Codell Sandstone, A Review of the Northern DJ Basin Oil Resource Play, Laramie County, Wyoming and Weld County, Colorado

Rob Sterling[1], R. J. Bottjer, and K. H. Smith

[1]Cirque

ABSTRACT

The Codell Sandstone has recently been the subject of extensive exploration and subsequent development activity in both the Colorado and Wyoming portions of northern DJ Basin. The Niobrara Formation has been the primary historical exploration target since the late 1980's due to success at the Silo Field from horizontal wells drilled in the Niobrara B Bench. In 2009, EOG Resources discovered the Hereford Field with the Jake 02-01H, producing approximately 1700 barrels of oil per day initially from the Niobrara B Bench. The next two years in the area saw much drilling focused for the Niobrara B Bench with the completion of many non-commercial wells. In 2012, SM Energy drilled a lateral focused on evaluating the Codell Sandstone. Cirque Resources, Kaiser Francis and EOG soon followed with their own exploratory wells, establishing the play. This new play area is thermally in the oil window. Codell Sandstone oil producers have gas-oil ratios less than 2000 scf/bbl. The Codell Sandstone thins from north to south due to erosional truncation beneath an angular unconformity at the base of the Fort Hays Limestone Member of the Niobrara Formation. Gross thickness ranges from 18 to 33 feet. The Codell Sandstone is a very-fine to fine-grained sandstone and produces oil from two main facies: bioturbated sandstone and laminated sandstone. The laminated facies is parallel to sub-horizontally bedded, has 8 to 15 percent porosity, and .01 to 0.10 millidarcies permeability. The bioturbated sandstone has 8 to 13 percent porosity and .008 to .05 millidarcies permeability. The Codell Sandstone is a low-resistivity pay zone that produces oil with low water cuts from zones with less than 10 ohm-m resistivity. Clay content is 15–25% with abundant microporosity as imaged with epifluorescent microscopy, accounting for high bound water content and explaining the low formation resistivity. Oil typing indicates the oil found in the Codell is sourced from the Niobrara and is distributed across the area through migration. Oil saturation varies across the play depending the on the distance from areas of oil generation and expulsion into the Codell. Use of mercury capillary injection pressure analysis was essential in resolving the oil migration route throughout the play area. Drilling and completion techniques have evolved since the first wells were drilled. Best practices to date involve 1280 acre spacing units with 9300' lateral lengths, cemented liner with perf & plug completion techniques.