

# Hydrogeology of the Shaunavon Formation: Regional Evaluation of the Hydrodynamic System and Hydrocarbon Migration

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## **Abstract**

*Recent hydrogeological mapping of fluid flow in southwestern Saskatchewan has produced a series of detailed maps, including fluid potential and water chemistry maps of Phanerozoic strata. This work has provided insight into regional hydrocarbon migration pathways and permeability variations in the Shaunavon Formation.*

*Regional fluid flow in the Shaunavon Formation is directed towards the north and northeast. A strong easterly hydraulic drive becomes apparent between Ranges 20 and 22W3M, where hydraulic gradients increase to over 15 m/km. The potentiometric low coincides with the "Shaunavon Oil Field Trend" and extends between Townships 6 and 15. Formation water chemistry along this trend is dominated by sodium chloride with total dissolved solids ranging from 10,000 to 20,000 mg/L. These concentrations decrease towards the southwest to approximately 5,000 mg/L and correspond to sodium bicarbonate water composition.*

*The time of peak oil expulsion and migration from the Lodgepole Formation, the source rock of Shaunavon oils, coincides with the onset of a hydrodynamic regime in the Williston Basin that resulted from the Rocky Mountain uplift and numerous uplifts and igneous intrusions in northern Montana. Cross-formational oil migration from the Madison Formation to the overlying Jurassic strata may have occurred in southwestern Saskatchewan and northern Montana through fractures and faults. The oils have likely been picked up by the strong hydrodynamic regime and driven to the present-day Shaunavon Oil Field Trend in the northeast. The migration towards this trend has occurred through the highly permeable Upper Shaunavon Member followed by the vertical filling of the low permeability Lower Shaunavon Member.*

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