HARRELL, STEPHEN, Hrubetz Oil Co., Abilene, TX

Petrophysical Traits and Reservoir Performance in Hrubetz Ellenburger Field, Coleman County, Texas

The Hrubetz Ellenburger field of Coleman County, Texas, produces from dolomite of the Ordovician Ellenburger Group. The discovery of commercial volumes of hydrocarbons in the Ellenburger has rejuvenated interest in areas formerly considered too mature to yield significant discoveries. The fractured nature of the reservoirs has required explorationists to reevaluate the criteria used in formation evaluation. Recognition of this type of reservoir requires conscientious sample examination as well as a knowledge of how fractures are manifested upon electric logs. Fractured intervals possessing porosities normally regarded as being below productive values are completed regularly with profitable results.

Producibilities vary, but estimates derived from decline-curve extrapolations suggest primary recoverabilities will be 50 to 100 bbl of oil/acre-ft of reservoir. The recoverabilities are a consequence of fractured reservoirs possessing a low volume of permeable pore space and a high degree of lenticularity. Accumulative production is expected to range from 15,000 to 40,000 bbl/well.

HATHAWAY, WAYNE L., North American Royalties, Inc., Midland, TX

Geology of North Part of Corsicana Shallow Oil Field, Ellis and Navarro Counties, Texas

Oil was discovered at Corsicana, Texas, in 1894 during the drilling of a city water well. The boom which followed led to the development of the first commercial rotary method of drilling, the use of gas engines to pump wells, and the first regulatory efforts of oil and gas by the state of Texas. Two other booms occurred in the early 1950s and late 1970s because of waterflooding and an increase in the price of oil.

Corsicana Shallow field consists of four producing horizons: Durango Sand, Wolfe City Sand, Pecan Gap Chalk, and Nacatoch Sand. The northern part of the field produces from the Wolfe City Sand of Campanian age within the Taylor Group. The sand can be divided into separate sand zones with independent oil-water contracts. As the sand zones are traced north and west, each thins and grades into shale. Corsicana field is located on the western edge of the East Texas embayment between the Balcones and Mexia-Talco fault zones. In the north part of the field, two fault trends are present, a N5°W up-to-the-coast fault zone and a N55°E trend of both up-to-the-coast and down-to-the-coast faults. Displacement along major faults ranges from 50 to 140 ft at the Wolfe City horizon. Production techniques varied in Corsicana field with most wells being completed open hole with 2-in. tubing used for casing during the early 1950s. After 1959, most wells were completed by perforating through casing and mechanically fracturing the pay sand. New production techniques employed in the early 1980s involved the use of salt-water mud systems, selective perforating and treating of individual sand zones, and cement bond logs and radioactive tracer surveys. A polymer injection project in progress southeast of the city of Corsicana may provide additional means of oil recovery if the pilot project proves successful.

HENTZ, TUCKER F., Bur. Econ. Geology, Austin, TX

Stratigraphic Framework of Upper Pennsylvanian and Lower Permian Marine-to-Continental Transition—Wichita Falls-Lawton and Sherman Quadrangles, North-Central Texas

Approximately 1,900 ft (580 m) of continental rocks of latest Virgilian, Wolfcampian, and early Leonardian age are exposed in an area of about 3,800 mi^2 (9,900 km^2) between the Brazos and Red Rivers of north-central Texas. The stratigraphic complexity of these strata has impeded internal correlation and mapping since the rocks were first described by W. F. Cummins in the late 19th century. Precise correlation of this discontinuously stratified fluvial sequence with well-defined, limestone-bounded, fluvial, deltaic, and marine formations to the south has been hampered because of (1) the pronounced change in lithology that accompanies this marked facies transition, (2) a shift in strike of approximately 65° that coincides with a change in facies tract, thus amplifying the stratigraphic complexity of the region, and (3) generally poor exposure of the gently inclined strata.

The continental sequence is composed of approximately 25 major and numerous minor, upward-fining, principally fluviogenic cycles. Sandstone units (5-60 ft or 1.5-18 m thick) mark the bases of these cycles and occur as regionally persistent zones with multistory and multilateral geometry. These generally resistant, cuesta-forming units interfinger with limestone-bearing strata or are separated from them along strike by intervening zones of red mudstone. The fine-grained upper portion of the cycles (10 to > 100 ft or 3 to > 30 m thick) is predominantly concretionary red mudstone, although gray and variegated claystone lenses, thin siltstone and sandstone beds, and lenticular and channel-fill conglomerates are characteristic.

Precise mapping of sandstone units and correlation with prominent limestone pinch-outs have permitted a stratigraphic tie with the marine section of the Colorado and Brazos River valleys. Continental rocks are divided into the Bowie and Wichita groups; equivalent marine strata are divided into the Cisco and Albany groups. Formations have been defined in each group to allow a maximum degree of intergroup correlation.

