Northeast BC Granite Wash Geological Carbon Capture and Storage Atlas (NTS 094A, H, I, O, P, parts of 093I, O, P, 094B, G, J, K, N)

N.L. Sweet, Canadian Discovery Ltd., Calgary, Alberta, nsweet@canadiandiscovery.com

Sweet, N.L. (2025): Northeast BC Granite Wash Geological Carbon Capture and Storage Atlas (NTS 094A, H, I, O, P, parts of 093I, O, P, 094B, G, J, K, N); *in* Geoscience BC Summary of Activities 2024, Geoscience BC, Report 2025-01, p. 83–88.

Introduction

In 2023, Geoscience BC released the *Northeast BC Geological Carbon Capture and Storage Atlas* (Canadian Discovery Ltd., 2023), which included maps in both PDF and shapefile formats, as well as a comprehensive database of oil and gas pool and aquifer data. This study identified and assessed promising geological carbon dioxide (CO_2) sequestration sites in northeastern British Columbia (BC) within the Western Canada Sedimentary Basin, quantifying their CO_2 storage potential and evaluating their ability to support carbon capture and sequestration (CCS) and low-carbon energy projects. As well, the atlas provided valuable information for policymakers, Indigenous groups, communities and industry stakeholders; recommended future CCS evaluation steps; and offered a methodology for assessing CO_2 sequestration potential in other BC basins, particularly those near major CO_2 emission sources.

The deep Granite Wash Formation (Granite Wash) was not included in the original atlas because of insufficient publicly available data. To address this data gap, Geoscience BC developed a new CCS project to assess the Granite Wash in northeastern BC (Figures 1, 2), and the technical work is being undertaken by Canadian Discovery Ltd. The primary goals of the project are to 1) regionally map the Granite Wash, 2) identify areas of northeastern BC where the Granite Wash has sufficient porosity, permeability and net reservoir thickness to be considered a potential CCS target and 3) calculate the CO_2 storage potential for two Granite Wash areas of interest (AOIs). This paper summarizes the project's key activities, expected outcomes and outputs.

Project results are expected to be made public in March 2026.

Geology of the Granite Wash

The Granite Wash is a diachronous lithostratigraphic unit composed primarily of siliciclastic rocks that unconformably rests atop a Precambrian basement comprising granites and metasedimentary rocks. The Granite Wash sands were deposited as part of an alluvial to braided plain in a deltaic and shallow marine environment surrounding an exposed Peace River arch land mass (Trotter and Hein, 1988). Regionally, Granite Wash siliciclastic units thin across the arch, thicken on the flanks and thin toward the distal edges. The structure of the underlying Precambrian basement influenced the deposition of the Granite Wash (O'Connell et al., 1990); the siliciclastic sediments typically blanketed the paleotopography of the Precambrian draping over highs and filling in lows (Dec et al., 1996). The Granite Wash can therefore be very thin or absent where the Precambrian was highly emergent at the time of deposition; these areas of nondeposition of the Granite Wash are referred to as 'bald highs'.

The siliciclastic units of the Granite Wash are composed predominantly of siltstones and fine-, medium- and coarse-grained feldspathic and quartz-rich sandstones. The most porous and permeable zones with the best potential to store CO_2 occur in the sandstones. The Granite Wash siliciclastic units are radioactive due to the high potassium content of the feldspar clastic component and are characterized by high readings on gamma-ray well logs (Figure 3).

In the study area, seals (caprocks), which acts as traps, occur both locally and regionally and at several levels in the subsurface. The seals overlying the potential storage reservoir need to provide containment and be geomechanically stable. Of particular note in the area is the Cretaceous Shaftesbury Formation, a thick regional shale unit that extends throughout the study area and is situated below the deepest groundwater level. This unit can act as a containment layer, preventing CO_2 migration to the surface.

