Section:

The Crown Point section provides one of the most complete middle Ordovician sequences available in the Champlain Valley. The strata here dip gently (approx. 8 degrees) to the northwest, such that as we walk to the north, we travel continuously up-section. The main exposures are within a single fault block, however, north-northeast trending normal faults are present on the west and east sides of the peninsula. The contact between the Chazy Group and underlying lower Ordovician Bridport Formation is exposed on the east side of the point, on the shoreline of Bullwagga Bay. This section will not be visited on this trip, but can be accessed from the main road just south of the Historic Site entrance. Those who wish to examine this contact may do so after the last stop.

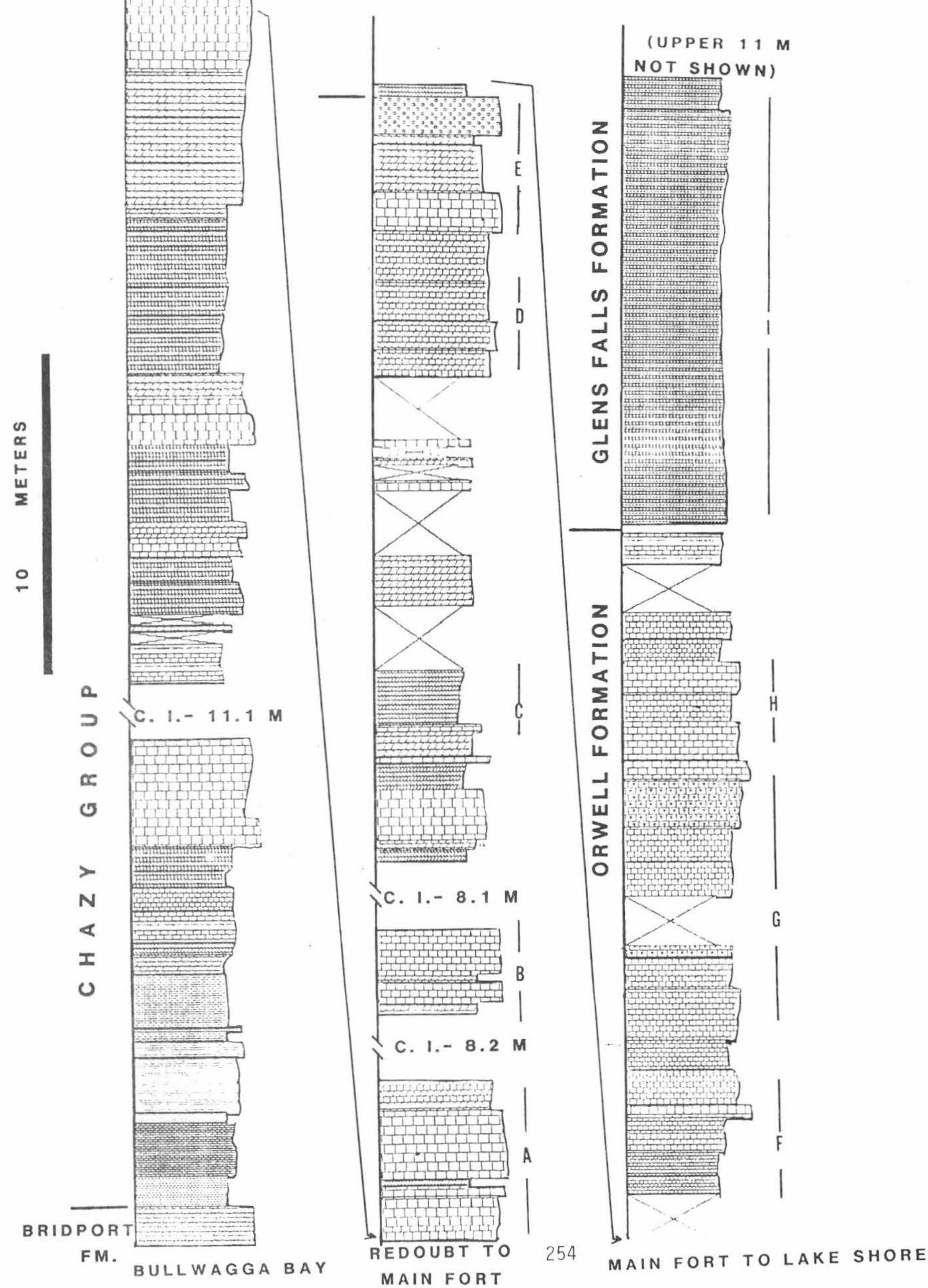
The Chazy Group at Crown Point comprises approximately 95 meters, the Black River Group approximately 24 meters, and the Trenton, 25 meters with the summit not exposed. The uniform strike and dip of the section allow for straightforward calculation of the thickness of covered intervals, making this an excellent site for introductory field course mapping exercises.

