SEDIMENTOLOGY AND GEOCHEMICAL INVESTIGATIONS OF THE EXPOSED ORDOVICIAN-DEVONIAN SEDIMENTARY ROCKS, ROSENDALE, ULSTER COUNTY, NEW YORK

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Figure 2 Muyiwa Taiwo Pointing at the Angular Unconformity between the Silurian High Falls Shale (above) and Ordovician Hudson River Shale (below)

Figure 3 Cobbleskill Unit is Characterized by Silicified Halysites (Silurian Coral)

Figure 4 High Falls Shale Exhibiting Slaty Cleavage

Figure 5 Penecontemporaneous slumping in High Falls Shale

Figure 6 Quartz-pebble Conglomerate (Shawangunk Conglomerate)

Figure 7 York Geology Group in Rosendale

Figure 8 Kalkberg Limestone with Cherty Horizons

Figure 9 Asymmetric Ripple Marks in Binnewater Sandstone

Figure 10 Mine Entrance

Figure 11 Moderately Dipping, Thickly-bedded Binnewater Sandstone

Figure 12 Shallow-water Ichnofaunal Assemblages in Binnewater Sandstone

Figure 13 Crinoid-rich New Scotland Limestone

Figure 14 Machel Rhoden Inspecting Cherty Horizon (Kalkberg Limestone)

Figure 15 Atiqa Tirmizi Conducting Field Check for Rosendale Dolomitic Limestone

Figure 16 Becraft Limestone showing Crinoid

Figure 17 Mine Entrance

Figure 18 Malek Shami Collecting Samples from Manlius Limestone

Figure 19 Darlene Defabio Utilizing Portable Hand-held XRF to Record In-situ Chemical Signature (Manlius Limestone)

Abstract

Many of the Ordovician-Devonian formations in Rosendale, Ulster County, NY are dolomitic to mixed dolomitic-calcitic limestone, shale, sandstone and conglomerate (Figure 1A & 1B). Sporadic occurrences of chertiferous and phosphatic zones are known to occur within the Devonian units. Carbonate rocks are highly fossiliferous and fossils observed in the area include: Halysites (Silurian), Gypidula Coemanensis, and numerous Crinoids and Brachiopods (Lower Devonian). Other primary sedimentary features observed in the exposed formations include ripple marks, mud cracks, cross bedding, sole marks, and penecontemporaneous slumping (in the High Falls shale). Shallow water ichnofaunal assemblages also characterize several formations particularly the Binnewater (Figures 2-19). Depositional environments range from strictly continental to fluvio-deltaic to shallow marine with periodic incursions of the shallow transgressive sea. Stratigraphic contacts between formations are of sharp, inter-fingering and gradational nature. Several formations display a remarkable facies change laterally. Representative samples collected from several outcropping formations were investigated to establish geochemical fingerprints by using both major and trace elements. In terms of establishing a viable geochemical markers with respect to individual formations, several bulk oxides including SiO_2, Al_2O_3, CaO, MgO, Na_2O, K_2O, FeO, TiO_2 and individual elements such as Mn, Cu, Ti, Zr, Ni, Pb, Y, Rb, Ba, and Ce were found to be statistically significant for characterizing investigated formations and further studies involving a large sample-set are underway to expand this geochemical work for regional correlation purpose (Table 1, Figures 20-22). Structurally all of the exposed formations particularly the Shawangunk conglomerate(Silurian), High Falls shale (Silurian), Binnewater sandstone (Silurian), and cement series (Devonian) were subjected to Acadian Orogenic events and displayed pronounced structural deformation and exhibited development of rock cleavages in shaley units, tight folding, intersecting joints, and faulting. Furthermore, tectonic overprinting on the depositional units is obvious as evidenced from the development of an angular unconformity between the Ordovician Hudson River shale and Silurian High Falls shale.