Project Methodology

Sedimentological and stratigraphic data will be obtained from geophysical well logs, geological well files and core descriptions. Data from Alberta (four townships to the east of the BC border) is included in the evaluation, as there are wells that penetrated the Granite Wash and the well files can provide additional information. Gamma-ray, sonic, neutron density, bulk density, microlog and resistivity wireline well logs will all be used to determine gross isopach, average porosity and net reservoir. Although limited, core

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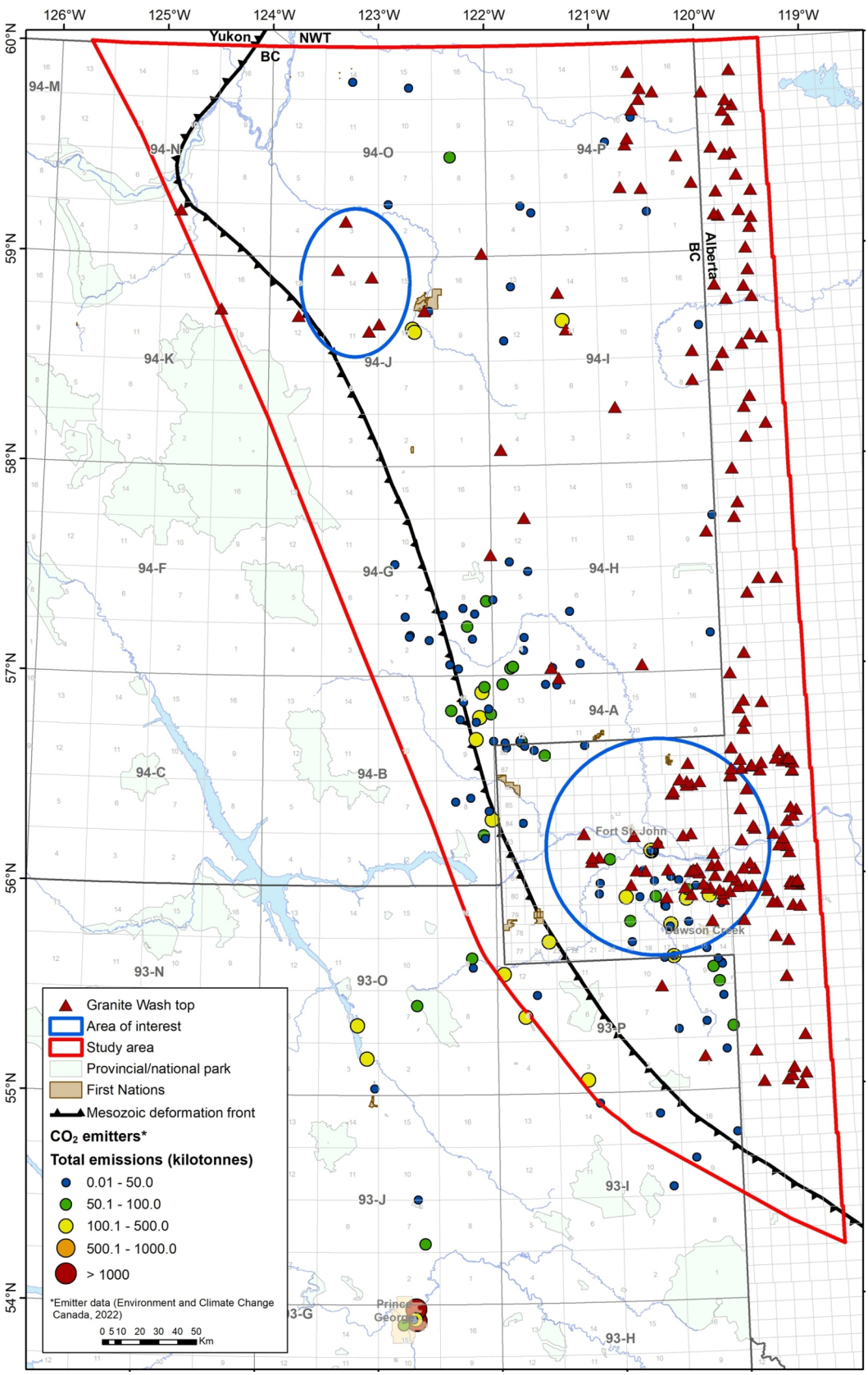

Figure 1. Project study area (red outline), northeastern British Columbia. The CO_2 emitters are shown as filled coloured circles, with the size and colour being proportional to annual CO_2 emission volumes. The two areas of interest in this study are outlined in blue. Granite Wash Formation (Granite Wash) well data from geoLOGIC systems ltd. (2024).

