# Depositional and Diagenetic Controls on Reservoir Quality in Deepwater Sandstones in the Lower Wilcox Group, Lavaca Canyon Complex in the Hallettsville Embayment, Southeastern Texas Gulf Coast

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## ABSTRACT

**The Lower Wilcox Group in the Lavaca Canyon Complex in the Hallettsville Embayment of southeastern Texas displays a variety of proximal-canyon-fill facies that includes channel-fill, levee, and heterogeneous debris-flow (debrite) and slump deposits. Reservoir quality in Lavaca Canyon sandstones is controlled by both depositional origin and diagenesis. Channel-fill sandstones are composed typically of aggradational successions of fine- to medium-grained, massively bedded sandstone with abundant mud rip-up clasts and organic fragments. Porosity values in these channel-fill sandstones range from 8 to 24% with an average of 18% and permeability values range from less than 0.1 to more than 100 millidarcys (md) with a geometric mean of 6.9 md. Levee facies consist of ripple-stratified beds of very fine- to fine-grained sandstone interbedded with sideritic mudstone and siltstone. In contrast to channel-fill facies, levee facies have lower porosity values that range from 1 to 19%, with an average porosity of 12%. Permeability values range from 0.002 to 47 md and geometric mean permeability in these levee deposits is 0.2 md. Debrite and associated slump facies are heterolithic sections of very fine- to upper fine-grained sandstones complexly interbedded with mudstone. Stratification is dominated by convolute bedding and subvertical to vertical beds that record mass transport and rotation of strata. Debrite facies have the lowest reservoir quality in the Lavaca Canyon Complex, with average porosity and geometric mean permeability values of 6.6% and 0.02 md, respectively.**

**Data from Wilcox sandstones in the Lavaca Canyon Complex, including 207 porosity and permeability analyses and point counts from 71 thin sections, were used to evaluate controls on reservoir quality. These sandstones occur at depths of 9681 to 10,086 ft (2950 to 3074 m) and temperatures of 250 to 266°F (121 to 130°C). They are composed mostly of feldspathic litharenites, lithic arkoses, and sublitharenites and have an average composition of 72% quartz, 13% feldspar, and 16% rock fragments. Ductile grains are abundant in these sandstones, averaging 14% of the whole-rock volume; they include metamorphic and volcanic rock fragments and contemporaneous mud rip-up clasts. Channel sandstones contain an average volume of 11.6% ductile grains, compared with**

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**15.5% in debrite deposits and 18.7% in levee deposits.**

**The most important controls on reservoir quality in sandstones in the Lavaca Canyon Complex are related to depositional energy: detrital clay-matrix content, grain size, silt content, and ductile-grain content. Channel-fill sandstones have the best reservoir quality because they have the lowest volume of clay matrix, the coarsest average grain size, and the lowest average silt and ductile-grain content. Channel-fill sandstones contain an average of 0.6% clay matrix, whereas levee and debrite deposits contain significantly more (10.5% and 11.1%, respectively). Similarly, the percent of silt grains is lower in channel sandstones (4.2%) than in levee (33.9%) and debrite deposits (17.3%).**

**Burial history models indicate that thermal maturity in onshore Lavaca Canyon Wilcox sandstones is somewhat higher than offshore Wilcox sandstones in the Gulf of Mexico. Therefore, Lavaca Canyon should be a good analog for understanding depositional controls on reservoir quality in offshore Gulf of Mexico channel and levee sandstones, but diagenesis is probably a less important control in the offshore Gulf of Mexico than in Lavaca Canyon. Because of their lower thermal maturity, offshore Gulf of Mexico Wilcox sandstones are likely to have undergone less quartz cementation than Lavaca Canyon sandstones.**