GUSSOW 2026
CRACKING THE CRETACEOUS CODE
October 13-15 | Banff, AB

Fluid Dynamics Post Operations in Undersaturated Tight Gas Sands: An example from the Wilrich Member, Spirit River Formation

Carolyn Currie, Cenovus Energy Inc.

ABSTRACT

The Wilrich Member is a Lower Cretaceous (Early Albian) siliciclastic unit within the Spirit River Formation of the Western Canada Sedimentary Basin (WCSB). Geographically, the Wilrich covers an extensive area in west central Alberta and is the primary target for a number of operators (Figure 1a). Stratigraphically, the Wilrich typically underlies the Falher Member and overlies the Bluesky Formation (Figure 1b). Geologically, the Wilrich is the first in a series of progradational cycles that record deposition along a wave- to storm-influenced shallow marine to deltaic system (Figure 1a). From a petroleum perspective, the Wilrich is known for tight to moderate-quality reservoirs, where productivity depends on subtle facies variations, natural fracturing, and diagenetic controls such as cementation and clay content.

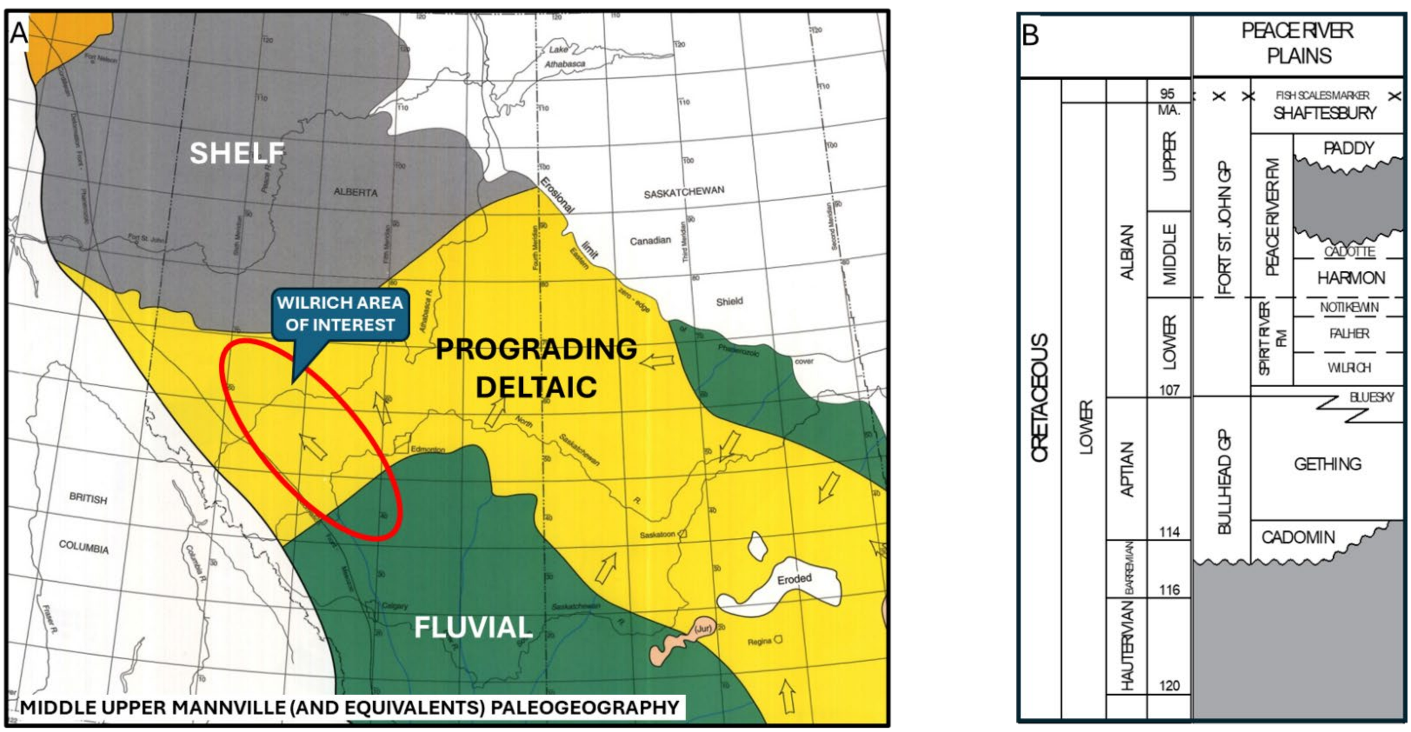

Figure 1: A - Middle Upper Mannville (and equivalents) paleogeographic map and Wilrich AOI; B – Stratigraphic Framework for the Cretaceous section in Peace River Plains area. Modified from Chapter 19 – Cretaceous Mannville Group, Altas of the Western Canada Sedimentary Basin

