# A1 AND B1: DEPOSITIONAL ENVIRONMENTS ACROSS A CENTRAL TROUGH OF THE NORTHERN APPALACHIAN BASIN, DEEP RUN SHALE MEMBER (MOSCOW FORMATION) OF THE FINGER LAKES

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## INTRODUCTION

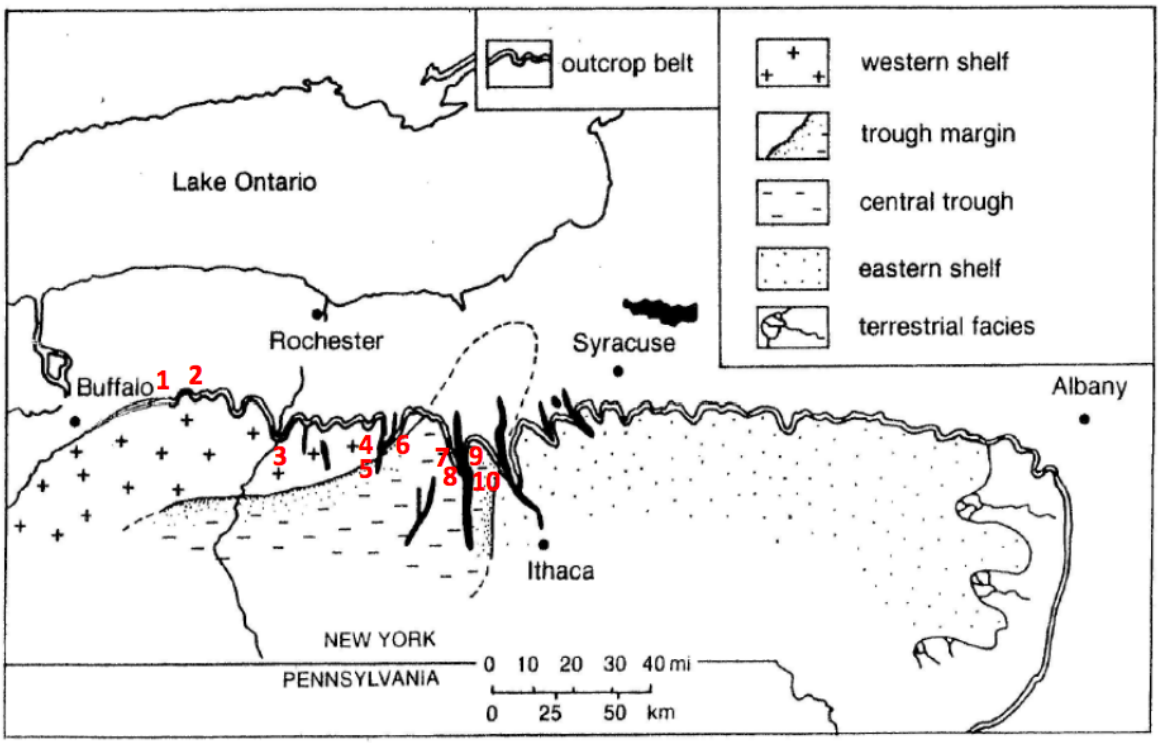
The Middle Devonian Givetian Hamilton Group is well known for its thick sequence of variably fossiliferous siliciclastics. Many naturalists and scientists including James Hall (1843), Amadeus Grabau (1899), and J.M. Clarke (1903) studied the fossil faunas preserved in these shales and limestones. Other early workers including Cooper (1930), attempted to correlate the distinct lithologic units within western and central New York. During the last 20-30 years detailed microstratigraphic and paleontological studies (Brett and Baird, 1985, 1994, Mayer, 1994, Mayer et al, 1994, Miller, 1991 and numerous others) have resulted in high resolution correlations and improved the general understanding of the dynamics of the Hamilton Group. The extensive stratigraphic field analysis by Baird (1979) firmly established the sedimentary relationships between the lithologic units at the boundary between the Ludlowville and Moscow Formations.

The purpose of the present study was to identify and correlate isochronous horizons and beds within the Deep Run Shale Member of the lower Moscow Formation across the Finger Lakes Region of New York State. Moreover, biofacies gradients were surveyed from west to east, facilitating interpretation of depositional history and environments. The study also examined the nature and character of this unit and its westward erosional truncation beneath the Menteth Limestone. Lastly, previously undescribed Ludlowville - Moscow sections were investigated along the west shore of Seneca Lake.

## PALEOGEOGRAPHY

During Middle Devonian Givetian time (~ 380-385 Ma), the regional geology of eastern North America was influenced by the breakup of Gondwana and the amalgamation of terranes and intense mountain building (Benton, 2004}. The convergence and collision of crustal fragments comprising the Avalon terrane (Blakey, 2008) resulted in the accretion of Avalonia to Laurentia. This orogenic event and associated deformation gave rise to the Acadian Mountains and concurrent loading was predominantly responsible for subsidence of the Appalachian Foreland Basin (Van der Voo, 1983, 1988, Ettensohn, 1985). Sediments eroding from these mountains were shed westward into the foreland basin. Hamilton Group mudstones and carbonates accumulated as a clastic wedge within the prograding Catskill Delta Complex in the northern arm of the Appalachian Basin.

Over 15 meters (50 feet) of sediments of the Deep Run Shale Member were deposited in a central subsiding trough located in the present day Canandaigua Lake Valley. This central depocenter was migrating westward due to structural flexure of the basinal crust through time. Successively higher units of the Ludlowville-Moscow Formations are observed to obtain their greatest thickness from east to west across New York (Brett et al, 2013). Furthermore, sections of the Deep Run Member thin to less than 5 meters (15 feet) toward the Seneca –Cayuga Valleys across an east-southeast trending shelf where the facies become equivalent to the Portland Point Limestone Member (Baird, 1979). Similarly, on the opposite, western side of the trough, Deep Run sediments dramatically thin to less than 2.5 meters (8 feet) in the present day Genesee Valley. The sediments, in turn, are completely removed by erosional truncation prior to the deposition of the Menteth Limestone across a west-northwest trending sediment starved carbonate shelf. Key Ludlowville-Moscow outcrops studied in western and central Finger Lakes of New York are shown in Figure 1.




1. **Eleven-Mile Creek**
2. **Murder Creek**
3. **Jaycox Creek**
4. **Tichenor Gully**
5. **Menteth Gully**
6. **Deep Run Gully**
7. **Kashong Creek**
8. **Houston Rd. Gully**
9. **Shale banks along Seneca Lake**
10. **Indian Creek**

Figure 1. Ludlowville – Moscow outcrop belt in New York. Numbered locations correspond to studied sections. (Modified from Brett and Baird, 1986).

## PRINCIPLES AND METHODOLOGY

The regional stratigraphy and paleoecology of the Deep Run Shale Member was determined by precise measurement of the individual beds contained within the sequence. A common steel tape and an eye

level were used to determine the exact thickness of each bed, centimeter by centimeter. Furthermore, the biofacies of each bed was determined by the careful attention to the smallest of details and collecting and recording all fossils found.

Initially, a general and broad spectrum of fossils was observed from each bed at all localities. However, to better understand and enhance paleoenvironmental interpretations, a detailed sampling of the fossils present or absent in key layers was conducted in three regions which included from west to east: Jaycox Creek (Genesee Valley), Deep Run Gully (Canandaigua Valley), and Kashong Glen (Seneca Valley). Whenever it was difficult to positively identify the fossil at the outcrop, field samples were brought back to the laboratory for further analysis. Species abundance is an estimate due to the shelly debris in these beds is commonly disarticulated and not in-situ. It is to this extent that the correlation of the beds and the interpretation of the paleoecological environments across the basin can be deduced for the Deep Run Shale Member.