To reach stop 2A from the Picnic Pavilion, we will walk back along the entrance road and cross the main highway to the Redoubt Fort excavations immediately southeast of the entrance road.

Stop #2A: Redoubt Fort east of N.Y. 8

Approximately 6 meters of variously burrowed, slightly dolomitic, thin to medium bedded bioclastic packstones are exposed in this section. The dolomite occurs in shaly weathering wisps and laminae and in burrow fills. Abundant "*Girvanella*" algal oncolites (algal accretionary grains) are present in the beds approximately 4 meters from the base of the section. Rounded dark calcite grains (abraded gastropod fragments) form the cores of the oncolites, and are scattered in other beds. Fossils are relatively abundant and best seen on bedding surfaces. Trilobite fragments, brachiopods, byrozoans, pelmatozoan plates, nautiloids and large *Maclurites magnus* are present. The relatively high faunal diversity, abundant lime mud and burrowing argue for a normal marine, low energy shallow subtidal carbonate environment. A possible modern analogue is found in the mixed mud and sand shelf to the west of the emergent Andros Island tidal flats, as described by Bathurst (1971) and Purdy (1963). The 5-10 cm thick beds of "oncolite conglomerate" and other more well-sorted grainstone beds may represent periods of storm winnowing of the bottom, with transportation of abraded sand from adjacent sand shoal environments (e.g. Locality 2B). The wavy, irregular dolomite laminae appear to result from post-depositional dolomitization of lime mud, followed by compaction and local pressure solution of calcite, producing irregular, clay- and dolomite-rich stylocumulate seams. Preferential dolomitization of burrows may be due to contrasts in porosity or permeability of burrow-fill versus burrow-matrix sediment. The burrow-fill sediment may have retained

COMPOSITE COLUMNAR SECTION AT CROWN POINT (STOP 2)



permeability longer during diagenesis, permitting pervasive dolomitization. This sort of fabric selective dolomitization is common throughout the Chazy and Black River Groups in the southern Lake Champlain Valley.

Stop #2B: Ledge immediately NE of gate to Historic Site

Cross-stratified coarse lime grainstones with bipolar crossbed dip directions are well-exposed near the entrance road. Siliciclastic sand grains (angular quartz and feldspar up to 2 mm in diameter) are locally concentrated along prominent stylolite seams. The carbonate particles are dominantly subrounded, abraded pelmatozoan plates, plus gastropod and brachiopod fragments. Large Maclurites fragments and grainstone intraclasts are present on the upper bedding plane surfaces of the ledge.

We envision the environment of deposition of this facies as shallow subtidal wave and/or current reworked sand bars. Active transport of abraded grains may have been accomplished by tidal currents as suggested by the bipolar cross-beds. The lack of burrows and well-preserved fossils may be due to the inhospitable shifting sand substrate. This environment may have been rather like the unstable sand shoal environments described from the Bahamas Platform by Bathurst (1971) and Ball (1967). The scale and style of cross-stratification present here are similar to that predicted by Ball from his studies of the bedforms and primary structures of the Bahamian sand bodies. Similar Chazyan facies in the northern Champlain Valley contain abundant oolites (Oxley and Kay, 1959).

Stop #2C: Low ledges on entrance road approx. 50 meters north of 2B

Brown weathering, slightly shaley dolostone exposed here contains small lenses and stringers of fossiliferous lime packestone. Trilobites, small brachiopods and Maclurites fragments are common. This exposure resembles the shelf lagoon facies of Stop 2A, although dolomitization is more pervasive.

