

bedded pelagic limestones and clastic limestones containing locally derived shallow-water carbonate debris. The carbonaceous-tuffaceous sequence is overlain by cyclic interbeds of green, gray, and pink limestone. The organic-rich strata on southern Hess Rise are dark-olive laminated limestone with a few clay-rich intervals that may contain altered volcanic ash. The association of volcanogenic sediments with organic-rich strata on Hess Rise is not as striking as in the Mid-Pacific Mountains, but the occurrences do suggest a coincidence of mid-plate volcanic activity and accumulation of organic matter at intermediate water depths in the tropical North Pacific during the middle Cretaceous. These organic-rich rocks are equivalent in age to organic-rich lithofacies elsewhere in the world ocean.

THOMAS, B. M., West Australian Petroleum Pty. Ltd., Perth, Western Australia

Generation and Occurrence of Hydrocarbons Related to Structural and Geothermal History of Onshore Perth Basin, Western Australia

The Perth basin, an elongate rift basin along the southwestern coast of Australia, contains over 15,000 m of mainly continental clastic sediments which range in age from Silurian to Holocene. Organically rich sediments are widely distributed throughout the Permian, Triassic, and Jurassic sections of the basin. However, as a result of the proximity of the Precambrian shield in the east and the predominance of terrestrial organic matter in the largely continental to marginal-marine sedimentary fill of the basin, the kerogen type is mainly humic and gas-prone. Hydrocarbon accumulations are therefore mainly gas and/or condensate, although a secondary light, highly paraffinic oil is of economic significance. Present commercial fields are restricted to the northern part of the basin and appear to be related to Permian, Triassic, and Jurassic mature source beds in the Dandaragan trough. In the Bunbury trough in the south, mature source beds are limited to a very deeply buried Permian coal measures sequence 2,000 m thick, from which significant but noncommercial gas flows and some condensate have been recorded.

Vitrinite reflectance data suggest that the uplift and erosion of the northwestern flank of the Perth basin were accompanied by higher geothermal gradients than are measured today in exploratory boreholes. In contrast, low geothermal gradients in the axis of the Dandaragan and Bunbury troughs ($<2.0^{\circ}\text{C}/100\text{ m}$) mean that generative temperatures are reached in these areas at relatively great depths. Producing accumulations often depend on a delicate balance between depth needed to generate hydrocarbons and the level at which porosity declines to unacceptable levels for gas production.

THOMAS, JOHN B., and EDWARD D. PITTMAN, Amoco Production Co., Denver, Colo.

Applications of Scanning Electron Microscopy to Hydrocarbon Exploitation

The Scanning Electron Microscope (SEM), which became available commercially in the mid 1960s, has added a new dimension to exploitation during the de-

cade of the 1970s. Of primary importance are studies of pore geometry and diagenetic history, which influence the type, distribution, and flow of fluids in the lithosphere.

The SEM provides a means of evaluating the abundance and location of micropores relative to macropores, which influence fluid distribution. If a rock contains a significant percentage of authigenic clay minerals or other fine particles, bound water may be retained in the micropores and cause a high irreducible water saturation. The reservoir may produce water-free hydrocarbons, but wireline-log calculations may indicate water saturations greater than 60%.

The SEM is useful for examining the effect of fluids and chemical additives on rocks during enhanced oil recovery. For example, laboratory tests have shown decreasing permeability during flow tests using a specific micellar fluid. SEM examination of "before and after" rock samples revealed that smectite, an expandable clay, was reacting to the fluid and plugging pore throats, yielding reduced permeability.

Reservoir studies using the SEM have shown that varying distributions and morphologies of clay minerals can be directly related to productivity of sandstones. Clay distribution, in order of decreasing reservoir quality and decreasing mean-pore-aperture size, is (1) discrete loosely packed clay particles, partially filling pores; (2) clay lining pores; and (3) clay bridging from one sand grain to an adjacent sand grain. Reservoir quality due to clay distribution types 1 and 2 is exemplified by Mesaverde sandstones in southwestern Wyoming. Measured porosities for the two types of reservoirs are similar, but permeability and, hence, productivity are markedly dissimilar.

THOMASSON, M. RAY, McCormick Oil & Gas Corp., Houston, Tex.

Forecasting—Fact or Folly?

Many dire forecasts about future hydrocarbon potential in the United States culminated in the pessimistic Club of Rome forecast and recent statements by officials of DOE that, "we cannot substantially increase our domestic production." Forecasts can be self-fulfilling, can impact the shape of the future, and should be examined in these terms.

A look at energy supply and demand predictions made over the last 6 years in the United States is instructive. Forecasts made in 1973 for a 1990 energy demand of 67 million BCOE (barrels crude oil equivalent) and a domestic supply of 45 million BCOE indicated a short fall of 22 million BCOE. Today, forecasts indicate a demand of 50.4 million BCOE and a domestic supply of 37.3 million BCOE producing a short fall of 13.1 million BCOE. Because we appear to be in a domestic-supply-limiting situation, we must examine very carefully the supply analysis used in the forecast.

Most forecasts contain a failure of imagination usually due to relying on today's "logic." This disallows the possibilities of breakthroughs which are the real future. Most important in looking at the future is to (1) describe its "volume," (2) determine what changes could affect the limits of the "volume," (3) do research in ar-