Title. Canada1Water Bedrock Geology

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1. Synopsis

The bedrock geology zonation map combines the lithology and formation information from the 1:5 million scale North American map for the metamorphic and igneous zones within Canada with the more detailed distributions of sedimentary units from the arctic and provincial geological maps (varying scales from 1:250,000 to 1:5 million).

58 references were reviewed to assign hydraulic parameters (saturated hydraulic conductivity) for 108 unique lithology types. Canada1Water further distinguishes 3 vertical bedrock layers; 1) simplified lithology with fractures, 2) detailed lithology containing both fractures and no fractures, and 3) simplified lithology completely unfractured, from top to bottom, respectively.

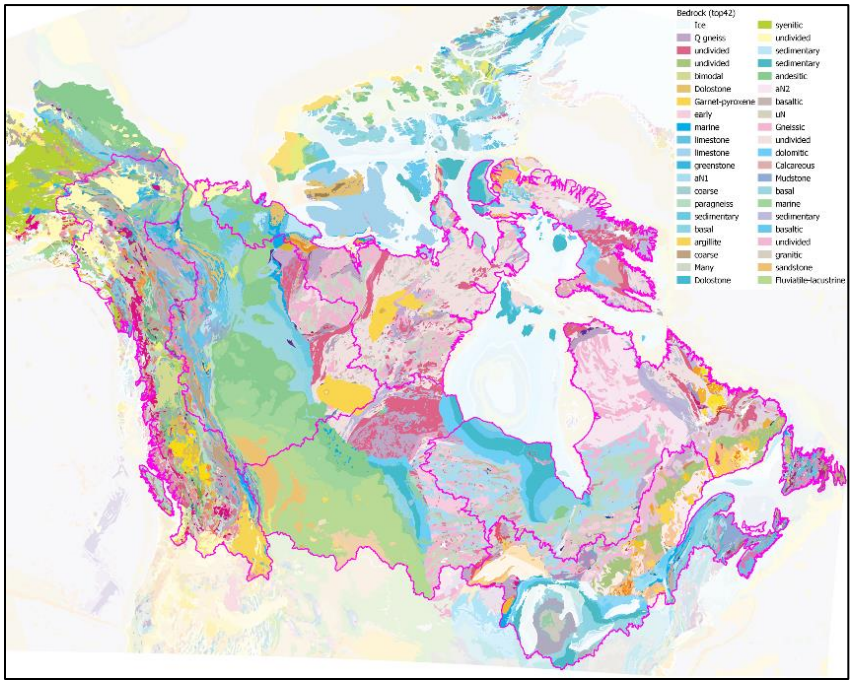

Figure 1. Bedrock geology mapping with hard rock generally in pinks/purples/yellows and sedimentary rocks in greens/blues.

2. Methods

Maps

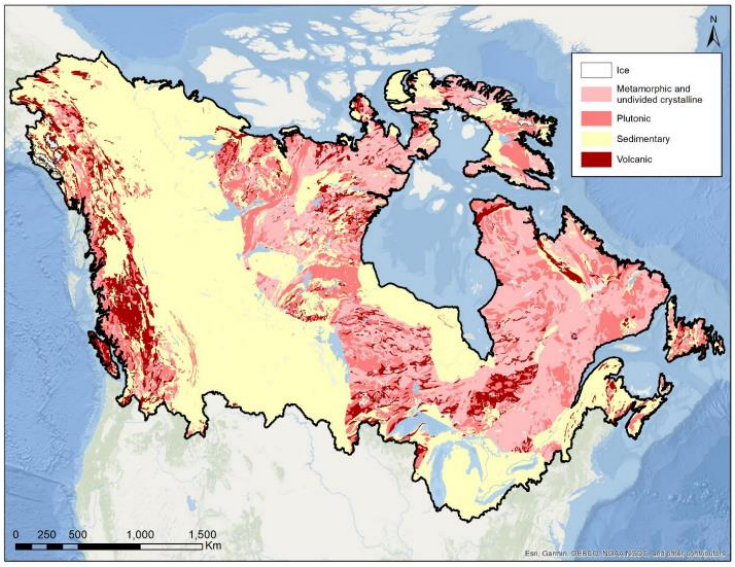

Figure 2. Igneous and metamorphic bedrock mapping which has no sedimentary basin detail.

