Structural Interpretation of Buried Silurian Reefs in Southwestern Indiana

Two or more generations of buried Silurian reefs are present in southwestern Indiana. Possibly all the larger reefs grew until Devonian time. Some may have attained thicknesses greater than those of any other group of Silurian reefs. Strata topping the reefs range from Middle or Late Silurian to Middle Devonian in age. Deep drilling is sparse in southwestern Indiana, and limited geophysical surveys are mostly confidential. Interpretation of the reef province then relies heavily on evaluation of structural deformation (broad sense) of the rocks both encasing and overlying these and other Silurian reefs and of the reefs-proper and their flanks.

The amounts of suprareef drape in strata as young as Pennsylvanian are related to reef thickness, kind of reef, erosion of reef and postreef rocks, height above reef, and counterproductive subreef sagging. Both suprareef draping and subreef sagging are expectable for any given reef. Long-continued diagenesis, even to the present time, was the most significant cause of such structural deformation; subreef soft-sediment deformation penecontemporaneous with reef growth also was a factor. Differential compaction between reef and contemporaneously deposited interreef rocks was the most important diagenetic process. Differential compaction in rocks far above the reefs, acting in concert with lithologic and thickness differences brought about by continued growth of drape structure, had a minor role. Differential solution and recrystallization could have contributed especially to subreef sagging. These interpretations temper some ideas that localized tectonic uplifts influenced both reef siting and suprareef draping and that early cementation resulted in structural stabilization of substrate, reef, and reef flank penecontemporaneous with growth.

The ranges in geologic circumstances that apply—in setting, reef genesis and abortion, erosion or nonerosion and burial of reefs, and postreef attainment of structural clues to reef recognition—suggest that southwestern Indiana has a reef-related reservoir potential that applies differentially within the reef province. The differential extends to the reefs themselves and to individual formations draped over the reefs. This province, surely, is inadequately explored for hydrocarbon potential in sub-Mississippian rocks.

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Coal in Pennsylvania: Geology, Current Production, and Reserves

Pennsylvania is at the northern end of the Appalachian coal basin. Approximately 15,000 sq mi (39,000 sq km) or one third of the state, is underlain by coal measures. The coal is Pennsylvanian to Permian in age, and includes bituminous and anthracite coal found in several separate fields.

The bituminous coals have dips of less than 2°, with some beds dipping up to 8° and rarely exceeding 8°. These steeper dips are found along the flanks of the major Plateau fold structures and in proximity to the Allegheny Front. Bituminous coal in the Broad Top field and in the anthracite basins have dips commonly exceeding 60°.

The earliest record of coal being mined in Pennsylvania was at Fort Pitt (now Pittsburgh) in 1761. To date, more than 22 billion tons of coal have been mined out or lost due to mining. Coal production in 1978 was 80,342,913 net tons of bituminous coal and 5,037,960 net tons of anthracite coal.

Recoverable reserves are estimated at 22 billion tons of bituminous coal more than 28 in. (71 cm) thick, and 8 billion tons of anthracite coal more than 24 in. (61 cm) thick. These estimates assume that all the major coals are continuous throughout their projected area of occurrence, as with the Pittsburgh seam.

However, recent detailed studies on the sedimentology of the Upper Freeport coal in southwestern Pennsylvania indicate that the stratigraphy of the coal-bearing measures may be more complex than previously believed. These units consist of a highly variable sequence of coals, clays, sandstone, shales, limestones, and other rock types occurring in lenses, pods, channel-fills, etc. Because of the presence of these coal-seam discontinuities in some of the coals, the current coal reserve estimates may be significantly inaccurate.

The Pennsylvania Geological Survey is currently cooperating with the U.S. Geological Survey in the National Coal Resources Data System. We are currently in the third year of the program to enter all point-specific data, including coal thickness and quality, into the computer. In addition, coal crop maps for each principal coal seam showing areas of deep and strip mining are being compiled. This program will result in much more accurate estimates of the remaining coal reserves in Pennsylvania.

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Coal Resources of Indiana and Potential Geologic Problems in Their Exploration

Indiana has about 33 billion tons of coal resources, and about 17 billion tons are estimated to be recoverable by present-day mining technology. Coal mining, beginning in the early 1800s and continuing until the late 1930s, was principally underground, but since 1940 mining has been mainly surface. At present only five of the more than 120 active operations are underground, and they produce about 2% of the annual tonnage.

Underground mining of coal in Indiana is expected to increase, since about 15 billion of the 17 billion tons of recoverable coal appear to be recoverable only by deep mining methods. Studies of past and present underground operations in the Springfield Coal Member (V), taking into consideration partings, roof conditions, faults, water problems, and gas concentrations in the coal and roof strata, should prove useful in planning for future operations.

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Coal Resource Studies in Virginia

There are three coal-bearing areas of Virginia: the Richmond and Farmville Triassic basins in the Pied-