## STRATIGRAPHY OF THE DEEP RUN SHALE MEMBER CANANDAIGUA LAKE VALLEY –SENECA LAKE VALLEY

On the east side of Canandaigua Lake, about 5.6 km (3 ½ miles) south of Routes 5 & 20 and the city of Canandaigua, a small creek named Deep Run Gully cuts downward into the bedrock exposing the complete type section of the Deep Run Shale Member. This unit is 15.95 meters (52.3 ft) thick and is overlain by the Menteth Member and underlain by the Tichenor Limestone and Jaycox Shale Members. Moreover, the upper strata of the Wanakah Member are also exposed at the base of the Deep Run Gully section. Cooper (1930) first designated the shale between the Menteth and Tichenor as the Deep Run Shale Member, which Baird (1979) supported. However up until now, the detailed microstratigraphy and paleontology of the Deep Run Shale Member has remained largely unstudied.

The Deep Run Shale Member conformably overlies the Tichenor, which typically exhibits a hummocky top surface (Fig. 2). The strata directly above the Tichenor, were interpreted by Brett and Baird (1986) to be part of a transitional phase of the Tichenor into the Deep Run Shale Member. This transitional phase of interbedded fossiliferous calcareous siltstone and calcareous shale was understood to merge downward both westward and eastward into condensed Tichenor deposits. At Deep Run, this unit is 1 meter (37 inches) thick and forms erosionally resistant ledges. This unit is hereby designated the Kipp Road Bed of the Deep Run Shale Member for strata at Deep Run Gully along Kipp Rd. The Kipp Rd Bed is regionally widespread and traceable in outcrop across the western Finger Lakes region of New York and is noticeably different from the Tichenor. The unit ranges regionally from a bluish-gray calcareous mudstone in the Genesee Valley to a medium-gray moderately calcareous siltstone in the Canandaigua Valley to a dark- gray blocky siltstone in the central Finger Lakes region (see also Baird et al 1988,1991 – thermal color effects).

The Kipp Road Bed contains a distinct and diverse well-preserved assemblage of fossils. Particularly noteworthy are very large *Eldredgeops rana* trilobites which are commonly articulated and up to 8 cm in length and 4.5 cm in width. *Greenops boothi*, typically represented only by a pygidium, and rare *Monodechenella macrocephala* trilobites can be found in this bed. Moreover, the trilobite *Bellacartwrightia whiteleyi* has been found in the Kipp Road Bed at Jaycox Creek in the Genesee Valley.

Additionally, large camerate crinoids including *Megistocrinus, Dolatocrinus* and *Gennaeocrinus* species, as well as associated holdfasts systems or “runners “are conspicuously abundant throughout the region. These “runners” commonly are about 1.25 cm in diameter and up to 30 cm long and can be found

throughout the Kipp Road Bed regionally making them an exceptionally useful marker. Additionally, rare *Placoblastus* blastoids are even found in conjunction with the other pelmatozoans.

Both tabulate and rugose corals are observed in the Kipp Road Bed but species type changes laterally from west to east across the Finger Lakes region. Whereas the corals *Favosites hamiltonaie* and *Heliophyllum halli* dominate in the Genesee Valley, large aggregations of *Cystiphyllum conifollis* as well as the colonial coral *Eridophyllum subcaespitosum* are abundant throughout the Canandaigua Valley. Eastward the Eridophyllum corals replace the Cystiphyllum corals in the Seneca Lake Valley.

Furthermore, various brachiopods including *Mucrospirifer mucronatus, Mediospirifer audaculous, Meristella, Nucleospira*, and chonetids as well as bivalves and fenestrate and fistuliporoid bryozoans are observed in the Kipp Road Bed.

Stratigraphically above the Kipp Road Bed up to the Menteth Limestone Member, in both the Canandaigua Lake Valley and Seneca Lake Valley, the Deep Run Shale Member is predominately a thick depocenter wedge of silty mudstone to siltstone. This interval is hereby designated the Willard siltstone interval for the excellent exposure of beds on the east shore of Seneca Lake immediately north of the town of Willard, New York. Although this medium-gray siltstone interval obtains its maximum thickness around Deep Run Gully, 15 meters (49.25 ft), it is easily recognized in eastern sections. On the west side of Seneca Lake at Kashong Creek, the interval thins to 12 meters (39.4 ft) and on the east shore of the lake, at Willard it further thins to 4 meters (13.1 ft). Similarly this interval thins dramatically west of the Canandaigua Valley.

At the top of the Kipp Road Bed to basal Willard transition there is an important interval of similar fossils at several localities. Articulated crinoid crowns of *Taxocrinus* commonly occur associated with the gastropod *Naticonema lineata.* On the east side of Canandaigua Lake, at the Deep Run type section, a major assemblage of these fossils is developed in the creek floor downstream from the Deep Run high falls. Similarly, on the west side of the lake, at both Tichenor Point and Menteth Gully are localized abundances of *Naticonema* and *Taxocrinus* columnals in this interval.

The Willard siltstone interval is conspicuously barren to poorly fossiliferous. Evidence of pervasive bioturbation exists from the numerous *Zoophycos* spreiten and pyritized marginal tubes throughout the interval. However, when macrofossils are found in the interval, they appear to be concentrated into shell-rich horizons or localized lenses or aggregations. Fossils are moderately abundant in these shelly horizons but of low diversity, and dominated by either a few in-situ brachiopods and/or bivalves. Brachiopods include *Mucrospirifer mucronatus, Mediospirifer audaculus, Tropidoleptus carinatus, and Devonochonetes coronatus* at Deep Run Gully. Likewise, bivalves include *Paleoneilo*, *Plethomytilus*, *Orthonata*, *Modiomorpha*, *Cypricardella*, and *Goniophora* at Kashong Glen as well as at the lake shore near Willard. Other typical fossils include scattered trilobites and crinoid debris.

A horizon in the middle of the Willard siltstone interval of harder siltstone appears to be spatially correlative between the Canandaigua Valley and the Seneca Valley, although the bed may be manifested slightly differently between outcrops. At Deep Run Gully and Kashong Glen, the bed is in the same stratigraphic position forming an erosionally resistant ledge in the face of the waterfalls of those creeks. In Deep Run Gully, the bed is 7.5-10 cm (3-4 inches) thick and is a prominent layer whereas at Kashong Glen it is only 2.5-5 cm (1-2 inches) thick cryptic layer. This isochronous horizon does not contain fossils and may have been deposited as a single large tempestite event.

The uppermost subunit of the Willard siltstone interval is characterized by coarse-grained, very wavy and undulating or irregular and jagged surfaces suggestive of increased silt content and is disconformably overlain by the Menteth Limestone Member. This erosional surface can be traced both east and west of the Canandaigua Lake Valley truncating the Deep Run Shale Member.

