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Rock Properties—Influence on Hydrocarbon Accumulation, Production, and Residual Oil Shows

No abstract available.

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Some Relations Between Diagenesis and Porosity (Real and Imagined), Sandstones of Mesaverde Group, Uinta Basin, Utah

Examination of core and surface samples from several nonmarine sandstones of the Upper Cretaceous Mesaverde Group in the southeastern part of the Uinta basin, Utah, reveals extensive diagenetic alterations. Diagenesis has significantly altered the porosity characteristics of the sandstones and is thought to have a definite influence on porosity log calculations and on the interpretation of various other geophysical logs, sometimes leading to erroneous interpretations of reservoir characteristics.

Leaching of rock fragments and carbonates—calcite, dolomite, and ankerite—has resulted in the development of significant amounts of secondary porosity which probably provide the favorable reservoir properties of the sandstones. Formation of authigenic pore-filling kaolinite, and illite, which replaces rock fragments and which lines pores, has produced microporosity, greatly increased pore surface area, and has created a tortuous pore network. These properties dramatically alter pore geometry and, thus, fluid-flow characteristics which significantly alter the response of resistivity logs and interpretation of sonic and neutron logs. Consequently, erroneous values may be obtained for calculated porosity and water saturation. Interpretation of mercury-injection curves is also influenced by authigenesis.

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Integrated Geologic and Geophysical Studies as Exploration Tool in Rift-Related Basins

The careful integration of gravity, magnetic, and well data can provide an economical exploration tool at least on a regional basis. Large, publicly available files of gravity and magnetic data are easily accessible. These data represent a valuable source of information which can be particularly effective when used to extrapolate between and below points of available well control. In addition to providing the information needed to optimize expenditures for seismic reflection surveys, the results from an integrated analysis may directly yield attractive prospects. This approach has been applied to several rift-related basins in the Mid-Continent and southwestern United States and the results are encouraging. The general subsurface geometry of the basin can be readily determined and, especially in the Mid-Continent region, the existence of large volumes of unexplored clastic sediments is indicated. In rifted areas, patterns of surficial faulting can be very complicated and sometimes misleading. In the basins studied, valuable information on the nature and subsurface extent of fault systems was obtained.

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Patterns of Thick Coal Deposition Across Powder River Basin in Northeastern Wyoming

Tertiary coal beds in the Powder River basin are the nation's largest resource of low-sulfur subbituminous coal. In northeastern Wyoming the north-trending depositional axis of the asymmetric, 100-km-wide basin is within 20 km of the west margin. Interlocking lines of cross sections prepared from geophysical logs of oil and gas wells and coal exploratory holes and set to a sea level datum, outline patterns, locations, and trends of thick coal deposition. Coal beds on the east flank of the basin dip west about 1/2° and tend to merge eastward. Five Paleocene (Fort Union) coals merge along the eastern margin to form a north-trending, 35-m-thick deposit known as the Wyodak coal. Near the depositional axis, five or more Eocene (Wasatch) coals merge to form a north-trending, 60-m-thick deposit known as the Lake deSmet coal. Across the intervening area two or more succeeding coals merge locally on broad depressed subsurfaces to form north-trending belts of thick coal, and succeeding belts of thick coal are offset westward toward the depositional axis. Lines of cross sections oriented north-south roughly parallel to the depositional strike provide stratigraphic control on the coal. Maximum structural relief (about 400 m) of coal beds on the east flank relates to basin subsidence during deposition of coal-bearing rocks when rates of subsidence progressively increased westward. North-trending patterns of thick coal deposition across paleoslopes are associated with connected areas for which optimum paleoenvironments were stable for extended periods of time and optimum rates of subsidence were maintained.

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Department of Energy Drilling Programs and the Geosciences

An understanding of the structure, dynamics, and genesis of the North American continent is critical to the Department of Energy (DOE). Geoscience programs and drilling on the continent by the DOE have, in the past, been designed for specific programs in fossil fuels, geothermal energy, uranium resource evaluation, and defense. Although not specifically used for studies of the continent, these programs have provided abundant data on lithologies and physical properties. Through the Continental Scientific Drill Program (CSDP), these existing data will be readily available to the scientific community through a central data facility. With the present attitude in Congress toward basic research, it is doubtful that any deep drilling program will be dedicated solely to the CSDP. It is more likely that many of the holes drilled for the DOE and other government agencies might be developed further as "wells of opportunity" by the CSDP to collect deep samples or be used for in-situ measurements. Through the use of wells drilled for other purposes but made available to the community for CSDP projects, feedback will continue to provide the answers needed by the DOE to understand and to develop the energy resources of the

continental crust. Throughout this program, particular thought will be given to involvement of a larger scientific community in potential research activities.

