they illustrate that the threefold subsurface division of the Clinton into the "Stray," "Red," and "White" is not locally reliable; instead the interfingering sand and shale lithosomes should be mapped in this interval.

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Prospects for Coal Development in Michigan Basin

Coal in the Michigan basin is in thin, relatively discontinuous, laterally variable seams of non-coking, high volatile B and C bituminous rank, with a range of 10,300 to 12,300 Btu.

The known coalfields range in size from about 100 to 1,500 acres (40 to 60 ha.), mostly in less than 250-acre (100 ha.) areas. Known remaining reserves are generally in beds less than 3 ft (0.914 m) thick. Ash and sulfur content are lower in the northeastern part of the basin, 3 to 9% and 1 to 3%, respectively, in the thicker and more continuous seams which have been mined, but to the south and west these qualities deteriorate to undesirable levels. However, it is possible the rank and quality both might be substantially improved by more modern cleaning technologies than were available at the time of the earlier mining when most of the analyses available were made.

The coal-bearing strata are of Early and lower Middle Pennsylvanian age as determined by marine invertebrate and plant fossil paleontologic techniques. This sequence ranges in thickness from the eroded edges basinward to as much as 650 ft (198.12 m) but the thickness is exceedingly variable owing to its deposition on an erosional surface of several hundred feet of relief which was developed entirely on rocks of varying levels of Mississippian age, and to the post–Middle Pennsylvanian erosion surface. The overlying strata in the center of the basin are consolidated shales, siltstones, and gypsiferous deposits of the "Redbeds" sequence of Late Jurassic age. Peripherally to this thin veneer above the Pennsylvanian in the central part, 300 to 600 ft (92 to 183 m) of unconsolidated Pleistocene gravels, silts, clays, and peat buries the Pennsylvanian over most of the areal extent. The relief on this pre-Jurassic plus pre-Pleistocene surface exceeds 200 ft (61 m) in many places and erosional channels appear to have removed the Pennsylvanian strata including the coals in a number of places.

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Devonian Shale Exploration Rationale Tested in Northeast Tennessee

Devonian shale exploration rationales are characterized by some geologic fracture-creating mechanism, for natural fracture systems are essential to natural gas production, even with advanced stimulation technology. One rationale predicts intense fracturing in the shale wherever proximally associated with the major thrust faults of the Appalachian Valley and Ridge province. Gruy Federal No. 1 Grainger County, TN (DOE EGSP-TN9), tested this rationale. The well penetrated the Saltville thrust fault (stratigraphic throw over 10,000 ft or 3,048 m) and encountered 720 ft (220 m) of Devonian-Mississippian Chattanooga Shale in the lower plate. A total of 220 ft (67 m) of core was extracted from the most highly organic intervals of the shale, and a full suite of wire-line logs was run. Widespread and locally intense fracturing observed in the core and evidenced by the logs vindicates the exploration rationale. By the time this paper is presented the well will have been stimulated and the well test results will be available.

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Facies, Paleoecology, and Depositional Environments of Energy Shale Member (Pennsylvanian) and Their Relation to Low-Sulfur Coal Deposits, Southern Illinois

Thick deposits of Energy Shale (Carbondale Formation, Desmoinesian) are associated with low-sulfur coal deposits in the underlying Herrin No. 6 coal in southern Illinois. The Energy Shale consists of wedges, up to 85 ft (25.9 m) thick, which thin away from the Walshville Channel (interpreted as a major distributary channel deposit in the study area).

Facies recognition and interpretation of depositional environments are based upon lithology, sedimentary structures, vertical and lateral relations, geometry, and paleoecology as well as organic matter content and total sulfur content.

Four facies are recognized in the surface mines studies. The thickest and coarsest facies is adjacent to the Walshville Channel and is characterized by numerous fining-upward channel-fill sequences of sandstone, siltstone, and silty shale. It is interpreted as a series of crevasse distributary channel-fills in the proximal parts of splays. This proximal splay facies grades laterally into shale with abundant plant remains, thin coal beds (splits from the Herrin No. 6 coal) and some siderite concretions. It is interpreted as the distal deposits of crevasse splays. The distal splay facies grades laterally into what is interpreted as an interdistributary bay-fill facies consisting of shale with laterally persistent siderite layers. Sixteen miles (25.8 km) from the Walshville Channel, a zone at the top of this facies is extensively burrowed and contains pectinoid bivalves, indicating some marine influence. The bay-fill facies grades laterally and vertically into shale, containing a moderately diverse marine fauna composed mostly of stunted individuals. It is interpreted as a marginal marine facies.

The Walshville Channel and the crevasse splay facies of the Energy were partly contemporaneous with Herrin peat deposition. The sulfur content of the Herrin No. 6 coal is highest beneath the marginal marine facies (the thinnest) and the proximal splay facies (the thickest) of the Energy Shale.

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