subsurface sedimentary layers.

Seismic mapping indicates much greater variation of near-surface horizons than mapping with well data. Axial planes of Acadian folds appear to be vertical. Fold amplitude diminishes between the Tully formation and the Lockport Group in some areas, while in other areas amplitude remains constant through the Devonian and Silurian section. In Chautauqua County, an anomalously thick Onondaga to Lockport interval parallel to regional fold axes has been interpreted as an anticline with a salt core, suggesting decollement tectonics.

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An Exploration Model for Medina Group Sandstones of Western New York and Northern Pennsylvania

Hydrocarbon accumulations in the Medina Group of western New York and northern Pennsylvania are controlled by stratigraphic traps. The discontinuous productive sand lenses were previously considered to be unmappable due to the erratic fluviatile deposition and marine reworking of the deltaic sediments. Wells were subsequently drilled only on the basis of pipeline availability, government spacing regulations, and general geology. Many of the completed wells proved to be marginal or noncommercial. Using core analysis, log data, and well production histories on several thousand wells, an exploration model has been developed to improve Medina well success ratios and performance. Specific sedimentary structures can be identified using characteristic gamma-ray patterns and they can be mapped in the subsurface. Highly productive coarsening-upward channel and bar-sand sequences can be projected into undrilled acreage, thereby reducing the percentage of non-economic wells drilled into the Medina sands.

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Oil and Gas Exploration in Appalachian Overthrust Belt of Southwestern Virginia

Hydrocarbon exploration is on the upswing in the southwestern Virginia portion of the "Eastern Overthrust belt." Several potential reservoir horizons have been identified on surface exposures, but remain untested. Major faults, including the Saltville and Pulaski thrusts, have as much as 16,000 ft (4,877 m) of displacement, suggesting potential structural traps in the largely allochthonous belt. Excluding the Early Grove gas field and the oil fields of Lee County, only a small number of wells have tested the strongly folded and faulted 20,000-ft-thick (6,100 m) sequence of Paleozoic sediments in the Valley and Ridge province. Seismic and leasing activities indicate several significant tests in the near future.

The Early Grove gas field was developed on an anticlinal flexure within the Greendale syncline. The field produced gas from porous anhydrite beds in the Lower Mississippian Little Valley Formation until shut-in in 1957. Five new wells since March 1980 have encountered near-virgin pressures in the old Little Valley pay zone and have discovered significant gas in the sandstones of the Price Formation.

Detailed field mapping near Rose Hill, Lee County, identified several fensters through the folded Pine Mountain overthrust block, and most oil exploration efforts have been concentrated in those windows. Recently, fensters near Ben Hur have also proved successful targets. Production is from shallow fractured carbonates of the Ordovician Trenton formation. An 8,020-ft (2,444 m) test by Shell Oil discovered a deeper major thrust, proving the allochthonous structure of the area, and indicating potential deep targets. An ARCO test now being drilled will help to evaluate the deeper possibilities.

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Stratigraphy and Facies Relationships of Silurian (Wenlockian) Rochester Shale: Layer Cake Geology Reinterpreted

Along its east-west trending outcrop belt in western New York and Ontario, the Silurian Rochester Shale displays classic "layer cake" stratigraphy. Lower and upper members and their component beds are traceable for distances exceeding 62 mi (100 km) east-to-west, without substantial change in lithology, fossil content, or relative thickness. In contrast, abrupt facies changes occur within the Rochester along short, 3 to 6 mi (5 to 10 km) north-south oriented sections (e.g., Niagara Gorge). Fossil-rich calcareous mudstones and thin limestones tongue out southward and are replaced by sparsely fossiliferous shales. Similarly, the frequency of storm-generated coquinites and calcisiltites decreases to the south. These observations indicate that facies belts are elongate east-west, perpendicular to a gently south-dipping paleoslope, and subparallel to the modern outcrop belt.

Vertical facies changes in the Rochester Shale at local sections reflect lateral (north or south) shifting of environmental tracts, due to migration of the northern paleoshoreline. The entire formation appears to comprise two transgressive-regressive sequences; the lower (Lewiston) member represents a symmetrical deepening-shallowing cycle, while the upper units (Burleigh Hill-Stoney Creek members) record a shallowing-upward hemicycle. Facies tongues in the north-south sections confirm these interpretations.

Layer-cake stratigraphy in the Rochester Shale is thus an artifact of parallelism between the outcrop belt and depositional strike. As such, the Rochester provides a useful paradigm for understanding numerous similar stratigraphic units in the northern Appalachian basin.

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Glacio-Eustatic Sedimentary Cycles in Trenton Limestone (Middle Ordovician) of Southern Ontario

The fully-developed ideal cycle consists of the following, from base to top, always with calcareous clay seams throughout.

(a) Coarse, poorly sorted intrabiosparite or biosparite grainstones, in crosscutting (often cross-stratified) lenses, or channelized. In places, grain flow is shown by lobate, steep-sided edges, often smoothed by well-sorted biosparite grainstones.

(b) Fine to medium-grained well-sorted biosparite grainstones, parallel or cross-laminated, usually in several thin beds.

(c) Very fine-grained, well-sorted, commonly graded biosparite and biomicrosparite packstones and grainstones, with coarser shell fragments concentrated at their bases.

(d) Nodular bioturbated biomicrite mudstones and wackestones, alternating with bioturbated calcareous clays. This unit may also contain lenses of poorly sorted biosparite.

Units (a) to (c) show abundant evidence of rapid deposition of individual beds, followed by extensive periods of non-deposition, erosion, or both, when the bed surfaces were burrowed by omission-type trace fossil-forming organisms, cemented, and colonized by attached organisms. The abundant and diverse hardgrounds of the Ordovician sequence are concentrated at these horizons. In the more argillaceous sections, subdued cyclicity occurs.

The difficulty of explaining these cycles by normal facies changes has led to a glacio-eustatic explanation. Actualistic comparison can be made with the recent Arabian shelf of the Persian Gulf.

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Preliminary Investigations for Underground Coal Mines

Coal exploration and development drilling techniques for under-