

FRACTURE CHARACTERIZATION BASED ON ORIENTED HORIZONTAL CORE FROM THE SPRABERRY TREND

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Natural fractures existing over a regional area have long been known to dominate all aspects of performance in the Spraberry Trend Area in the Permian Basin, West Texas. However, there is little or no information on the actual fracture system other than orientation on a gross basis from injection programs in the 50's and 60's, and fracture spacing inferred from a few existing vertical cores. Previous descriptions and old core reports did not distinguish between natural and coring induced fractures, a common occurrence during core acquisition in the Spraberry. Almost all the information available from the early years, when almost all Spraberry data was obtained, provides no detailed information on the natural fracture system. The orientation, containment within zone, degree of mineralization (DOM), fracture aperture and spacing are important questions when considering any field procedure; yet after considerable data gathering, it became apparent that only superficial information was available.

The first core (vertical) retrieved as part of the current program in 1993, the Shackelford 1-38A, happened to intersect a vertical natural fracture with significant mineralization that had clearly grown into unoccupied space. Furthermore, this open, mineralized fracture was contained within a thin pay sand and was observed to terminate at a shale parting. This fracture was the first direct evidence of the existence of natural fractures within the pay sands. Recent acquisition of horizontal core from the Upper Spraberry has radically altered our understanding of the natural fracture system in the Spraberry Trend Area. This well, the E.T. O' Daniel #28, was cored with the intent of intersecting natural fractures in the thin sand streaks where oil saturation is found in the Upper Spraberry. Over 100 natural fractures were intersected exhibiting an intriguing and diverse array of fracturing behavior.

Three distinct fracture sets, trending generally North-Northeast (NNE), Northeast (NE), and East-Northeast (ENE), are present in cores from the 1U and 5U Spraberry reservoirs. Each fracture set has a distinct and characteristic pattern of: 1) spacing; 2) mineralization; 3) distribution with respect to lithology; 4) surface characteristics; and 5) distribution of strikes.

NE-striking fractures (average strike 43 degrees) are commonly mineralized with barite and are found only in the 1U reservoir. They are regularly and closely spaced (average 3.17 ft),

have uniform strikes, and are limited to the sandstone and siltstone facies of the formation.

Unmineralized NNE- and ENE-trending fractures (average strikes 32 degrees and 70 degrees respectively) are less regularly spaced, and occur together in the 5U reservoir. The NNE set occurs only within the clastic facies of the 5U unit, whereas ENE fractures are present both within the 5U clastics and in the overlying black shales. ENE fractures have the most irregular spacing distribution, averaging 3.79 ft but ranging from fractions of an inch up to 13 ft.

The NNE-trending fractures have an average spacing of only 1.62 ft. They commonly have an irregular surface morphology and an en echelon to locally anastomosed character, suggestive of an origin in incipient shear. They have the widest dispersion of strike azimuths. Fracture surfaces of the other two sets are relatively planar, and they probably formed as extension fractures.

Cores recovered from the black shales underlying both the 1U and 5U units contain no natural fractures, whereas cores from the overlying black shales contain fractures of the ENE set.

Specific aspects of these fractures that may be important to production include:

- Fracture strikes are segregated by reservoir unit and lithology.
- NE-striking fractures are typically partially mineralized, but mineralization is absent from this set in the basal foot of the 1U reservoir.
- None of the NNE or ENE fractures are mineralized.
- NNE and ENE fractures occur together, in what is probably an intersecting mesh of fractures within the 5U reservoir.
- No fractures are present in the shales immediately underlying either reservoir, but the ENE fractures occur in shales just overlying both reservoirs.

The data from this core highlight the variability in fracture characteristics that may be present within the Spraberry reservoirs despite the relatively homogeneous lithology and an absence of major structures.

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