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ABSTRACTS

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Ash Fusion Study of West Virginia Coals

As more industries and utilities convert to coal, ash fusion information becomes more important for boiler design (waste disposal systems). For example, burning a low fusion temperature coal can cause slagging—the buildup of molten ash on boiler waterwall tubes. Not only is boiler efficiency lowered, but downtime is also increased.

Recently, potential buyers of West Virginia coal have inquired frequently about ash fusion. However, the amount of information in the West Virginia Geological and Economic Survey's data base is limited to data from about 800 samples, 50% of which were collected in five counties. Thus, the survey is conducting a study of ash fusion temperatures for the state's coals, to increase available data and its geographic coverage.

A Leco AF-500 automated ash fusion analyzer was used in this study, which addresses: (1) reliability of results from an automated analyzer, (2) comparison of automated data with conventional data, (3) techniques of sample preparation, high-temperature ashing, and cone preparation, (4) ash-fusion trends in the state, and (5) research developments.

The research sought to develop for West Virginia coal a statistical correlation model relating ash-elemental data with fusion data, and to investigate the relationship between ash color and fusion temperature. (Light-colored ashes generally have higher fusion temperatures than darker ashes.)

The ash fusion project adds vital information to our computer data base. With this addition, the survey can offer a more complete, unbiased source of information about West Virginia seams to prospective buyers of West Virginia coal.

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Trenton Limestone Fracture Reservoirs in Lee County, Southwestern Virginia

The search for the elusive fracture-type oil and gas reservoirs in southwestern Virginia's Lee County has continued intermittently since the opening of the Rose Hill oil field in 1942. Tests as early as 1910 were based on surface oil seeps. Charles Butts, a pioneer Appalachian geologist, recognized several windows eroded through the Pine Mountain thrust plate. Three Lee County oil fields were developed within or near these windows, but a recent increase in drilling has expanded onto the overthrust sheet.

The Ben Hur oil field, 16 mi (26 km) northeast of the Rose Hill pool, was opened in 1963. Since 1981, a burst of exploration has enlarged these two fields and added one new oil field and the first commercial gas well.

Production is obtained principally from a nonporous biomicrite with secondary fracturing, which is locally intense. From 1943 to 1980, 42 wells recorded production of nearly 123,000 bbl or about 3,000 bbl/well. Since 1981, increased oil prices created heightened interest in Lee County drilling, which resulted in production of 128,112 bbl of oil in a 3-yr span, more than during the previous 39 yr.

The Trenton Limestone is generally 400-500 ft (122-152 m) thick, and production has been obtained at depths between 1,300 and 2,500 ft (396 and 762 m). The fracture identification log run by Schlumberger has proven quite useful, but oil shows are also readily noted while air drilling. Many wells respond to an acid-frac stimulation. Exploration for the more highly fractured reservoir areas is presently frustrating, and logical geologic concepts have not replaced plain good luck.

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Origin and Implications of Fluid Inclusions from Filled Fractures, Oriskany Sandstone, Allegheny Plateau, Pennsylvania

Two cores from the Lower Devonian Oriskany Sandstone underlying the Allegheny Plateau in south-central Somerset County, Pennsylvania, contain fractures that may either be filled with epigenetic minerals or unfilled. The 1 Sipe core, taken from an unproductive well drilled on the crest of an anticlinal structure, is characterized by numerous discontinuous vertical fractures. The 1 Romesburg core, taken from a productive well drilled on the flank of an anticlinal structure, contains numerous fractures that lie parallel with bedding planes. The walls of these fractures consist of smooth slickensided surfaces.

Quartz and ferroan-calcite crystals filling fractures contain numerous hydrocarbon-bearing fluid inclusions. The distribution of these fluid inclusions within most minerals allowed a determination to be made regarding the relative times of migration of fluid hydrocarbon phases in the subsurface with respect to the paragenetic sequence of mineralization events.

