from decreasing flow regime. This sequence of bedding, together with the vertical decrease in grain size observed, is typical of a fluvial sandstone. Sandstones (quartzarenite) are characterized by a high quartz content (85 to 98%), moderate matrix (5 to 10%), and a small amount of minor constiuents (muscovite and calcite).

Electric log cross sections reveal lateral variation in sandstone thicknesses. Sand bodies are lenticular and discontinuous, characteristic of intermittant braided stream deposition. Reservoir sandstones have porosities ranging from 12 to 22% and permeabilities of up to 500 md. Recognition of the vertical sequence of primary rock properties is indicative of braided stream deposits, and the associated electric log characteristics may aid in future exploration and production efforts for similar reservoirs.

GRANDER, H. KIRK, Univ. Maryland, College Park, MD

Geomorphic Controls on Course of Juniata River in Valley and Ridge Province, Pennsylvania

Structural and lithologic factors affect stream-flow patterns of the Juniata River, a cross-axial superimposed consequent stream, in the Valley and Ridge province of Pennsylvania. From an examination of the influence of folding, faulting, and jointing upon the course of this stream and its major tributaries through a succession of points and reaches, the various means have been identified by which its course is determined across both weak and resistant rock deformed into a variety of geometric attitudes. Jointing, thrust faulting, normal and reverse faulting, superimposition, subsequent stream development, and monoclinal shifting in the classic sense of Gilbert are the geomorphic controls. No one control is dominant, all being effective, owing to the complexity of the jointing, folding, and faulting of the region. Monoclinal shifting will probably dominate as the principal geomorphic control in the geologic future.

HELLMANN, ROLAND, Univ. Maryland, College Park, MD

Flocculation Reduces Cation Exchange Capacity of Suspended Estuarine Sediment

The variation in the cation exchange capacity (CEC) of suspended sediment entering the Delaware Bay was determined as a function of salinity. Cation exchange capacity is based on Ca, Mg, Na, and K, the four commonest exchangeable ions. A comparison of the CEC (units in meq/100 g) of suspended sediment with salinity shows a sharp initial decrease from 73 meq/100 g at 0% salinity to a minimum value of 29 meq/100 g at 2.44% salinity, then a gradual rise to 48 meq/100g at 15.03% salinity. The observed trends between CEC and salinity were correlated with sampling conditions (depth, temperature, pH), mineralogy, iron III hydroxide and organic coatings, and the degree of particle flocculation. A very good ($> .90$) linear correlation exists between the degree of flocculation, expressed as the proportion of primary (individual, $< 2\mu$) particles, and the CEC's of the overall suspended sediment. The other variables do not show any significant correlation with the CEC-salinity trend. It is evident, therefore, that the process of flocculation leads to a decrease in CEC values. It is speculated that the process of flocculation is a function of the ionic strength of the water. The attraction or repulsion of suspended particles is a surface-charge phenomenon which is controlled by the ionic strength of the water.

HOLDEMAN, TIMOTHY G., Wright State Univ., Dayton, OH

Transmission Survey Using Seismic Guided Waves: Cadiz, Ohio

When seismic survey energy is initiated within a coal seam, internally reflected S and P waves constructively interfere to form a seam wave. The seam wave is a high-frequency, dispersive wave which may exhibit both Rayleigh-type and Love-type modes. Since the seam wave is confined to the coal seam, its frequency content and dispersion characteristics are a function of the elastic properties and thickness of the coal seam. Large variations in the elastic properties or thickness of the coal seam, such as faults, sand bodies and pinch-outs, will affect the frequency and dispersion of the seam wave.

Seam-wave studies applied to coals in the eastern United States are few. The paper gives an acount of a transmission survey shot across a block of coal in the Oak Park Mine located near Cadiz, Ohio. The coal seam, under investigation is the lower Freeport (6A) which is 54 in. (14 cm) thick at the Oak Park Mine. Conducting an underground seismic survey presents many difficulties including: (1) mine accessibility; (2) underground-safety regulations; (3) source and receiver coupling; and (4) maneuverability. Comparison of the observed dispersion and predicted dispersion of the seam wave reveals its dominant mode and frequency content.

JACKSON, WILLIAM D., Texas Tech Univ., Lubbock, TX

Geochemical Controls on Aquia Aquifer in Maryland and Model for a Major Cation Source

The Aquia Formation is a Paleocene-Eocene glauconitic marine sand. It forms part of the Pamunkey Group of the Atlantic coastal plain. The geochemistry of the water in the Aquia aquifer, as shown by computer analysis, is controlled by the hydrologic flow regime and the mineralogy of the sediments. The ionic exchange of Na for Ca in glauconite and the dissolution of the sedimentary minerals are believed to be major sources of the cations in the aquifer waters. A model equation for the dissolution of glauconite has been developed and found to be thermodynamically feasible. The value for Gibbs free energy of formation for glauconite was estimated by a known method for layered silicates and found to be -1425 Kcal/mol. This produced a log Kiap/Keq ratio of -197 and shows glauconite undersaturated with respect to the formation water.

JACOBSEN, EDWIN F., Univ. Maryland, College Park, MD

Coal Geology of Lower Youghiogheny Basin, Garrett County, Maryland

The Lower Youghiogheny basin (130 sq mi or 338 sq km) ranks fourth in total area of the five synclinal coal basins of western Maryland. Approximately 1,000 ft (305 m) of coal-bearing strata of Early to Late Pennsylvanian is exposed (Pottsville, Allegheny, and Conemaugh Formations). The Pottsville Formation rests unconformably on the Mauch Chunk Formation of Late Mississippian. The contact separating the Pottsville and Allegheny Formations is the top of the Homewood Sandstone, and that separating the Allegheny and Conemaugh Formations is the top of the Upper Freeport coal bed. A coal bed correlated with the Little Clarksburg, which occurs in the upper third of the Conemaugh Formation in West Virginia, is

stratigraphically the highest coal bed in the section; the uppermost part of the Conemaugh is not present. Structurally, the basin in Maryland is the southern termination of the Youghiogheny syncline, which is asymmetrical and plunges to the northeast.

