Mechanical Stratigraphic and Tectonic Controls on Natural Fracturing in the Eagle Ford Formation, South-Central and West Texas

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ABSTRACT

The Eagle Ford Formation, like many other self-sourced unconventional reservoirs, is heterolithic and mechanically layered. Detailed analyses of mechanical layering and structural history in the Eagle Ford clearly illustrate the first order control of mechanical layering on nucleation and propagation of brittle deformation features. Analyses of natural exposures along Sycamore Creek near Del Rio, Texas, and at Ernst Tinaja in Big Bend National Park, Texas, document contrasting deformation styles that reflect the different tectonic histories of the two localities. In both cases, early brittle deformation was dominated by shear and hybrid failure (faulting). Early faults at the Ernst Tinaja outcrops are interpreted as resulting from Laramide contractional deformation, whereas the early normal faults at the Sycamore Creek exposure likely formed in response to regional extensional deformation characteristic of the Gulf of Mexico Coastal Plain Province of South Texas. Faults at both locations show dip changes (refraction) related to the mechanical properties of the rock. Opening-mode (extension) fractures developed after faulting in response to regional extension and erosional unroofing. These fractures reflect strong influence of mechanical layering on nucleation, spacing, vertical penetration, and lateral extent of fractures. Systematic extension fracture networks are best developed in chalk and limestone beds—these fractures tend to be bed-restricted, terminating in adjacent mudrock or ash beds. Abutting of extension fractures against faults and occasional occurrence of extension fractures cutting across faults indicate their formation after faulting. These observations provide a foundation for using mechanical stratigraphy and tectonic history to predict fractures in the Eagle Ford and other reservoirs.

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