DIXON, J., Geol. Survey Canada, Calgary, Alberta, Canada

Geology of Canadian Arctic Basin

The Canadian Beaufort Sea is underlain by up to 12,000 m of Upper Cretaceous to Quaternary sediments. These sediments were deposited in a series of prograding depositional complexes containing fluviodeltaic, shelf, slope, and basinal clastics. At least 10 major regional unconformities within the Upper Cretaceous to Quaternary section are recognized. The 2 most pronounced unconformities developed in late Eocene and late Miocene times.

In the Beaufort-Mackenzie basin, the Upper Cretaceous to upper Miocene sediments were deformed primarily by gravity tectonics into large-scale diapiric anticlines and rotated listric fault-bounded blocks. Some reverse faulting, associated with mud diapirism, is evident in the western part of the basin. The late Miocene unconformity separates the deformed sediments below from the essentially undeformed, overlying Pliocene-Pleistocene strata.

Beneath the eastern Beaufort Sea, seaward of Amundsen Gulf and Banks Island, the Upper Cretaceous and younger strata thicken abruptly basinward across a hinge line developed at the edge of the Arctic platform (mostly composed of pre-Mesozoic strata). The Upper Cretaceous to Quaternary sedimentary prism along this part of the continental margin is not disrupted by diapirism or listric faulting; in fact it is relatively undeformed, with only minor normal faulting in the older part of the prism.

DIXON, S. A. and D. W. KIRKLAND, Mobil Research & Development Corp., Dallas, TX

Relationship of Temperature to Reservoir Quality for Feldspathic Sandstones of Southern California

The diagenetic alteration of a sandstone results from the combined effects of many factors. In order to ascertain the role played by a particular diagenetic factor, the remaining diagenetic factors must be held constant. For the sandstones of the basins of southern California, we have found that the effects of almost all of the principal diagenetic factors are essentially uniform; the notable exception is thermal history. Because of this, we have been able to evaluate the diagenetic imprint of temperature upon the sandstones. Measured reservoir property data taken on core samples of reservoir sandstones from 16 fields in the Los Angeles, Ventura, and San Joaquin basins were used to determine the average rate of porosity and permeability loss with depth for each field. A straight line appears to be the proper representation for the porosity versus depth profiles for the interval of interest. The slope of this line is defined here as the porosity gradient. Porosity gradients for the fields investigated range from 1.1 to 5.8% per 1,000 ft. A direct relationship exists between the porosity gradient and the present geothermal gradient for the 16 fields that have been examined. As geothermal gradient increases, porosity gradient increases. The correlation coefficient between these variables is +0.916 for geothermal gradients between 1.6°F and 2.2°F/100 ft. A similar relationship also exists between the rate of permeability loss with depth and the geothermal gradient, but the average deviation from the mean permeability value is so great, the relationship has little practical significance.

DOMERACKI, DANIEL D., JON J. MCCLURG, and JOHN C. HORNE, RPI/Colorado, Boulder, CO

Predictive Depositional Models for Eolian Deposits of Leo Member of Minnelusa Formation, Powder River Basin, Eastern Wyoming

A study of 980 wells, 24 outcrop sections, and 29 cores was conducted in the Powder River basin of northeastern Wyoming in order to develop predictive depositional models for the Leo sandstones of the middle member of the Minnelusa Formation. Given the limited amount of data available, an approach was devised that relied on synthesis of information from modern analogs with data derived from the ancient to predict regional patterns of deposition. This information was then used to determine genetic relationships between the patterns of regional sedimentation and proven stratigraphic traps. Six Leo oil and gas fields were examined in detail; the Qatar Peninsula and Um Said sabkhas serve as modern analogs.

The results of the study show that the Leo member of the Minnelusa and equivalent units of the Powder River basin were deposited as dune sequences within and adjacent to the Lusk embayment, a northward-extending arm of a large epeiric sea that existed southeast of the study area. Situated approximately 15° north of the paleoequator, the study area was the site of accumulation of sands transported from a northerly source by northeasterly trade winds. Accumulation and distribution of these windblown sands in the area surrounding the Lusk embayment were controlled by the local depositional setting, tectonic framework, and a series of minor fluctuations of eustatic sea level. The greatest potential for preservation of these dune deposits occurred during periods of rising base level.

DONOGHUE, JOSEPH F., Florida State Univ., Tallahassee, FL

Recent Estuarine Deposits, Chesapeake Bay and Apalachicola Bay

Estuarine facies are not easily discernible in the ancient record, because they represent a transition stage between fluvial and marine deposits. Modern estuarine sediments, nevertheless, are widespread because of the ongoing marine transgression. This widespread occurrence indicates that, during a highstand, estuaries are important centers for deposition of sediments shed from the continents. Sedimentologic studies have been made of 2 major estuaries: Chesapeake Bay (the largest United States estuary) and Apalachicola Bay (estuary of the largest river in Florida). A detailed sediment budget for the Chesapeake, using radiotracers, clay mineralogy, magnetic stratigraphy, and other methods, demonstrates that the estuary is filling rapidly with sediment. Its remaining sedimentologic lifetime can be measured in centuries. Most of this infilling has come at the expense of shoreline erosion. The rate of sedimentation, as measured by C-14, Pb-210, and Cs-137, has accelerated sharply over the past 2 centuries, from a few millimeters per year to present rates of a few centimeters per year. Sediment trapping effectiveness of the Chesapeake is nearly 100%. For Apalachicola Bay, the filling rate has been slower, although it appears to be nearly as efficient in retaining sediment. It has undergone a comparable change in sedimentation rates and sources over the past few centuries, as shown by magnetic stratigraphy and clay mineralogy. Given favorable conditions, such estuaries might be expected to contribute relatively thin but areally extensive bodies of fine-grained sediment to the rock record.

DORFMAN, MYRON H., and JAMES DUPREE, Univ. Texas at Austin, Austin, TX

Facies Characterization by Use of Well Logs; San Andres Formation (Permian), Hanford Field, Gaines County, Texas

Formulation of depositional models of carbonate reservoirs are now sufficiently sophisticated so that structural and stratigraphic traps of considerable complexity can be identified by use of core data. However, limited core data have, in many cases, made interpretation of the lateral extent and continuity of these beds difficult. As a result, location of wells, determination of zonal continuity, and enhanced recovery operations have presented difficulties to the petroleum geologist and engineer.

In an attempt to determine if well logs, using minimal core data, could be used to define carbonate facies by depositional texture, a study of the Sligo Formation (Cretaceous), south Texas, was recently published. This study of a shelf-type stratigraphic trap concluded that high- and low-energy carbonate facies could be readily identified by use of well-log cross plots, allowing for identification of reservoir parameters of size, geometry, zonal continuity, and distribution of porosity and permeability—parameters traditionally determined by use of cores.

This study of Hanford field represents a more sophisticated approach to definition of facies by use of well-log cross plots. Based on another study of Hanford field, core descriptions were correlated with well logs, and the digitized logs were then subjected to numerous cross plots. It was determined that facies could be readily disaggregated in this manner, and that permeability could be reasonably estimated using the Kozeny equation, where core data were unavailable. The fact that the San Andres Formation (Permian) has been subjected to extreme diagenesis makes this study a significant step beyond the primary textural patterns encountered in earlier work on the Sligo Formation. Its implications are important, since extensive log data, together with minimal core information, will allow the explorationist and engineer to locate and better define individual productive zones and their extent at reduced cost.