HILLIS, GEORGE A., Bass Enterprises Production Co., Fort Worth, TX

Petrophysics of Morrow Formation, Southeastern New Mexico

In 1982, Bass Enterprises applied successfully for tight gas designation for the Morrow Formation over an area of approximately 320,000 acres encompassing the Big Eddy and Poker Lake Federal Units in Eddy County, New Mexico. Relating to this application, a petrophysical study was made to determine the pay section in the Morrow and the in-situ permeability of it.

Initially log and core data were quality controlled, porosity logs were calibrated using core data, and Pickett plots were used to determine the formation water resistivity (R_w) and the formation resistivity factor (F). Subsequently, the R_w and F values were used in determining water saturation. The pay section was then identified by determining the porosity and water saturation cut-offs from porosity vs. water saturation crossplots and production tests from zones of varying water saturation.

Standard laboratory-measured core data analyzed at 200 psi provided the porosity-permeability relationships which allowed permeability data to be obtained using the porosity logs. Using additional core data, a relationship was established between this "surface" permeability and a permeability measured at subsurface conditions more analogous to that of the reservoir. This relationship was used to determine the in-situ permeability of the pay section.

This discussion covers several critical aspects of reservoir description, and, although the data involved pertain to the Morrow Formation, it is stressed that these principles can be used for other reservoirs. When possible, such aspects should be investigated more frequently, be it in an exploration or a development program.

JONES, E. L., Mobil Research and Development Corp., Dallas, TX

Current and Future Trends in Geologic Research and Applications

It is a high risk venture to predict trends for any science because new discoveries or new demands can change the directions that are seen at present.

A major trend in geology is the participation of geologists in reservoir management from time of discovery through the life of a field. A significant task for the geologist in reservoir management is to participate in selecting the appropriate enhanced oil recovery (EOR) method and in its application. As a consequence of these tasks, geologic applications change from the traditional descriptive aspects to a more quantitative approach.

Exploration management also requires a predictive role for geology. This includes predrilling predictions of reservoir quality and geometry, of aspects of the reservoir fluids including type of prospect fill-up, and of migration routes.

To refine and expand these predictive capabilities, the combination of geology with the other earth sciences, particularly geophysics and geochemistry, will continue to expand in scope.

Certainly not all of the current and future trends in geology have been identified in this discussion. It seems obvious, however, that these expanded roles for geology should insure that it will continue to have a significant place in both the exploration and production aspects of the petroleum industry.

JORDAN, CLIFTON J., Mobil Research and Development Corp., Dallas, TX

A Shorthand Notation for Carbonate Facies—Dunham Revisited

Carbonate facies can be described in a concise format that reads like an algebraic equation:

CARBONATE FACIES = (LITHIC DESCRIPTOR) (COMPOSITION) (TEXTURE) ± REMARK.

Lithic descriptors are portrayed by symbols for sedimentary structures, admixtures of argillaceous or arenaceous material, diagenetic features, and/or porosity. The second term, composition, generally used for describing the sand-size fraction of the rock, is represented by symbols designed to look like the grains themselves. Compositional symbols that appear in the equation should include only common rock-forming particle types, listed in order of decreasing abundance. The third term of the equation, texture, consists of a one-letter or two-letter abbreviation for the textural terms of Dunham or of Embray and Klovan. The fourth term of the descriptive equation is optional and allows a qualifying remark, using a minimum of appropriate symbols. Thus, a limestone that is cross-stratified and consists of 75% ooids and 25% carbonate cement is written as XOG.

Advantages of this shorthand system are (1) it is graphic and can be used to expedite routine sample logging and digital data recording; (2) it is useful in maps and cross sections to illustrate facies patterns in carbonate rocks, (3) it provides an international shorthand that transcends language barriers, and (4) it is both descriptive and genetic and has important implications for porosity prediction, and is thus an aid in the search for stratigraphic traps.

KENNEDY, NOEL L., and THOMAS E. YANCY, Texas A&M Univ., College Station, TX

Depth-Gradient Analysis and Biotic Succession in Colony Creek Cycle (Late Pennsylvanian) of North Texas

The Colony Creek Shale (Canyon Group) in north Texas contains a vertical succession of lithologies and biotas deposited during regression from deep water to shallow water and strandline deposition. Stratigraphic successions in the Colorado River valley and the Brazos River valley of the outcrop belt are similar, showing that regression was of regional extent. A thin layer of platy, phosphatic black shale containing an ammonoid fauna occurs at the base of the Colony Creek and is diagnostic of deep-water deposition. This unit is similar to deposits of maximum transgression (stillstand) of many Pennsylvanian cycles. The overlying shoaling-upward portions of the Colony Creek are characterized by upward increase in sand content, increasing numbers and thicknesses of sand beds, and culmination in a horizon of subaerial exposure.