Stop #2D: East point of British Fort, by horizontal water tank and adjacent south moat

Approximately 3 meters of thickly laminated limestone and dolostone is exposed in the southeast "moat" of the British Fort. The dominant facies here consists of alternating 0.5-2 cm thick laminae of limestone and dolostone - often termed a "ribbon rock". The limestone ribbons are mudstones and appear blue-grey on slightly weathered surfaces. The more resistant dolostone weathers tan to brown. An erosional surface with 10-20 cm of relief is exposed near the base of the south wall. Abundant Maclurites occur in a shell bed on this surface. Trough cross-strata consisting of gently dipping ribbon rock are present above the erosional surface. Dolomitized burrows transect the limestone ribbons in the lower 1 meter of the section. On the less-weathered prominence on the SE corner of the moat, shallow scours containing a shell hash of brachiopods and gastropod debris are present, along with intraclasts of lime mudstone in dolostone and "Mexican Hat" structures (rolled intraclasts or pseudoclasts with a dolomitized burrow center).

We interpret this sequence as a tidal flat facies. The rhythmic limestone/dolostone "ribbon" fabric is interpreted as representing alternating slightly finer (lime mudstone) and coarser (dolostone) "tidal bedding" similar to that described by Reineck and Singh (1980) from the clastic mud/sand tidal flats of the North Sea. The Maclurites shall bed may mark the basal erosional level of a tidal channel, with the cross-stratified ribbon laminites forming by draping on the channelled surface. Variations in degree of burrowing record subtle differences in degree of subaerial exposure of the flat and/or reworking by tidal currents. Limited in situ faunal diversity is also expected in the stressed tidal environments. The absence of mudcracks and any indication of evaporite minerals suggests that we are seeing only the lower portion of a wet intertidal flat system preserved here.

Stop #2E:

Enter Parade Grounds by barracks. Around 1916, gunite was sprayed on the interior walls to protect the mortar from deteriorating. Starting in 1976, the N.Y. State Division for Historic Preservation began extensive maintenance, removing loose gunite, replacing rotted stones and repainting the stone walls.

In the outer wall of the first barracks, note at about eye level the stones that are nearly white-weathering. These are lime mudstones from the "Lowville" facies of the Orwell Limestone, exposed at Stop 2F.

The broad limestone outcrop west of the barracks is a cross-stratified limestone with scattered subrounded quartz and feldspar sand grains. Trough cross-strata and "herringbone" co-sets of planar-tabular cross-strata are visible on the low vertical face. Large angular clasts of slightly dolomitic lime grainstones and Maclurites magnus shells are present on the uppermost bedding surfaces.

We interpret this facies as a current-dominated sand shoal environment rather similar to the exposures at Stop 2B.

Westward across the parade grounds there is a massive, bioturbated, brown weathering dolostone unit (similar to Stop 2C), overlain by 0.5 meters of very coarse-grained bioturbated, lightly dolomitic feldspathic quartz sandstone. This sandstone forms the summit of the Chazy Group (Crown Point Formation). The abundant angular quartz and feldspar granules in the sandstone suggest derivation from a relatively close granitic (Adirondack?) source terrane. These sands were apparently transported from the west during an interval of relative emergence of the carbonate platform and were briefly reworked in a shallow marine setting. The basal dolostone bed of the Black River is exposed immediately atop the sandstone.

Stop #2F: Moat Walls at North Entrance to British Fort

The section from here to locality I is within the Orwell Limestone. The basal beds consists of thick-bedded to massive lime mudstones with vertical spar-filled burrows (form - genus Phytopsis) and rare ostracodes. Fossil abundance and diversity increase in the overlying beds, with gastropods (Loxoplocus), corals (Lambeophyllum, Foerstephyllum) and brachiopods appearing. Grain size increases upsection, with sporadic appearance of intraclast grainstones and ripple cross-lamination. Overall this section is similar to the Lowville Limestone of the type Black River Group of the Tug Hill region. The facies pattern here suggests a progression from restricted (tidal or lagoonal?) mud flats (Phytopsis lime mudstones) to more open marine mixed mud/sand shelf environments.

The summit of the moat outcrop exposes a horizon of black chert nodules which can be traced laterally across the road to locality G.

Stop #2G: Ledges extending from service road to lake shore

Watch for poison ivy!

