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Multi-scale fault analysis of Laramide aged oblique-slip faults relating to pre-existing structures, SW Texas

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Near Del Rio, Texas, the Pecos River winds more than 50 miles through canyons that reveals the stratigraphy of an Albian-aged carbonate ramp. This area lies directly above the Paleozoic Ouachitan fold-thrust belt, with associated E-W and SE-NW trending, sub parallel thrust faults, which bound both sides of the Devil River's Uplift on the southern margin of the Val Verde Basin. At the surface, there are multiple hierarchies of faults expressed in two predominant orientations, ~N48°E (ENE) and ~N78°E (NE), that form conjugate fault zones roughly tracing subsurface basement faults. The surface faults are on the order of 1-40 km in trace length and can be seen at outcrop and satellite scale.

There is evidence that the reactivation of underlying Paleozoic faults was a significant control on subsequent fracture development within the Albian platform. While the exact age is unknown, it is believed that the reactivation occurred during Laramide-age compressional tectonics commonly mapped in Northern Mexico. It is proposed that as Paleozoic basements faults were stressed, some slipped obliquely creating Riedel shear fractures in the overlying Cretaceous strata. Faults associated with oblique offset generally form at predictable angles to the controlling plane or primary plane of slip. The predominant fault orientations match modeled failure angles of oblique compressive fracture propagation during left-lateral shearing.

This study will analyze the surface fractures in the Pecos River Canyon area in outcrop, satellite, and seismic scale (using 3D data 150 mi SE of the outcrop area) to characterize fracture populations with respect to tectonic controls, fracture-intensity, mechanical facies, and spatial arrangement among other methods. This information will provide constraint for fracture development zones proposed to be influenced by pre-existing faults. Furthermore, the fracture statistics will be useful for predicting fracture development in other actively explored regions of south Texas which may also be undergoing oblique-slip and fracture development as well as help quantify the influence of mechanical stratigraphy on secondary fracture development around larger fault features.

Satellite mapping and seismic interpretation is currently underway. The seismic data is a 3-D volume from the nearby Maverick Basin, which lies ~150 miles SE of the study area in a similar tectonic province with predicted similar fault mechanics and mechanical stratigraphy Pecos River Canyon. Soon outcrop studies along the Pecos River Canyon will be conducted where stratigraphic architecture has been shown to influence fracture development, and fracture populations in different lithofacies are expected and will be quantified. Exposures within Lewis Canyon display fracture-intensity zonation patterns around faults.

Keywords: Larmide Orogeny, Reactivation, Oblique-slip, Pecos River, Maverick Basin, Mechanical Stratigraphy