Small Faults, Big Damage Zones — An Example of Fault-Related Fractures and Dissolution Collapse in a Ramp Crest Carbonate System, Lower Pecos River Canyon, Texas

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Fractures that develop in faulted carbonate strata, especially faults of less than 5 m offset, are problematic for reservoir characterization due to detection difficulty in the subsurface. This study documents an outcrop example of fracture development and dissolution collapse along faults with minor offset. The outcrop exposure along the Lower Pecos River is unique in many ways, but most striking is that carbonate strata containing faults are continuously exposed for more than 60 miles. This provides an opportunity to study progressive fracture development from minor, mechanically-bound fractures culminating in brecciated faults and dissolution collapse zones.

Lewis Canyon lies along the Lower Pecos River Canyon exposing three upper Albian (Cretaceous) high frequency sequences. A single high frequency sequence consists of transgressive systems tract (TST) dominated by mud-rich facies containing low-relief chondrodontid clam mounds capped by radiolitid rudist rudstones and bafflestones. TST bed thickness is variable ranging from 15 cm to 2 m within the mounds. Highstand systems tract (HST) facies consist of accumulated lower shoreface grainstones that are 10-15 m in thickness. Variability in thickness and facies types creates a heterogeneous architecture with higher fracture intensity in the thin-bedded TST compared to the grainstones of the HST. This relationship is pervasive in outer zones greater than 100 m from exposed faults. Fracture intensity increases as proximity to the fault increases up to 2 meters where significant brecciation is common.

Faulting along the outcrop area is a result of Laramide compressional tectonics that created compressional folds in northern Mexico. Folding is not observed along the Pecos River Canyon. Rather, Laramide reactivation of Ouachitan-age reverse faults creates oblique slip on the preexisting basement faults and secondary faults associated with oblique slip. Scale of outcrop exposure and minor fault offset, make this a a great locality to improve understanding of the interaction of stratigraphy, fracture, and faulting at a scale that is most problematic to reservoir characterization.