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ACHAUER, C. W., ARCO Oil and Gas Co., Dallas, TX

Minnelusa Depositional Cycles and Erosional Topography, Rozet Fields Area, Powder River Basin, Wyoming

Marine cyclic deposition is very apparent in cores of the upper Minnelusa Formation in the Rozet fields area, Powder River basin, Wyoming. A complete cycle from bottom to top is comprised of (1) subtidal facies of dolomicrite or dolomitized packstone that sometimes contains fusulinids or crinoid fragments, (2) intertidal facies of algal-laminated or layered dolomicrite which is, sometimes, desiccated and slightly brecciated, and (3) supratidal facies of anhydrite marked by "chicken-wire" structure. However, complete cycles are interrupted by exceptionally clean, well sorted quartz sandstone units that may have been deposited in a variety of closely related, coastal environments, including very shallow subtidal, intertidal, beach, and eolian.

A Minnelusa cycle and its facies have close counterparts in the Holocene sabkhas in Abu Dhabi. In addition, mapping of Minnelusa sabkhas reveals that they are very narrow, trend in the same direction, and are separated by quartz sandstone buildups that may represent eolian dune trends. A Holocene analog of the Minnelusa sabkha-eolian dune complex is seen in the area southeast of Abu Dhabi where narrow sabkhas are separated by eolian dune ridges. Thus, it appears that Minnelusa anhydrites formed in a sabkha setting very similar to the modern sabkha-eolian dune complex southeast of Abu Dhabi.

Erosional topography at the top of the Minnelusa Formation plays a prime role in the entrapment of hydrocarbon in the Rozet fields and, apparently, in many other fields that produce from the Minnelusa.

ALLEN, TERRY S., Phillips Petroleum Co., Salt Lake City, UT

Roosevelt Hot Springs Unit Development

The Roosevelt Hot Springs Unit, Beaver County, Utah, was unitized in April 1976, and was the first geothermal unit approved by the United States Department of the Interior. Current plans call for start-up of a 20 Mw geothermal power plant in April 1984, with the Roosevelt Hot Springs Unit producing 2.5 million pound-mass/hr (172,500 bbl/d) of fluids. This paper outlines the various steps taken during development of the resource from 1976 to the expected 1984 start-up. The topics briefly discussed will consist of a geologic description, exploration review, testing and data collection, resource and reservoir evaluation, and the 20 Mw geothermal plant.

ANDERSON, SIDNEY B., North Dakota Geol. Survey, Grand Forks, ND, LEE C. GERHARD, Colorado School Mines, Golden, CO, and JULIE LEFEVER, North Dakota Geol. Survey, Grand Forks, ND

Structural and Sedimentologic History of Nesson Anticline

The Nesson anticline extends for 75 mi (120 km) and is the most prominent surface structure in the North Dakota portion of Williston basin. First mapped in 1918 by A. G. Collier, its description was published in a bulletin of the U.S. Geological Survey. Its axis trends north-south and is crossed by several northeast-southwest and northwest-southeast subsidiary anticlinal folds. Oil was first discovered in commercial quantity in North Dakota on the Nesson anticline in 1951. Since that time, hydrocarbons have been produced from Cambrian, Ordovician, Silurian, Devonian, and Mississippian strata.

Available well control indicates that the Nesson anticline was initiated during the Precambrian. Indications are that the structure probably was normally faulted on the west margin. Structural deformation was episodic, with recurrent motion along the same fault system through time. Cross sections and isopach and structure maps document the changes in fault motion and basin communication with open marine waters.

Continuing movement of the border faults of the Nesson anticline probably have enhanced porosity development by fracturing and by creation of sedimentary and diagenetic environments which favor porosity development.

ANNA, LAWRENCE O., Anna Geoscience, Inc., Lakewood, CO

Structural Influence on Lower and Middle Cretaceous Sedimentation, Northern Great Plains

Sedimentation during the Lower and middle Cretaceous in the northern Great Plains (eastern Montana, North Dakota, South Dakota, and northeastern Wyoming) was influenced by recurrent movement of basement fault blocks. Regional thickness variations of four time-stratigraphic intervals are linear and have dominant orientations of northeast and northwest. Regional distribution of porous and permeable sandstone in the Muddy-Newcastle formation and equivalents (Albian), and in the Inyan Kara Group and equivalents (Aptian-Albian) are also linear and have dominant orientations of northeast and northwest. Similar thickness variations and directions of Lower Cretaceous units on the southwest flank of the Black Hills have been described in detail by Weimer and others in 1983.

A depositional model, incorporating structural and sea level changes, shows that marine and nonmarine units thicken in structurally low areas and thin over structurally high areas.

A tectonic model to account for the linear orientations, illustrates the effects of simple and pure shear stress systems. The stress systems were formed from the recurrent movement of basement faults possibly caused by movement of the North American plate during the Cretaceous.

Major surface expressed folds and faults and surface lineaments have dominant orientations of northeast and northwest. These features either overlap or are parallel to linear thickness trends of Cretaceous rocks. Both surface and subsurface features are thought to have resulted from common basement fault block movement.

Sedimentation and tectonic models can be used to predict vertical and lateral distribution of marine and nonmarine rocks. When integrated with these models, orientation of fractures and routes of fluid migration can be predicted by paleostructure analyses.

BAARS, D. L., Consulting Geologist, Evergreen, CO, and G. M. STEVENSON, Consulting Geologist, Denver, CO

Paleotectonic Control of Pennsylvanian Sedimentation in Paradox Basin

The Paradox basin of the east-central Colorado Plateau province is an elongate rhombic evaporite basin of Middle Pennsylvanian age. It is bounded on the northeast by the Uncompahgre and San Luis segments of the Ancestral Rockies. The northwest-trending basin sagged along preexisting basement rifts by strong east-west extension during Desmoinesian time. The dominant zone of weakness was the northwesterly Olympic-Wichita basement lineament that lies along the eastern margin of the salt basin and the southwestern front of the Uncompahgre and San Luis uplifts. Less prominent northwest and northeast shear zones are ubiquitous, but are especially well developed in basement and Paleozoic rocks underlying the San Juan basin and the southwest shelf of the Paradox basin. It is a classic pull-apart basin developed along anastomosing wrench faults which first developed at about 1,700 m.y.B.P., and were rejuvenated repeatedly throughout the Paleozoic.

Initial subsidence and associated sedimentation occurred in the southeastern divergent termination of the basin in Atokan and early Desmoinesian time, when the Grenadier and Sneffels horst blocks were elevated to form the San Luis uplift. The quartzite-dominated horsts shed large volumes of relatively nonfeldspathic quartzose sediments into shallow seaways of northern New Mexico and southwestern Colorado. By mid-Desmoinesian time, the true Uncompahgre uplift was elevated to the north, and shed vast accumulations of arkose into the eastern margins of the basin. Meanwhile, cyclic evaporites, dominated by salt, accumulated in the structurally restricted basin. The southwestern shallow shelf of the basin developed along a broad zone of basement rifting, extending across the northern San Juan basin, the Four Corners platform, and northwest to beyond the Henry Mountains. The Four Corners lineament served to terminate salt deposition along the structural shelf and create local shoaling conditions to host myriad algal bioherms that would become prolific petroleum reservoirs. These fields include the giant Aneth field and the recently developed Bug field complex. Unlike the dramatic events along