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Lithostratigraphic borehole test sites in the northern Newark Basin: recent studies of Mesozoic rift basin geology

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A two-borehole test site is located in the northern part of the Newark Basin, situated on the western side of the Hudson River immediately north of the New York-New Jersey border and on the campus of Lamont-Doherty Earth Observatory of Columbia University. The site consists of Test Well-3 (TW-3: 41.00398°N, 73.91268°W) and Test Well-4 (TW-4: 41.00292°N, 73.91061°W), which are located roughly 700 ft (∼210 m) apart, and both of which intersect outcropping Palisade Sill and underlying sediments of the Newark Basin. TW-3 extends to a total depth of 1500 ft (457 m), terminating in lacustrine and fluvial sediments of the Stockton Formation; TW-4 was drilled to a total depth of 1802 ft (∼550 m), terminating in crystalline basement gneiss below the basin. Both holes are capped and remain mostly open (TW-4 is cased to 750 ft and collapsed below 1700 ft), and available for further experimental studies.

The Newark Basin is a sediment-filled rift basin formed 200 Ma in the Late Triassic, containing lacustrine and fluvial sediments with abundant red beds, interbedded sandstone, siltstone, and mudstone, and igneous intrusives. The site has been used for many research projects conducted over the years, including a hydrogeological study of the Palisade Sill and contact zone, a study of the biogeochemical effects of a simulated carbon dioxide leak into shallow aquifers, numerous studies on groundwater resources and pollution remediation in fractured aquifers, and most recently, for lithostratigraphic and geomechanical characterization of reservoirs for geological carbon storage. These multi-disciplinary and multi-scale scale studies provide broad datasets (core, geophysics, and cross-borehole), offering insight into the lithostratigraphy, hydrogeology and geologic setting of this Mesozoic rift basin.

This presentation highlights the lithological description and multi-scale petrophysical analysis of basement rocks, overlying marginal facies of the early synrift strata, fracture hydrology at the northeastern basin edge, and the basal contact of the Palisade Sill that were drilled and cored in the northeastern part of the Newark Basin, near its terminus. A variety of lithologically distinct sediments were encountered with brick-red to dark-purple mudstones and sandstones, abundant gypsum-filled fractures, and a thin zone with anomalously high uranium concentration. The low-permeability Palisade Sill is a dolerite intrusion and the crystalline basement is Fordham gneiss, overlain by a dark-purple hydrophilic mudstone and a thin sandstone layer. Comparison of the datasets in TW-3 and TW-4 shows that overall formation characteristics are similar, however individual lithological units and their hydraulic properties vary laterally over short distances. This test site may be used to study outcrop-borehole, borehole-borehole, and core-borehole petrophysical correlation, testing of experimental instruments, and analysis of reservoir and hydraulic properties in heterogeneous formations. For more information, see http://mlp.ldeo.columbia.edu/research/n-newark-basin-project-overview/