RELATION OF SMECTITE—ILLITE TRANSFORMATION AND DEVELOPMENT OF ABNORMAL FLUID PRESSURE AND STRUCTURE IN THE NORTHERN GULF OF MEXICO BASIN

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ABSTRACT

Water expelled from smectite into the pore system of the host shale during the process of diagenesis may migrate out of the shale early or may be totally or partially trapped and released slowly through time. In areas such as the northern Gulf of Mexico basin, where much of the water is partially trapped, clay diagenesis data indicate a close relation between high fluid pressure build-up and the smectite-illite transformation process.

Abnormal pressures affect, in part, the type and quantity of hydrocarbons accumulated since pressure controls the direction of fluid flow and partially controls the geometry of structures formed in basins where shale tectonism is the primary mechanism for structural development. In basins of these types, contemporaneous faults and related anticlines are the most common types of productive structures found. The depth to which faults can penetrate and the angle of dip that faults assume at depth is dependent largely upon fluid pressure in the sedimentary section at the time of faulting. Some faults formed in the overpressured Tertiary section of Texas have been observed to flatten and become bedding plane types at depths near or above the temperature level required for thermal generation of hydrocarbons. This observation suggests faults of these types play a minor role in draining hydrocarbons from deep shales within basins where thick overpressured sedimentary sections are present at shallow depths and where shale tectonism is the primary mechanism for structural development.

Microfracturing resulting from increased fluid pressure is indicated to be a primary mechanism for flushing fluids from deep basins where thick abnormally pressured sedimentary sections are present. This flushing process would be enhanced by clay diagenesis since water supplied from smectite would case the process to continue for longer periods of time and to extend to greater depths than could be attained if only remnants of the original pore water were present in the section. Large volumes of diagenetic water present within the microfracturing interval could also act as a vehicle for primary hydrocarbon migration provided hydrocarbons are present in sufficient quantities to be transported.

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