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Tectonics, Sedimentation, and Petroleum Potential, Northern Denver Basin, Colorado, Wyoming, and Nebraska

A stratigraphic analysis of Paleozoic and Mesozoic strata in the northern Denver basin shows that recurrent movement on basement faults influenced sedimentation, especially during major sea-level changes. The research integrates surface and subsurface data for an area of approximately 30,000 mi^2 (77,700 km^2).

Twenty stratigraphic intervals in the Paleozoic and Mesozoic were identified from well data. Areas of thickness variations on isopach maps within these stratigraphic intervals are caused by onlap, offlap, convergence, and subtle unconformities which may be directly related to the development of paleostructure. In general, thin areas on isopach maps correspond to paleohighs and thick areas correspond to paleolows. In the northern Denver basin, four major northeast-trending paleostructures had recurrent movement during the Permian and Cretaceous, and three major northwest-trending paleostructures had recurrent movement during the Pennsylvanian, Permian, Triassic, and Cretaceous. Wedge-outs of Cambrian, Ordovician, Mississippian, and Triassic strata were also controlled by the northeast- and northwest-trending fault systems. In addition, the late Paleozoic stratigraphic sequence is thicker in the subsurface than in surface measured sections which is evidence for major paleostructure movement.

The tectonics and sedimentation model of recurrent fault-block movement will aid in the exploration for hydrocarbons in the Denver basin by predicting the distribution of both source and reservoir rocks and by identifying early traps associated with paleostructures. Moreover, the large number of wells which penetrate only the Cretaceous section may be used in some areas to predict the Paleozoic paleostructure.

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Influence of the Pre-Cretaceous Unconformity on Deposition of Lower Mannville Clastic Sequence, Drumheller, Alberta

The paleotopography of the Pre-Cretaceous unconformity and distribution of the overlying sediments has been examined in a 576 mi^2 (1,491 km^2) area of south-central Alberta using all available cores, geophysical logs, selected well cuttings, micropaleontology, and seismic sections. Control averages one well per square mile.

The Cretaceous strata in this area lie unconformably on Mississippian carbonates and shales. The relief is controlled, in part, by the lithology of the subcropping Paleozoic formations.

The basal sandstones of the lower Mannville are valley-fill deposits ranging in thickness from 0 to more than 100 ft (30 m). They are separated from the underlying Paleozoic carbonate rocks by a detrital assemblage consisting of variegated, poorly sorted, cherty rocks. This thick basal quartz sandstone assemblage can be subdivided into a number of distinct lithic units which are recognizable on the basis of core studies, but are not readily identifiable on geophysical logs.

Three different lithic units have been mapped integrating all available data. A depositional model has been constructed which clarifies the relation between the unconformity and the occurrence of basal quartz hydrocarbon reservoirs.

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Model of Ocean's Coupled Carbon, Oxygen, and Phosphorous System

A simple steady-state one-dimensional advective-diffusive model of the coupled carbon, oxygen, and phosphorous system is developed. The model can be viewed as an extension of Wyrtki's model of the oxygen distribution. The occurrence of anoxia requires two conditions: (1) sufficiently high productivity, and (2) sufficiently low oxygen concentration in the bottom water. It is shown that anoxia is likely to occur fairly high in the water column (as the present-day oxygen minimum does).

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Prudhoe Bay Field—Geophysical Case History

In June 1968, ARCO-Exxon completed the Prudhoe Bay State I well, discovering the largest oil accumulation in the United States. This discovery was the result of a 4-year seismic program which began in 1963. Prior to this time, and beginning in 1943, the U.S. Navy carried out a 10-year exploration program within Naval Petroleum Reserve 4. Small accumulations of oil and gas were discovered on NPR 4 during this period. Industry exploration started on the North Slope in 1958 with geologic field work. The first industry seismic work began in 1962. Initial emphasis was between the Colville and Canning Rivers on federal acreage within the foothills belt north of the Brooks Range. By 1963, each of the three predecessor companies of Atlantic Richfield (Atlantic Refining Co., Richfield Oil Corp., and Sinclair Oil Corp.) were involved in separate geophysical exploration programs. North-south regional seismic lines and State of Alaska land availability resulted in shifting, in 1964, the exploration effort north to the Arctic coastal area. By this time both the Prudhoe Bay and Colville structures had been delineated. In December 1964, during the first state sale on the North Slope, Sinclair in partnership with British Petroleum (now Sohio-BP) leased the entire Colville structure. By mid-1965 additional seismic control had further defined the Prudhoe Bay structure. The critical state lease sale of July 1965 determined the eventual ownership of Prudhoe Bay field. It resulted in Richfield-Humble (now Exxon) buying the top tracts, with BP acquiring flank acreage. In January 1967, ARCO-Humble acquired additional offshore tracts. Prior to the Prudhoe discovery well in January 1968, 10 wells had been drilled on the North Slope by industry without commercial success.

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Pyrolitic Properties of Maceral Types

The gas and oil generation potential of organic matter of a source rock depends on the nature of the organic matter and its thermal history. The maceral composition is a direct measure of the original organic matter in immature rocks. The optical properties of specific maceral groups are used for the determination of their degree of maturation. Pyrolysis is a means for the evaluation of the generation potential. A combination of these methods enables a comparison of generation properties of different sources.

Kerogen concentrates were separated by heavy liquids into frac-