These exposures closely resemble the Chaumont (House Creek Limestone of Fisher, 1977) facies of the Black River type section. Thick-bedded to massive richly fossiliferous lime packstones and wackestones document a normal marine, relatively low energy carbonate shelf environment. In addition to the forms mentioned earlier, the large stromatoporoid (calcisponge) Stromatocerium, the high-spired gastropods Hormotoma and Subulites, the nautiloids Actinoceras and Geisonoceras, plus bryozoans, brachiopods and pelmatozoan material are common. on some bedding surfaces, black chert nodules follow large horizonal burrows. The chertification here is post-depositional and involved dissolution and reprecipitation of siliceous skeletal material (sponge and radiolarian). The uppermost bed in this set of ledges is a black chert bed approximately 2 cms thick. This bed can be traced to the lake shore where a similar section can be seen. Glacial abrasion obscures much of the detail that is exposed on more weathered surfaces.

Stop #2H: Blocks and Quarry Walls by Lake Shore

The quarry was established in 1870 by the Fletcher Marble Co. in an unsuccessful attempt to find a source of "black marble" dimension stone. The quarry is reportedly only 1 meter or so deep. The narrow spit going north was built to load blocks on barges, but evidently no blocks were shipped. The quarried blocks consist of medium to thick-bedded fossiliferous packstones and wackestones with some ripple cross-laminated grainstone beds visible in the north quarry bench. Strophomenid brachiopods, bryozoans, pelmatozoan stems and fragments of the trilobite Isotelus are present. The environments represented here are similar to those at 2G. As we continue north and walk along the lake shore, more exposures of the upper part of the Orwell can be examined. The bedding surfaces contain abundant opercula of Maclurites logani, and scattered Forstephyllum, Lambeophyllum and Stromatocerium are found. The byssate bivalve Ambonychia is also present.

The transition from the Orwell to overlying Glens Falls Limestone is covered by beach gravels as we continue west along the lake shore.

Stop 2I:

The contact between the Orwell Formation and the basal Glens Falls Limestone is covered by beach gravels. The lower 16 meters of the Glens Falls lies below the first occurrence of Prasopora. Cryptolithus appears approximately 20 meters from the base of the section. Thus, only the uppermost 10 meters of section are time equivalent to the Westport exposures seen at Westport. The Glens Falls at Crown Point consists of the same muddy packstone facies seen at Westport. Limestone beds typically have shelley basal portions which rapidly grade upward into muddy packstones. Thin calcareous shale interbeds define the bedding. This facies is again interpreted as storm surge-ebb current deposits with intervening shale suspension rainout. There is a slight tendency for the bedding style in the lower portion of the section to be more wavy or lenticular, perhaps suggesting that storm wave scour occurred. The upper portion of the section is slightly thinner bedded, and bryozoans become relatively more abundant. Fine examples of the various trace fossils which characterize this facies are to be found on the bedding surfaces, including Chondrites.

Fossils are abundant and rather diverse. Trilobites (usually fragmental) include Isotelus, Flexicalymene and rare Cryptolithus; the brachiopods Sowerbyella, Rafinesquina; Dinorthis and Dalmanella; bryozoans Prasopora, Eridotrypa and Stictopora; plus orthocone cephalopods and pelmatozoan debris. Gastropods, which are so abundant in the underlying Orwell limestone are exceedingly rare in the Glens Falls.

The Glens Falls here records the continuing deepening of the Middle Ordovician shelf that began with the deposition of the Phytopsis lime mudstones at Stop 2F. The shale interbeds and generally more argillaceous character of the Glens Falls document increase in terrigenous mud input, perhaps derived from the rising Taconic Orogenic complex to the east. Quartz and feldspar grains of volcanic origin are also common in insoluble residues of Glens Falls limestones, suggesting increased eruptive activity at this time.

The contrast in terrigenous content of the Chazy group vs. Black River and Trenton Groups is noteworthy. Insoluble residues from Chazy Group carbonates contain abundant, coarse-grained, rather angular quartz and feldspar grains (e.g. Stops 2B and 2D) whereas the Black River and Trenton Groups lack coarse sand-size grains and contain either volcanic quartz and feldspar (Black River and Trenton Groups) or clay plus volcanics (Trenton Group). This change is likely related to a shift in available clastic course from the slightly emergent cratonic basement to the west that was exposed during Chazy Group deposition to the rising Taconic volcanic/metamorphic complex to the east during Black River-Trenton deposition.

Southern Extension of the Trip:

For those who are proceeding south from Crown Point, we are willing to offer brief additional stops in the upper Cambrian and lower Ordovician Beekmantown Group and Potsdam Sandstone in the vicinity of Ticonderoga, New York. If you wish to return via I87, return to Rts. 9N and 22, proceed south to Ticonderoga and then west on Rt. 74 to I87.

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