AAPG EASTERN SECTION MEETING

October 3-4, 1983

Southern Illinois University
Carbondale, Illinois

Abstracts

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Photoacoustic Microscopy of Coal Macerals

The application of photoacoustic microscopy to characterizing coal macerals will be presented. Photoacoustic microscopy can be used as an analytical tool that is responsive to the thermal-elastic properties of individual macerals. In a typical experiment, the crushed-particle coal pellet is mounted on a piezoelectric transducer, and the unit is mounted on the stage of a reflectance microscope. Upon absorbing the chopped light, the temperature of the maceral rises and falls with the same frequency as the modulated light. The resulting temperature variation produces a periodic strain that is detected by the transducer, whose output voltage represents the photoacoustic signal. It is known that the photoacoustic signal is a function of the absorbing maceral's density, specific heat, and coefficient of linear expansion. The unique ability to probe the thermal-elastic properties of macerals is a principal advantage of photoacoustic microscopy when applied to the study of coal macerals.

A standard reflectance microscope is modified to measure both the reflectance and photoacoustic data from the same macerals. Since reflectance depends on the optical parameters of the maceral, and the photoacoustic signal depends on the thermal-elastic properties of the maceral, the two measurements are complementary. Macerals which differ in density, specific heat, or linear expansion exhibit different photoacoustic responses, even though they may display the same optical properties. In this respect, photoacoustic microscopy offers a potentially valuable way of differentiating between macerals which have identical optical properties but different thermal-elastic properties. Data will be presented showing both the photoacoustic and reflectance measurements from different vitrinite macerals of the same sample, as well as from samples of different rank.

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Origin of Coal Seam Structures, Sullivan County, Indiana

Structures of Pennsylvanian coal seams in Sullivan County, Indiana, reflect deeper structural components, of which regional dip is dominant. Other components of structure result from differential compaction. The effects of these components are characterized by their closure, size, shape, and orientation. (1) The Mississippian unconformity surface is characterized by parallel valleys with up to 300 ft (91 m) of local relief. (2) The composite "lower" Pennsylvanian section below the Seelyville Coal has variable sandstone content. Some paleovalleys are filled with multistory sandstones, and others with claystone. Thickness of fill has intermediately scaled effects on overlying coal structures. The combined effects of "lower" Pennsylvanian thickness and sandstone content result in updip and downdip undulations in elevation of the coal seams along the regional strike, with an amplitude of up to 25 ft (8 m) and a magnitude of ± 2 to 3 mi (3 to 5 km). The resultant oriented, linear, structure highs parallel the trend of the underlying paleoridges. (3) Silurian pinnacle reefs form small, circular features with a diameter of 1 to 2 mi (1.5 to 3 km) and closures of 25 to 50 ft (8 to 15 m) on Pennsylvanian coal seams, 50 ft (15 m) on the Aux Vases Shale, and 150 ft (45 m) on the New Albany Shale. (4) The distributions and standard deviations of thicknesses, dips, and grain size of the sedimentary rocks between the coal seams demonstrate that seams above the Seelyville Coal were deposited in parallel and have concordant modern structures. Specific facies between seams have limited influence on the overall structure.

Coal structures in the Illinois basin can be defined by a drilling program that penetrates only 150 ft (45 m) of Pennsylvanian strata. The cost of testing nonreef structures can be halved by termination at a Mississippian horizon if 50 ft (15 m) of closure cannot be substantiated. Below the Seelyville Coal, units examined demonstrate basin-margin convergence.

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Tracing the Sole of a Thrust Through Thick and Thin of Salina Group (Upper Silurian): Decollement Tectonics of Southern Tier, New York

The elusive decollement of the Allegheny Plateau is identified by repeat stratigraphic sections on gamma-ray logs, and is mapped along the Southern Tier of New York. The detachment surface is found at three progressively lower stratigraphic levels from east to west within the Salina Group.

In the eastern counties, Chemung, Schuyler, Tompkins, and Tioga, Unit F (salt) sections of the Syracuse Formation are vertically repeated two and three times along splays of the main thrust fault residing within Unit F. Fault throws as great as 400 ft (120 m) are shown on gamma-ray logs. Correlations provide evidence for overthickened sections, which are accounted for by imbricate thrusting of the section, thereby stacking the salt beds atop each other over decollement. The three-dimensional dome shape of the Syracuse Formation with planar base supports a thin-skinned tectonic origin and negates the primary depositional genesis. The thrust was upward to the northwest, and subsurface faults are associated with folds at the surface.

In Steuben and Allegany Counties, the overthickened Unit E sections of the Syracuse Formation again suggest the presence of stacked repeat sections rather than a depocenter. The detachment surface is near the base of Unit E. Mapping indicates that the rocks from the northwest have slid and overridden those to the southeast in the central region.

To the west in Chautauqua County, decollement terminates in a structure with northeast strike, here named the "Chautauqua anticline." This prominent subsurface thrust zone is of smaller proportions, but structurally comparable to the Burning Springs anticline of West Virginia. At the northwest edge of the underlying salt beds, the horizontal decollement bends upward into the Upper Silurian and Lower Devonian rocks, eventually dying out in the fissile shales of the Hamilton Group. Thin-skinned slippage has occurred on at least two planes—those of the evaporite beds in the Syracuse and Vernon Formations. The Chautauqua anticline forms the structural trap for the targets of recent plays in the Bass Islands and Akron dolostones of the Rondout Group overlying the Salina.

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Economics of Coal Industry East of Mississippi River

The past decade has seen a worldwide resurgence of coal as an energy source. The United States has been a major beneficiary of rising world coal trade, first in the coking coal sector and in recent years in the steam coal sector. Within the United States, a tremendous change has occurred in regional coal development patterns within the past 10 years. In 1972, almost 85% of U.S. coal was produced east of the Mississippi River; in 1982, only about 67% of U.S. coal was produced in the east. Eastern coal production increased only 8% in the decade, whereas coal production west of the Mississippi almost tripled. This shift in coal production away from the eastern U.S. was driven by the interplay between the utility companies' choices for compliance with the Clean Air Act and with the production and transportation economics of the two major coal producing regions. Consequently, significantly different developments have occurred in different coal fields within the eastern United States. This