and starfish; and thin lenses of limestone. The Grimsby Sandstone overlies the Power Glen Shale. It is composed primarily of red sand and siltstone deposited in foreshore to upper delta-plain environments. The foreshore sediments in the Grimsby are generally clean, white, and well-sorted because clay and silt-size particles were winnowed by wave processes.

The foreshore deposits of the Whirlpool and Grimsby Sandstones contain the cleanest, best sorted sands in the Medina Group, and possess the greatest primary intergranular porosity. Although primary porosity in the Medina has been largely obliterated by quartz overgrowths, these foreshore deposits offer good potential for porosity development and provide gas reservoirs in the Medina Group.

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Rocky Gap Sandstone and Huntersville Formation—Potential Hydrocarbon Reservoirs of Southwestern Virginia

In southwestern Virginia, west of New River and east of East Stone Gap, the Lower Devonian Rocky Gap Sandstone and Huntersville Formation have the best potential as hydrocarbon reservoirs. Both units have a large areal extent and a combined thickness locally exceeding 150 ft (45 m).

In outcrops formed by the present erosional cycle, the Rocky Gap Sandstone is a poorly indurated and friable sandstone. Secondary porosity could have formed also by leaching during erosional cycles both before and after deposition of the Oriskany Sandstone. Combined with primary and fracture porosity, the Rocky Gap Sandstone appears to have good reservoir potential.

All of the exposures of the Huntersville Chert are fractured. The thrust faulting of southwestern Virginia could have led to the development of significant fracture permeability and porosity in the subsurface. Like the Huntersville Chert in West Virginia, the unit could become an important gas producer in southwestern Virginia.

Both the Tonoloway Limestone and the Millboro Shale are excellent source beds for hydrocarbons. In western counties, the Onondaga Limestone also smells highly petroliferous after fracturing. Conodont color alteration index (CAI) maps of Silurian through Middle Devonian rocks in the Appalachian basin indicate that the rocks are above the upper limit of thermal maturity for gas.

Unconformities throughout the area have the potential for stratigraphic traps. More detailed seismic surveys of the area can help to define structural and stratigraphic traps that are capped by the Millboro-Chattanooga Shale.

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Silica Cement Source and Porosity Preservation for Ohio's Lower Silurian Sandstones

The Lower Silurian sandstone sequence of Ohio is comprised of sandstone, siltstone, and shale, commonly recognized as three more-or-less distinct informal subunits. The lowermost is called white Clinton, the intermediate is red Clinton, and the uppermost is stray Clinton. These subunits have been correlated by others, respectively, as the Cabot Head Shale, the Grimsby Sandstone, and the Thorold Sandstone of western New York. The sandstones and siltstones are generally tight and highly cemented by pervasive secondary silica. Original depositional clay was probably mixed-layer illite-smectite which, as indicated by x-ray diffraction, was transformed to the present discrete illite and very minor iron-chlorite. Remnant expandable illite-smectite is present as less than 5% total clay. The released silica of this transformation probably provided much, if not most, of the silica cement. The remnant mixed-layer illite-smectite occurs within the sandstones where apparently it was preserved by the protective framework of detrital sand grains. Other probable minor sources of silica cement were pressure solution of original quartz grains and dissolution of allogenic feldspar, as exhibited in this section and by scanning electron microscopy. Porosity increase toward the middle of some sandstone intervals suggests migration of silica from transformed overlying and underlying shales. Porosity was preserved, in part, by collophane grain coatings inhibiting authigenic silica growth, as exhibited by petrography and scanning electron microscopy, and by clay overgrowths, as demonstrated in earlier study.

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Computer Mapping of Coal-Quality Data in West Virginia—an Aid in Finding the Right Coal for an Application

In 1907, the first studies of the state's coal reserves were initiated as part of the West Virginia Geological and Economic Survey's statewide geological mapping program. Since then, extensive work has been conducted to map and characterize the state's minable seams. This effort has shown that the coals exhibit a wide diversity of quality, and this diversity provides the coal user a choice of grades to meet specifications for varied applications.

Approximately 6,000 coal samples have been analyzed, and a computer data base of coal-quality information is now maintained and continues to grow. An extensive mapping project makes this information convenient to use.

The objective of coal-quality mapping is to produce a series of contour maps showing the variations in quality for West Virginia coal. Parameters being mapped include sulfur, ash, Btu, fuel ratio, Hardgrove grindability, volatile matter, fixed carbon, and kilocalories per kilogram. This type of information is extremely valuable for someone interested in buying, selling, evaluating, or developing West Virginia coal.

The maps are computer-generated at a scale of 1:500,000 and show the trends of quality in the state's coal measures. From these maps, a "target area" map can be prepared. (A target area is a particular geographic area where coals meeting a user's specifications are likely to be found. Target areas change in size, shape, and location as the coal specifications change.)

These maps are supplemented further by two computer-generated products. One is a "target point" map. (A target point is a specific point-location where coal meeting the required specifications has been sampled.) The other computer product is a list of seams and geographic areas within the state in which coal that meets the desired specifications has been sampled.

These computer techniques provide a statewide overview and quickly show areas in West Virginia that match the right coal to the desired end-use.

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Gas Reserves in Medina Group of Northwestern Pennsylvania as Related to Fracture-Porosity and Stratigraphic Control

Gas reserves in the Medina Group of northwestern Pennsylvania were investigated for fracture-porosity and stratigraphic control with remote sensing and geophysical tools. Lineaments were mapped on Landsat MSS band 7 (scale 1:250,000), and RBV (scales 1:125,000 and 1:500,000) images, and low-altitude photographs (scale 1:20,000). Zones of high estimated-net gas reserves were noted along French Creek, between Meadville and Franklin, Pennsylvania. A lineament, which bisects the French Creek lineament and is oriented N55°E, also parallels and overlaps gas-pool trends. The largest gas pool underlies an area devoid of lineaments mapped on Landsat imagery.

The dominant lineament orientations measured from the high- and low-altitude imagery coincide when compiled for the entire study area. This relationship is not evident for individual 7.5′ quadrangles. Coal cleat orientations, available in the New Lebanon, Sandy Lake, and Kennerdell quadrangles, are not parallel with the dominant lineament orientations. Joint orientations, available in the Meadville quadrangle, coincide with dominant lineament orientations in the area.

The gamma-ray log was used to establish stratigraphic parameters and to approximate lithologies. Sandstones were subdivided into "qualities" representing degrees of shaliness. Other variables derived from this log with respect to the Medina Group include: depth below sea level, formation thickness, net-sandstone thickness, and Cabot Head Shale thickness. The Whirlpool Sandstone Member was not included in this analysis. No statistical correlation was found between the above variables and estimated-net gas reserves. Visual inspection reveals trends common to the isopach maps and estimated-net gas reserves. Thus, stratigraphic control probably is important to hydrocarbon-pool location and geometry, with the proper combination of variables yet to be identified.