The main reservoir units are often interpreted as shoreface sands, delta-front sands and local incised or distributary channel sands. Key petrophysical attributes are summarized in the table below:

	Average	Min	Max
Total Porosity (%)	6.2	0.3	18.4
Effective Porosity (%)	4.5	0.0	16.5
Permeability (Klink @ NCS) (mD)	8.36E-02	2.02E-05	6.63E+00
Water Saturation (%)	33.0	0.5	98.4

In order to understand how fluid dynamics are affected by completion operations; we need to first understand the insitu fluid dynamics of the reservoir before completions.

What has been particularly appealing about the Wilrich Member is the lack of water production (20-40% load fluid recovery) in most areas of the overpressured deep basin region of the WCSB. This is because the Wilrich is undersaturated or desiccated, meaning that there is no mobile water and no capillary bound water present and that the clays are partially desiccated also. This is explained using the basin-centered gas system model outlined nicely by Newsham and Rushing (2002) where they encountered the same phenomena in the Bossier Sands. A simple cross-plot comparing the pore volume of water extracted via core analysis to an empirical calculation of clay-bound water can give a quick assessment of desiccated vs. hydrated portions of the reservoir (Figure 2).

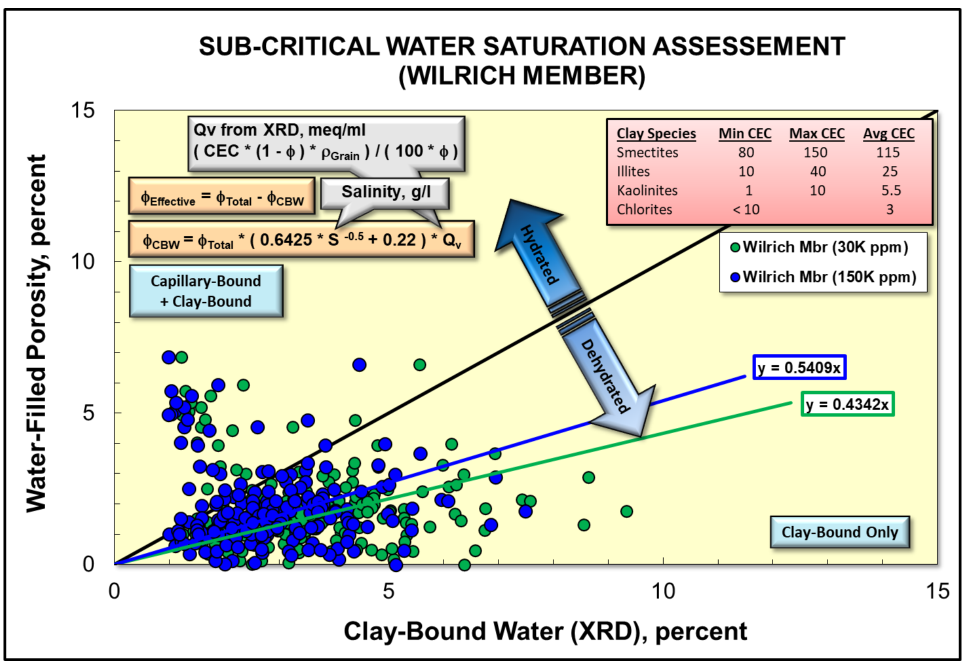

Figure 2: Sub-critical water saturation assessment cross-plot

So what happens when we put fluids back on this reservoir when we frac and complete these wells? If we are only getting 20-40% of the load fluid back – where is that load fluid going? Operationally, if there is an extended shut-in period and flowback/production is delayed were completion fluids sit in the reservoir for an extended period of time – does that have an IP rates and ultimate EUR?

This presentation aims to theoretically explain the fluid dynamics within the Wilrich Member and how those dynamics change post operationally.

REFERENCES

Hayes et.al., (1994): Cretaceous Mannville Group of the Western Canada Sedimentary Basin; in Geological Atlas of the Western Canada Sedimentary Basin, G.D. Mossop and I. Shetsen (comp.), Canadian Society of Petroleum Geologists and Alberta Research Council, URL https://ags.aer.ca/atlas-the-western-canada-sedimentary-basin/chapter-28-geological-history-the-peace-river-arch.

Newsham, Kent & Rushing, J.A.. (2002). Laboratory and Field Observations of an Apparent Sub Capillary-Equilibrium Water Saturation Distribution in a Tight Gas Sand Reservoir. 10.2523/75710-MS.