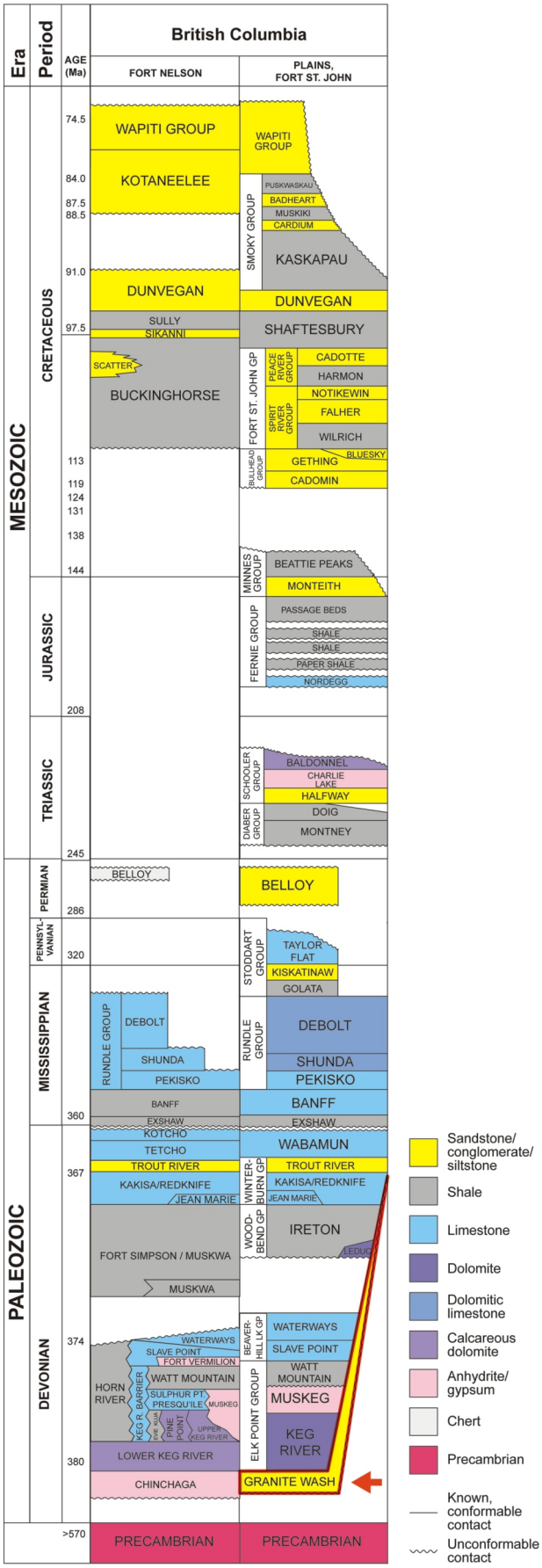

Figure 2. Stratigraphic chart for northeastern British Columbia (modified from BC Ministry of Energy, Mines and Low Carbon Innovation, 2011; Core Laboratories Petroleum Services, 2017). Granite Wash Formation is outlined in red. Abbreviations: Lk, Lake; Pt., Point; R, River.