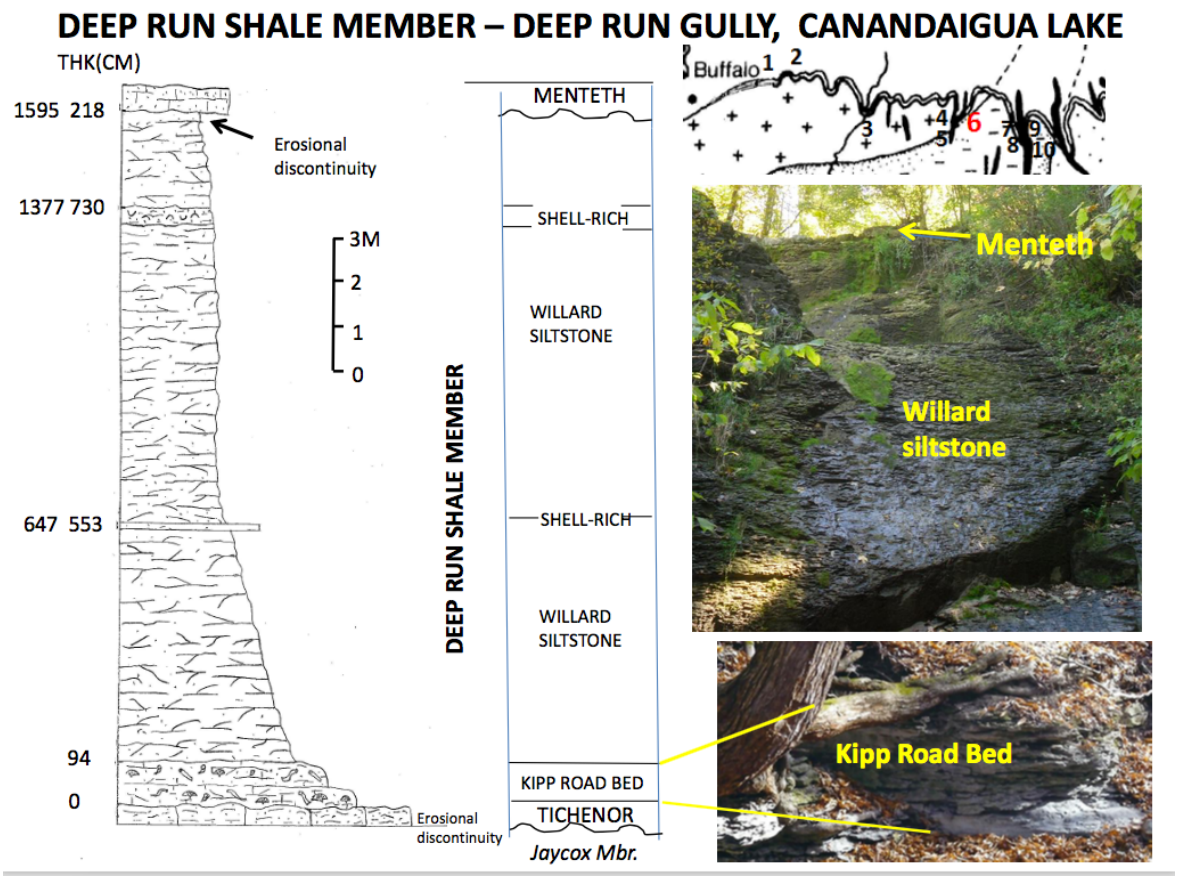



Figure 2. Generalized stratigraphic column of the Deep Run Shale Member type section at Deep Run Gully, Canandaigua Lake Valley.

# STRATIGRAPHY OF THE DEEP RUN SHALE MEMBER
# CANANDAIGUA LAKE VALLEY – ERIE COUNTY

The Deep Run Shale Member thins dramatically west of Canandaigua Lake. At Jaycox Creek in the Genesee River Valley, the Kipp Road Bed and the Willard siltstone interval, are still observed but notably thinner (Fig. 3). The complete section comprising the Deep Run interval is only 2.4 meters (8 ft) thick in which the Kipp Road Bed is 29 cm (11.4 inches) thick and the Willard siltstone interval is 2.1 meters (7 ft) thick.

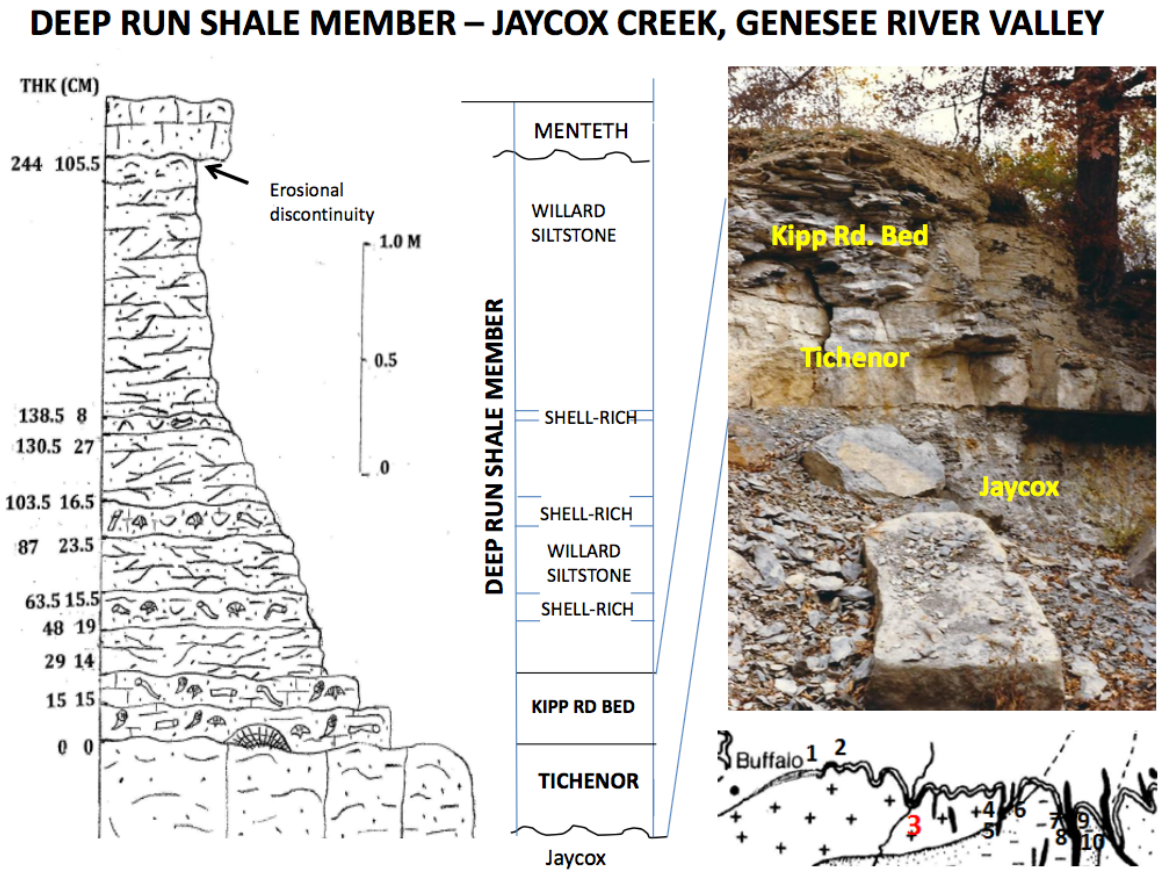



Figure 3. Generalized stratigraphic column of the Deep Run Shale Member at Jaycox Creek, Genesee River Valley.

The Kipp Road Bed is a bluish-gray calcareous mudstone in the Genesee Valley rich in fossils including large rugose and tabulate corals, large phacopid trilobites, crinoids and blastoids, brachiopods and bivalves as well as fenestrate and fistuliporoid bryozoans. The Willard siltstone interval contains three distinct shelly horizons separated by barren to poorly fossiliferous, *Zoophycos* churned mudrock.

