DEPOSITIONAL TEXTURE-DEPENDENT AND INDEPENDENT DIAGENETIC CONTROL OF PETROPHYSICAL PROPERTIES, NORPHLET SANDSTONE, ONSHORE AND OFFSHORE ALABAMA

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ABSTRACT

Diagenetic factors influencing reservoir heterogeneity vary significantly throughout the region of Norphlet hydrocarbon production. Distribution of some diagenetic components in these eolian reservoirs is controlled by depositional texture, including preferential carbonate cementation of coarser-grained laminae, concentration of pyrobitumen in finer-grained laminae, localization of pressure solution seams, and concentration of cements in deposits of specific eolian subenvironments, such as interdunes. The distribution of these diagenetic components, which create local to widespread barriers and baffles to fluid flow, can be determined by depositional modeling.

However, the distribution of other diagenetic components in Norphlet reservoirs, including quartz, clay minerals, and pyrobitumen, is independent of depositional texture and cannot be determined by similar modeling. Factors controlling the distribution of texture-independent diagenetic components include the availability of chemical constituents from external sources, past and present positions of hydrocarbon-water contacts, and the time available for diagenetic reactions to proceed. In onshore fields, such as Hatter's Pond field, the position of fluid contacts influences reservoir quality. Permeability is highest above the hydrocarbon-water contact where authigenic illite is less abundant. The opposite relationship occurs in offshore fields in Alabama coastal waters and Federal OCS, areas where sandstone below paleo or present hydrocarbon-water contacts has the highest reservoir quality. Up to four diagenetic zones may occur stratigraphically. In descending order they are: (1) the dominantly quartz-cemented tight zone at the top of the Norphlet; (2) an interval above paleo or present fluid contacts in which pyrobitumen grain coats reduce pore volume and constrict pore throats; (3) an interval between paleo and present fluid contacts which lacks pyrobitumen and has the highest reservoir quality; and (4) an interval similar to interval 3 that lies below the present gas-water contact. Delineation of controls on the distribution of these intervals is critical to evaluation of gas reserves in offshore areas.