

Reservoir Quality and Porosity-Permeability Trends in Onshore Wilcox Sandstones, Texas and Louisiana Gulf Coast: Application to Deep Wilcox Plays, Offshore Gulf of Mexico

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ABSTRACT

Evolution of porosity and permeability in Lower Tertiary Wilcox sandstones during burial diagenesis was evaluated using petrographic and petrophysical data from onshore sandstones of the Texas and Louisiana Gulf Coast. The results provide insight into reservoir quality of deeply buried Wilcox sandstones beneath the Gulf of Mexico shelf and in the deep Gulf. Wilcox sandstone samples used in this study were deposited in the Holly Springs Delta of Louisiana, the Houston Delta of the upper Texas coast, and the Rosita Delta of the lower Texas coast. Petrographic analysis of 534 Wilcox thin sections from 90 wells was combined with core-analysis data from >10,000 core samples from 189 wells to determine regional variation in pore-type evolution and porosity-permeability trends with increasing burial depth and temperature.

Petrographic data show that Wilcox sandstone pores change from a mix of primary and secondary pores and micropores at lower temperatures to predominantly secondary pores and micropores at temperatures >300°F (150°C). Primary porosity, the most important control on permeability, decreases from an average of 40% at the time of deposition to 5–8% by 250°F (125°C) and 1–2% at temperatures >390°F (>200°C). Core-analysis data were used to calculate porosity-permeability transforms within different temperature intervals in each area. Because the sandstone pore types change with increasing temperature, porosity-permeability transforms also change; at higher temperatures, permeability is lower per porosity unit. A transform developed for low-temperature sandstones is not appropriate to use in higher-temperature sandstones. At temperatures >212°F (100°C), Wilcox sandstones in the Houston Delta System have lower permeability for a given porosity than sandstones in the Holly Springs and Rosita delta systems. These data suggest that high-temperature Wilcox sandstones beneath the present shelf and in the deep Gulf that were sourced by the Holly Springs and Rosita deltas may have better reservoir quality than do sandstones derived from the Houston Delta.