

O.L.M.C. HENDERSON #1 31-067-21471

LAFAYETTE TOWNSHIP, ONONDAGA COUNTY, NEW YORK

FORMATION TOPS FROM GAMMA RAY LOG PICKS AND SAMPLES
ELEVATION FROM GROUND SURFACE

0-419 Glacial Valley Fill, clay, silt, sand, gravel, boulders, till
 419- Top of Bedrock
 419-448 Manlius Formation, limestones
 448-503 Rondout Formation, Dolostones
 503-531 Cobleskill Formation, Limestones
 531-624 Bertie Formation, Dolostones and shales
 531-541 Williamsville Member, Dolostone
 541-594 Forge Hollow Member, Shale
 594-624 Fiddlers Green Member, Dolostone

614 Below approximately 614' all Gamma Ray Log tops are 10' deeper than the corresponding sample tops from the core description - believe this reflects a pipe tally error during flow testing of the water zone at 606'-614' or more likely during redrilling of cavings in the interval prior to resuming coring. Tops listed below are Gamma Ray Log tops which correlate with core description tops 10' shallower. Log total depth of 1058' is also 10' deeper than the driller total depth of 1048' which corresponds with this analysis.

624-782 Camillus Formation, Shales
 782-1034 Syracuse Formation, Salt and shales
 The top of the Syracuse Formation is a change to black shale from the overlying dolostones. The top of the Syracuse could also be picked as the top appearance of salt in these shales as there appears to be an abrupt change from an environment of anhydrite deposition above to salt deposition below 805'(795' in core).
 828-878 Salt, "2nd salt ?"
 929-1034 Salt, "3rd and 4th salt ?"
 1034- Vernon Formation, Shale
 1058 TD Logger, 1048 TD Driller

From main 16" well - NX Triple Tube Coring

The following core description is a field description.
The core was not split or unnecessarily broken.
Core was boxed with a minimum of disturbance to preserve
the character of the natural fracturing.

- 430.0 - 448.0 LIMESTONE, dark gray to very dark gray, thin to medium bedded with black shale partings, borings stylolites and soft sediment deformation, aphanitic
- 431.0 Vertical fracture
- 434.0 Fracture, steeply inclined, irregular
- 435.8 - 436.8 Vertical fracture, no staining
- 443.0 - 444.0 1/8" black shale interbeds
- 447.0 - 447.7 Fractures inclined 45°
- 448.0 - 451.5 DOLOSTONE, Light to medium gray, thin to medium bedded, bioturbated
- 451.5 - 455.7 DOLOSTONE, dark gray, shaly with cut and fill soft sediment deformation, top transitional to thin bedded
- 452.3 - 452.9 1/16" thick vertical calcite filled fracture
- 455.7 - 462.2 DOLOSTONE, medium gray, hard, with white calcite and dolomite blebs and filled vugs. Scattered vugs below 461' are calcite and gypsum (selenite) crystal lined.
- 462.2 - 462.5 DOLOSTONE, medium gray, calcareous, shaley with white crystalline calcite lined vugs, vugs open but not connected
- 462.5 - 462.8 Medium gray shaly limestone interbed
- 462.8 - 464.3 DOLOSTONE, medium gray, shaley, scattered calcite crystal lined vugs, several coring induced fractures.
- 464.3 - 465.2 DOLOSTONE, becoming darker gray shaly, moderately calcareous
- 464.5 - 465.0 Vertical fracture
- 465.2 - 475.0 DOLOSTONE, dark gray, medium to thin bedded with interbedded thin limestones which have fine vugs or solution cavities. Also interbedded dark gray shales which are recovered broken in the core barrel
- 467.8 1" fractured dolomitic shale "rubble" zone
- 469.0 1" fractured dolomitic shale "rubble" zone
- 469.3 - 470.3 Fractured zone, fractures appear tight to water

