EETiG 2024
Adventures in Pore Space: Shared Reservoirs in New Energy
Calgary, AB | February 7-8, 2024

Salt of the Earth
(+NEBC Lithium Program Update)

Kaush Rakhit, Canadian Discovery Ltd.

Disclaimer

Disclaimers

The information contained herein has been prepared solely for information purposes and is not intended to be used for trading or investment purposes or as an offer to sell or the solicitation of an offer to buy any security or financial product. The information has been compiled by Canadian Discovery from internal sources as well as prepared from various public and industry sources that we believe are reliable, but no representation or warranty, expressed or implied is made by Canadian Discovery, its affiliates or any other person as to the accuracy or completeness of the information. Such information is provided with the expectation that it will be read as part of a mosaic of analyses and should not be relied upon on a stand-alone basis. Past performance should not be taken as an indication or guarantee of future performance, and Canadian Discovery makes no representation of warranty regarding future performance. The opinions expressed in this report (presentation) reflect the judgment of Canadian Discovery as of the date of this report and are subject to change without notice. This report (presentation) is not an offer to sell or a solicitation of an offer to buy any securities. To the full extent provided by law, neither Canadian Discovery nor any of its affiliates, nor any other person accepts any liability whatsoever for a direct or consequential loss arising from any use of this report (presentation) or the information contained herein. As in all aspects of oil and gas evaluation, there are uncertainties in the interpretation of engineering, reservoir and geological data: therefore, the recipient should rely solely on its own independent investigation, evaluation, and judgment with respect to the information contained herein and any additional information provided by Canadian Discovery or its representatives. All trademarks, service marks, and trade names not owned by Canadian Discovery are the property of their respective owners.

Forward-Looking Statements

This presentation may contain certain forward-looking information as defined in applicable securities laws (referred to herein as “forward-looking statements”). Forward-looking statements involve known and unknown risks, uncertainties and other factors which are beyond Canadian Discovery’s ability to predict or control and may cause Canadian Discovery’s actual results, performance or achievements to be materially different from any of its future results, performance or achievements expressed or implied by forward-looking statements.

Accordingly, readers should not place undue reliance on forward-looking statements. The forward-looking statements contained herein are made as of the date hereof, or such other date or dates specified in such statements. Canadian Discovery undertakes no obligation to update publicly or otherwise revise any forward-looking statements contained herein whether as a result of new information or future events or otherwise, except as may be required by law. If the Company does update one or more forward-looking statements, no inference should be drawn that it will make additional updates with respect to those or other forward-looking statements.

Acknowledgements

- The research concerns the territory of the Treaty 8 First Nations of British Columbia. Anyone considering new development or activities in their territories should engage early and engage often with the appropriate Indigenous groups.

- Canadian Discovery Ltd. and Matrix Solutions Inc.
  - » The project partners for their support of this project, including Geoscience BC, Natural Resources Canada, LihtiumBank, and Northern Development Initiatives Trust board
  - » Randy Hughes and the Geoscience BC team
  - » Project Advisory Committee
    - Daniel Alessi, University of Alberta (Chair)
    - Sobhi Alhashwa, Ovintiv
    - Colin Frostad, Tourmaline
    - Eric Munson, Shell (Vice-Chair)
  - » The dedicated team that completed this study: Kaush Rakhit, Christa Williams, Eric Pelletier, David Murfitt, Matthew Scorah, Meridee Fockler, Allison Gibbs, Marielle Hopf, Tessa Wilson, Paul Patton, Lina Hage and Candace Keeler

