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Athabasca Regional Hydrochemistry in the McMurray Formation

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Summary

The influence of sub-Cretaceous hydrogeology on the McMurray formation waters may have significant impacts on mining and in-situ resource developments in the Athabasca region. Improved understanding of the modern fluid flow regime requires a more comprehensive regional study of the processes that control groundwater quality and flow in the Athabasca region. Regional hydrochemical mapping of McMurray formation waters was conducted in the Athabasca Oil Sands Region. The objective of this study was to understand the extent and magnitude of heterogeneity in regional salinity, and to identify the underlying geological processes that generate regional variability in formation water chemistry. Data were collected from publicly available sources including environmental assessments, government reports and peer-reviewed literature. Throughout the Athabasca region, the hydrochemistry of McMurray formation water was generally brackish to fresh, and consistent with a general hydrogeological model of local-scale, topographically-controlled flow. However, substantial locally elevated salinity values were observed in an approximately linear trend from the southeast to northwest of the region (Township 78, Range 4 West of the 4th Meridian to Township 100, Range 10, West of the 4th Meridian). The linear trend in elevated salinity values for McMurray formation waters is underlain by the dissolution edge of the Prairie evaporite deposits, and consistent with a zone of vertical hydraulic conductivity between the McMurray formation and underlying Devonian brines. Vertical hydraulic conductivity is possibly related to sub-Cretaceous karst structures, including collapse breccias and sinkholes, directly underlying the McMurray formation (Broughton, 2013). Elevated hydraulic head values in the Devonian aquifers that may be related to Pleistocene glacial recharge events (Grasby and Chen, 2005), could provide the driving force for upward migration of saline fluids that can create significant challenges for resource development in the Athabasca region.

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References

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