- 474 - 475 Brecciated shaley dolostone with muddy fines - poor core recovery in this zone
- 475.0 - 477.0 DOLOSTONE, dark gray, shaley, medium bedded
- 477.0 - 483.5 SHALE, dark gray, dolomitic, thin bedded, 1/8" vertical calcite filled fractures, soft - disintegrates into flat fragments on removal from core barrel.
- 482.5 - 483.0 Calcareous mud seam
- 483.5 - 484.5 DOLOSTONE, dark gray, shaly, grades downward into massive sugary dolomite
- 483.5 - 485.2 Vertical fracture, paper thin, white calcite filled
- 484.5 - 503.0 DOLOSTONE, dark gray to very dark gray, massive becoming thin bedded below 491'
- 485.2 Vugs, calcite and dolomite crystal lined
- 490.9 - 492.0 Vertical fracture, paper thin, calcite filled
- 492 Stylolite
- 503.0 - 507.0 LIMESTONE, very dark gray to black, dolomitic stylolites, thick indistinct bedding and black shale partings and interbeds up to 1/4" thick soft sediment deformation - core has blebby appearance.
Black shales are reasonably intact in core barrel but disintegrate on removal.
- 507.0 - 513.0 LIMESTONE, very dark gray, shaley with thin black shale interbeds and stylolites below 510'
Discontinuous slickensides on parts of stylolite surfaces.
Thinner bedding downward.
- 512.5 2" fractured "rubble" zone, no staining, possible water zone?
- 512.5 - 517.6 Several thin fracture zones, possible water entry? Zones 1/2" to 2" thick look like a handful of washed crushed stone when core barrel opened.
- 513.0 - 531.0 LIMESTONE, black, dark gray mottling, bedding bioturbated, soft sediment deformation, interformational pebbles, numerous stylolites
- 515 20° inclined slickenside on stylolite surface
- 517.2 - 517.9 Vertical fracture, no staining
- 531.0 - 541.0 DOLOSTONE, medium to dark gray, thin bedded, gypsiferous,
Top contact gradational with overlying limestone
Interbeds of gypsum and black shale
Approximately 40% of core is white gypsum beds which appear as a collection of blebs or nodules usually less than 3" thick.

- Contacts with adjoining shales and dolomites are jagged with shale bedding frequently distorted or fractured - white gypsum fills fractures.
- 541.0 - 563.0 SHALE, black, noncalcareous, gypsiferous, with white gypsum interbeds as above,
- 541.0 - 547.0 Decrease in dolomite content.
Below 547' gypsum blebs and fragments become small - 1/8" diameter or less and appear disseminated in the thin bedded noncalcareous black shales. bedding broken by cut and fill, Fine interformational conglomerates of both gypsum and shale.
- 553.3 1" fractured "rubble" zone, clean, no staining
- 555.5 2" fractured "rubble" zone, filled with mud fines.
- 563.0 - 568.0 SHALE, dark gray, thinbedded, gypsiferous and noncalcareous dark gray shale, soft sediment deformation, cut and fill, interformational conglomerates - fine pebble sizes
Decrease in gypsum content from overlying shales
- 568.0 - 571.1 as above with slight dolomitic content
- 571.1 - 579.0 SHALE, as in 563' - 568' interval, dark gray noncalcareous, thinbedded
- 579.0 - 588.1 SHALE, dark gray, slightly dolomitic, gypsiferous thin bedded, Bedding thin, wavy, broken with soft sediment deformation and small interformational clasts.
- 579.4 1/4" thick undulating black shale with 1/16" gypsum seam and small vug.
- 583.0 - 584.4 Dark gray shale interbed
- 588.1 - 591.4 SHALE, medium to dark gray, slightly dolomitic with white gypsum and thin selenite beds and horizontal veins - maximum thickness 1/8"
Shallow angle paper thin fractures filled with white gypsum.
- 591.4 - 594.0 SHALE, black, slightly dolomitic, soft
- 591.8 - 592.1 60° inclined fracture, no staining
- 592.7 Paper thin gypsum filled vertical fracture.
- 594.0 - 606.0 SHALE, black, dolomitic, thick bedded with selenite crystals in predominately empty vugs. Vugs are up to 1/2" in diameter but do not appear to be interconnected.

594.5 Horizontal slickensides

596.2 - 596.4 Jagged solution channel in inclined fracture

597.2 1" fractured "rubble" zone, clean, no staining

598.7 Horizontal slickensides

599.1 - 600.0 Nearly vertical fracture , widened by solution

606.0 - 614.0 DOLOSTONE, dark gray, shaly, medium bedded with black shale partings

608.0 - 610.0 2' fractured "rubble" zone - looks like coarse washed crushed stone in the core barrel
2+' of missing core in this interval could make this interval up to 4' thick
100+ gpm water zone - artesian

611.0 - 613.0 Fractured and vuggy with 20° dip on shale partings and 1/8" gypsum veins
Slickensides on undulating black shale surface
20° inclined black shale parting

613.0 - 614.0 Fractured "rubble" zone of washed coarse crushed stone - probably water bearing
poor core recovery in this 1' core run.