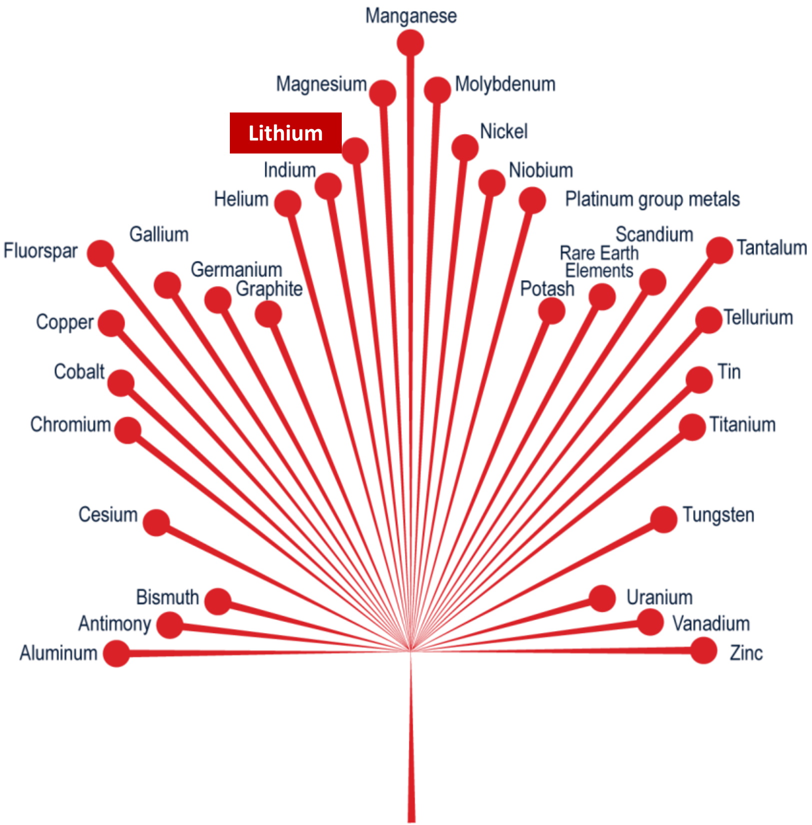
Presentation Outline

- ‘Lithium’ the worldwide and Canadian landscape
  - Types of lithium brines

- NEBC lithium brine project
  - Project goals and outcomes
  - The need for more data

- Proxies for lithium in saline brines
- Lithium in Produced Water
- Lithium concentration mechanisms
- Challenges, Key Findings and Future Work

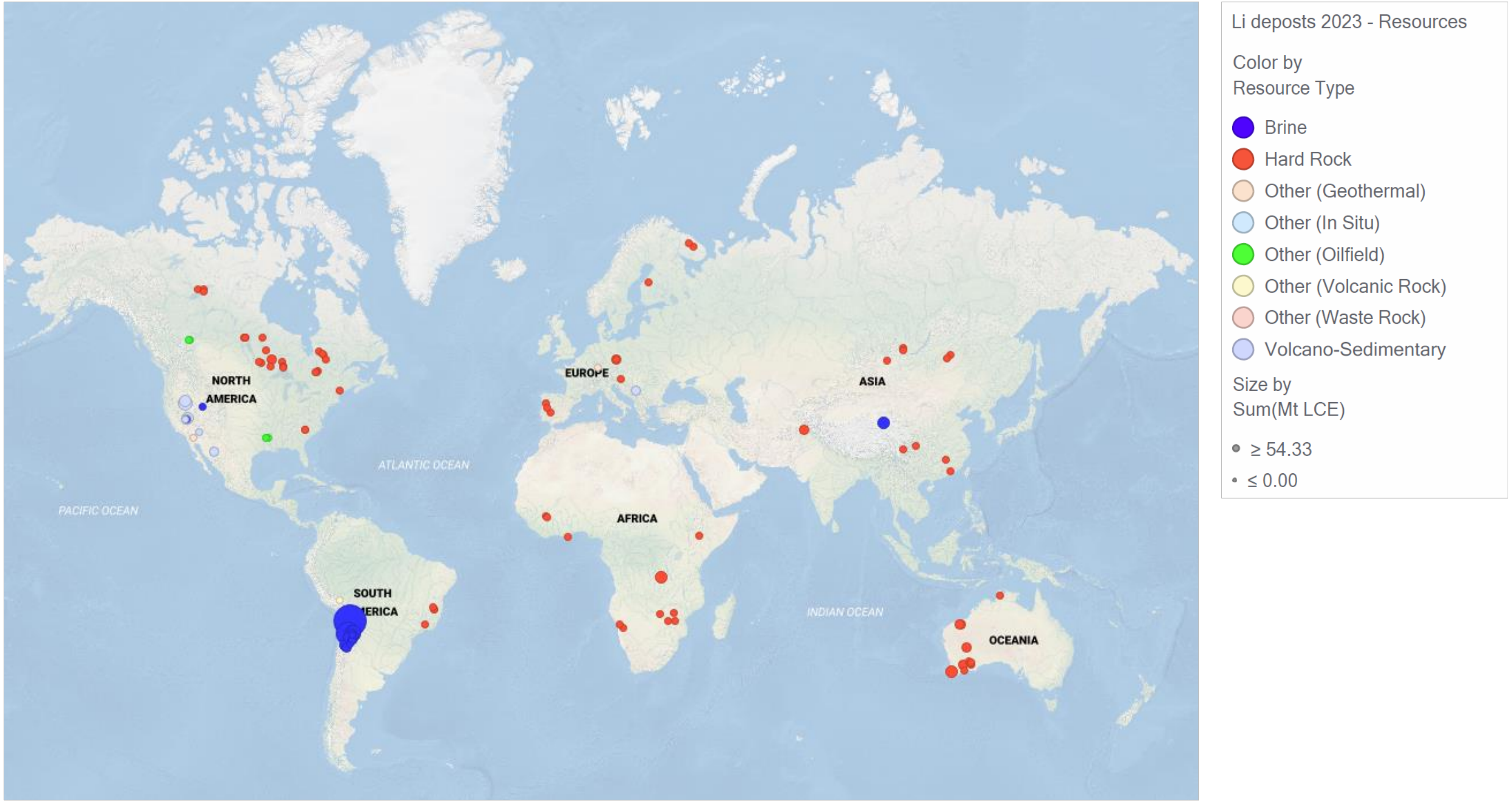
Introduction – Canada’s Critical Minerals List



