

SEALING CHARACTERISTICS OF MARINE SHALES INTERPRETED IN A SEQUENCE STRATIGRAPHIC CONTEXT

DAWSON, Wm. C., ChevronTexaco, Inc., Bellaire, TX; and
W. R. ALMON, ChevronTexaco Inc., Bellaire, TX

Sealing characteristics of marine shales are among the least understood aspects of petroleum systems. Mercury-injection capillary pressure (MICP) analysis is used to estimate seal capacity. Petrophysical measurements indicate that the largest interconnected pore throats ultimately control seal behavior. Pore throat diameter is influenced by numerous factors: composition (total clay content, and organic enrichment); fabric and texture (fissility, silt content and bioturbation); and diagenesis. Top seal capacity increases as clay content increases and decreases as the content of detrital silt increases. Depositional fabric appears to exert primary control on seal character, and early cementation can significantly enhance seal capacity.

The analyzed shales record deposition in middle to outer neritic marine paleoenvironments and are interstratified with sandstones representing deltaic to submarine fan lithofacies. Ten shale microfacies can be defined based on differences in fabric and petrophysical properties. Highstand shales have 10% non-wetting MICP saturations ranging from 2,200 to 5,300 psia. Transgressive shales have 10% non-wetting MICP saturations ranging from 6,000 to 18,000 psia. The highest MICP values correspond to shales containing significant percentages of authigenic carbonates. Marine shales occurring within the upper part of third-order transgressive systems tracts are excellent top seals. These finely laminated, silt-poor, transgressive shales commonly have elevated percentages of organic matter and authigenic iron minerals. The sealing capacity of transgressive shales typically exceeds that of condensed and maximum flooding shales. Silt-rich highstand and lowstand shales have considerably less sealing capacity. Seal capacity generally increases, basinward, from near shore to distal offshore marine settings.