Datapages/Search and Discovery Article #90224 GeoConvention © 2014, FOCUS - Adapt, Refine, Sustain Calgary, Alberta, Canada, May 12-16, 2014

Controls of Rock Mechanical Properties on in-situ Reservoir Properties: Insights from Laboratory Core Analyses of the Duvernay Formation in Alberta

Albert Cui[1]

[1]Trican Geological Solutions Ltd., Calgary, AB, Canada

Abstract

Understanding of in-situ properties of unconventional shale gas reservoirs is critical for properly evaluating their hydrocarbon potentials and optimally placing and stimulating horizontal wells drilled to tap the hydrocarbons in-place. However, laboratory core analyses for reservoir properties are often conducted under ambient condition. Reservoir rock properties (e.g., permeability, porosity, and fluid saturation) measured under ambient laboratory condition can be significantly different from the in-situ high stress condition, especially in-situ reservoir matrix permeability and conductivity of hydraulic fractures (either propped or un-propped) that are strongly stress-dependent. The stress-dependence of reservoir properties controlled by its mechanical properties is well known but poorly quantified for shale reservoirs. In this study, rock mechanical properties (Young's modulus, Poisson's ratio, strength, and hardness) and reservoir properties (including porosity and permeability) have been measured in laboratory on cores from the Duvernay Formation in Western Canada Sedimentary Basin, Alberta. Based on the measured rock mechanical properties, in-situ porosity and permeability are deduced from their ambient laboratory values and their dynamic changes with in-situ stress likely experienced by a producing reservoir are also modeled in combination with some direct measurements of the stress-dependent matrix permeability and fracture conductivity. Despite the significantly variable reservoir and mechanical properties from sample to sample, strong controls of mechanical properties on in-situ reservoir properties are evident and highlighted with fundamental geomechanical analysis. The results suggest that a better understanding of rock mechanical properties is essential to evaluate and develop the liquid-rich Duvernay play.