Focused Investigation, Insights and Impact of Fluid-Filled Storage Volume; A Case Study in the Niobrara-Codell of the DJ Basin

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Abstract

For decades subsurface characterization experts have relied on calibration of fluid-filled storage volume (porosity and saturation) from laboratory analysis performed on crushed rock samples and results tied to geological and petrophysical property models. Lack of further innovation to advance the application of the crushed rock technique to accurately quantify rock properties across maturity, organic- enrichment and lithological variation resulted in a prevalent disconnect between petrophysically calibrated models (wireline based) and original oil-in place versus the prediction of recoverable hydrocarbons at the wellhead (both hydrocarbon and water phases). In this study we present an innovated and integrated rock and fluid laboratory work flow that resolves the identified past challenges with laboratory property quantification, particularly porosity and saturations. Further, the technique resolves the known laboratory loss of fluids from investigated rock volume as samples are prepared by crushing the material for complimentary methods to be applied and measurements performed. Last, the integrated work flow integrates both open and closed retort application, geochemical total organic carbon and programmed pyrolysis investigation as well as nuclear magnetic resonance to result in increased accuracy and understanding of the rock and fluid properties of investigated rock volume. With the improvement in quantification, petrophysical wireline based models can be corrected for the quantification of lost fluid elucidating the understanding and perspectives of prospective unconventional target zones. The laboratory data integration to the wireline evaluation and geological context results in an opportunity to bridge the gap between the subsurface characterization to an improved predictive wellhead performance understanding. In this case study we highlight and discuss learnings from four wells, spanning the maturity variation in the DJ basin from dry gas to black oil while comparing and contrasting the Niobrara-Codell development stack in each location. Then, linking the modified and innovated laboratory technique to production performance of the relevant horizontal wells, demonstrating how the subsurface to wellhead, static to dynamic behavior interaction can be understood.

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