ROZENDAL, R. A., Shell Oil Co., Houston, TX

Conventional United States Oil and Gas Remaining to be Discovered

Annually, Shell Oil Co. makes a forecast of conventional United States oil and gas resources remaining to be discovered, and differentiates the part of that forecast that will be found in the first and second decades of the future. The primary purpose of these forecasts is for use as a planning tool to aid in deciding the future directions and levels of effort for Shell Oil Co.

A major assessment effort was carried out in 1978 when future estimates were 60 billion bbl of oil and 315 tcf of gas. The annual assessments since then have been done in less depth until this year's major reassessment effort. The results of this assessment will be discussed, the methodology used will be reviewed, and Shell Oil Co.'s use of the results will be discussed to better place the Shell Oil Co. forecast in context with forecasts made by the U.S. Geological Survey, industry, and other forecasters.

RUGGIERO, ROBERT W., Sohio Petroleum Co., Houston, TX, and ALAN J. SCOTT, Univ. Texas at Austin, Austin, TX

Depositional History and Performance of a Bell Canyon Sandstone Reservoir, Ford-Geraldine Field, West Texas

The late Guadalupian Bell Canyon Formation comprises alternating siltstone and fine to very fine-grained sandstone, which constitute economically important, shallow (2,000-3,000 ft, 600-900 m) oil reservoirs in the Delaware basin. In Ford-Geraldine field (Reeves and Culberson Counties), the Ramsey sandstone member, uppermost sand of the Bell Canyon Formation, was deposited in a deep-water, sediment-starved, euxinic basin.

Bottom-hugging hypersaline density currents spilling off the shelf through breaches in the Permian platform margin gouged elongate, subparallel channels into the slope and preexisting Laurentian-type fan.

Occasionally, sand-laden currents flowed through these channels, either scavenging sand stored on the shelf near the channel head or scouring material from intermittent depocenters on the slope. Where the slope gradient decreased significantly, sand was deposited within the channel. Isopach maps how that the distribution of coarser sediment was highly influenced by channel-bottom topography. The back-filling lobate geometry of these flows indicates that the channels were retrograding to a more gentle slope during a late Guadalupian period of high sea-level stand.

After eastward tilting of the Delaware basin in the Tertiary, hydrocarbons migrated updip toward the toes of the lobes and along the western margins of the channels. The reservoir sands are encased in less permeable, laminated siltstone; therefore, the terminal part of the channels provided excellent stratigraphic traps.

The Ford-Geraldine field produces from one of these Ramsey sand-filled terminal channels with original reserves estimated at 110 million bbl of oil. Within this complex trap framework, hydrocarbon distribution in the field is determined by a combination of stratigraphy, subtle structure, and hydrodynamics. Large variations in sandstone porosity and permeability over short vertical and horizontal distances result from: (1) channeling within the larger channel complex, (2) the occurrence of thinly laminated siltstone layers isolating individual sand layers, (3) sandstone pinch-out into siltstone, and (4) the distribution of calcite and authigenic clay cements. Primary and secondary production extracted 22% of the original oil in place. Tertiary production (alternating carbon dioxide and waterflood) is underway. Reservoir characteristics described here must be incorporated into the enhanced recovery model to make valid predictions of tertiary recovery performance.

RUSSELL, BILLY JOE, JR., Stephen F. Austin State Univ., Nacogdoches, TX

Depositional and Diagenetic History of Bodcaw Sand, Cotton Valley Group (Upper Jurassic), Longwood Field, Caddo Parish, Louisiana

Bodcaw Sand contains fine-grained sandstones and siltstones deposited within a barrier-bar-complex. Based on vertical changes in sedimentary structures, texture, and mineralogical composition, upper-, middle-, and lower-shoreface lithofacies in the Bodcaw Sand can be identified. Cross-stratification and low-angle laminations, rarely disrupted by biogenic structures, characterize the fine-grained upper-shoreface sandstones. Middle-shoreface sandstones have undergone extensive reworking by biotic and abiotic factors. Few primary sedimentary structures and early generation trace fossils are preserved in middle-shoreface sandstones. Lower-shoreface siltstones and very fine-grained sandstones contain lenticular and wavy bedding, much of which is disrupted by bioturbation.

