Discrete Fracture Network Model Developed from a High Resolution LIDAR Outcrop Survey of a Naturally Fractured Unconventional Niobrara Reservoir, Denver Basin

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Abstract

The presence of natural fractures is an important attribute of an unconventional reservoir. The purpose of this study was to characterize the fracture patterns and to determine the drivers that influenced fracture distributions within the Niobrara Formation, a major resource play in the Denver Basin. A dataset comprised of fracture plane orientations and fracture intensity variations was acquired at the Niobrara outcrop. The study identified two major joint sets and two conjugate shear fracture sets. Local tectonic variations, such as listric faults in the negative flower structures, result in increased fracture swarms' intensities. The orientations of the fracture sets remain consistent throughout the interbedded chalks, marls, and limestones. However, there is an apparent variability of fracture intensities associated with changes in lithology. Fracture styles were characterized at several scales: lithofacies-bound fractures (chalks), strata-bound fractures (limestones), and throughgoing fractures (frequently happen in swarms). A geological model consisting of structural framework, lithofacies model, and DFN[1] model was then developed. The information gained should serve as an analog to improve future reservoir characterization in the subsurface and result in better well planning and placement.

[1] Discrete Fracture Network