Statistical analysis reveals a continuum of communities in the shales of the Colony Creek. These communities represent the continuing response of organisms to shoaling but are partly the result of an increase in sand content within the shales. The basal phosphatic black shale contains a community distinguished by its ammonoids. The overlying gray shales contain a diverse pleurotomariid community, which grades upward into a *Neospirifer*-productid community. In shoal-water deposits a distinct *Neospirifer*-myalinid community appears. The top of the sequence contains a molluscan community in sand substrates, which is characterized by *Permophorus*. The brachiopod *Crurithyris* is dominant in most shales in the succession and is not depth controlled. This succession of lithologies and biotas is typical of cyclothem deposits in other regions of North America and in Europe.

KNIGHTS, WILLIAM J., Circle Seven Oil & Gas, Inc., Fort Worth, TX

Subsurface Strawn and Atokan Series, Southwest Jack County, Texas

Lower Pennsylvanian sediments in the Fort Worth basin are prolific hydrocarbon producers. These sediments are deltaic in nature and are characterized by complex stratigraphy. The problem of locating new reserves and exploiting producing zones depends largely on subsurface mapping and a detailed knowledge of the stratigraphy.

The Atokan and Strawn progradational sediments in the study area consist of 13 separate depositional cycles, each of which isolated several reservoirs. Each of these groups of reservoirs has potential for structural and/or stratigraphic hydrocarbon traps. Mapping located prospects in the Strawn on noses in the Dog Bend Limestone, in Atokan conglomerates in structural lows associated with faulting in the Marble Falls, and in deeper horizons, such as Mississippian reefs and Ellenburger highs, and on structural highs in the Marble Falls.

MCKEE, BRYCE J., Baylor Univ., Waco, TX

Oolite Shoal Reservoirs in Pettet Formation (Lower Cretaceous), Southeast Shelby County, Texas

The Pettet Formation is a southward-thickening carbonate wedge, deposited during Aptian (Early Cretaceous) time in the region that is now the Gulf coastal plain of east Texas, Arkansas, and Louisiana. Within the Pettet are characteristic oolite sequences which formed in a northwest-southeast-striking belt paralleling the shelf edge.

In southeast Shelby County, Texas, the Pettet oolite shoals were studied, using available well cores and induction-electric logs. The oolite shoals appear to have formed on top of remnant topographic highs in the underlying Travis Peak Formation, in series of vertically stacked cycles of grainstone development.

The oolite shoals display five constituent lithofacies: (1) mudstone, (2) oolitic packstone, (3) skeletal-oolitic packstone, (4) skeletal-oolitic grainstone, and (5) oolitic grainstone. The oolitic grainstone lithofacies is the most volumetrically significant constituent of the Pettet oolite shoal reservoirs, comprising approximately 95% of each sequence.

Three diagenetic environments are seen in the oolite shoals: marine phreatic zone, vadose zone, and freshwater phreatic zone. Porosity is mainly primary interparticle, with some secondary intraparticle and vuggy porosity also being important. The freshwater phreatic diagenesis appears to have had the most effect on the Pettet reservoirs, creating minor recrystallization-induced porosity occlusion and excellent porosity-enhanced dissolution zones.

Hydrocarbon reserves in the Pettet Formation are related to certain structurally modified oolite shoals. Salt swelling and diapirism in the underlying Jurassic Louann Salt appear to be the mechanism responsible for the formation of locally developed anticlinal noses and domes. These small anticlinal features, when occurring beneath or adjacent to an oolite shoal, result in the upward tilting of the strata with subsequent migration and stratigraphic trapping of oil and gas.

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Significance of Framework Dissolution in Interpreting Sandstone Provenance

Dissolution of unstable framework grains such as feldspar and rock fragments (including chert) is common in sandstones worldwide. Such framework dissolution usually results in a depletion of unstable framework grains and a corresponding enrichment of quartz. Failure to recognize this diagenetic modification of composition of a sandstone will result in misinterpretation of its provenance. A proper evaluation of sandstone composition may be achieved by including the dissolved portion of a framework grain as a grain, rather than as porosity, while point counting. This should be useful in interpreting original composition of sandstones and their provenance.

STAPLES, MARCUS E., Bass Enterprises Production Co., Fort Worth, TX

Exploration of Basal Bend Bar System, Southeast Foard County, Texas

The Bend conglomerates of north Texas are lithologically diverse Lower Pennsylvanian sandstones and conglomerates deposited by a variety of depositional systems. In southeast Foard County, the basal Bend conglomerates form oil-productive sandstone bodies morphologically identical to both ancient and modern coastal marine bars.

A basal Bend shale isopach map of southeast Foard County delineates the paleotopography of the eroded Mississippian surface over which the