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ABSTRACTS

Remote Sensing with Fiber Optics in Oil and Soil Exploration. Torsten Alvager, Department of Physics, Indiana State University, Terre Haute, Indiana 47809; Ashok Puri, Department of Physics, University of New Orleans, New Orleans, Louisiana and Ramnath Raymond, Department of Physics, Indiana State University, Terre Haute, Indiana 47809.——The recent introduction of fiber optical light guides for remote spectroscopic sensing has opened a new era of studies of hostile or otherwise inaccessible environments. The method is also of importance in a variety of other situations such as in studies of solid state systems and systems related to damage and environmental control, as well as in experiments devoted to search for oil and other similar commodities, which is the topic of this investigation.

An instrument especially designed for in situ investigations has recently been built at Indiana State University for this purpose. This makes it possible to study scattering as well as fluorescence from samples of interest. Results with model systems indicate that the method is suitable for field use in oil and soil exploration.

Bedrock Joint and Fracture Patterns in Indiana: A Progress Report. Curtis H. Ault, Indiana Geological Survey, 611 N. Walnut Grove, Bloomington, Indiana 47405.——Bedrock joints and fractures are ubiquitous where bedrock is exposed in Indiana. Recent studies of the patterns, orientation, and density of jointing in Indiana have revealed a consistent east-northeasterly orientation for major jointing and a corresponding north-northwesterly orientation for secondary orthogonal jointing. There is an apparent counterclockwise shift of about 50° in orientation in the southern tier of counties of southwestern Indiana. Although most of the orientations of the jointing can be attributed to regional lithospheric stress, orientations at some isolated localities are better explained by rock inhomogeneities, settling of reef-flank beds, or topography and structure. A few anomalies are not yet explained. Intriguing applications and potential uses of these data include comparison of directions of bedrock jointing with directions of jointing in compact glacial till as possible indicators of differing genesis; applications to operations of surface and underground mines for limestone, dolomite, and coal; and characterization of fracture permeability in bedrock, particularly where solution channels have occurred along joints.

Distribution and Sources of Iron in the Salem Limestone of South Central Indiana. Mark A. Brown, Donald D. Carr, Margaret V. Ennis, R. K. Leininger and Louis V. Miller. Indiana Geological Survey, Bloomington, Indiana 47405.——The

Mississippian Salem Limestone, the nation's leading dimension limestone, also is suited for other uses, including manufacture of lime, cement, and glass. For lime and cement, iron content is not critical; but for glass, iron should not exceed 0.1%.

Elemental analyses of Salem facies reveal that iron content correlates with insoluble-residue concentration. Gainstone (dimension-stone) facies contain an average of 2% insoluble residue and an iron content less than 0.1%. Micritic and dolomitic (bastard-stone) facies contain 4 and 11% insoluble matter, respectively, and a combined average of 0.6% iron. Depositional environment apparently controlled the accumulation of insoluble residues and, thereby, the distribution of iron. Insoluble materials were winnowed out of high-energy environments but accumulated in the lower energy settings.

Chemical studies show that pyrite is the dominant iron-containing mineral. Reducing conditions necessary for pyrite formation were produced in association with organic matter, a major insoluble component in micritic and dolomitic facies. Illite, a common insoluble material, is a potential but minor source of iron.

Cuttoff Sandstone and Succession of Upper Pennsylvanian Strata in the Wabash Valley. Garre A. Conner, Departments of Geology and Biology, Indiana University, Bloomington, Indiana 47405.——D.D. Owen, 1837, described upper Pennsylvanian strata at the Cuttoff on the Wabash River below New Harmony referring to the Cuttoff sandstone; a logial name extensible to contemporary investigations. Sandstone exposures in the lower Wabash Valley are petrologically similar occuring in cyclic fluviatile and deltaic sequences representing members from St. Wendel to Merom sandstones. C.E. Wier, 1955, described exposures in Posey, Gibson, and Knox Counties omitting the Cuttoff, but imparted the inference that the Cuttoff sandstone may be equivalent with the St. Wendel or the Merom. G.A. Conner, 1987, identified *Neuropteris* variation in the Raben Branch coal flora related to Medullosan seed fern expansion associated with the Westphalian-Stephanian Euramerican time boundary. Further investigation of floras in the Cuttoff sandstone reveal variations not present below the St. Wendel sandstone. Analysis of *Neuropteris* variations in shales associated with Merom sandstone may provide a basis for resolving equivalency with the Cuttoff sandstone.

Early Pennsylvanian Landscape in Western Indiana. John B. Droste and Stanley J. Keller; (JBD) Department of Geology, Indiana University, Bloomington, Indiana 47405 and (SJK) Indiana Geological Survey, 911 North Cottage Grove, Bloomington, Indiana 47405.——About 325 million years ago, in very early Pennsylvanian time, the place now called Indiana was subject to subaerial erosion. Data from approximately 20,000 wells provide the evidence to reconstruct the drainage pattern for western Indiana and to show the relationship of six ancient physiographic regions to the eroded outcropping Mississippian bedrock. The stream courses of four primary rivers and of several dozen major rivers and major creeks have been mapped. Each physiographic region was the surface locus of specific stratigraphic units. From north to south a distincitve region is associated with each of the ancient outcrop areas of the Borden Group, the Sanders and Blue River Groups, the West Baden Group, the Stephensport Group, the Tar Springs Formation through the Menard Limestone, and the Palestine Sandstone through the Grove Church Shale. This entire area was covered by renewed sedimentation during Early Pennsylvanian time.

