
Reservoir Quality and Pore-Type Evolution in Tertiary Wilcox Sandstones of the Northern Texas Gulf of Mexico Coast during Burial from 0.2 to 6.6 km (560 to 21,680 ft)

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ABSTRACT

As the search for gas in the Gulf of Mexico focuses increasingly on reservoirs at depths >4.5 km (>~14,760 ft), the greatest unknown and most critical risk factor is reservoir quality. Petrographic analysis of Wilcox sandstones on the upper Texas Coastal Plain provides insight into the evolution of porosity and permeability during burial that is useful to deep exploration both onshore and in the deepwater Gulf of Mexico.

Wilcox sandstones are mostly lithic arkoses and feldspathic litharenites having an average composition of Q59F22R19. Provenance did not change significantly during Wilcox deposition in this area, nor does average sandstone composition vary among lower, middle, and upper Wilcox sandstones. However, lowstand slope-fan deposits contain more rock fragments (mainly metamorphic and volcanic) than do deposits from highstand or transgressive systems tracts. Wilcox sandstones deposited in deepwater environments in the Gulf of Mexico are likely to contain more rock fragments than do their linked highstand equivalents.

With increasing burial depth, total volume of porosity decreases, and the proportion of different pore types changes. Average core-analysis porosity declines from 35% at 0.4 km (~1312 ft) to 10.7% at 4.5 km (~14,760 ft). Pores change from a mix of primary, secondary, and micropores (P35S38M27) at shallower depths to predominantly secondary pores and micropores in deeper sandstones (P7S35M58). By 3.5 km (~11,480 ft), most primary pores have been lost by mechanical compaction or occluded by quartz cementation, and secondary pores generated by feldspar dissolution compose the majority of macropores. Average permeability decreases from 976 md (millidarcies) at 0.4 km (~1312 ft) to 0.2 md at 4.5 km (~14,760 ft). Because most deep sandstones are dominated by secondary and micropores, the porosity-permeability transforms for deep and ultradeep sandstones will have lower slopes than those for shallower sandstones.