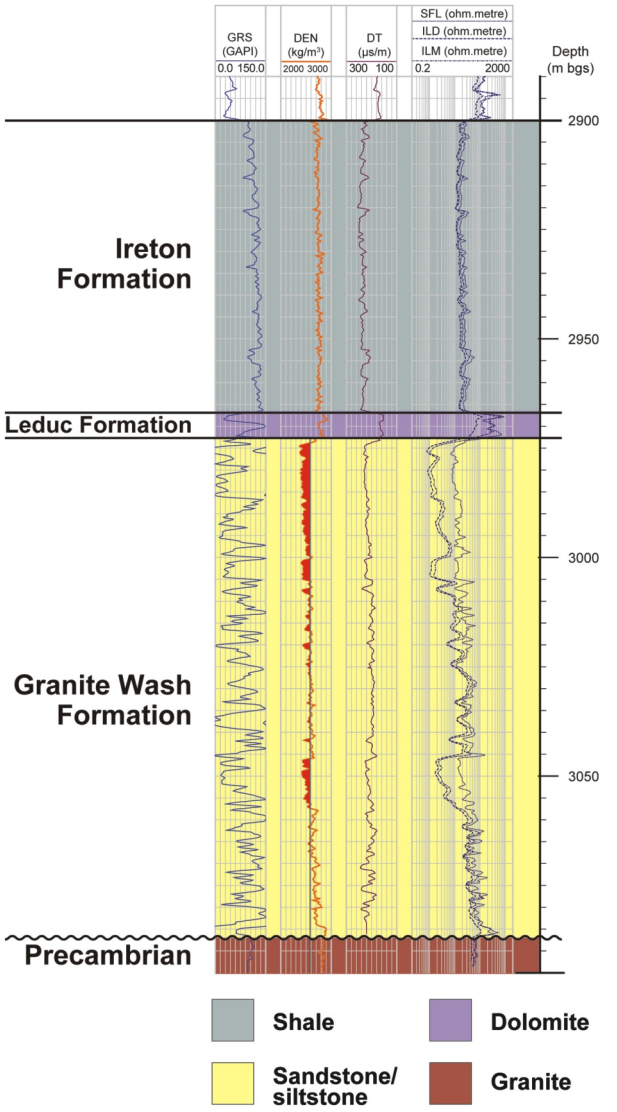

Figure 3. Petrophysical well log highlighting the stratigraphic tops and the typical log responses of the Granite Wash Formation (net reservoir highlighted in red; log from geoLOGIC systems ltd. [2024]). Abbreviations: bgs, below ground surface; DEN, density; DT, sonic delta-t; GAPI, gamma API units; GRS, gamma ray; ILD, deep induction; ILM, shallow induction; SFL, spherically focused log.

and drillstem test data will also be used to further characterize the reservoir.

Through the generous donation of industry partners, over 580 km^2 of 3-D seismic and 3540 km of 2-D seismic mapping is being used to map stratigraphy and structure, focusing on the Granite Wash and Precambrian basement. Areas of existing natural faulting need to be understood and assessed as to the risk of reactivation along their faults and potential for the fault to breach the seals. This project will assess and potentially categorize the various orientations and depths of seismically identified faults.

The seismic and geological data will be combined to create a suite of maps that will be used to identify areas with the greatest reservoir potential and to inform calculations of CO_2 storage potential. Based on the geological and geophysical data accessed for the project, two areas of interest (AOIs) in the study area were identified based on the greater availability of data, which allows for more detailed mapping (Figure 1). Figure 4 is an enlarged map of the southern AOI showing the position of the Peace River arch and the location of the schematic cross-section shown in Figure 5. The schematic section in Figure 5 highlights the generalized depositional geometry of the Granite Wash. Initial isopach mapping of the southern AOI indicates up to 200 m of Granite Wash.

Detailed porosity trends will be established for the AOIs. When calculating the net reservoir for the AOIs, a cutoff of 5% porosity will be used when sufficient porosity well logs are available, and when unavailable, net reservoir will be estimated using spontaneous potential, caliper and microlog responses. Initial mapping of the southern AOI showed up to 110 m of net reservoir.

Granite Wash saline aquifer data will be vetted for CO_2 storage suitability criteria, including cutoffs for porosity and permeability, as well as sufficient depth, temperature, pressure and trapping for effective storage, and aquifers with potential for CO_2 storage will be identified. Those aquifers with the potential for supercritical CO_2 storage will need to have initial reservoir pressures greater than 7500 kilopascals and temperatures greater than 31.1° C (the critical point for CO_2). At supercritical conditions, CO_2 has high density like a liquid, but low viscosity like a gas—ideal for injection and storage of greater volumes as compared to storage in the gaseous phase. The CO_2 density calculations require absolute pressure and temperature at reservoir conditions from equations of state (Span and Wagner, 1996). The CO_2 densities for this study will be calculated using a web computation tool (Wischnewski, 2007).

