The American Association of Petroleum Geologists Bulletin
V. 64, No. 8 (August 1980) P. 1276-1290

ASSOCIATION ROUND TABLE

DISTINGUISHED LECTURE TOUR ABSTRACTS, 1979-80

ALMON, WILLIAM R., Davies, Almon, and Associates, Houston, Tex.

Impact of Diagenesis on Exploration Strategy and Reservoir Management

Where is the best place to drill for hydrocarbons? This fundamental question has been answered differently ever since the search for petroleum began. For many years, the reply has been, "On the highest structural closure." More recently, a better understanding of sedimentary depositional environments has led to a general appreciation that stratigraphic pinch-outs are important places to test. Now, another answer can be proposed, "In diagenetic traps." A diagenetic trap is defined as one created by postdepositional modification of a portion of a sedimentary rock unit (e.g., a cementation barrier or a zone of secondary porosity).

The importance of diagenesis in the creation or destruction of porous reservoirs has been accepted, although not well understood, for several years. Its importance in forming hydrocarbon traps is only beginning to be appreciated. It is the goal of this paper to outline the most significant aspects of diagenesis with respect to hydrocarbon exploration and production, and to emphasize the importance of a diagenetic evaluation in any integrated exploration or production strategy.

On a basinal scale, we must consider the stratigraphy and tectonics not only in their traditional senses, but also in relation to the sources of subsurface water and the movement of that water throughout a basin. The regional water movement is important to both the migration of hydrocarbons and to diagenesis.

The proper timing of diagenetic cementation, porosity generation, and petroleum migration can result in the formation of diagenetic traps, in addition to the well-known structural and stratigraphic traps. To understand and to explore for such traps, we must understand the most typical cementation and porosity patterns in any given formation. This understanding should allow us to predict where a hydrocarbon column might be trapped against a cementation barrier or in secondary porosity.

An understanding of diagenesis allows us better to evaluate individual hydrocarbon plays. Diagenesis has a tremendous impact on the interpretation of wireline logs, especially resistivity/conductivity measurements. If we know the type and degree of diagenetic alterations in an area, we can determine whether apparently "wet" zones are truly wet or if they are actually productive. Careful evaluation of the diagenesis of a formation can aid with the interpretation of shows in nonproductive or marginally productive wells. The relation between pore geometry, degree of diagenesis, and location of hydrocarbon shows can potentially tell us the position of a hydrocarbon reservoir.

In reservoir management, the role of diagenesis begins with a basic understanding of the principal problems caused by pore heterogeneity and diagenetic minerals. Clay minerals, the most common diagenetic minerals, are largely responsible for formation damage. This damage arises when an incompatible fluid is introduced into a reservoir and interacts with the clays causing dissolution, disaggregation, or changes in clay surface properties (i.e., wettability). Different clays are susceptible to different types of formation damage. As a result, mud systems, completion fluids, and stimulation systems must be designed to prevent formation damage.

Reservoir management also requires an understanding of the reservoir heterogeneity. This heterogeneity can arise from variations in the environment in which the reservoir was deposited or from postdepositional alterations. Diagenetic analysis of the reservoir rock (i.e., thin sections, X-ray diffraction, SEM) is a must to properly evaluate spacial permeability variations. Once the significant rock property variables are identified, a reservoir can be divided into flow units and reservoir-rock types. Within each reservoir-rock type, the water-oil relative permeability characteristics will vary only slightly in contrast to large changes in air permeability. The benefits of such a reservoir study are: (1) ability to determine optimum flow rates for different wells during primary production, (2) optimum location of the injection-flow rates for injection wells during enhanced recovery operations, and (3) a factual base for further reservoir modeling.

BEBOUT, DON G., Louisiana Geol. Survey and Louisiana State Univ., Baton Rouge, La.

Energy Resources of Water-Bearing Geopressured Reservoirs

Estimates for the total gas resource in place in geopressured Tertiary sandstone reservoirs along the Gulf Coast range from 3,000 to 100,000 Tcf (85 to 2,832 trillion cu m). This wide range in estimates was the incentive for initiating an extensive research effort in Texas and Louisiana to obtain more reliable data on geologic, engineering, environmental, legal, and social aspects of developing the geopressured resource. These studies include investigation of the available heat and hydraulic energy present in these aquifers in addition to the methane. All resource calculations are based on interpretations of total sandstone thickness, lateral extent of reservoirs as defined by depositional and structural boundaries, porosity and permeability, reservoir drive, salinity, temperature, pressure, and methane solubility. Diverse estimates arise from inadequate knowledge concerning these critical parameters.

To obtain answers to the many questions, an extensive research program has been established at The University of Texas at Austin by the Bureau of Economic Geology and the Center for Energy Studies. The bureau has been conducting broad regional geologic studies (for resource assessment and geothermal fairway delin-