614.0 - 616.5 SHALE, dark gray, noncalcareous disturb bedding

615.0 - 616.1 Mass of shallow angle fractures less than 1/8" thick filled with white fibrous gypsum

616.5 - 623.0 SHALE, dark gray, hard, noncalcareous to slightly dolomitic. Thick bedded with black noncalcareous shale interbeds and scattered horizontal thin gypsum filled fractures.

623.0 - 628.5 SHALE, dark gray, dolomitic, silty?,
627.1 1" horizontal gray clay seam, slightly calcareous

628.5 - 636.6 DOLOSTONE, dark gray, shaly, medium bedded

632.8 Gas Show in fracture "rubble" zone - appears as coarse washed crushed stone in core barrel

636.6 1" fractured "rubble" zone, clean, no staining

636.6 - 642.8 DOLOSTONE, dark gray, shaly with black shale interbeds. Wavy distorted and broken bedding thin to medium bedded

637.5 - 637.9 Vertical fracture, closed, no staining

642.7 Partial slickensides in black shale bed

642.8 - 645.9 SHALES, dark gray and black, interbedded, noncalcareous, thin bedded with thin gypsum beds, soft sediment deformation and shearing

- 645.9 - 648.8 Transition to greenish-gray shale with gypsum and dark gray shale interbeds
- 645.9 - 648.1 Vertical fracture, closed, no staining
- 648.8 - 658.0 SHALE, greenish-gray, massive, with scattered gypsum beds and blebs
- 650.2 45° fracture, closed, no staining
- 653.0 - 653.3 Vertical fracture, tight, no staining
- 654.2 - 654.2 45° slickenside surface, no mineralization
- 656.4 - 656.4 60° slickenside surface with 1/16" of smeared gypsum on shear surface
- 658.0 - 660.0 transition to thin bedded, gypsiferous, silty dolomitic shale
- 660.0 - 668.5 SHALE, dark gray, dolomitic
- 662.7 Horizontal slickensides in vuggy white gypsum seam 1/8" thick
- 662.9 Horizontal, vuggy 1/8" thick gypsum seam
- 663.5 Horizontal, vuggy 1/8" thick gypsum seam
- 667.3 30° slickenside surface, no mineralization
- 668.5 - 677.5 SHALE, greenish-gray, noncalcareous with thin horizontal gypsum seams and gypsum blebs
- 671.6 - 672.2 Mass of thin gypsum filled fractures
- 677.5 - 679.0 Silty layer of soft sediment deformation, thin shales broken and fragmented
- 679.0 - 694.0 SHALES, black, with interbedded dark gray dolomitic shales and siltstones
Bedding varies from thin wavy to thick apparently undeformed beds.
Occasional thin white gypsum beds
- 690.0 - 692.0 Vertical fracture, no stain, poor core recovery in this interval
- 692.0 - 693.0 Fractured "rubble" zone - looks like washed crushed stone, thickness uncertain because of poor core recovery
- 694.0 - 715.5 SHALE, black, slightly dolomitic, thick bedded
- 695.5 - 695.7 45° slickenside surface, no mineralization
High core time rate caused by mechanical problem

- 715.5 - 734.3 SHALE, slightly greenish gray, dolomitic with occasional thin gypsum beds and white gypsum blebs
- 716.5 Slickensides on undulating surface, no staining
- 720.4 - 721.1 Vertical fractures with thin gypsum filling
- 726.1 20° inclined slickenside, no mineralization
- 728.3 - 729.1 DOLOSTONE, interbed, medium gray, shaly
- 732.8 - 733.0 Vertical fracture, no staining or mineralization
- 734.3 - 747.0 SHALE, dark gray, dolomitic and slightly dolomitic mostly thin-bedded, with thin gypsum interbeds and blebs, Variable bedding - wavy, broken conglomeratic - shale fragments
- 737.6 Horizontal dark gray mud and gypsum seam
- 738.0 - 738.2 45° fracture, closed, no staining or mineralization
- 741.2 Slickensides, irregular surface, no staining or mineralization
- 746.3 Slickensides, nearly horizontal, no staining or mineralization
- 747.0 - 751.0 Dolostone, dark gray, shaly with gypsum blebs fragments and soft sediment deformation
- 751.0 - 762.5 SHALE, dark gray to black, brecciated(some is soft sediment deformation, some brittle fracturing with thin gypsum veins and fracture fillings
- 753.5 - 753.8 Breccia zone cemented with gypsum
- 755.0 - 755.5 Vuggy zone, "dirty" muddy residue indicates not recently flushed by flowing water
Selenite crystal lined vugs
- 756.6 ½" "rubble" fragments could contain water?
- 758.0 - 762.5 Mass of very thin white gypsum filled fractures
- 762.5 - 766.1 DOLOSTONE, dark gray, shaly with thin black shale interbeds, black shale partings, thin gypsum beds and fracture fillings
- 766.1 - 770.0 DOLOSTONE, black, shaly, extremely vuggy, vugs open but "dirty" - muddy such that they do not appear to be transporting water
no crystals in vugs
- 770.0 - 772.5 DOLOSTONE, black, shaly, gypsiferous, thin to medium bedded