Theoretical and effective CO_2 storage potential for the Granite Wash aquifer(s) will be provided in the report. Theoretical storage is the mass of CO_2 that can be stored in the aquifer and is based on the mapped pore volume of the reservoir and CO_2 density. Effective storage is the capacity for CO_2 storage after accounting for various reservoir conditions and fluid properties. For regional aquifers, given the large aerial extent and the fact that injected CO_2 must displace fluid in place, the calculations for effective storage capacity are provided on a ninetieth percentile (P90; high), fiftieth percentile (P50; mean) and tenth percentile (P10; low) basis, as a function of the percentage of total theoretical storage potential. This data will be gridded and summarized on a megatonne per township (or equivalent) map.

Conclusion

Mapping of the Granite Wash Formation (Granite Wash) will augment the existing maps and database generated for the *Northeast BC Geological Carbon Capture and Storage Atlas* and contribute to Geoscience BC's objective of providing atlas-style CO_2 storage assessment reports for the geological basins across British Columbia (BC).

The deliverables of the Northeast BC Granite Wash Geological Carbon Capture and Storage Atlas project include

1) catalogue of all relevant geoscience reports and data;
2) structural map and gross thickness map for the Granite Wash, as well as a structural map for the underlying Precambrian basement;
3) detailed maps and data tables for the Granite Wash in the areas of interest, including average porosity, net reservoir and CO_2 storage potential;
4) preliminary assessment of carbon storage reservoir technical risks;
5) identification of data gaps and recommendations for future research phases; and
6) public report and atlas.

This project will ultimately provide further insights into the geological framework and carbon storage potential of the Granite Wash in northeastern BC.

Acknowledgments

The project is a partnership between Geoscience BC, the BC Ministry of Energy, Mines and Low Carbon Innovation and the BC Energy Regulator, with data contributions from Canlin Energy Corporation, Logan Energy Corp. and other industry partners. The City of Fort St. John and the Canadian Hydrogen Association is also supporting the research. Geoscience BC gratefully acknowledges the financial support of the Province of British Columbia through the BC Ministry of Energy, Mines and Low Carbon Innovation. The author would also like to thank W.S. Donaldson at Canadian Discovery Ltd. for taking the time to review this paper.

