

Relation of Reservoir Petrophysical Properties to Horizontal Codell Production in Colorado and Wyoming

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ABSTRACT

A collaborative geologic, engineering, and data mining effort has yielded insights into Codell production in the northern DJ. Data mining facilitated the access and download of over 6,500 public domain .las files for modern vertical wells in the Wattenberg/Silo corridor. Raster logs were used to supplement the .las data, net sandstone pay was picked based on a bulk density cutoff of 2.525 gm/cc, and a grid was constructed using values from over 8,000 wells. Using the top of the Codell and the base of net sandstone pay as depth limits, and an 8 - 25% density porosity calculation range (based on matrix and fluid density of 2.68 and 1.0 gm/cc, respectively), ϕ_{ih} was computed in Petra for over 5,000 wells with .las files only, and a ϕ_{ih} grid constructed. Both grids were "sampled" to over 900 horizontal Codell producers within the study footprint, and the assigned petrophysical values were cross-plotted against length-normalized production data. ϕ_{ih} correlates better than net sandstone with length-normalized production. However, both correlations vary with geographic area, and break down to some extent outside of Wattenberg Field. Normalized production in the Silo, Fairway-Brensee, and Redtail areas displays relatively poor correlation with net sandstone and ϕ_{ih} . In contrast, the Codell horizontal production in all areas (including Wattenberg) shows a consistent, inverse, correlation with water-oil ratios from vertical and horizontal producers (Figure 2), suggesting an important role for thermal maturity in Codell productive potential. Cross-plots of normalized production with hydrocarbon pore volume show the best overall correlation, and support the hypothesis that thermal maturity may be a more important production driver than mechanical reservoir properties in some areas. This conclusion informs the consideration of Codell sourcing, and whether migrated portions of the play may exist. While mainly a subject for follow-on study, preliminary analysis of elemental Uranium log data (from over 300 .las files) has also been conducted for this study. The analysis outlines possible subdivision of the play into thermal maturity categories, even within Wattenberg. The northern DJ Codell play has evolved in a very rich data environment, with respect to both geologic and engineering data. Optimization and expansion of the play will surely benefit from further analysis of this wealth of existing data.