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Early Marine Cementation at Parasequence and Sequence Boundaries: Implications for Seal Development and Reservoir Compartmentalization

Tertiary-aged siliciclastic strata in Indonesia (shallow marine) and offshore Angola (deep marine) include numerous carbonate-cemented (calcite and siderite) horizons. These thin (10 to 30 cm) intervals consist of pervasively cemented, fossiliferous, quartzose sandstones and siltstones, which can occur as discrete beds or nodular horizons. Petrographic features (cementation pre-dated significant compaction) and stable isotope geochemistry are suggestive of an early submarine paleoenvironment of precipitation. Well log-scale sequence stratigraphy indicates that of these dense carbonate-cemented horizons are represented by resistivity 'spikes' at the bases of channelized (tidal and estuarine) sandstone units. Some maximum flooding surfaces are represented by calcite-cemented foraminiferal siltstones. Other carbonate-cemented units containing *Glossifungites* mark bases of major (third-order) transgressive packages (e.g., 21 ma sequence boundary in Central Sumatra Basin). Such cemented horizons provide a useful datum for field-wide correlation and reservoir-scale mapping.

Core studies reveal the occurrence of hydrocarbon saturation in porous sandstones that over- and underlie these densely cemented horizons. The common association with hydrocarbons implies that sealing potential exists. Mercury injection capillary pressure (MICP) analyses reveal that, where not fractured, these cemented horizons are excellent seals. In addition to acting as top and bottom seals, high-frequency cemented horizons may induce reservoir compartmentalization. Carbonate nodules can substantially reduce net pay. Subsurface pressure data show that cemented horizons having regional extent can maintain significant (5,000 to 10,000 psia) pressure differentials. Siderite-cemented marine shales, developed within transgressive and condensed intervals, can form exceptional seals having 10% MICP saturations ranging from 12,000 to 18,000 psia.