The Deep Run Shale Member continues to thin westward across Genesee County to 28-30 cm (less than 1 foot) thick at Murder Creek. The Kipp Road Bed is a gray, very calcareous, blocky mudstone about 13-15 cm (5-5.9 inches) thick and contains conspicuous crinoid “runners” and corals. Moreover, the Willard siltstone interval is also about 15 cm (5.9 inches) thick and contains a sparse fauna predominately of the brachiopod *Mucrospirifer mucronatus* and a few bivalves. In turn, the Menteth Limestone sharply overlies this unit. The upper contact of the Deep Run Shale Member with the Menteth is highly irregular and has been erosionally overstepped by the Menteth.

Still further west, the unit if at all present is only a few centimeters thick at Elevenmile Creek. Here in places the Menteth Limestone directly overlies the Tichenor Limestone with only a vestige of the Deep Run Shale Member remaining sometimes between those units. In Erie County, west of Buffalo Creek and Cazenovia Creek, the condensed sequence comprising both the Menteth Limestone and Deep Run Shale Members are completely missing due to erosional overstep by the Windom Shale Member (Baird, 1979).

## ANALYSIS OF UPPER LUDLOWVILLE-LOWER MOSCOW STRATIGRAPHY, SENECA LAKE VALLEY - A REINTERPRETATION OF BASIN AXIS DEPOSITION

Previous research by Baird (1979), Brett and Baird (1986), and Mayer (1994) examined in detail the Ludlowville – Moscow stratigraphy on the western side of Seneca Lake particularly at Kashong Glen (Fig. 4). However, investigation of these rock layers as the units intersect and dip beneath the shoreline of the lake, only 7.4 km (4.6 miles) south of Kashong Glen, has been hindered due to their inaccessibility from summer homes along the lake. By initially exploring the shoreline with a small boat, direct access was gained at the most pertinent points which provided important information about the geology of these previously undescribed sections. Additionally, a very small, unnamed stream gully emptying into the lake in this area and adjacent to Houston Road down cut into the rocks exposing the Jaycox through Menteth strata (Fig. 5).

Moreover, these sections have revealed additional beds, which may have been deposited only in the central trough of the Appalachian Basin prior to Deep Run time. At Houston Road Gully, the Jaycox Shale Member is overlain unconformably by the Tichenor which is 71 cm (28 inches) thick of interbedded crinoid-rich shale and recrystalline limestone. These layers grade upward into the Kipp Road Bed, which is 10 cm (3.9 inches) thick and exhibits the typical trilobite, crinoid “runner”, brachiopod fauna. The Willard siltstone interval consists primarily of 14.53 m (47.67 ft) thick of barren to poorly fossiliferous calcareous siltstone intermixed with three very thin shell-rich horizons. The uppermost strata is 32 cm (12.6 inches) thick of wavy, coarse-grained siltstone which resemble “stacked” ripple marks. The Menteth Limestone Member disconformably overlies this sequence of strata.

At Kashong Glen, the Jaycox-Tichenor-Deep Run transition is noticeably different from the section at Houston Road Gully and consists of three distinct layers. At the base, a very hard 38 cm (15 inch) thick bioturbated, Menteth-like calcareous siltstone ledge unconformably overlies the Jaycox Shale Member. This bed, in turn, is overlain by a 122 cm (48 inch) thick calcareous siltstone unit barren of fossils. The uppermost layer is characterized by a richly fossiliferous muddy encrinite. This layer traditionally has been referred to as the Tichenor; however, the present study interprets these deposits here and at Houston Road Gully to lie above the Jaycox (uppermost Ludlowville Formation) and to be localized, early phases of Tichenor (Moscow Formation) deposition. Moreover, these deposits represent partial closure of the sequence boundary unconformity that floors the Moscow Formation.

The lowermost layer of the Deep Run Shale Member is 132 cm (52 inches) thick series of silty fossiliferous layers displaying the typical fauna so characteristic of the Kipp Road Bed. The overlying Willard siltstone interval consists of 13.31 m (43.67 ft) thick barren to poorly fossiliferous unit with a few shell-rich horizons. Similar to Houston Road Gully, the uppermost strata is 33 cm (13 inches) thick wavy, coarse-grained siltstone resembling ripple marks which is, in turn, overlain disconformably by the Menteth Limestone Member.

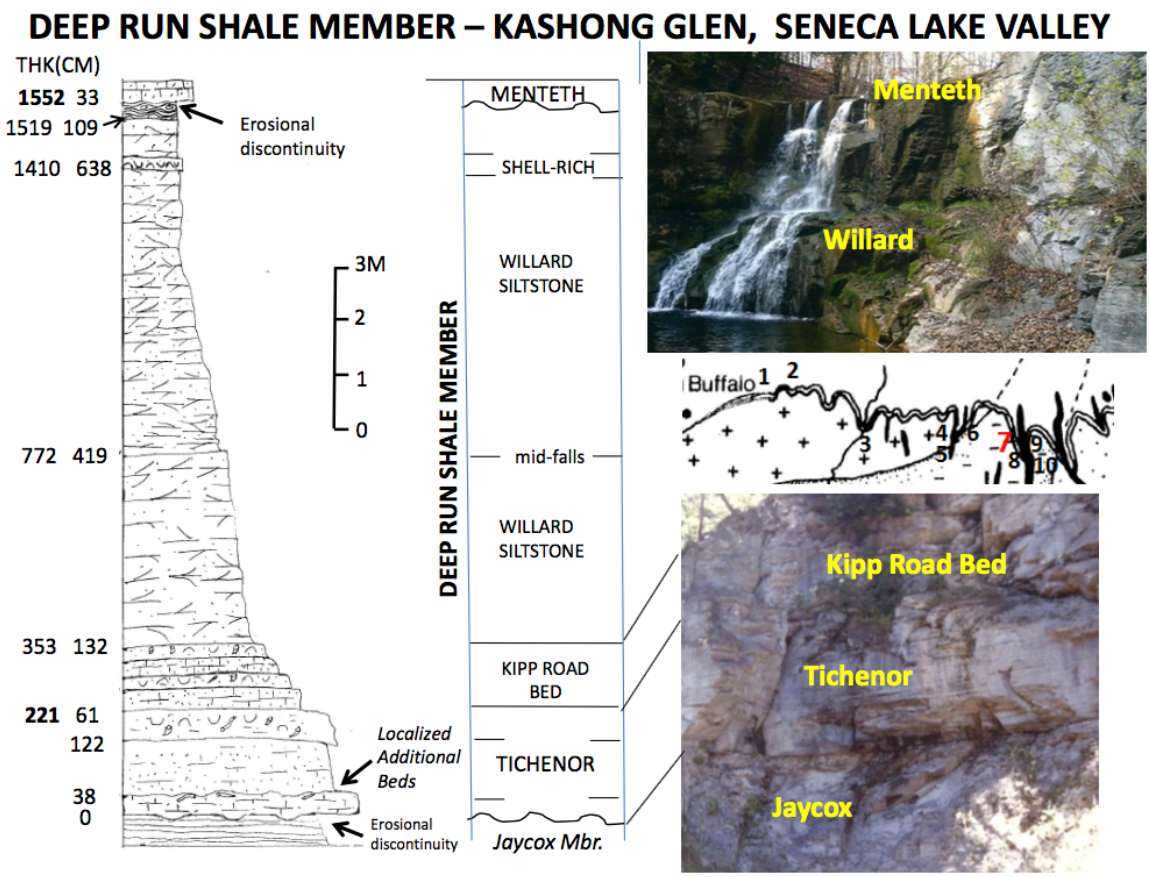



Figure 4. Generalized stratigraphic column of the Deep Run Shale Member, Kashong Glen, Seneca Lake Valley.