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Source-Rock Potential of Evaporitic Environment

Examination of modern saline lakes, solar ponds, and lagoons shows that the evaporitic environment can be very productive of organic matter. Few species survive in the brines, but those that do survive commonly exist in abundance. In a model evaporitic embayment, the flow of surface currents is persistently toward regions of highest salinity, so that there is a continual supply and concentration of those nutrients being brought into the saline environment. Prolific growth of phytoplankton may occur, analogous to phytoplankton blooms in areas of upwelling in modern oceans. Only carbonates precipitate in the "mesosaline" part (4 to 12% salinity) of the marine evaporitic environment and no great dilution of organic matter by clastic or biogenic sediments occurs. Because of stratification of the brine and the chemically reducing conditions associated with brines, much of the organic matter produced is preserved. The result may be a potentially rich carbonate source rock, frequently unrecognized in the geologic column. In the Middle East, mesosaline conditions have occurred many times from Triassic to Cretaceous and may be responsible for the vast reserves of petroleum in the area. Evaporitic conditions may also have played a part in the petroleum productivity of many other basins, including the Michigan, Paradox, Williston, and Devonian of western Canada.

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Patterns of Shallow-Marine Deposition, Upper Cretaceous of Northern Colorado

Economically important sandstone bodies encased in marine shales have been described from the Western Interior region of Utah, Colorado, Wyoming, and New Mexico. Our study of a part of an Upper Cretaceous shelf region in northern Colorado shows that the occurrence and distribution of shelf sands were dependent upon a large dynamic sediment system associated with both major and minor transgressive-regressive phases.

Discrete sandstone members of the Mancos and Pierre Shales represent beach, distributary mouth bar, shoreface, and mid-shelf bar deposits. Texture, sorting, bioturbation, thickness, and bed forms of these units are variable, reflecting the variation in rate of deposition and wave energy. Evidence of transgressive reworking is present locally on the caps of some units. Although some sandstone members (e.g., the Hygiene) have been previously correlated over seaward distances exceeding 50 mi (80 km), our detailed examination of cross-bedding patterns and composition indicates deposition in distinctly different shallow-marine environments. Bed forms (medium-scale tabular cross-beds) and lithology of easternmost exposures of the Hygiene are similar to those in modern sand bars on the United States Atlantic, Bering Sea, and North Sea continental shelves, suggesting deposition at mid-shelf depths. Sources of sands were to the west; dominant direction of transport, however, was to the south.

Key factors in the Upper Cretaceous were the relation between nearshore depositional environments and mechanisms of sediment transport on the shelf. Nearshore sedimentation rates apparently were high but episodic; shelf areas were broad and shallow resulting in discontinuous seaward progradation of delta-front sheet sands; and minor, local transgressive phases, as well as major phases, had impact on the geometry and stratigraphic associations of discrete marine sand bodies during the Late Cretaceous.

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Processes Controlling Characteristics of Surficial Sand Sheet, U.S. Atlantic Outer Continental Shelf

A surficial sand sheet covers almost the entire Atlantic outer continental shelf of the United States. Until recently, the processes controlling the characteristics of this sheet were inferred mainly from the texture and composition of bottom grab samples and from the bathymetry. Studies of these aspects outlined the general nature and age of major processes, but they were necessarily limited in scope.

With the advent of leasing of the outer shelf for petroleum exploration, many process-oriented studies were initiated by the U.S. Geological Survey. These studies included measurements of the velocity of bottom currents, the frequency of bottom-sediment movement, the kinds and amounts of suspended sediments in near-bottom waters, and the acoustic and sedimentary characteristics of the shallow subbottom strata. These new measurements, when used in conjunction with previous data, show that attributes of the surficial sand sheet such as the thickness, volume, composition, texture, and internal structure have been controlled by a variety of ancient and modern processes. Ancient processes include those associated with glaciers, ancestral rivers, nearshore-marine environments, and subaerial solution and erosion. Modern processes include tidal-, wind-, and wave-driven currents, internal waves, movement of water masses, regional circulation patterns, sediment bioturbation, latitudinal changes in biogenic components, and bottom fishing. A knowledge of the various factors effecting the sand sheet is fundamental to (1) an understanding of its general geologic history; (2) the paleoenvironmental interpretation of ancient sand strata; (3) a determination of the distribution and fate of anthropogenic sediments and pollutants; and (4) an evaluation of potential sand resources and geologic hazards.

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Environmental Control of Trace Fossil Morphology

Sandstones, shales, and coal of the Fentress Forma-