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OLMC #1 CORE DESCRIPTION

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- 772.5 - 775.0 SHALE, black to dark gray, dolomitic, gypsiferous Fractured by both soft sediment deformation and fracturing. Thin gypsum filled fractures and blebs
- 775.0 - 783.0 SHALE, becoming brownish gray downward, slightly dolomitic, soft, gypsiferous(selenite), thinbedded with thin gypsum filled fractures and blebs, bedding indistinct
- 783.0 - 786.5 SHALE, black, noncalcareous, muddy breccia with gypsum
- 785.2 - 785.5 Mud seam with black shale fragments
- 786.5 - 793.0 SHALE, medium to dark gray, slightly dolomitic with gypsum blebs and fracture fillings
- 790.0 - 791.0 Breccia zone, vertical slickensides, gypsum and selenite filled fractures
- 793.0 - 795.0 SHALE, thin-bedded, dark gray with thin black shales and gypsum beds, wavy
- 795.0 - 797.0 SHALE, dark gray and thin black interbedded Salt and gypsum present in shale in in veins
- 795.5 - 795.9 Vertical fracture, salt filled
- 797.0 - 818.5 SHALES, dark gray to black, dolomitic, thin bedded with gypsum blebs and salt casts salt filled fractures Occasional thin salt bed below 811.5'
- 806.4 - 807.8 Stromatoporoid, dolomitized, thin voids filled with salt
- 807.8 - 818.5 Shales as above with gypsum blebs bedding becomes less distinct
- 818.5 - 820.2 SALT, clear to black banded, crystalline, with gradational contacts
- 820.2 - 822.3 SHALE, with salt filled vugs
- 822.3 - 849.0 SALT, banded clear to black, with small black shale inclusions
- 849.0 - 868.0 SALT, black, black shale inclusions up to 3" diameter. Shale contacts jagged. Distribution of shale fragments appears random with no orientation or remnants of bedding visible
- 868.0 - 919.0 SHALE, Black, slightly dolomitic, thin bedded with dark gray shale interbeds, fractured with numerous horizontal(parallel with bedding) and vertical fractures, occasional gypsum blebs 20° dip, gradational contacts with both overlying and underlying salts.

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OLMC #1 CORE DESCRIPTION

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- 883.5 - 885.5 Breccia zone, fracture voids are salt filled with fine pyrite crystals
- 884.7 Fault surface, 45° inclined slickensides
- 891.4 - 893.0 Increase in gray gypsum lenses
- 894.8 Slickensides on bedding surface, 10° dip
- 905.0 - 907.0 Stromatoporoid, dolomitic
- 919.0 -1023.7 SALT, dark gray to black, occasional band of light gray salt, scattered dolomitic shale inclusions with jagged edges, most shale inclusions do not exceed core width in diameter
- 985.5 Occasional shale fragment exceeds core diameter
- 1023.7-1042.5 SHALE(Vernon), slight greenish-gray, dolomitic, with light reddish-orange salt filled fractures, vugs and stylolites. Fractured, Scattered gray gypsum filled vugs and blebs. Salt filled vugs have a fine insoluble(dolomite?) crystal lining.
Bedding thin to medium - fractured and distorted.
- 1042.5-1048.0 TD SHALE, dark gray, dolomitic, with salt filled fractures and gypsum blebs.
Similar to overlying shale but lacks overlying greenish color tint.