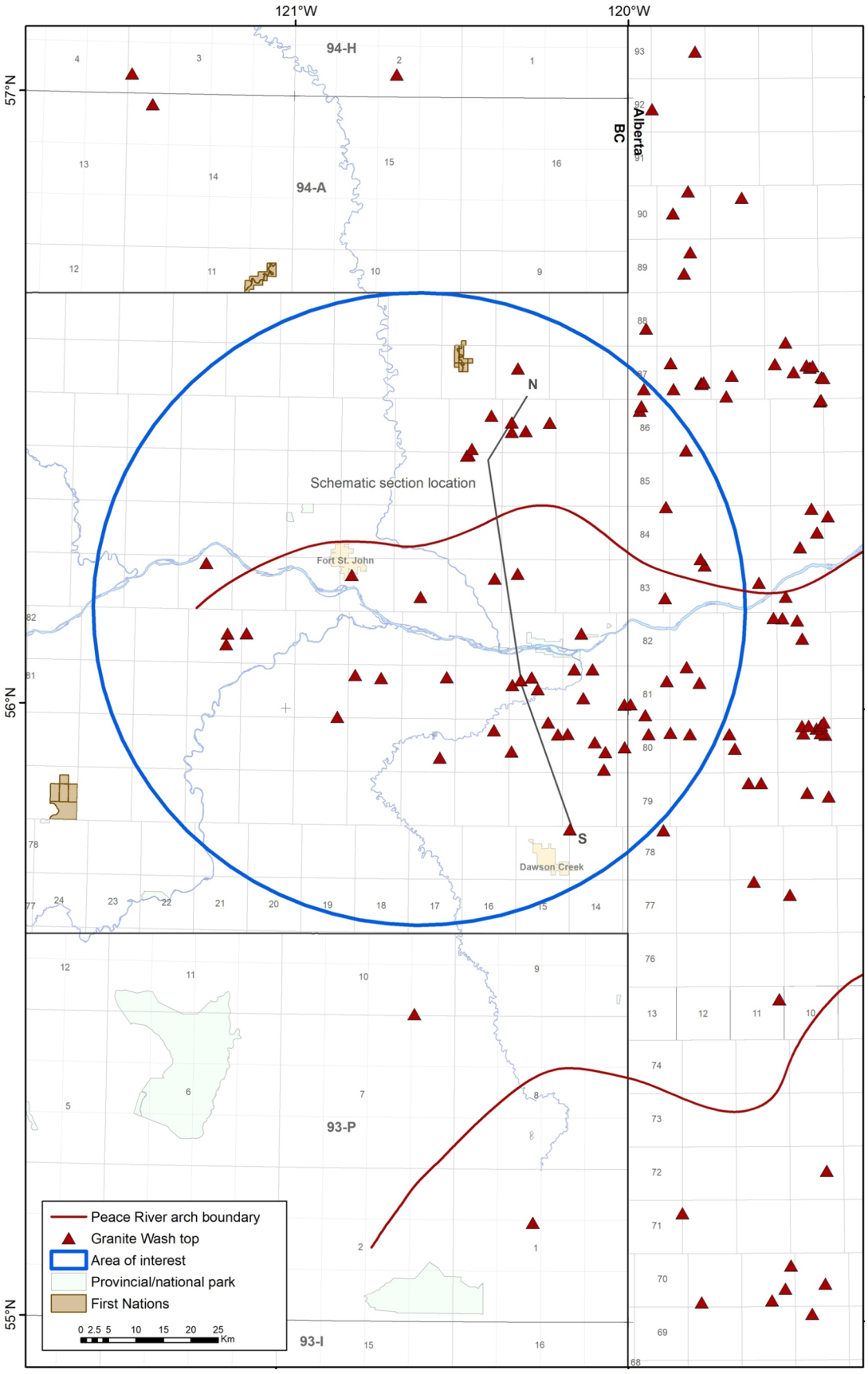

Figure 4. Southern area of interest with boundaries of the Peace River arch and the location of the schematic cross-section in Figure 5. Granite Wash Formation (Granite Wash) well data from geoLOGIC systems ltd. (2024).

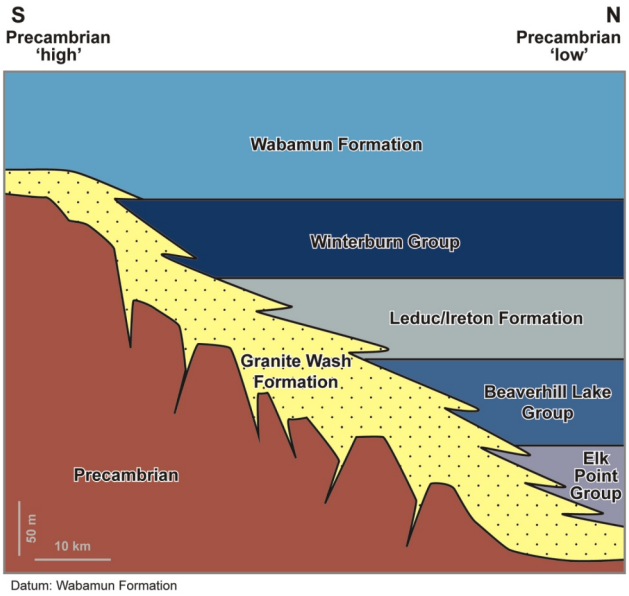

Figure 5. Schematic cross-section of the Precambrian to the Devonian Wabamun Formation in the southern area of interest near the Peace River arch. See Figure 4 for the location of the cross-section.

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