- On March 11, 2021, Canada unveiled its Critical Minerals List. This list comprises 31 minerals, all found in Canada.
- These minerals are:
  - Essential to Canada’s economic security
  - Required for Canada’s transition to a low-carbon economy
  - A sustainable economic source of critical minerals for our international partners

Source: https://www.nrcan.gc.ca/sites/nrcan/files/mineralsmetals/pdf/Critical_Minerals_List_2021-EN.pdf

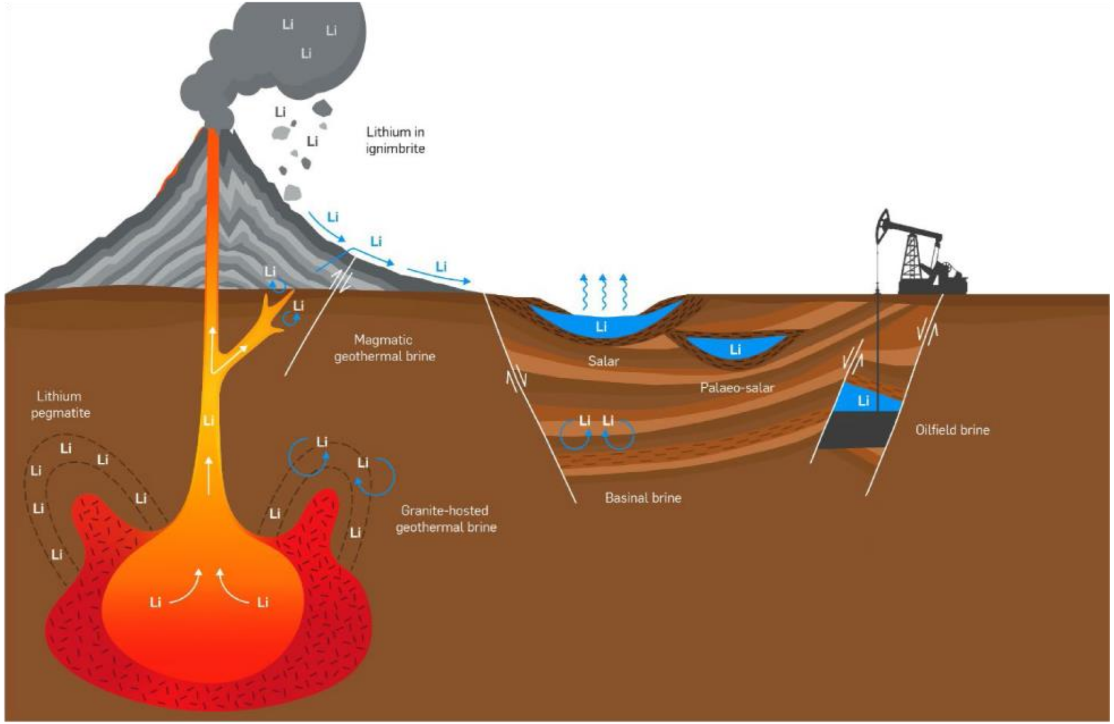
Global Lithium Resources



Benson et al. 2023

Types of Lithium Brines

- Continental – Salar de Alcama, Chile, Clayton Valley NV (environmentally sensitive)
- Geothermal Brines – Salton Sea, U. Rhine, (limited opportunities)
- Deep Sedimentary 'Oilfield' Brines WCSB, Smackover, aquifers and **produced waters** (multiple basins, extensive resource, low conc., environmentally sustainable)



Source: Bunker et al., 2022

The Canadian Lithium Extraction Project Landscape

World Mine Production of Lithium by Country, 2022

Ranking	Country	Tonnes	Percentage of the Total
1	Australia	61,000	47.2%
2	Chile	39,000	30.2%
3	China	19,000	14.7%
4	Argentina	6,200	4.8%
5	Brazil	2,200	1.7%
6	Zimbabwe	800	0.6%
7	Portugal	600	0.5%
8	**Canada**	**500**	**0.4%**
World Total		**129,300**	**100.0%**