Analysis of fluid inclusions indicates that fractures were opened at 22,000 ft (6,700 m) and remained open throughout an extended period of uplift. Furthermore, inclusions contain hydrocarbon-rich fluids that are comparable to reservoir hydrocarbons in the nearby Shamrock field. This relationship implies that hydrocarbons that currently exist in reservoirs were conducted along fractures that were once open.

Fractures crosscut diagenetic features, indicating that diagenesis, for the most part, preceded fracture events. Although they differ in origin and orientation, fractures characterizing Oriskany strata were healed by a consistent sequence of epigenetic minerals.

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Mapping Seismic Reflectors in Southern New York: Compensation for Velocity Anomalies in Glacial Overburden

In the process of incorporating seismic coverage and well data into a single mappable interpretation, many seismic time sections were found to display data with improper static corrections for near-surface velocity anomalies. These anomalies originate in the glacial overburden, which exhibits sudden and sizable variations in thickness and seismicity through much of the Allegheny Plateau of southern New York. An expedient method to compensate for these variations was sought to use the seismic analog data.

Along the southern tier of New York, detachment structures have been mapped in the Salina and overlying groups, whereas the top of the underlying Lockport Group has been mapped as a relatively smooth homocline dipping south. An appropriate method was selected that is dependent on the simplicity of the structural configuration at depth rather than the complexity of near-surface reflectors. The interface between the Vernon Shale (basal Salina) and the underlying Lockport carbonates is an easily identified reflector on seismic sections. By using the map of the Lockport surface as a reference, reflectors immediately above and below can be mapped using the travel times between reflectors and velocity analyses to calculate isopach information between reflectors. Additional reflectors can be mapped by adding or subtracting isopach information in an upward or downward continuation manner.

This velocity correction involves digitizing the seismic reflectors and shotpoint map, making or obtaining subsurface regional maps of a reference horizon, and performing simple mathematical calculations on a microcomputer. Independent operators can use this inexpensive and straightforward method to rescue some analog seismic data that might otherwise be regarded as useless. Subtle zones of structural closure have been mapped where initial observations suggest the presence of chaotic deformation.

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Control of Lineament in Fluid Migration and Ore-Mineral Localization in Rifts and Rift-Faulted Basins

Many paleorifts and rift-faulted basins are characterized by high gravity, magnetic, and thermal anomalies, and high-density mantle cushions in the crust. Base metals are among the many important ore minerals and hydrocarbon accumulations occurring in the sedimentary formations and fracture zones of such rifts, and basins are commonly related to thermal processes and fluid migration through fractures, faults, and other micro or macro passages. Experimental and theoretical studies show that thermomechanical stresses owing to diapirism result in (1) development of fractures or faults and their patterns, (2) rejuvenation and opening of preexisting fractures, faults, or lineaments providing passages for migration of fluids or hydrothermal solutions, and (3) orientation of fracture pattern of preexisting anisotropy in rocks. Experiments show that changing property from brittle to brittle-ductile to ductile influences the volume percentage of dilation of the preexisting fractures and exerts control on the orientation, patterns, and opening of fractures in the overlying rocks. Rock mechanics experiments also show that extensive en echelon fractures or faults that develop under high fluid pressure by brittle to brittle-ductile extensional fracturing provide additional passage for the migration of fluid during active thermal uplift or rift formation, but they close during subsidence or basin formation. However, marginal fractures or thrust faults formed during doming and uplift open during subsidence and rift-basin formation, and facilitate fluid migration and late hydrothermal ore-mineral localization.

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Micro-Platform Carbonate Development and Facies in Mauch Chunk Formation (Chesterian) of Southwestern Pennsylvania

Through much of southwestern Pennsylvania, adjacent Maryland, and West Virginia, Upper Mississippian (Chesterian) strata are represented by intertonguing of red clastics of the Mauch Chunk Formation and carbonates of the Loyalhanna and Wymps Gap Limestones.

