accretion and the nature of deformation associated with accretion and dispersion. Such data are needed for further define specific exploration targets in the circum-Pacific region.

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Clay Mineral Reactions in Clastic Diagenesis

Studies of clastic sediments have documented the formation and transformation of clay mineral assemblages during burial diagenesis. The transformation of smectite to illite in shale by its reaction with the decomposition products of detrital K-feldspar and mica results in the production of new pore water at depth. The overall reaction mobilizes all the major chemical components in the shale, most of which are consumed in the formation of the diagenetic assemblage illite/smectite + chlorite + quartz. However, part of all the components is undoubtedly transported from the shale to sandstone units and is involved in cementation, replacement, and diagenetic clay mineral formation in these reservoir rocks.

In contrast to burial diagenetic reactions in shale, where the sequence is monotonic and reasonably predictable, diagenetic reactions in sandstone are frequently variable. This variability is probably attributable to the fact that sandstones are open systems in which the reactions that proceed are controlled in part by the influx of new pore water, the chemistry of which is determined by an outside source.

The useful understanding role of clay minerals in hydrocarbon exploration will follow from a determination of the system shale/sandstone/organic material. We need to tie in the nature and timing of shale mineral reactions and their control on the fluid and mass transfer from shale to sandstone.

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Petroleum Exploration Characteristics of Small Depressions, East China

In eastern China there are more than 100 Mesozoic-Cenozoic continental depressions; some of these have areas ranging from several hundred square kilometers to 2,000 km^2 (772 mi^2). Many oil fields have been discovered in these depressions.

From the geologic and exploration histories of the Qianjiang, Miyang, and Damintun depressions the writer has summarized five essential features in exploring small depressions.

(1) Because the distance of oil migration is less than 50 km (31 mi) in continental basins, exploration in small depressions should be guided by the idea that source beds control hydrocarbon distribution.

(2) Locate the deep part of the depression by gravimetric and magnetic prospecting with some seismic profiling and drill stratigraphic wells in the deeper part to evaluate the capacity of oil generation and to record other geologic and geophysical parameters.

(3) Drill wildcats not only on the anticlines but also on structural noses and monoclines, because nonanticlinal pools commonly predominate (about 70% or more of reserve) in small depressions.

(4) If a few wildcats are dry holes and no sand beds are encountered during the early stages of exploration, negative conclusions should not be made in a hurry. If a possible source bed exists, further exploration should be conducted even if the area of the depression is less than 1,000 km^2 (386 mi^2).

(5) In mature small depressions, exploration should be directed mainly to finding various subtle traps in the same way as exploring in large depressions.

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Belayim Marine Oil Field of Egypt: A Case History

Belayim Marine 1 drilled in 1961 encountered oil in a Miocene sand-shale section. The well logged a clear oil-water contact in the lowest sand bed which at the time was believed to be the common oil-water contact for all the interbedded sequence. Based on the results of this well and other subsequent wells drilled inside the oil-water contour, the oil reserves were volumetrically calculated and a development program was effected. In 1978, when the field came back under the Egyptian control, a number of reservoir studies indicated that the oil in place is at least double the amount calculated. The additional reserves could not be accommodated in the rock volume sitting above the logged oil-water line. It was suggested then that the logged oil-water line is valid only for the lowest sand bed and higher sand beds can have their own oil-water lines. The concept when checked by drilling proved to be valid. The additional reserves are now under development.

If the actual size of the field has been known at an earlier stage, a different and more rational development program could have been adopted. It is therefore highly recommended that in similar reservoirs in interbedded successions possible oil-water lines be thoroughly defined for the different sands at an early stage of development.

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Organic Geochemistry of Recent Marine Ooids as a Key to Origin of Petroleum in Oolite Reservoirs

Organic geochemical investigation of recent marine ooids (457 ± 76 to $1,516 \pm 86$ years) from the Schooner Cays area, Bahamas, has yielded data that suggest a probable source bed function for their ancient equivalents. Chromatographic analysis of gas desorbed from the ooids reveals the presence of C_1 to C_{5+} compounds believed to be authigenic. These include between 1.7 and 3.6×10^{-5} gm C_1 to C_4 saturated hydrocarbons per gram organic carbon. Total organic carbon (TOC) content varies between 1.23 and 4.13 wt. %, depending on the purity of the sample, with the lowest values reflecting an increased contribution of skeletal debris to the ooids. Total organic extract (TOE) values range from 550 to 650 ppm and show a slight transformation in the direction of oil formation. The organic matter isolated from ooids (termed protokerogen) is dominantly of algal facies. Elemental composition of this protokerogen showed mean atomic H/C, O/C, and N/C ratios of 1.76, 0.24, and 0.19, respectively. Following pyrolysis, CR/CT ratios were found to be very low, with a mean of 0.18. All the results, including a thermal alteration index (TAI) of 1 to 1.5 on Staplin's scale and a very strong green to blue-green fluorescence under ultraviolet light excitation, point toward an immature, high grade, kerogen-type material with enormous potential for generating hydrocarbons. Additional experiments using a high pressure cell to simulate diagenesis in the ooids showed profound changes in their organic geochemistry with the contained organic matter following the predicted evolution path for type II kerogen. There is strong evidence that with deeper burial and prolonged exposure to higher temperatures, and perhaps to catalytic influence of the clay minerals (0.05%) and traces of metals (e.g., Ti, Mn, Sr, V) found in ooids, the organic matter will generate significant amounts of hydrocarbons. In those oolites with a favorable history of porosity development, the hydrocarbons would migrate along the continuous groundmass of organic matter within the ooids and into the pore spaces to accumulate as petroleum.