- Lithium brines in aquifer projects more advanced than produced water

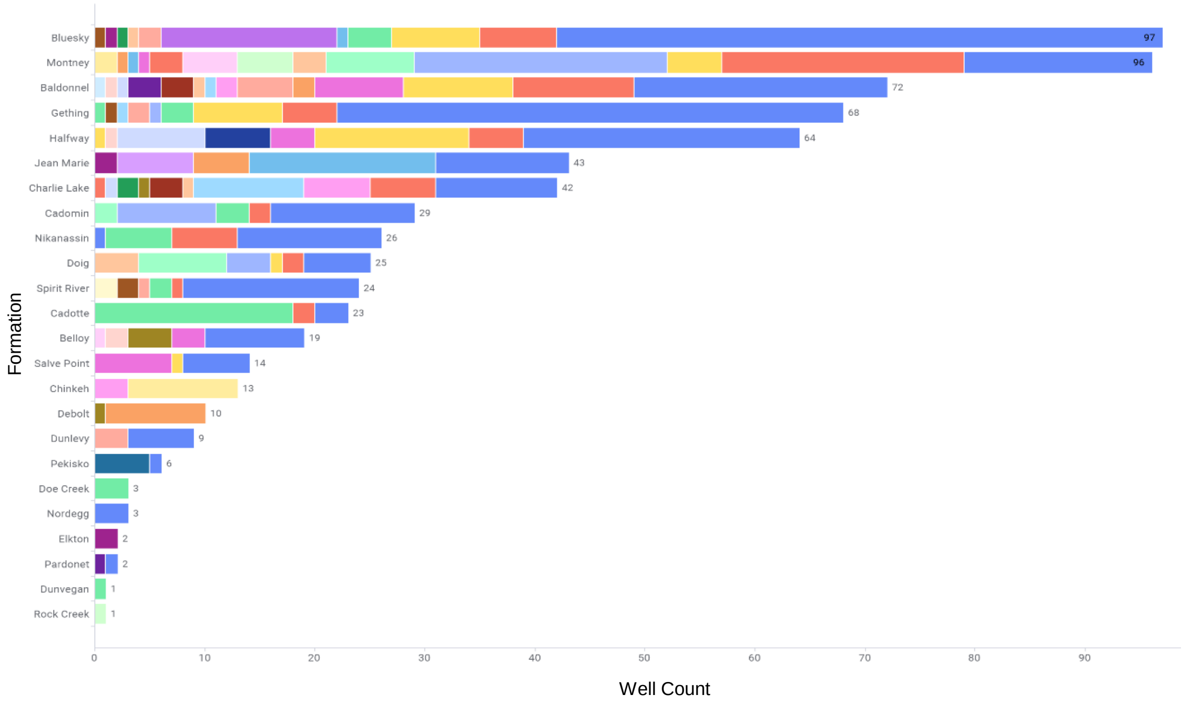
NEBC Project Status

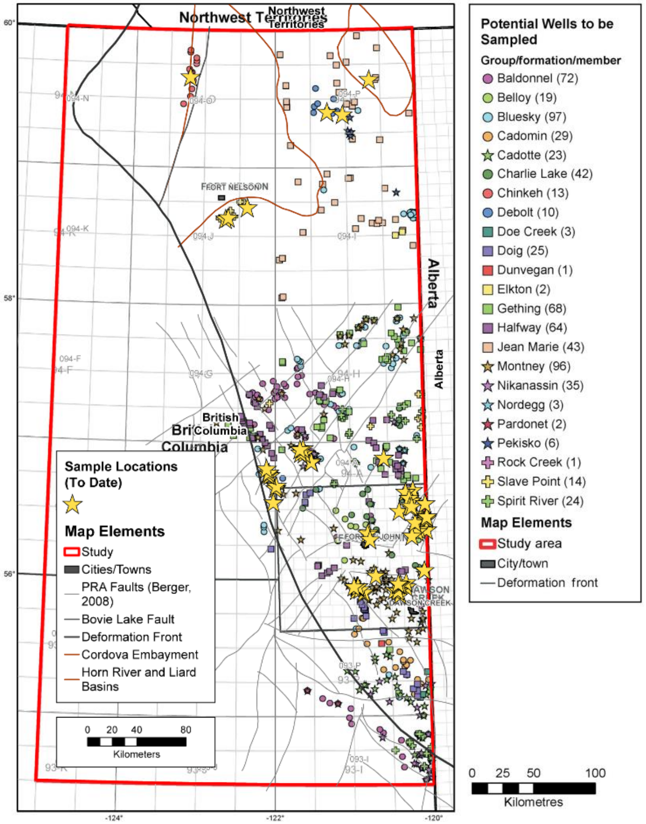
Canadian Discovery Ltd.

Project Goals and Timelines

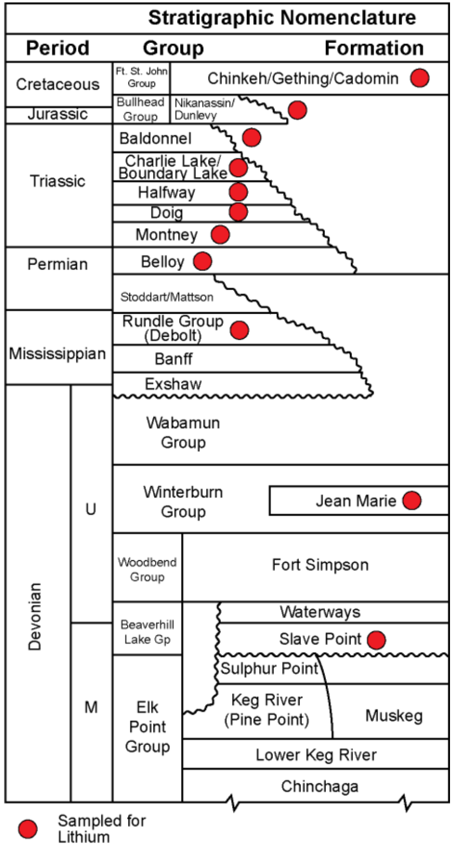
- **Phase 1**: Co-ordination and Desktop Planning, *Project Initiated Q3/2021*
- **Phase 2a** – Field Sampling Program Execution and Data Analysis
  - a. Field sampling program
  - b. Laboratory analysis
- **Phase 2b** – Data Processing and QA/QC
- **Phase 2c** – Reporting and Deliverable Submission, *Public Release Q1/2024*
  - *project data confidential as of EETiG Emerging Resource Conference*