The North American coverage bedrock map cannot be used alone as it does not contain detailed enough lithological descriptions in the sedimentary basins in order to assign hydraulic parameters. Thus detailed sedimentary basin mapping from provincial and arctic maps was join to complete a detailed igneous, metamorphic and sedimentary bedrock map.

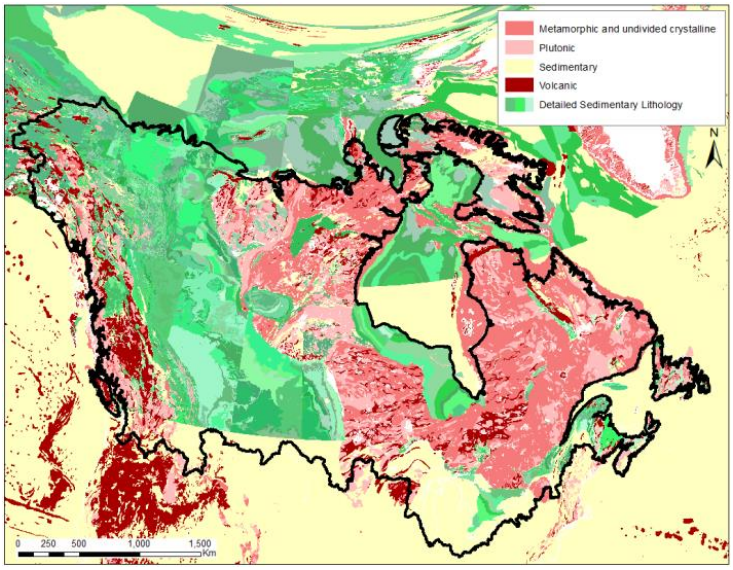

Figure 3. Igneous and metamorphic bedrock mapping joined with detailed sedimentary basin mapping.

Table 1. Sedimentary basin mapping datasets

Province/Territory	Scale	Reference
British Columbia	1:1,000,000	Cui et al, 2017
Alberta	1:1,000,000	Prior, 2013
Saskatchewan	1:1,000,000	Saskatchewan Geological Survey (nd)
Manitoba	1:1,000,000	Manitoba Geological Survey (nd)
Ontario	1:1,000,000	Armstrong and Dodge, 2007
	1:250,000	Ontario Geological Survey, 2011
Quebec	1:250,000	Thériault and Beauséjour, 2012
New Brunswick	1:1,000,000	Fyfe and Richard, 2007
Nova Scotia	1:1,000,000	DP ME 43, Version 2, 2006
Newfoundland	1:1,000,000	Newfoundland and Labrador Geological Survey, 2013
Yukon and Nunavut (Arctic dataset)	1:5,000,000	Harrison et al, 2011
North-West Territories	1:250,000	Okulitch and Irwin, 2014

Hydraulic Parameterization

Where hydraulic properties (saturated hydraulic conductivity) are available for named aquifers/formations these will be used, otherwise book -values based on general lithology are applied. A total of 108 unique bedrock lithology units/types were identified and had a range of saturated hydraulic conductivity parametrized.

In Canada1Water models, three vertical bedrock zones were defined with a general decrease in permeability with depth to represent fractured and unfractured bedrock regions.

I. The upper most layer represents fractured bedrock zones, and as such the upper range of hydraulic conductivity values for a simplified geology of 12 unique zones were used.
II. The middle bedrock layer contains both fractured and unfractured zones, in which the full detailed 108 unique zones and the mean (geomean) of the range saturated hydraulic conductivity values were used.
III. The bottom bedrock layer represents unfractured bedrock zones, in which the lowest range of hydraulic conductivity values for a simplified geology of 12 unique zones were used.

