SIGNIFICANCE OF HYDROCARBON DISPOSITION IN PETROLEUM EXPLORATION (ABSTRACT)

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ABSTRACT: An important facet of petroleum geochemistry is the study of the distribution and character of organic matter in rock systems. Developments in this field have resulted in new knowledge on the history of petroleum. The acquired knowledge can, in turn, be utilized in the search for petroleum. Three examples of research programs dealing with the character and distribution of dispersed and accumulated organic matter are illustrated to indicate the present and future potential of geochemistry in exploration. These examples are selected to outline the manner in which geochemistry may be applied in evaluating the petroleum potential of a region, in helping to outline attractive areas for exploration within the region, and in indicating the presence of an oil pool in a specific prospect.

A regional study of the Lower Cretaceous Mowry Shale in Wyoming shows that the concentration of organic matter increases in the northeast-southwest direction. The areas of maximum concentration of organic components in the Mowry coincide with the major occurrences of Lower Cretaceous oil fields in this region. Similar observations of the relationship of the abundance of organic matter in fine-grained sediments to the occurrence of petroleum in adjacent reservoirs have been reported by A. B. Ronov, G. T. Philippi and M. Louis. The patterns of concentration of organic matter in shales thus appear to reflect the areas of greater petroleum potential. The results also suggest that a portion of the petroleum generated in a source rock can be and is accumulated in close proximity to the locale of petroleum generation.

The chemical constitution of Lower Cretaceous crude oils from the Clearwater group on the eastern flank of the Alberta Basin and from the McMurray sands at Athabaska strongly indicates the correlation of these petroleums. An equivalent source, probably the Lower Cretaceous shales, is suggested. Major differences in composition have also been observed between the Lower Cretaceous crude oils and the Devonian reef petroleums in the basin. Crude oil correlation studies of this type suggest that petroleum accumulates in reservoirs close to the source beds, and that vertical migration is restricted, except possibly along open fractures in the rock system.

Low molecular weight hydrocarbons present in petroleum have been found to partition in the subsurface between the oil and water phases. The most soluble of these hydrocarbons, benzene, occurs in decreasing concentration in the brine with increasing distance from the oil pool. Evidence also exists for the migration of benzene several miles laterally, but vertical migration through overlying, fine-grained, competent rock is negligible. These observations indicate the potential utility of hydrocarbon-in-brine measurements in predicting the presence of, and distance to, undiscovered petroleum accumulations. They also add further support to the view of restricted vertical migration of hydrocarbons.

In summary, it is clear from the composition, properties and distribution of organic matter that oil pools do not occur randomly in the subsurface, but rather they occur in those parts of the geologic column where petroleum has been generated, where reservoir rocks are available, and where

suitable trapping conditions exist. From considerations of the disposition of organic matter in a rock system, it should therefore be possible to determine which parts of the geological section are likely to be productive and the amount of petroleum generated in a given rock unit. More directly, the types and amounts of hydrocarbons and their distribution in the subsurface can be used to evaluated the existence of undiscovered oil.