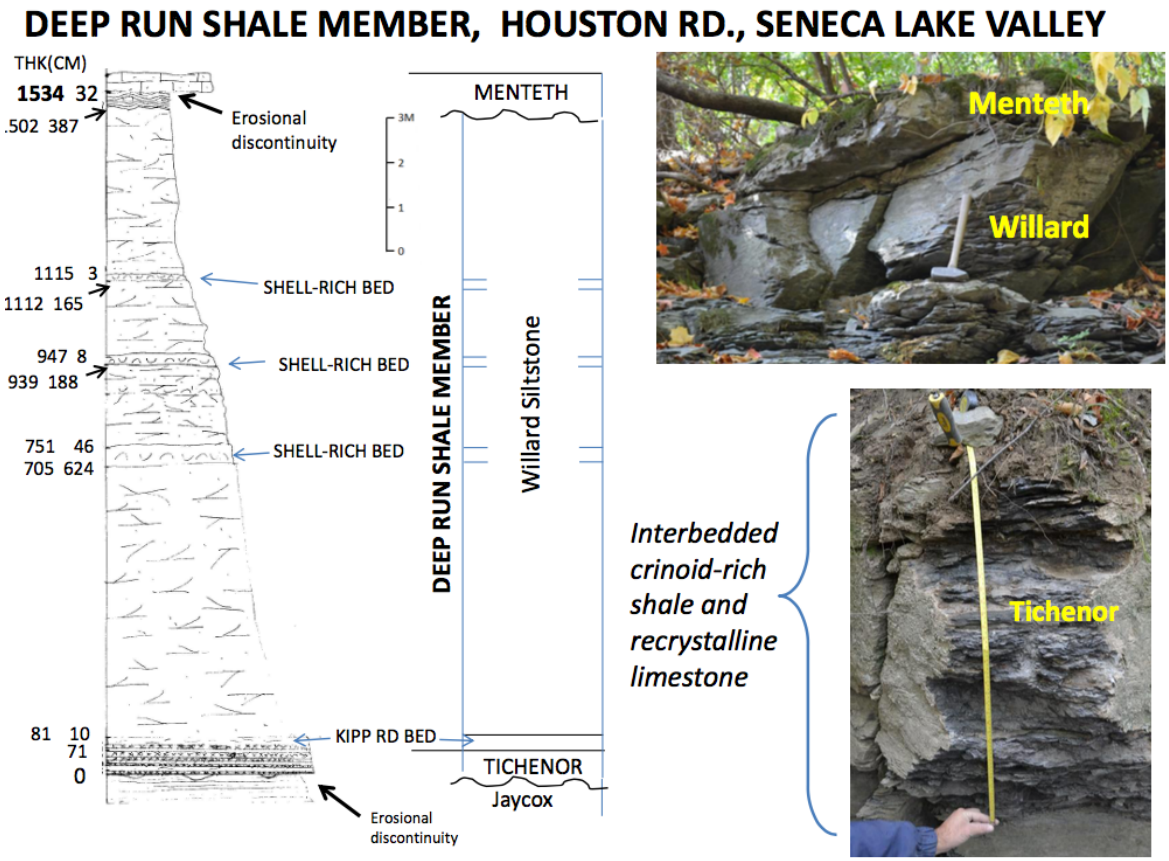



Figure 5. Generalized stratigraphic column of Deep Run Shale Member, Houston Road Gully, Seneca Lake Valley.

## BIOFACIES GRADIENTS AND DEPOSITIONAL ENVIRONMENTS

The Deep Run Shale Member displays several isochronous beds, which can be directly correlated across the western and central Finger Lakes Region (Fig. 6). Moreover, several geographically widespread lithofacies and biofacies can be directly related to inferred depositional environments. Reconstructions of these depositional environments are based on the paleoecological models for the Hamilton Group presented in Brett, Baird, and Miller (1986) as well as in Brett et al (1990, 2007, 2013). The model (Fig. 7) shows the distribution of fossil associations along gradients of increasing bathymetry compared to gradients of increasing sedimentation and increasing turbidity. Furthermore, Brett et al (1994, 2013) have shown that the axis of the northern arm of the Appalachian Basin undergoes a progressive westward shift across New York State probably due to thrust loading in the Acadian Orogeny. During the time of the deposition of the Deep Run Shale Member, sediment accumulation was greatest in the central basin or depocenter now occupied by Canandaigua Lake Valley. Both to the east and west of this central trough, sediment accumulation was significantly less, as observed in the thickness of the outcrops of the Seneca Lake Valley and the Genesee River Valley. Furthermore, across the western shelf, sediment starvation played an important role in the depositional environments observed in the western localities.

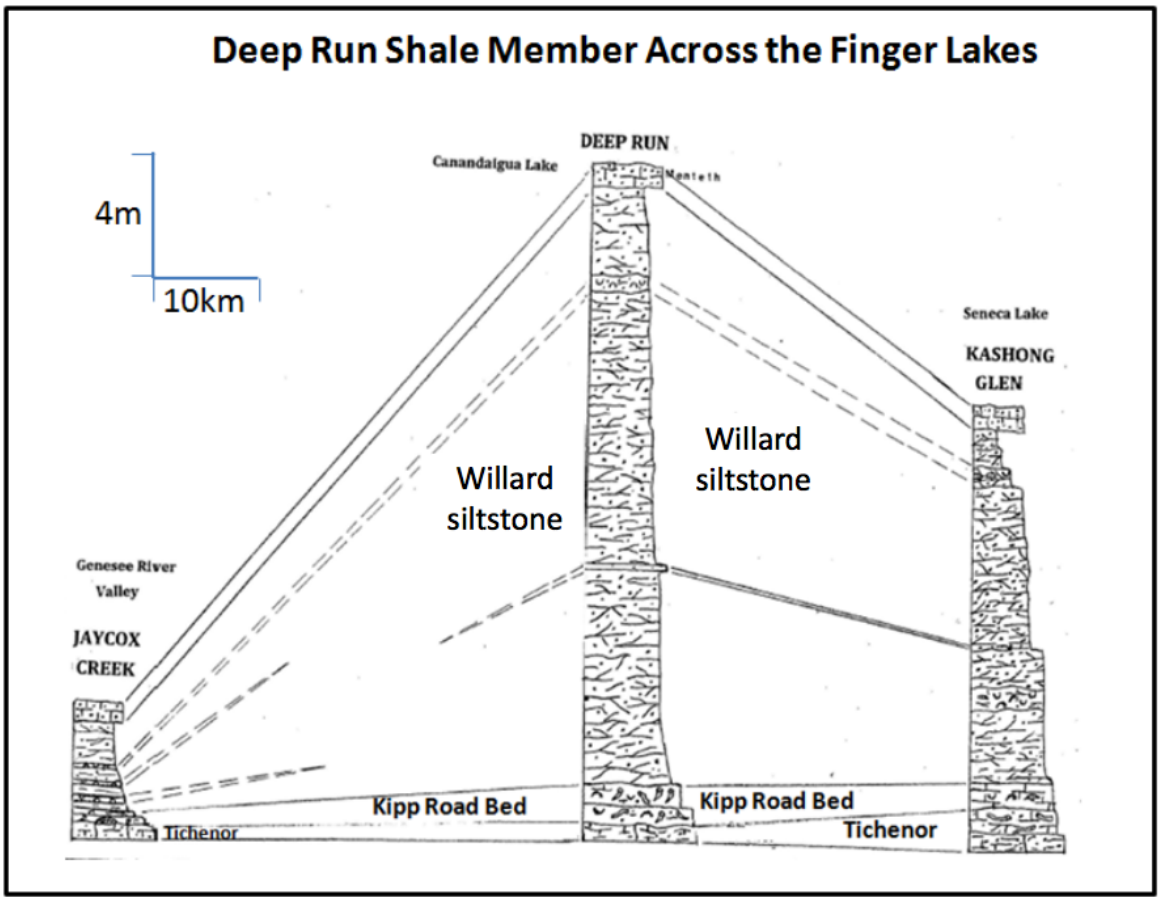



Figure 6. Correlation of the Deep Run Shale Member from the Genesee River Valley to Seneca Lake. Note schematic drawn to show emphasis on key units and not specific locality details.