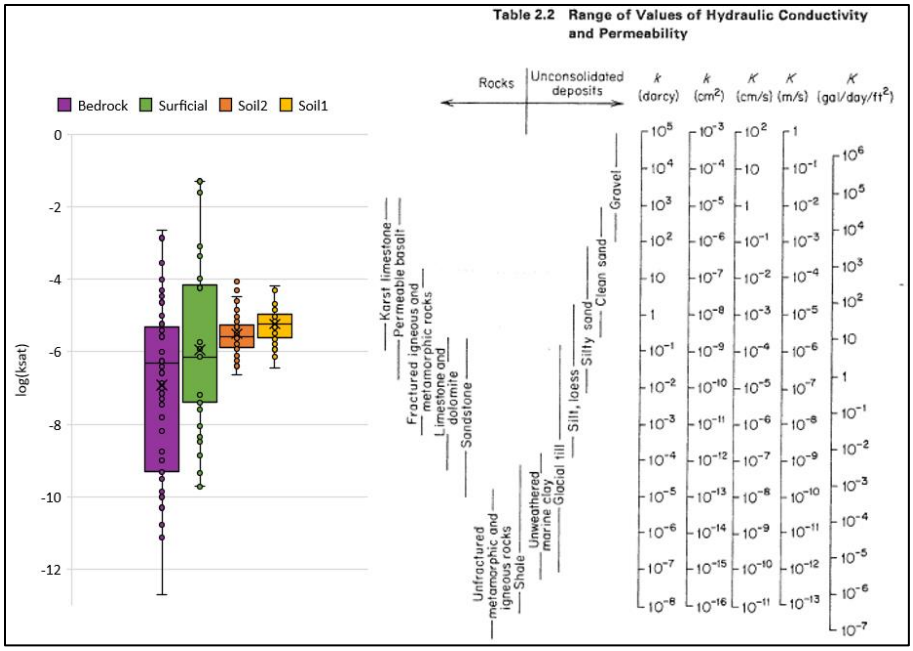

Figure 4. Distribution of saturated hydraulic conductivity bedrock (purple) values compared to Freeze and Cherry, 1979.

3. Bedrock Geology Mapping dataset references

- North America:

Garrity, C.P., and Soller, D.R., 2009, Database of the Geologic Map of North America; adapted from the map by J.C. Reed, Jr. and others (2005): U.S. Geological Survey Data Series 424 [https://pubs.usgs.gov/ds/424/].

- British Columbia:

Cui, Y., Miller, D., Schiarizza, P., and Diakow, L.J., 2017. British Columbia digital geology. British Columbia Ministry of Energy, Mines and Petroleum Resources, British Columbia Geological Survey Open File 2017-8, 9p. Data version 2019-12-19.

- Alberta:

G.J. Prior (2013): Notes to accompany Map 600: bedrock geology of Alberta; Alberta Energy Regulator,

AER/AGS Open File Report 2013-02, 31 p.

- Saskatchewan:

1:1,000,000 geology direct from Sean Boseman

- Manitoba

Unpublished 1:1,000,000 geology 2022-01-06 from Greg Keller

- Ontario:

Armstrong, D.K. and Dodge, J.E.P. 2007. Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 219. 1:

Ontario Geological Survey 2011. 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release–Data 126 - Revision 1.

- Québec:

Thériault, R. and Beauséjour, S. 2012. Geological map of Québec. Various Documents (DV) 2012-07, Ministère des Ressources Naturelles du Québec, Val d'Or, QC.

- New Brunswick:

Fyffe, L.R. and Richard, D.M. 2007. Lithological map of New Brunswick; New Brunswick Department of Natural Resources, Mineral Policy and Planning Division. Plate 2007-18

- Nova Scotia:

DP ME 43, Version 2, 2006. Digital Version of Nova Scotia Department of Natural Resources Map ME 2000-1, Geological Map of the Province of Nova Scotia, Scale 1:500 000, Compiled by J. D. Keppie, 2000. Digital Product Compiled by B. E. Fisher and J. C. Poole

- Newfoundland:

1:1,000,000 geology direct from Coleman-Sadd

Geological map of Labrador; by Wardle, R.J., Gower, C.F., Ryan, B., Nunn, G.A.G., James, D.T., and Kerr, A., 1997: Scale: 1:1 000 000. Government of Newfoundland and Labrador, Department of Mines and Energy, Geological Survey. Open File GS# LAB/1226

Geology of the Island of Newfoundland (digital version of Map 90-01, with minor revisions) by Colman-Sadd, S.P., Hayes, J.P. and Knight, I. 1990: Scale: 1:1 000 000. Government of Newfoundland and Labrador, Department of Mines and Energy, Geological Survey Branch. Open File GS# NFLD/2192

- Northwest Territories:

Okulitch, A. V. and Irwin, D., 2014. Geological Compilation of the Western Mainland and Southern Arctic Islands Regions, Northwest Territories; Northwest Territories Geoscience Office, NWT Open File 2014-01.

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