

# Regional Hydrogeology of the Bakken Formation of the Williston Basin (Canada – USA)



Daniel Skoreyko, Benjamin Rostron  
*Advisian, Edmonton Alberta, Canada*  
*University of Alberta, Edmonton, Alberta, Canada*  
*Department of Earth and Atmospheric Sciences*

## ABSTRACT

The Bakken Formation is currently the most productive oil producing formation in the Williston Basin, and one of the most economically important tight oil plays in North America. Oil in the Bakken Formation has been shown to migrate from the central, thermally mature portion of the Bakken Formation outwards and toward the less mature portion of the formation, and north to Canada. Previous studies have shown that a clear understanding of the hydrogeology and migration pathways is crucial for resource development; however, the influences and implications of groundwater flow and hydrochemistry in the Bakken Formation have been relatively poorly studied.

Pressure and chemistry data from both the Canadian and U.S. portion of the Bakken Formation were compiled into newly-created databases spanning the entire Williston Basin. An intensive iterative culling procedure was used to remove all non-representative formation pressures and formation water analyses affected by nearby production, injection, and hydraulic fracturing operations.

Detailed potentiometric surface maps, water driving force maps, and hydrochemical maps were generated from the remaining data. Results reveal a large central area with greater-than-hydrostatic formation pressures, which decrease outwards returning to near-hydrostatic conditions in distal areas of the basin. Water composition and salinity within the Bakken Formation is variable. Total dissolved solids range from less than 10,000 mg/L to over 300,000 mg/L. Formation waters within the Bakken Formation are dominantly Na-Cl type formation waters, however, Na-SO<sub>4</sub> waters occupy the northwest portion near the transition of the Bakken Formation of the Williston Basin with the Bakken/Exshaw Formation of the Alberta Basin. Brine origin as determined from Na-Cl-Br systematics performed on Na-Cl type formation waters reveal that Bakken Formation brines are of multiple origins.

This study provides the most comprehensive regional hydrogeological and hydrochemical characterization of the Bakken Formation across the Williston Basin to date.