Kipp Road Bed: Fossils in the western exposures of the Kipp Road Bed are representative of the *Favosites hamiltoniae* biofacies of Brett et al (2013). The fossils observed in sections at Jaycox Creek and further west are very diverse and abundant, yet this faunal assemblage may represent a time-averaged accumulation of fossils aggregated by relatively slow sedimentation. This is due to the observation of well-preserved corals *Favosites hamiltoniae* and *Heliophyllum halli* mixed in with disarticulated and/or broken shell and crinoidal debris within a condensed stratigraphic section. Furthermore, the occurrence of these corals, along with large trilobites, fenestrate bryozoans and brachiopods, is indicative of clear, warm, shallow water (Fig. 8).

As the Kipp Road Bed is traced eastward into the central depocenter, the *Favosites hamiltoniae* biofacies very gradually grades basinward into the *Spinocyrtia-Ptychopteria* biofacies of Brett et al (2013). Particularly noteworthy is the loss of the corals *Favosites* and *Heliophyllum* which are replaced by *Cystiphyllum* and Eridophyllum. However, most of the additional taxa remain similar but a few chonetid brachiopods, as well as the pteriomorph bivalve *Actinopteria,* are present to abundant as part of the *Spinocyrtia-Ptychopteria* biofacies. This indicates that the water became too deep and/or too turbid to support colonies of *Favosites* and *Heliophyllum* and taxa more tolerant of those environmental conditions were present. Moreover, on the eastern side of the central trough and the eastern shelf, corals disappear altogether.

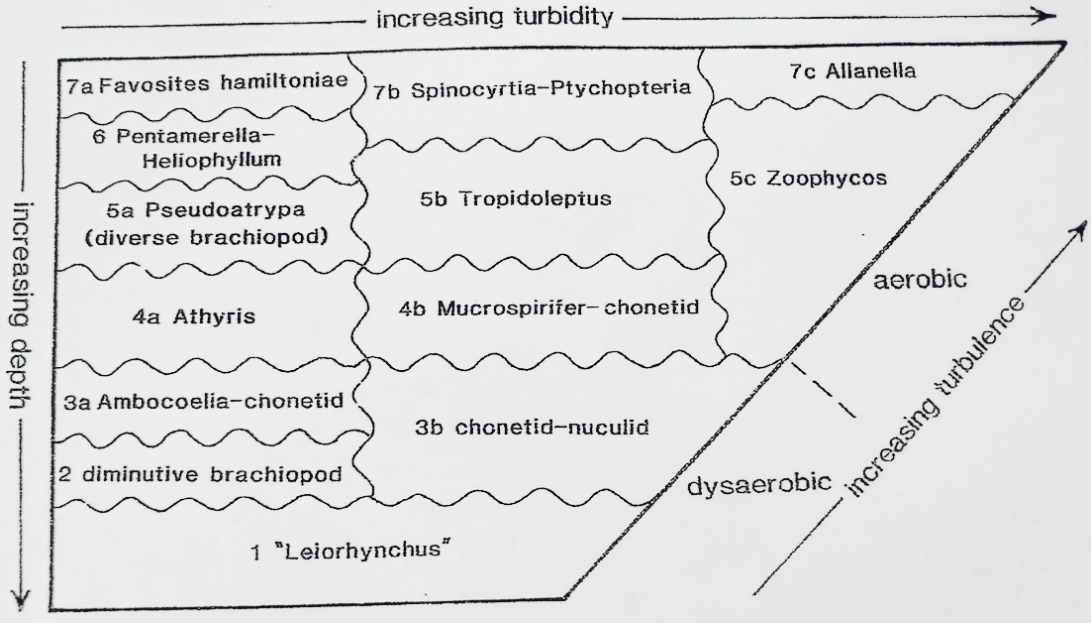



Figure 7. Paleoecological model relating Ludlowville – Moscow biofacies to inferred bathymetry, sediment accumulation rate and turbidity. Adapted from Brett et al. (1990, 2013).

These beds also seem to record a nutrient-rich, robust ecosystem. The occurrence of large trilobites with rare phyllocarids suggest a hierarchy within an active food chain. These beds are also characterized by the presence of large infaunal to semi-infaunal diverse bivalve fauna. The common occurrence of the clams, *Grammysia*, *Modiomorpha*, *Goniophora* and others are suggestive of "good times" as well as the abundance of *Zoophycos* and *Tropidoleptus* further suggests at least moderate to high nutrient presence.

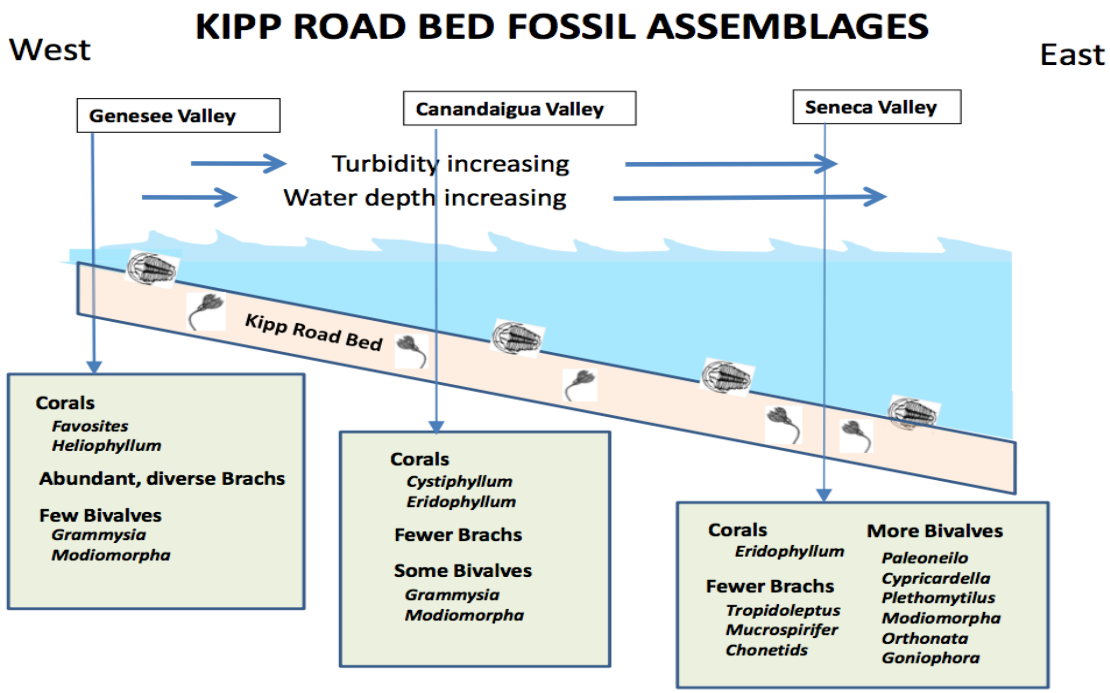


Figure 8. Schematic illustrating lateral change in Kipp Road Bed fossil assemblages from west to east across the Finger Lakes.

