Structure and Geochemistry of a Cambro-Ordovician 360m Core from Saratoga Springs Region, New York State: Implications for Tectonics, Gas Exploration, and CO_2 Sequestration

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The Ordovician section in the Mohawk Valley has served as a model for Taconic plate tectonics, for Trenton-Black River gas production, and now for Utica black shale gas production. We conducted a detailed fracture analysis on a 635m (2084ft) unoriented core (75-NY-2, Charlton, NY; housed at NYS Museum) that penetrates the Cambro-Ordovician section from Schenectady Formation down to Grenville basement. Detailed analysis of kinematic indicators (e.g., calcite-filled rhombochasms, slickensides, vein offsets) provides structural guidelines for future gas production from the Utica Shale, and constraints on timing of fluid migration and faulting.

We measured 455 vein-filled fracture/faults in the core, including horizontal ($0\text{-}10^0$), shallow dipping (10^0 to 45^0), and steeply dipping ($>45^0$) vein-filled fractures, as well as vein-filled normal and thrust faults. In contrast to the Utica, the Schenectady and Frankfort formations are highly fractured and exhibit discrete deformed zones at 67m and 132m bgs (Schenectady Fm.,) and at 156m, 162m, and 171m bgs. (Frankfort Fm.) These zones have 94 slickensided/fiber calcite surfaces coated with anthraxolite; the upper 3 zones include soft-sediment deformation and scaly cleavage. The deformed intervals are mid Katian (late Caradocian) in age (~452-450Ma). Stable isotope ^{13}C and ^{18}O from 18 samples indicate two groups of veins. The core experienced migration of both Taconic wedge fluids (typical of the thrust veins in the core) and hydrothermal Mohawk Valley/Finger Lakes Trenton-Black River fluids. The soft sediment deformation, scaly cleavage, and localization of fractures in soft sediment deformation zones suggest these deformation zones were dewatered during late Taconic deformation.