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Improved Characterization of Vicksburg Sandstone Reservoirs Using Integrated Sequence Stratigraphy and Petrophysics

The natural gas-bearing transgressive systems tract (TST) Vicksburg interval in TCB Field, South Texas, was the focus of a comprehensive petrophysical evaluation. This interval was deposited in a transgressive shallow marine setting and is composed of thinly bedded and laminated silty, very fine-grained sandstones, siltstones and shales. The TST interval was selected for its specific sedimentary features and compositional complexity that are typical of low resistivity/low contrast shaly sandstone reservoirs. The goal was to develop improved formation evaluation techniques for this type reservoir. Cores were sampled for thin-section, x-ray, SEM, ϕ-k, capillary pressure and cation exchange capacity (CEC) analyses. Array induction, gamma ray, neutron-density, micro-imaging and nuclear magnetic logs were calibrated to cores. High-resolution logs allowed the recognition of reservoir and non-reservoir facies thicker than 1-ft., while micro-imaging resolved beds down to the one-half inch scale. High-resolution density porosity measurements were very close to measured core porosity values and used to estimate total porosity. The low resistivity signatures of sandstones are mainly generated by the abundance of clays, especially I/S mixed-layer clays. The Pickett crossplot technique was used to derive m, n and Rw values for water saturation (Sw) calculation. Resistivity modeling using Waxman-Smits and Modified Dual-Water methods also yielded m and n values that agreed with those from the Pickett technique. Reliable results were achieved using the simple Archie equation modified using the newly estimated m, n and Rw values. Modified Archie, Waxman-Smits and Modified Dual-Water methods yielded Sw values that correlated best to those from core analyses.