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Fracture Characterization in the Austin Chalk: A Horizontal Core from the Lower Austin Chalk, Pearsall Field, Frio County, Texas

The Upper Cretaceous Austin Chalk is an important low-permeability fractured reservoir, commonly exploited through horizontal drilling. Successful wells optimize well-bore azimuth and length, target horizon, and storage volume potentially connected to the well bore through fractures. To achieve this end, fracture orientation, aperture, effective aperture, spacing, length, height, fill, and permeability must be determined. Two horizontal laterals and a vertical segment of an Austin Chalk core (Newsom No.1B from Pearsall field, Frio County, Texas) serve to (1) illustrate how each parameter affects well potential and (2) provide examples of both natural and drilling-induced fractures.

Fracture aperture-size distributions in the horizontal sections of the core follow power laws. Spacing-size distributions are negative-logarithmic or lognormal, and fractures are clustered. The aperture size above which fractures are open is 0.14 mm, meaning that many small fractures contribute to system connectivity. Fracture height is governed by truncation effects at marl horizons and pressure-solution seams, which in turn partly depend on fracture aperture and thickness of the inhibiting layer.

Opening-mode fracture systems are dominated by subcritical crack growth. We have measured the subcritical crack index, a key rock property that controls spatial architecture of fractures, in samples from the Newsom No. 1B core. Subcritical crack index values for Austin Chalk are high (95 to 124). Geomechanical boundary element models of fracture growth produce highly clustered fracture patterns, with large unfractured regions between clusters, when the subcritical-crack-index input value is high. These models are consistent with fracture patterns typical of the Austin Chalk.