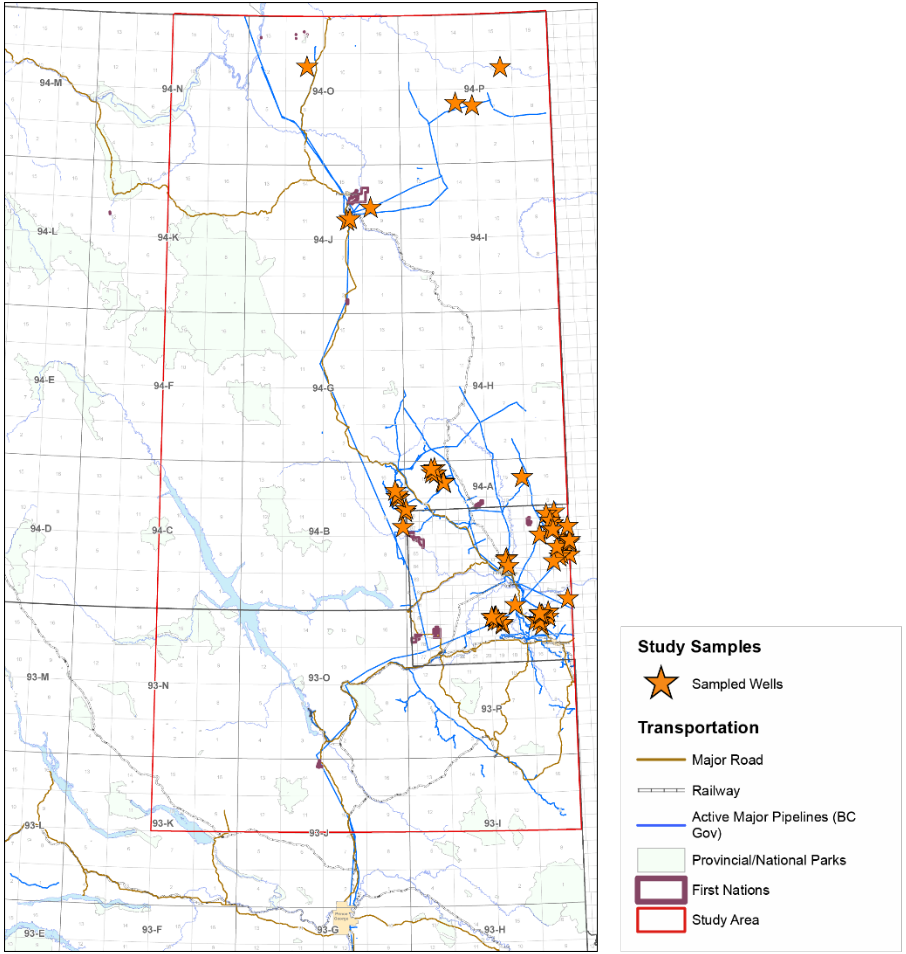
693 wells identified for sampling
576 active gas wells, 116 active oil wells (133 sampled)