The lower clastic wedge of the Mauch Chunk represents an episodic shoreline progradational event that buried the underlying Loyalhanna carbonates. The sea level rise concurrent with the Wymps Gap transgression resulted in nearly continuous deposition of clastics in nearshore areas while carbonates were being deposited on more offshore areas. This resulted in the development of a lobe of clastics (forming a small platform) that created significant topography to be transgressed by the deepening Wymps Gap sea. Facies development of the Wymps Gap carbonates was markedly influenced by this inherited topography. In areas where clastics are thin, the Wymps Gap is represented by a medium-bedded, dark-gray, petroliferous, clay-rich carbonate mudstone to wackestone. These sediments are representative of open shelf deposition, in moderate water depths below storm wave base. Along the margin of the thick clastic lobe, the Wymps Gap is represented by a light-gray, locally cross-bedded carbonate grainstone to packstone. These accumulations appear to represent a slope-break platform-edge shoal environment. Over the top of the thick lobe of clastics, highly argillaceous, nodular-bedded, variegated, bioturbated carbonate mudstone to packstone formed. These facies represent platform deposition landward of the shoal environment in an open-circulation shallow lagoon.

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Undiscovered Recoverable Natural Gas in Pennsylvania—Estimates and Projections

The total of probable, possible, and speculative resources of undiscovered recoverable natural gas from conventional reservoirs in Pennsylvania is estimated to be approximately 8.5 tcf. The total undiscovered and potentially recoverable gas resource in unconventional reservoirs may be about 11.1 tcf.

Conventional natural gas resources were estimated in five general stratigraphic "packages," using differing approaches made necessary by the variable character and density of the data available, conditioned by time considerations. These packages and their total of probable, possible, and speculative resources are: Mississippian and Upper Devonian sands, 3.6 tcf; Onondaga/Oriskany and related reservoirs, 1.5 tcf; Lower Silurian Medina Sandstones, 1.8 tcf; Silurian Tuscarora and Cambrian-Ordovician formations, 0.7 tcf; Eastern Overthrust belt, 0.9 tcf.

Unconventional resources are: natural gas in coal beds, 2.7 tcf; Devonian shale gas, 8.4 tcf.

General subdivisions of the estimated conventional resources are 31% probable, 40% possible, and 29% speculative. In contrast, subdivisions of estimated unconventional resources are 11, 24, and 65%, respectively.

Short-term projections demonstrate that production of natural gas in Pennsylvania can be doubled without stress and maintained at that level for several years. Much beyond 10 yr, however, projections become speculations. One can say only that significant quantities of natural gas will be produced in Pennsylvania for many more decades. Whether gas production 50 yr hence will be in greater, equal, or lesser quantities than current production is beyond meaningful prediction.

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Hydrocarbon Production in Appalachian Basin: a Glance at the Forest

The Appalachian basin covers approximately 175,000 mi^2 (450,000 km^2) and contains about 0.5 million mi^3 (2 million km^3) of sediments. In the century and a quarter since Drake's first well, more than 500,000 wells have been drilled, producing 3.2 billion bbl of oil and 41 tcf of gas, mostly from shallow depths. Basin oil and gas production largely peaked by World War I. The stratigraphic nomenclature of the basin has arisen from that largely developed by early cable-tool drillers.

Hydrocarbon production has been established in all of the Appalachian's Paleozoic systems. Devonian rocks have been the most productive, and the Mississippian and Devonian combined account for more than three-fourths of all Appalachian oil and gas production. Stratigraphic traps are by far the dominant feature of Appalachian oil and gas fields.

Although the Appalachian basin is a generally mature oil and gas province from a developmental standpoint, this is only true above a depth of much less than 10,000 ft (3,000 m). New shallow discoveries will doubtless continue to be made. In addition, using the improved exploration technologies now available to the petroleum industry, it is reasonable to expect deeper discoveries, particularly in association with the deeper unconformities known to exist in the basin.

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Ohio Paleozoic Source-Reservoir Combinations: Source Rock Quality and Source-Oil Correlation Studies