Willard siltstone interval: The transition from the Kipp Road Bed to the Willard siltstone interval is relatively abrupt. Water depths and rates of sedimentation must have increased significantly as siliciclastics become increasingly thick and fossils become scarce and widely scattered. Rapid burial at the onset of the deposition of the Willard siltstone interval is further indicated by the localized abundances of well-preserved fossils including articulated *Taxocrinus* crowns. Depositional environments shift in the central trough (Canandaigua Lake Valley) from the *Spinocyrtia – Ptychopteria* biofacies to the *Tropidoleptus* through the *Mucrospirifer* – chonetid to the chonetid - nuculid biofacies (Fig. 7). The presence of the brachiopods *Tropidoleptus*, *Mucrospirifer*, *Mediospirifer*, and *Devonochonetes coronatus* as well as nuculid bivalves, such as *Paleoneilo* and numerous other bivalves including *Modiomorpha*, *Cypricardella* and *Goniophora* clearly indicate muddy and or turbulent, deep water environmental conditions. Except for occasional small phacopid trilobites and crinoidal debris, the taxa of the *Favosites hamiltoniae* biofacies are gone. No tabulate or rugose corals can colonize and live on this rapidly accumulating muddy sediment substrate.

Moreover, an additional biofacies represented by the taxon *Zoophycos* is present in the silty mudstone to muddy siltstone deposits of the Willard interval (Fig. 9). Sediment mixing by the *Zoophycos* – producing animal created a seafloor too unstable for colonization by most benthos (Rhoads, 1974) resulting in a low density low diversity faunal assemblage. Within this barren to poorly fossiliferous sequence, a few scattered shell-rich horizons indicate periods when sedimentation rates temporarily slowed thereby allowing minor colonization of the seafloor by benthos. Often-times these taxa are preserved in-situ suggesting renewal of rapid burial and the return to the *Zoophycos* biofacies.

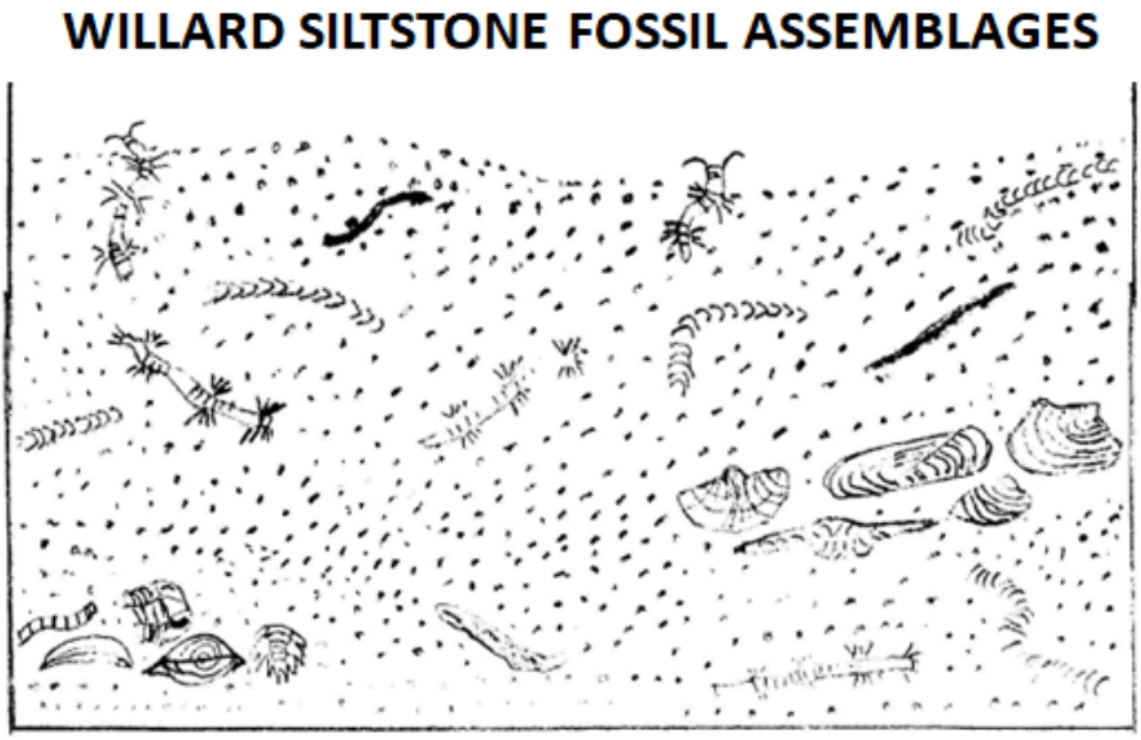



Figure 9. Schematic illustrating Willard siltstone fossil assemblages. Note substrate is barren to poorly fossiliferous with pervasive bioturbation and localized shell-rich horizons.

At some point in time, sea levels began to drop, the water became shallower, and sedimentation rates slowed due to apparent sediment bypass. At the very top of the Willard siltstone, an erosional surface developed presumably during a shallowing episode at the end of the deposition of the Deep Run Shale Member. Evidence of this surface is manifested by the wavy and irregular, very thin, less than 5 cm (2 in.) thick "stacked" ripple-like beds directly beneath the Menteth Limestone. This cryptic surface lacks fossils and may have originated at or above intertidal wave base. Additionally, well-developed scour and fill sedimentary structures form part of the base of the Menteth Limestone. This erosion removed or truncated sediments both east and west of the central trough depocenter. Coupled with sediment starvation on the western shelf, all traces of the Deep Run Shale Member have been removed in the vicinity of present-day western Erie County. On the eastern shelf, Baird (1979) showed the facies of the Deep Run Shale Member merged into the Portland Point Limestone Member east of the present-day Seneca Lake Valley.

## SUMMARY

Detailed microstratigraphic study of the Deep Run Shale Member has revealed two regionally mappable units through the Finger Lakes of New York consisting of a 1 m thick lower, fossiliferous layer designated the Kipp Road Bed and an upper, barren to sparsely fossiliferous interval designated the Willard siltstone. These units were deposited across a western shallow shelf and a central basinal trough of the northern Appalachian Basin. Moreover, sections along the west shore of present-day Seneca Lake revealed more beds, which may have been deposited only in the central trough and are interpreted to be early stages of Tichenor deposition.

The Kipp Road Bed is a muddy siltstone characterized by high species diversity and abundance, which decreases basinward due to increased bathymetry and turbidity. The Willard siltstone interval is typified by low species diversity and scarcity, which reflects rapid rates of sedimentation with intense bioturbation and maximum water depths. A few widely scattered very thin, shell-rich horizons in the Willard contain many well-preserved in-situ fossils indicating a temporary slowing of sedimentation, limited short-term colonization of the substrate followed by renewed rapid burial.

Although the Deep Run Shale Member records a general deepening of sea level commencing with the deposition of the subjacent Tichenor Limestone, sea level must have dropped at some point, which allowed an erosional surface to develop near the very top of the Willard. Siliciclastics were truncated both east and west of the central trough prior to the deposition of the Menteth, thereby ending the accumulation of sediments of the Deep Run Shale Member.

## ACKNOWLEDGEMENTS

I would like to thank Frederick M. Haynes (retired Petrophysicist ExxonMobil) for his assistance in measuring important stratigraphic sections of the Deep Run Shale Member at both the type locality along Canandaigua Lake as well as at the section along Houston Road. Furthermore, I would like to thank him for aiding in the preparation of many diagrams utilizing his expertise with Microsoft PowerPoint software.

