

# **Fluid Flow and Geochemistry of the Mississippian Aquifers Williston Basin, Canada and U.S.A.**

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Mississippian aged strata (in particular the Madison Group) in the Williston Basin (Canada-USA) contain abundant hydrocarbon deposits that have produced over 1500 MMBO during the last fifty years. The Williston Basin contains an active groundwater flow system and previous research has shown that geochemistry (e.g. O & D isotopes, Br) of formation waters is useful for tracing fluid flow across the basin. To date, there has not been a systematic study of the geochemistry of formation waters in the main oil producing zone (Mississippian) in the basin. Problems with aquifer correlation across an international boundary combined with a vast number of producing wells has restricted a regional scale analysis of this zone. Water and oil samples were collected from more than 150 producing wells from the Midale Beds (Charles Formation) across the Williston Basin.

Mapped results reveal large variations in geochemical and isotopic compositions across the basin. These results show: i) formation waters have distinct chemical fingerprints which can be applied in various petroleum exploration and production activities; ii) large variations in isotopic compositions indicate variable flow pathways within the aquifer; iii) some parts of the aquifer host formation waters with a composition very similar to original Mississippian seawater. We interpret the variations in geochemistry to reflect a history of widely variable flow rates in the aquifer, over time. These new geochemical data indicate the Mississippian flow system is not a simple regional groundwater flow system. Rather, it is a highly-variable flow system across the basin, thus impacting petroleum migration and emplacement in this important hydrocarbon producing zone.