

Unconventional Tight Light Oil Play Types, Western Canada Sedimentary Basin

Per Kent Pedersen¹

¹Associate professor, Department of Geoscience, the University of Calgary; owner, consulting company

Abstract

Oil production in North America has the last years surged due to the successful exploitation of unconventional low-permeability (tight) light oil reservoirs in North America by multistage hydraulic fractured horizontal wells. Tight light oil plays exhibit a wide range of reservoir characteristics, that can be subdivided into three main play categories:

1. “Shale Oil” – light oil plays where the source = the reservoir, matrix permeability is very low, nano Darcy, and organic matter is usually high. These plays are analogous to shale gas plays.
2. “Tight Oil” – light oil plays where the source \neq the reservoir, and matrix permeability is low (< 0.1 mD). These plays are analogous to tight gas plays and may be composed of clastics or carbonates or a mixture.
3. “Halo Oil” – light oil plays where the source \neq the reservoir, and matrix permeability is relatively high (> 0.1 mD) compared to the other two play type categories. Halo Oil plays represent portions of conventional light oil pools that do not meet traditional petrophysical cutoffs and pay criteria, and may be composed of clastics or carbonates or a mixture.

Examples for the three light oil play categories will be presented from the Western Canada Sedimentary Basin; Shale Oil (Turonian Second White Specks Formation), Tight Oil (Late Devonian to Early Mississippian Bakken Formation), and Halo Oil (Turonian Cardium Formation). The tight light oil reservoirs span a wide range of depositional and tectonic settings and exhibit very different reservoir geometries and lateral extent. For each play the geological, reservoir, and production characteristics will be presented and discussed to deduce the primary controls on production performance in each play category. Note that the same stratigraphic unit might grade into a different play categories in different part of a basin depending on geologic setting, reservoir type, fluids, and pressure. For the mature plays a review will be presented of the success in identifying sweet spots during the initial exploration phase, leading to a discussion of the reservoir parameters that control the production, with the sweet spot often in an area of overlap of several parameters. The unconventional tight light oil play classification scheme facilitates a subdivision of the broad range of unconventional light oil plays and proper use of analogs for early phase light oil plays.