HGS LUNCHEON MEETING

The Significance of Textural, Compositional, and Diagenetic Interaction on Porosity Development in Gulf Coast and Other Reservoir Sandstones

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Social Period, 11:30 a.m., Luncheon and Meeting, 12:00 p.m.
The Houston Club

Porosity development in reservoir sandstones is greatly influenced by diagenetic processes which characteristically are programmed by pre-burial conditions of depositional facies and framework composition. Textural and mineralogical characteristics can have a great impact on discrete chemical and physical diagenetic processes affecting the sand body. Commonly, these effects (e.g., cementation, compaction) result in considerable modification of pore space in part or all of the sequence and significantly influence exploration and exploitation strategy.

Depositional factors including lithology, sedimentary structures, and texture (mainly grain size, sorting) have had a pronounced effect on porosity development in Gulf Coast and other sandstones. Commonly, discrete diagenetic processes are segregated within sandstone sequences on the basis of grain size trends attributed to variation in depositional energy. In lower Miocene (offshore Texas) and Jurassic Norphlet (offshore Alabama) sandstones, physical and chemical compaction effects are most pronounced in finer-grained facies resulting in irreversible porosity loss. Chemical compaction (pressure solution) processes in these intervals likely provided an in situ source of silica and carbonate cement which selectively precipitated in adjacent/nearby coarser-grained sandstone intervals. In addition, pressure solution effects on grain and stylolitic scale along argillaceous/organic bed laminae may result in the development of effective barriers to vertical fluid flow in sandstones (e.g., Nubia, Gulf of Suez).

Mineralogical composition of reservoir sandstones is extremely critical to effective porosity development, as framework grains of contrasting composition behave differently with burial diagenesis. Labile lithic fragments (volcanic, metamorphic, sedimentary) may be subjected to significant physical compaction by ductile grain deformation. The degree of porosity reduction by this mechanism is governed by the type, abundance, and distribution heterogeneity of lithic components within the depositional environment. In contrast, the alteration of particular types of framework components may aid in porosity preservation or enhancement within a sandstone sequence. The selective dissolution of detrital feldspar in lower Miocene sandstones from Matagorda Island (offshore Texas) accounts for up to 30% of total effective porosity. Correspondingly, diagenetic alteration of minor amounts of volcanic detritus (3-8 volume percent) in several Tuscaloosa Sandstone intervals (upper Cretaceous, Louisiana) has resulted in the development of authigenic chlorite coatings (5-13 volume percent) which have preserved primary intergranular interstices by inhibiting the precipitation of quartz cement. Principal pre-burial controls on sandstone composition include provenance, transportation, and mineral partitioning within the depositional environment. In sedimentary basins possessing a common sediment source, the concentration of framework components due to variations in size, shape and density can result in significant differences in the intensity of diagenetic reactions and ultimately, porosity distribution within a sandstone sequence.

DICK LARESE - Biographical Sketch

Dick Larese received his PhD in geology from West Virginia University in 1974. From 1972-1977, he was employed as a geologist with the West Virginia Geological and Economic Survey where he served as Head of the Economic Geology Section. In 1977 he joined Amoco Production Company, Research Center (APR), in Tulsa as a clastic sedimentary petrologist. At present he is a Research Associate in the Petrology/Lithochemistry Group at APR specializing in reservoir exploration and exploitation problems. His principal research interest is directed toward on the relationship of sandstone diagenesis and depositional processes in natural and experimental systems.