Bodcaw Sand has low porosity and permeability. Vertical and lateral variation in porosity and permeability are related to depositional textures and diagenetic fabric of Cotton Valley sediments. Bodcaw Sand has experience a complicated diagenetic history. Compaction, cementation, replacement, and dissolution modified primary rock properties following deposition of barrier-bar sediments. Cementation plays an important role in modification of reservoir properties. Important authigenic minerals identified in Bodcaw Sand include silicates, carbonates, and phyllosilicates. Based upon textural relationships between allogenic grains, authigenic constituents, and pore characteristics, a relative succession of diagenetic events can be interpreted. Two major diagenetic sequences occurred within Bodcaw Sand. Diagenetic events within one sequence included cementation by silica, phyllosilicates, and calcite, as well as, dissolution and replacement reactions. The other sequences primarily involved diagenetic reactions of calcite precipitation, dissolution, and replacement.

RUTLEDGE, ANNE K., and JOHN C. LORENZ, Sandia Natl. Labs., Albuquerque, NM

Facies Relationships and Reservoir Potential of Ohio Creek Interval Across Piceance Creek Basin, Northwestern Colorado

The Ohio Creek member of the Mesaverde Group of Late Cretaceous age grades from a fluvial to a paralic facies from the southern to central parts of the Piceance Creek basin. The Ohio Creek is considered here to be the nonmarine to paralic equivalent of the Lewis transgression to the north. Although it is fluvial in the type area and southern part of the basin, evidence of marine influence in the east central part of the basin includes: (1) zones of abundant logs with large fossil *Teredinidae* burrows, (2) palynological evidence from outcrops at Rifle Gap and the U.S. Department of Energy MWX wells, and (3) marine-type sedimentary structures visible in outcrop. In this east-central area Ohio Creek depositional environments are interpreted as distributary channel and estuarine.

Although the Ohio Creek is highly altered by diagenesis and is an aquifer in some parts of the basin, the equivalent zones are productive of hydrocarbons in the north-central parts of the basin. Continued changes in facies toward a marine environment to the north affected the petrologic characteristics and sand body/reservoir morphology, increasing the reservoir potential of this zone to the north. The variably thick interval is recognizable in the subsurface as an extensive sandy zone with blocky shaped log profiles; it should provide good reservoirs where porosity and permeability are not occluded by diagenesis, and where continuity with surface exposures has not allowed gas escape and water influx.

SALLER, ARTHUR H., Louisiana State Univ., Baton Rouge, LA

Deep Marine Dolomitization, Enewetak Atoll

Dolomite is present 1,250-1,400 m (4,100-4,600 ft) below sea level in Eocene strata of the Enewetak Atoll. Petrographically, the deep Enewetak dolomite postdates brittle compaction of rigid grains in the host Eocene strata. The $^{87}Sr/^{86}Sr$ ratios of these dolomites (0.70865-0.70901) indicate that the dolomites formed mainly between middle Miocene and the present. Because the top of the lower Miocene is more than 900 m (2,900 ft) above the deep dolomitic interval, the dolomite must have formed at a minimum burial depth of 900 m (2,900 ft). Stable oxygen isotope determinations suggest dolomite precipitation from cold marine water. Lower Miocene and Eocene carbonate strata on the atoll are currently in open communication with cold, modern ocean water and probably have been since deposition. At a depth of approximately 1,000 m (3,300 ft), modern Pacific Ocean water becomes undersaturated with respect to calcite but is still supersaturated with respect to dolomite. Therefore, it is proposed that the deep Enewetak dolomites precipitated from cold, deep ocean water (undersaturated with respect to calcite) percolating through the atoll at burial depths of more than 900 m (2,900 ft).