Figure 1A

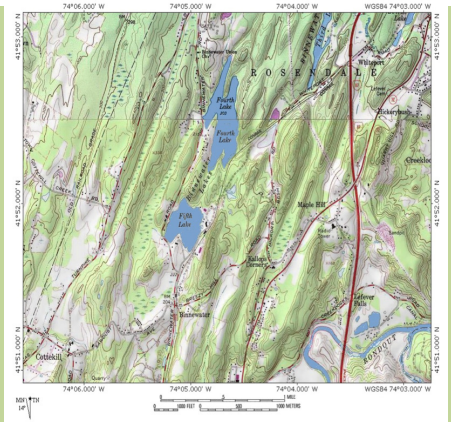

Figure 1B Topographic Map of the Field Area, Rosendale

Results

Table 1 Bulk Oxides and Representative Trace Elements Data (used XRF and ICPMS methods available at ALS Minerals, USA, Inc.)

Unit	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	CaO %	MgO %	Na_2O %	K_2O %	LOI %	Ce ppm	Cr ppm	Mn ppm	Ni ppm	Sr ppm	Y ppm	Zn ppm	Zr ppm
Esopus	71	11	4	3	2	1	2.50	5	16	20	119	31	55	10	36	12
GlenLs	75	2	1	10	0.5	0.2	0.5	8.5	11	9	272	6	149	7	25	3
PortELs	30	1.5	1	35	0.5	0.15	0.34	29	13	3	104	4	433	8	7	3
BecraftLs	22	0.8		40	1	-	0.1	34	19	2	200	1	753	8	4	1
KalkLs	46	0.75	0.5	28	0.4	-	0.2	23	10	3	196	1	345	8	14	1
CoeyLs									5	1	297	0.02	354	1	136	1
ManLs	26	5	2	19	12	0.3	2	30	18	10	1120	8	96	7	15	6
WhitepLs	14	3	2	25	15	0.2	1	37	16	6	1680	6	142	7	10	5
RosenLs	19	4	3	22	14	0.25	1	35	16	7	3180	8	82	7	24	4
BinnewSs									21	13	400	10	14	2	10	4
HighFSh	61	16	6.5	0.6	3	-	4.6	6	20	28	940	40	17	12	63	12
ShawangCgl	94	2	1.6	-	0.15	-	0.5	0.85	10	12	57	21	16	2	-	7
HudsonRSh	54	10.50	4	12	1.55	0.5	3	12.7	30	13	152	20	290	10	54	9

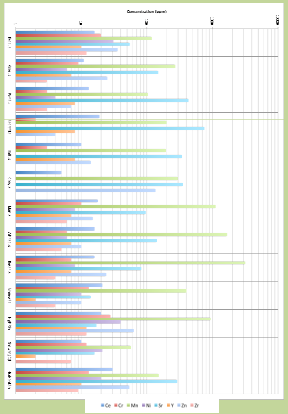

Figure 20 Representative Trace Elements Plot

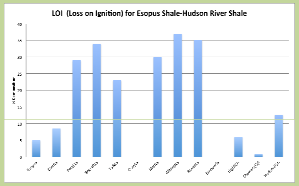

Figure 21 Loss on Ignition Data (carbonates and shaley units)

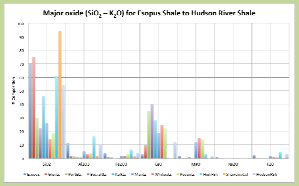

Figure 22 Bulk Oxide Plots

Several formations display a remarkable facies change laterally. Representative samples collected from several outcropping formations were investigated to establish geochemical fingerprints by using both major and trace elements. In terms of establishing a viable geochemical markers with respect to individual formations, several bulk oxides including SiO_2, Al_2O_3, CaO, MgO, Na_2O, K_2O, FeO, TiO_2 and individual elements such as Mn, Cu, Ti, Zr, Ni, Pb, Y, Rb, Ba, and Ce were found to be statistically significant for characterizing investigated formations and further studies involving a large sample-set are underway to expand this geochemical work for regional correlation purpose.