The coal beds of the basin were traced using new data from surface mines, water well logs, a mine-drainage pollution study, recent aerial photographs (May 1979), and unpublished data from the Maryland Geological Survey. Field checking, where possible, substantiated the available data. Two marine intervals, the Ames and the Brush Creek shale, aided in the correlation of the coal beds. A structure contour map of the top of the Upper Freeport coal bed was used to project the outcrop patterns of coal beds onto a topographic map.

Fourteen coal beds were identified in the Lower Youghiogheny basin. Of these, five are minable or potentially minable, the Upper Freeport and the Lower Kittanning being the more important. On the basis of this study, the Barton and Clarion coal beds are newly recognized in the basin. The Clarion coal bed has been mined in conjunction with the Lower Kittanning coal bed and knowledge of its existence adds a significant tonnage to calculated coal resources of the basin. A revised stratigraphic column for the basin shows the stratigraphic position of the Barton and Clarion coal beds. A map showing the coal beds indicates minable and potentially minable areas in the basin.

JORDAN, JOHN E., JR., Wright State Univ., Dayton, OH

Geologic/Geophysical Study of Fluvial Delta in Offshore Louisiana

The purpose of the paper is to define the geologic features of a delta lobe in offshore Louisiana and relate them to seismic characteristics. The seismic facies found in the delta sequence were also studied and compared to the different subdivisions of the delta lobe and its respective geologic features.

The data consisted of a grid of eleven seismic lines which covered an area of 550 sq mi (1,430 sq km). Four wells with various geophysical logs, and paleontologic determinations of their environments, were also included in the data.

A synthetic seismogram and two models were developed: a depositional model, and a seismic facies model. The synthetic seismogram was made from Well C using a velocity log and a density log to obtain the reflection coefficients. These reflection coefficients were then filtered using a time-variant filter. The depositional model was constructed on the basis of the correlation and interpretation of SP logs, the paleoenvironments, and a dip log. The seismic facies model was developed by correlating the seismic reflection characteristics found in the synthetic seismogram with the seismic lines.

MCCOLLOUGH, WILLIAM FERRELL, Univ. Maryland, College Park, MD

Structural Variations in Wissahickon Group

Four phases of deformation have been recognized along a 16-km transect perpendicular to strike from Mt. Airy to Sykesville in the Maryland Piedmont. Axial plane foliations, S_1, S_2, S_3, S_4, and associated lineations, L_1, L_2, L_3, L_4, are the result of successive superposition of four deformations, D_1, D_2, D_3, D_4. The three phases, D_1, D_2, D_3, vary systematically in orientation across the region. The D_4 phase occurs only locally.

The oldest deformation, D_1, developed a major foliation across the region. The major foliation is represented by a schistosity in the southeast and a slaty cleavage in the northwest. Primary bedding is isoclinally folded, with the major foliation parallel to the limbs of these folds. The folds were most likely rendered isoclinal owing to flattening during successive phases of deformation. In the southeast, the S_1 surface dips steeply southeast and then flattens northwestward to become part of a recumbent fold system. The associated L_1 lineations plunge gently to the southwest or northeast.

The D_2 deformation developed a near-vertical foliation which remains uniform in orientation across the region. In the southeast, the S_2 surface is a crenulation cleavage while northwestward, it changes into a fracture cleavage, locally obliterating the major foliation, S_1. The preexisting S_1 surface was cylindrically folded coaxial with F_1, about an axis that plunges gently southwest. The F_2 folds are commonly the best developed and vary from open to tight.

The D_3 deformation is characterized by a northwest-dipping crenulation cleavage, S_3, and associated crenulation lineations, L_3. The degree of development of the crenulation cleavage is locally variable, but, in general S_3 becomes better developed to the southeast.

The D_4 deformation is not continuous across the region. This can be attributed either to its overall weak development or to its parallel orientation with the preexisting structures. In the extreme northwest, kink bands grade into broad folds that disappear in the extreme southeast.

Studies of the microfabric across the region allowed fold styles to be characterized for each phase of deformation, as well as the determination of metamorphic grade. Although the metamorphic grade increases to the southeast, the peak of metamorphism at any location was coincident with D_1.

D_1 utilized nearly horizontal flow, while D_2 and D_3 were dominated by near-vertical movements. The D_1, D_2, and D_3 phases were probably generated during the Taconic and Acadian orogenies. The D_4 structure was probably a result of the Appalachian orogeny.

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Structural, Optical, and Chemical Relations in Upper Freeport Coal of West-Central Pennsylvania

A direct relation in trends has been made between the structural deformation of west-central Pennsylvania and two petrographic properties of the Upper Freeport coal. Using samples collected by the U.S. Geological Survey, data for vitrinite reflectance and fixed-carbon percentage were generated and contour maps developed. It was found that the values increased in a near-linear northwest to southeast trend—the same trend as that of increasing regional deformation. Further development and refinement of these kinds of contour maps give the means for coal companies to infer the probable rank of a particular coal in areas where there has not necessarily been extensive analysis. The results and conclusions in this paper point to a possible method of predicting certain optical and chemical parameters of coals on the basis of their structural history and scattered samples collected in the basin.

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Thermal and Subsidence History of Williston Basin

The Williston basin is a large intracratonic basin located in North Dakota, Montana, and Saskatchewan. The sedimentary and tectonic histories of the Williston basin have been resolved