I would like to thank my wife, Tammy Mayer, who assisted me in measuring the difficult stratigraphy at Kashong Glen. Not only is the ravine very steep and strenuous to gain access into and out of, she braved the heat, humidity and bugs. She untiringly listened to my ideas while not having a formal education in

geology. She helped in typing the manuscript and most importantly she has been very patient with me during this research project.

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## ROAD LOG AND STOP DESCRIPTIONS

| Cumulative Miles | Incremental Miles | Route Description |
|---|---|---|
| 0 | 0 | Leave Alfred University |
| 0.8 | 0.8 | proceed on North Main Street |
| 2.1 | 1.3 | Continue straight on NY-244E |

| | | |
|---|---|---|
| 6.1 | 4.0 | left onto NY-21 N |
| 6.3 | 0.2 | Turn left onto Karrdale St |
| 6.6 | 0.3 | Turn right to merge onto I-86 E/NY- 17 E |
| 11.5 | 4.9 | Take Exit 34 N to merge onto NY- 36 N |
| 25.5 | 14.0 | Turn left onto I-390 N ramp |
| 25.7 | 0.2 | Merge onto I- 390 N |
| 41.2 | 15.5 | Take Exit 7 toward Geneseo |
| 41.6 | 0.4 | Turn right onto NY-408 N |
| 41.7 | 0.1 | Continue straight on NY–63 N |
| 45.0 | 3.3 | Continue straight on US-20A E |
| 45.7 | 0.7 | Turn left onto Main Street |
| 46.1 | 0.4 | Proceed onto Rt. 39 Avon Road |
| 48.5 | 2.4 | Continue north, past Nations Road, site on left across field<br>Must obtain permission from Genesee River Conservancy Research Reserve. |

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## STOP 1: Jaycox Creek – The Rest of The Story

Location Coordinates: ($42.829^0$ N, $77.790^0$ W)

Jaycox Creek is a classic exposure of the Ludlowville and Moscow Formations within the Hamilton Group. This is the type locality for the Jaycox Shale Member, which contains 2 prominent mappable coral beds, the lower Green's Landing Coral Bed and the upper Cottage City Coral Beds separated by variably fossiliferous shales and calcareous mudstones. Although many studies have examined the stratigraphy and paleontology of the Jaycox Shale Member, (Grasso, 1973, Baird, 1979, Brett and Baird, 1994, Mayer, 1989, Mayer, 1994), most people have not scrutinized the overlying Tichenor Limestone and the Deep Run Shale Members.

The Deep Run Shale Member is well exposed here from the base of the Kipp Road Bed through the upper Willard siltstone (Fig 3). The bluish-gray calcareous mudstones of the Kipp Road Bed are observable in the creek floor and banks and exhibit great faunal diversity and abundance. Moreover, the Willard interval, characterized by barren to poorly fossiliferous bioturbated siltstones also contains three distinct shell-rich lenses. Whereas the transition from the Tichenor Limestone to the Deep Run Shale Member is relatively gradational, the uppermost contact of the Willard is abrupt with the overlying Menteth. Sediments of the Deep Run Shale Member are observed to be much thinner in the Genesee Valley than in the Canandaigua Valley due to apparent sediment bypass on the western shelf of the Appalachian Basin and from erosional overstep by the Menteth Limestone Member.

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| Cumulative Miles | Incremental Miles | Route Description |
|---|---|---|
| 54.9 | 6.4 | Proceed north on Rt. 39 to Avon |
| 55.7 | 0.8 | Turn right onto West Main Street (Routes 5 & 20)<br>proceed around traffic circle to east Main Street<br>continue to McDonald's on left.<br><br>This is a Lunch/Restroom stop. |

| | | |
|---|---|---|
| 82.1 | 26.4 | Proceed east on Routes 5 & 20 to NY-364 S. |
| 85.6 | 3.5 | Turn right onto NY-364 S (East Lake Road) |
| 85.7 | 0.1 | Pass Kipp Road |
| | | Park in Deep Run Beach area. Walk across road to creek. |

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## Stop 2: Deep Run Gully

Location Coordinates: (42.821$^0$ N, 77.259$^0$ W)

This creek not only is the type locality for the Deep Run Shale Member but also provides an excellent view of the upper Wanakah, Spafford and Jaycox Members. Of interest in the small falls at the base of the overall section is the Limerick Road Bed of the Spafford Shale Member. Moreover, in the Jaycox Shale Member the lower Green's Landing Coral Bed and the upper Cottage City Coral Beds are observed in the floor and banks of the creek. The top of the first major waterfall is capped by the Tichenor Limestone, which disconformably overlies sediments of the Jaycox Shale Member.

Above the falls and in the floor of the creek, the transition from the Tichenor Limestone to the Kipp Road Bed is again relatively gradational. Here in the Canandaigua Valley, the Deep Run Shale Member obtains its maximum thickness within the central depocenter of the Appalachian Basin. The Kipp Road Bed exhibits decreased species diversity apparently due to increased water depths and turbidity. Also, the Willard siltstone interval contains a few shell-rich lenses within a predominately barren to sparsely fossiliferous siltstone indicating overall rapid sedimentation rates punctuated by a few periods of quiescence allowing colonization of the substrate. The Menteth Limestone tops this sequence of siltstones forming an erosionally resistant ledge to a second large waterfall at Deep Run Gully.

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This field trip will not observe the Deep Run Shale Member at Kashong Glen due to the inherent steep sides of the ravine. Similarly, the sections along the west shore of Seneca Lake will also not be examined due to their inaccessibility. However, just one-half mile north of Deep Run Gully on Canandaigua Lake is an exceptional exposure of the Jaycox Shale Member at Green's Landing. This will be our last stop.

| Cumulative Miles | Incremental Miles | Route Description |
|---|---|---|
| 86.2 | 0.5 | Proceed north on East Lake Road to Tamberlane Farms |
| | | Must ask permission to enter property. |

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## Stop 3: Green's Landing

Location Coordinates: (42.830$^0$ N, 77.257$^0$ W)

Approximately 1600 ft. east of Rt 364, this small stream cuts through the Jaycox Shale Member as well as the Kipp Road Bed of the Deep Run Shale Member. The only slight falls along this creek is created by the cap of the Tichenor Limestone, otherwise, the locality is generally ramped upstream and provides an accessible view of these units.

Here, the lower coral bed of the Jaycox derives its name because of its remarkable development in this creek. The Green's Landing Coral Bed is an argillaceous mudstone containing an abundance of tabulate and rugose corals as well as brachiopods, bryozoans, crinoids, gastropods, and trilobites. Although

recognizable in many localities, this mass of rock is a distinctly bedded biostrome built by and composed mainly of the remains of sedentary organisms.

Additionally, the Cottage City Coral Beds as well as the other units of the Jaycox are observable in outcrop in the floor and banks of the creek. These strata are, in turn, disconformably overlain by the Tichenor Limestone Member which gradually grades upward into the Kipp Road Bed.

The Kipp Road Bed is the only bed of the Deep Run Shale Member exposed at Green's Landing. The medium gray, silty mudstone to calcareous siltstone contains a moderately abundant fauna of large phacopid trilobites as well as camerate crinoids, which have facilitated correlation of this unit across the Finger Lakes. Moreover, the Willard siltstone interval and Menteth Limestone Member are both covered at this site.

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**End of Trip:** Head south on NY-364 S toward Middlesex;
Turn right onto NY-245 S toward Naples;
Turn left onto NY–21 S toward North Hornell;
Turn right onto NY-66 W;
Turn right onto NY-21 S toward Alfred Station;
Turn right onto NY-244 W toward Alfred University.