

Geologic hydrogen potential mapping in Manitoba's sedimentary basins

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Summary

Geologic hydrogen is formed by natural processes and can occur in potentially economic accumulations in the subsurface of sedimentary basins, but has been largely overlooked as a resource and as a result has suffered the effects of analytical blindness. Hydrogen is formed by several reactions, including radiolysis and rock-water interactions related to serpentinization and iron oxidation of Precambrian rocks—with serpentinization theorized to be the best source of geologic hydrogen. The migration pathways, reservoirs and seals within the overlying sedimentary strata in Manitoba provide the ideal system to support hydrogen accumulation. Little is known about the hydrogen natural occurrences in Manitoba. This reconnaissance study focused on hydrogen potential within the sedimentary strata of the Williston and Hudson Bay basins.

In order to understand the geologic hydrogen system in strata of these sedimentary basins, potential bedrock sources of hydrogen were identified and oil and gas wells with reported concentrations of hydrogen were reviewed and discussed in Nicolas (2024; Figure 1). A compilation of gas analyses results from government petroleum technical well files indicated very low concentrations of hydrogen, with only 10 analyses having hydrogen concentrations of >1 mol. % and two of those with values of ~8 mol. % (Nicolas, 2024).

Potential Precambrian hydrogen generation sources were identified by mapping drillholes reported to have basement lithologies with the potential to generate hydrogen from a rock-water interaction. The target lithologies, identified by keyword searches through core government descriptions, included serpentinized (including serpentine), iron (iron formation, iron sulphide, iron-rich), olivine and ultramafic (including dunite, peridotite, komatiite) (Nicolas, 2024). To further define the area of these potential sources, the drillholes were mapped in combination with total field magnetic anomaly data. A good example of an identified area with excellent hydrogen generation potential is the Neepawa iron deposit (Figure 1).

This study showed that natural hydrogen occurrences do occur and identified Precambrian basement features and lithologies that may produce hydrogen with diffusion into the overlying sedimentary strata (Nicolas, 2024). Occurrences of hydrogen in gas analyses from oil and gas wells in Manitoba are very low, but this may be a result of analytical blindness to hydrogen and is not indicative of any hydrogen anomalies.

Future gas analyses conducted on fluids from oil and gas wells should consider testing for hydrogen to ensure accurate results going forward and build up a database. In addition, greenfield exploration efforts for hydrogen could benefit from being focused in areas of the identified Precambrian structures and specific hydrogen-generating lithologies. Overall, Manitoba has good potential to support a hydrogen system, as it has good potential sources, migration pathways, reservoirs and seals required for accumulations.

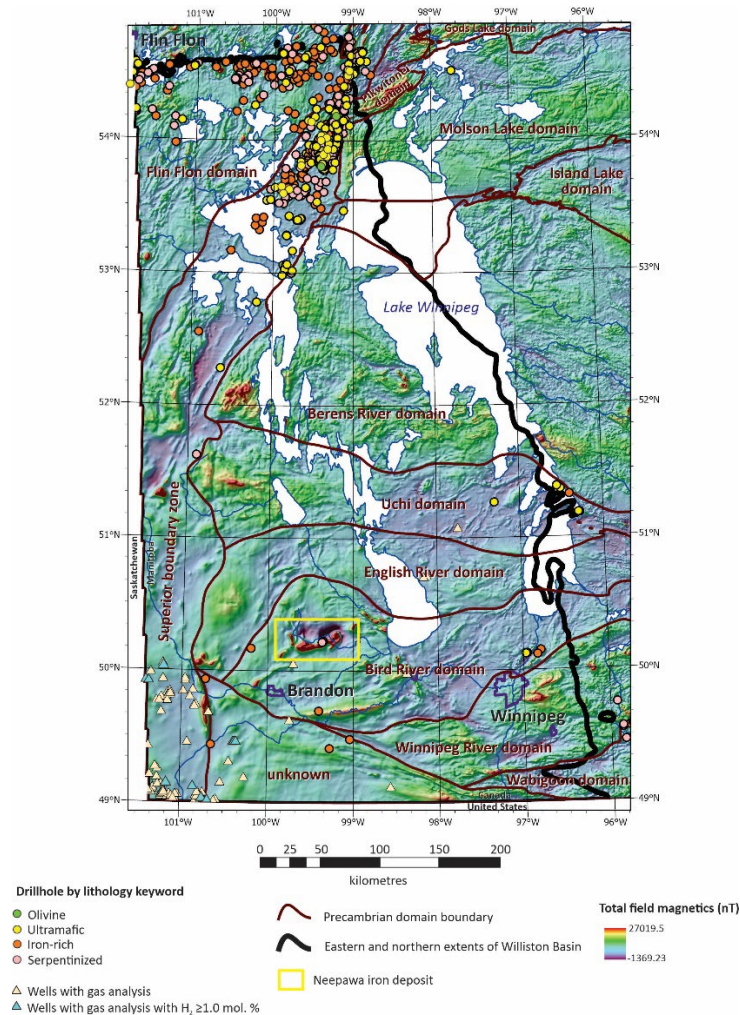


Figure 1: Shaded total field magnetic anomaly map of the Williston Basin in southwestern Manitoba (Manitoba Business, Mining, Trade and Job Creation, 2024) showing the Precambrian domain boundaries as drawn by McGregor (2013), and the distribution of drillholes with records that included the following lithology keywords (from McGregor, 2013): serpentinized (including serpentine), iron (including iron formation, iron sulphide, iron-rich), olivine and ultramafic (including dunite, peridotite, komatiite). Abbreviation: nT, nanotesla. Modified from Nicolas (2024).

References

Manitoba Business, Mining, Trade and Job Creation, 2024: Geoscience service; in GIS Map Gallery, Manitoba Economic Development, Investment, Trade and Natural Resources, Manitoba Geological Survey, URL <https://rdmaps.gov.mb.ca/Html5Viewer/index.html?viewer=MapGallery_Geology.MapGallery> [September 2024].

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Nicolas, M.P.B. 2024: Geologic hydrogen in the Williston and Hudson Bay basins, southwestern and northeastern Manitoba (parts of NTS 53, 54, 62, 63); *in* Report of Activities 2024, Manitoba Economic Development, Investment, Trade and Natural Resources, Manitoba Geological Survey, p. 164–171.