silty shales, siltstones, and sandstones laid down by turbidites on the basin floor (Snake Hill Shale). Transport direction was to the east on the slope, and axial (north-northeast-south-southwest) on the basin floor. Clay particles were derived from the volcanic source terrane. The facies gradually shifted west laterally; the length of time span investigated is about 6 m.y.

From the distribution of organic carbon and the concentration of benthic epifauna and infauna, it can be inferred that conditions were aerobic on the shelf (> 1 ml/L O_2), anaerobic on the slope (< 0.4 ml/L O_2), and dysaerobic on the basin floor (< 1 ml/L O_2). Through time, four long-term anaerobic and dysaerobic cycles are revealed, lasting between 500,000 and 1,000,000 yr. Anaerobic cycles are characterized by over 50% higher organic carbon values, lack of infaunal burrowing traces, and a highly impoverished benthic epifauna. Dysaerobic cycles are marked by lower organic carbon contents, sporadic burrowing traces, and a slightly more diverse and abundant benthic epifauna. This cyclicity was most likely caused by changes in the density stratification within the water column, possibly related to climatic changes. The longest anaerobic cycle occurred during the transgressive phase that led to widespread deposition of black shale over the carbonate platform.

Anoxic conditions in the Taconic foreland basin may have been influenced by the prevailing global oceanographic conditions during the Middle Ordovician.

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Subsurface Stratigraphy of Upper Cambrian Through Carboniferous Rocks in Western and Central Pennsylvania

The analysis of geophysical well log data from 20 deep wells in western and central Pennsylvania, southern New York, and northern West Virginia confirms the presence of anomalies in the distribution and thickness of the Lower Ordovician Beekmantown, Middle Ordovician Trenton, Lower Devonian Oriskany, and Middle Devonian Onondaga and Tully rock units. The nonuniformity of these rock units occurs in an area of western Pennsylvania referred to by W. R. Wagner in 1976 as the Olin basin. The margins of this feature are delineated by Upper Cambrian and Lower Ordovician growth faults. Wagner considered these faults to be extensions of Precambrian basement faults.

A structural depression in southwestern Pennsylvania and northwestern West Virginia hosted the depocenters of many of the Ordovician, Silurian, and Devonian sediments. This feature coincides geographically with the southern boundaries of the Late Cambrian Olin basin. Displacement along Precambrian basement faults coincident with this structure could have accounted for the distribution and thickness of the Beekmantown sediments in this region. The correlation of bentonite layers of the Trenton Group in western Pennsylvania indicates that faulting coincident with this depression appears to have affected the distribution and thickening of sediments across this basin.

Limited, renewed displacement of Wagner's Upper Cambrian growth fault as a positive flexure, resulting in an uplift of basement highs in Devonian time, might have accounted for the minimum deposition of the Oriskany, Onondaga, and Tully units in western and north-central Pennsylvania.

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Effects of Clastic Dikes on Roof-Rock Stability in Central Pennsylvania Coal Mine

Clastic dikes are common in coal beds of the Appalachian basin. Their presence often causes delays in mine production and poses safety hazards to mine personnel. The U.S. Bureau of Mines is conducting research on the occurrence and origin of clastic dikes and associated roof-rock instability, to gain a better understanding of the effect clastic dikes have on ground pressure around mine openings. Geologic mapping and pressure monitoring of clastic dikes at the Greenwich Collieries North Mine, Indiana County, Pennsylvania, has provided insights to this problem.

The North Mine (producing from the lower Freeport coal bed) is experiencing an increase in the number of clastic dikes and associated roof failure as mining advances toward the axis of the Brush Valley syncline. Over 200 individual clastic dikes of claystone matrix with fragments of shale and coal have been mapped at the mine. The dikes range in thickness from a maximum of 2 ft (60 cm) to as small as 0.25 in. (6 mm) and commonly extend vertically from the roof rock 20 ft (6 m) above the coal bed into the coal bed, but rarely through the coal bed to the underclay. Observations of the dikes indicate that they were formed by tensional and compressional forces and may be related to paleostress fields. Characteristically the dikes penetrate the coal bed at high angles to bedding with as much as 8 in. (20 cm^3) of normal-fault type displacement at the contact of coal bed and roof rock. The measured strike of the clastic dikes shows a strong bimodal distribution of N40°W and N50°E, which is offset 30° to the east of the bimodal distribution of the coal cleat (face N70°W and butt N20°E). Joints in the shale roof rock show a dominant peak of N 40° W, which is coincident with one of the major peaks of the dike distribution.

The depositional environment may have been an important factor in clastic dike formation, as the abundance of preserved casts of tree stumps in the shale roof is inversely proportional to the number of clastic dikes.

Hydraulic pressure-monitoring devices were installed near the clastic dikes to monitor the development of associated roof failure. The results of this monitoring show that the roof behaved as two cantilever beams where a clastic dike was present and that the roof must be supported immediately after mining. Analysis of the anisotropic qualities of the roof strata and rock-pressure conditions suggests that changes in the in-situ stress field near clastic dikes have aided in the propagation of roof failure.

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Berea Sandstone Reservoirs in Ashland and Medina Counties, Ohio

The Berea Sandstone is one of the better known rock formations in Ohio. It occurs at shallow depths throughout a broad belt in central Ohio and crops out to the north and west of these counties. Stratigraphically, the Berea Sandstone is part of the Waverly Group and is underlain by the red and gray Bedford Shale and overlain by the black Sunbury Shale, all of which are of Early Mississippian age.

In Ashland and Medina Counties, the Berea may be divided into two separately identifiable units. The upper unit, called the "blanket" Berea in outcrop, is approximately equivalent to the "cap" Berea in the subsurface. The second unit, which lies below the "cap" Berea varies considerably in its thickness. The thickness of the Berea Sandstone (excluding the "cap") ranges from zero to over 125 ft (38 m) in the study area. The thickness changes occur within very short distances (i.e., 100-200 ft or 30-60 m) owing to the original depositional conditions responsible for the formation of the sand body.

The traditional, long-standing, and generally accepted view is that the Berea Sandstone was deposited in Ashland and Medina Counties in southward-flowing river channels. More recent drilling in these counties has demonstrated that these sand channels are not continuous, but are isolated sandstone bodies in which petroleum has accumulated.

The reservoir capacity of the Berea is between 8 and 22% with an average porosity of 15%. The sandstone consists of loosely cemented, medium to fine-grained quartz with only rare shale breaks below the "cap" Berea. In Ashland and Medina Counties, Berea wells generally produce oil. Initial production in this area ranges between 1 or 2 bbl and to 40 BOPD after treatment. Reservoirs in the Berea Sandstone generally are productive where the sandstones are thick. They are also productive where the sandstone is thinner, but high on structure. Although a high structural position is preferred, the critical consideration is the thickness of the sandstone body and the reservoir geometry.

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Coal Rank Trends in Eastern Kentucky

Examination of coal rank (by vitrinite maximum reflectance) for eastern Kentucky coals has revealed several regional trends. Coal rank varies from high volatile C (0.5% R_{max}) to medium volatile bituminous (1.1% R_{max}), and generally increases to the southeast. One east-west-trending rank high and at least four north-south-trending rank highs interrupt the regional increase. The east-west-trending rank high is associated with the Kentucky River faults in northeastern Kentucky. It is the only rank high clearly associated with a fault zone. The four north-south-trending rank