Southwestern Indiana's Abandoned Coal Mine Problems. Julie Elbert, University of Southern Mississippi, Hattiesburg, Mississippi 39406-5051 and Lee Guernsey, Indiana State University, Terre Haute, Indiana 47809.——Coal has been and continues to be an important economic activity in the state of Indiana. The extraction of a resource is not without an impact on man and the environment. Prior to the Surface

Mining Control and Reclamation Act of 1977 lands affected by coal mining were not required by law to be reclaimed. The lands mined prior to 1977 are termed "Abandoned Coal Mine Lands." The National Update on Abandoned Mine Lands was charged with inventorying and prioritizing these problems. The general results of this Update are presented here for Indiana. There are over 1,070 danger problems and greater than 5,577 acres are affected in seventeen southwestern Indiana counties.

"Weatherwatchers" and You: Viewer Responses to Television Severe Weather Warnings. WILLIAM A. GUSTIN, Department of Geography and Geology, Indiana State University, Terre Haute, Indiana 47809.——Television severe weather warnings are the primary means of notifying the public of dangerous weather conditions. However, there are increasing indications of shifting attitudes of the public to the severe weather warning symbols displayed on television. In this presentation, comparisons are made between a study of viewer responses to severe weather warnings, which was published in 1982, and a study conducted in the spring of 1987 by the author of this presentation. Both of these studies were centered on the WTHI-TV 10 viewing area in west-central Indiana and east-central Illinois. Also, the same set of 12 viewer response questions were used in each study. The main difference between these 2 studies was the way the surveys were conducted. The first survey was distributed as a random sample, while the latter one was distributed through the WTHI-TV 10 "weatherwatcher" network. This also allowed for a comparison of the attitudes of weatherwatchers and non-weatherwatchers. WTHI-TV 10 in general and Kevin Orpurt, Weather Director at WTHI-TV 10, in particular, as well as the weatherwatcher network were instrument in the completion of this project.

Distribution of Sulfur Forms in Indiana Coal Resources. WALTER A. HASENMUELLER, LOUIS V. MILLER AND JIMMY J. JOHNSON, Indiana Geological Survey, Bloomington, Indiana 47405.——Sulfur occurs in Indiana coal as sulfides (pyritic sulfur), sulfates, and organic compounds, each of which behaves differently in various physical and chemical coal-cleaning processes. We compiled sulfur-forms data (moisture-ash free basis) on 189 complete channel samples of Indiana coal to assess the distribution of sulfur forms. Pyritic sulfur ranges from less than 0.01 to 8.2 percent and averages 2.1 percent, organic sulfur ranges from 0.2 to 7.2 percent and averages 1.6 percent, and sulfate sulfur ranges from less than 0.01 to 3.0 percent and averages 0.4 percent. Average inorganic sulfur (pyritic plus sulfate) is highest (5.0 percent) in unnamed coals in the Staunton Formation and lowest (0.6 percent) in the Lower Block Coal Member (Brazil Formation). Average organic sulfur is highest (4.6 percent) in the Colchester Coal Member (Linton Formation) and lowest (0.6 percent) in the Lower Block Coal Member. Inorganic sulfur correlates moderately well with organic sulfur ($r = 0.4874$). The broad ranges and large variance of sulfur-forms data and the poor correlation between sulfur forms suggest complex geologic controls. A larger data base is required to advance interpretation beyond this general assessment.

Relation of Petrology to SO_2 Absorption of Carbonate Rocks from Southern Indiana. N.R. SHAFFER AND L.J. KRAUSE, Indiana Geological Survey, 611 N. Walnut Grove, Bloomington, Indiana 47405.——Wet scrubbing of SO_2 from stack gas using limestone slurries is the most common technique for complying with EPA restrictions at existing powerplants. Many chemically similar stones, however, show different capacities for absorbing SO_2. We collected, according to lithology, 170 carbonate-rock samples from southern Indiana to determine if petrology related to SO_2 absorption capacity, as measured by an empirical relative-reactivity test.

Physical properties of absorption (0.4 to 11.8), specific gravity, and insoluble

residue (0.3 to 35.4, average 6.8%) plus detailed petrographic point counts showed the following relations to reactivity values: There appear to be poor correlations of gross absorption or specific gravity with reactivity and a negative correlation (−0.43) of insoluble residue with reactivity. Petrographic percentages of dolomite (−0.52), clay (−0.47), quartz (−0.39), and porosity (−0.38) showed significantly negative correlations with reactivities. Calcite showed worse correlations. Petrographic information, though no panacea, can aid in assessing suitability of limestones for SO_2 scrubbing.

Sulfur Forms, Trace Elements and Mineralogy of the Danville Coal Member (VII) in Indiana. Randall E. Taylor and Haydn H. Murray, Department of Geology, Indiana University, Bloomington, Indiana 47405.——The Danville Coal Member (VII) occurs at the top of the Pennsylvanian age Dugger Formation. This coal ranges in thickness from 0.2 to 6.5 feet, averages 12,200 BTU per pound, 12.5% ash, and 1.5% sulfur. Operating mines are found from Vermillion to Warrick Counties. The pyritic sulfur averages 0.67%, the sulfate sulfur 0.02%, and the organic sulfur 0.81%. Elements more concentrated in the Danville coal than in other Illinois basin coals are Ba, Ni, Al, Mg, Na, K, and Ti. Mineral matter in the Danville coal are kaolinite, illite, quartz, and pyrite along with traces of calcite, chlorite, smectite, and gypsum. The relatively low sulfur content of the Danville coal is attributable to a combination of being overlain in many areas by a thick non-marine shale unit and its depositional position on the upper portion of a deltaic platform.