

tions markedly change by lateral intertonguing along northeast-southwest depositional strike. The Irish Valley Member, in much of the area, consists of alternations of marine and nonmarine sediments which are arranged in several motifs. Each motif consists of a fining-upward facies assemblage, showing a variety of structures attributed to subtidal and intertidal flat sedimentation. The Sherman Creek Member consists of nonmarine mudstone and siltstone and subordinate amounts of sandstone, organized into a succession of fining-up cycles, deposited on a low relief and inactive coastal plain with small and high sinuosity meandering streams and broad flood basins. The Duncannon Member consists of interbeds of nonmarine, thick to massive and complexly cross-bedded sandstone with subordinate amounts of mudstone and siltstone, believed to represent low sinuosity to possibly braided river systems. The Duncannon facies dominates the Catskill Formation in the central parts of the area and intertongues laterally with the Sherman Creek Member and parts of the Irish Valley Member which comprise the main bulk of the Catskill to the south and north. In the same area, the Irish Valley facies, while attaining its tidal origin, is not characterized by repetition of motifs. Paleoenvironmental synthesis suggests that the Catskill shoreline was fed by a tide-dominated delta in central Pennsylvania (Centre County) and was flanked to the south and north by broad tidal flats which graded landward to an inactive coastal plain environment.

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#### Carbonate Diagenesis in a Quartzarenite: Dolomitic Keefer Sandstone of West Virginia

After deposition as a coastal marine deposit, the Silurian Keefer Sandstone underwent an elaborate diagenetic sequence. In general, the processes were: quartz cementation, calcite cementation, dolomitization, and finally dedolomitization. Diagenesis in this formation, as interpreted from petrographic study, was complex because the composition of pore fluids changed throughout its postdepositional history. Quartz overgrowths precipitated early, most likely from marine connate brines. The second generation of cement, poikiloprotic calcite, precipitated when meteoric-derived phreatic water percolated through the sand during a major regression of the sea. Clay minerals in the matrix favored dolomitization of calcite cement, fossils, and calcite mud by serving as sites of nucleation or catalysts and perhaps by providing magnesium. Later, at a moderate burial depth, saline subsurface brines dedolomitized isolated dolomite crystals.

Primary porosity in the Keefer (Big Six) of southwestern West Virginia was virtually occluded by these early cements. Most microscopically visible porosity is secondary and attributed to the volume reduction of carbonate material with dolomitization of local calcite. Several Silurian-Devonian sandstones are petrographically similar to the Keefer, and its postdepositional history, as interpreted here, may serve as an example of diagenesis in other dolomitic and calcareous quartzarenites of the Appalachian basin.

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#### Illinois Coal—A Major Bituminous Coal Resource

About two-thirds of Illinois is underlain by coal-bearing strata of the Pennsylvanian System. Major coal seams crop out along the margins of the Illinois basin coalfield and are at depths of up to 1,000 ft (300 m) in the deep part of the basin in southeastern Illinois. Identified bituminous coal resources of Illinois are 162 billion tons (147 billion metric tons) which exceeds the bituminous resources of any other state. Over 20 billion tons (18 billion metric tons) of potentially surface-minable coal (<150 ft or 45 m deep; >18 in. or 45 cm thick) have been mapped, of which 5 billion tons (4.5 billion metric tons) are estimated to be economically recoverable at present. At 50% recovery, about 50 billion tons (45 billion metric tons) of coal with an average thickness of 4 ft (122 cm) or greater are recoverable by deep-mining techniques. Most of these resources occur primarily in two seams—the Springfield and Harrisburg (No. 5) and the Herrin (No. 6) Coal Members. Little exploratory drilling has been done on the Jamestown, Seelyville, De Koven, Davis, and other coals that may represent a substantial additional coal resource. Coal seams of Illinois commonly are overlain by black shale or limestone, which provides a relatively stable roof for modern, high-speed underground mining. Illinois coal is a high-volatile C bituminous coal having high heat values. About 4% of the state's identified coal resources are relatively low in sulfur (<2.5%). Studies of stratigraphy and depositional environments have revealed deposits of low-sulfur coal in areas overlain by thick gray shale. As deeper parts of the basin are explored, new discoveries of low-sulfur coal are expected. At present in Illinois, approximately 60 million tons (54 million metric tons) of coal are produced annually from about 60 mines. At least 12 new mines are expected to open during the next several years, and annual production may exceed 75 million tons (68 million metric tons) by 1985.

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#### Coal Resources in Ohio

Coal is Ohio's single most important mineral resource. With decreasing supplies of oil and natural gas and a lack of alternate energy resources, increasing reliance will be placed on coal as the primary energy resource. To assist in the development and utilization of Ohio's coal resources, the Ohio Division of Geological Survey is continuing to investigate and report on the coal deposits in the state as well as investigating methodologies instrumental to the cleaner burning and more effective utilization of the coal.

Two investigations of deep coal resources in parts of southeastern Ohio have recently been completed, and resources of the Clairon (No. 4a) and Sharon (No. 1) coals in southern Ohio are currently being investigated. Ancillary to coal resource studies is the federally funded Division of Geological Survey project to accurately show the location and extent of abandoned underground coal mines on U.S. Geological Survey 7.5-min-