Stratigraphic Chart and Infrastructure Map

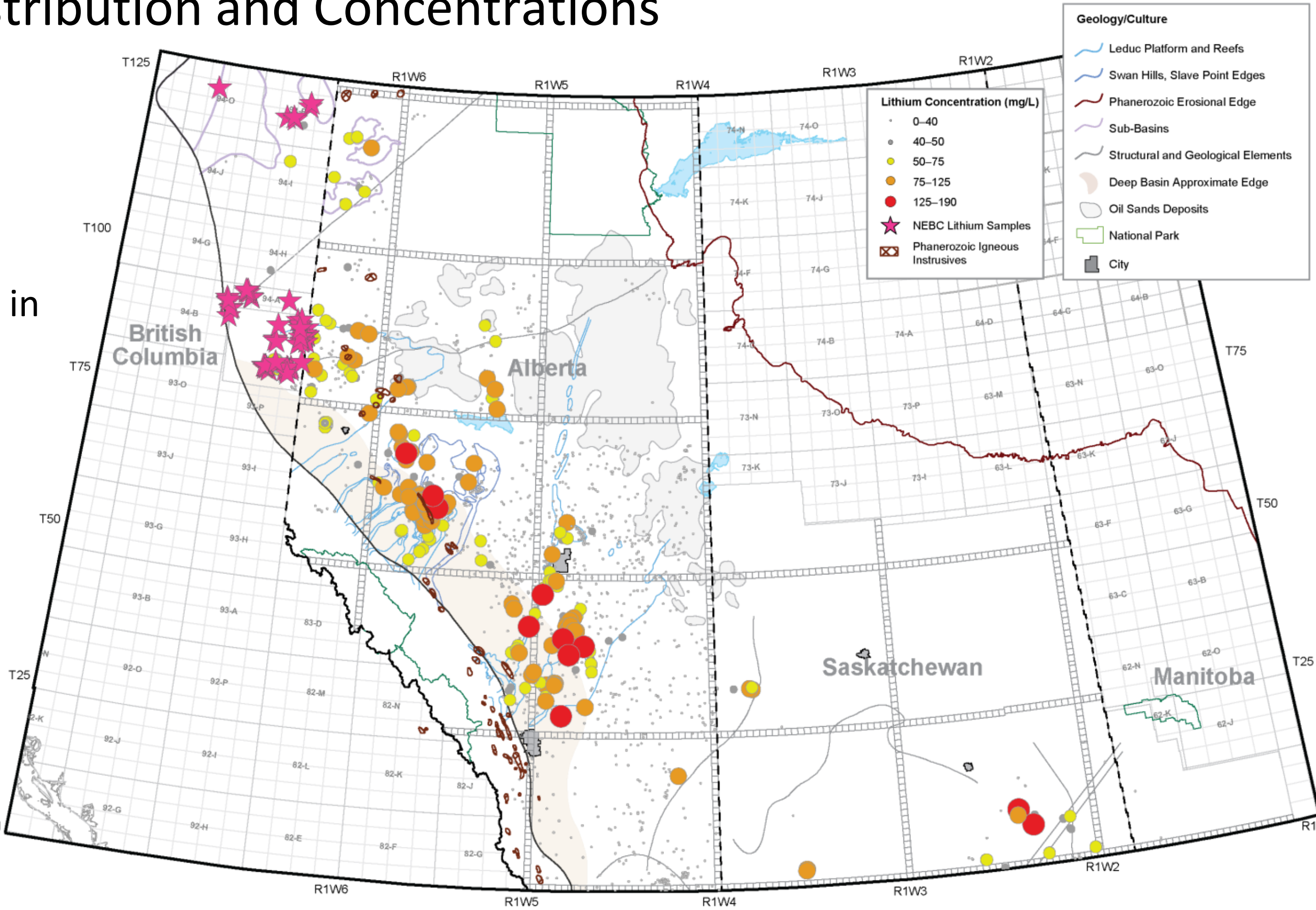




Modified from Bachu and this

Lithium Sample Distribution and Concentrations in the WCSB

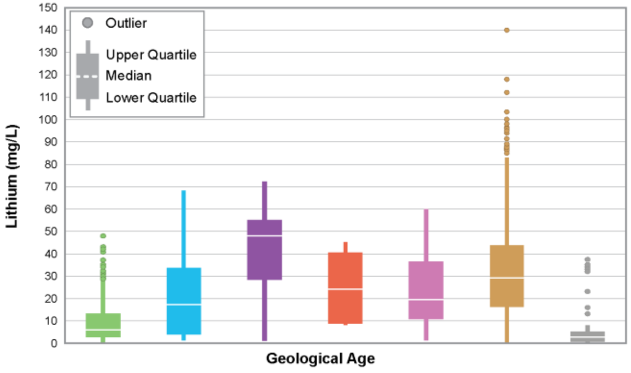
- 133 of samples added from NEBC Program
- 229 sample available from GSC in NEBC, used in project analytics



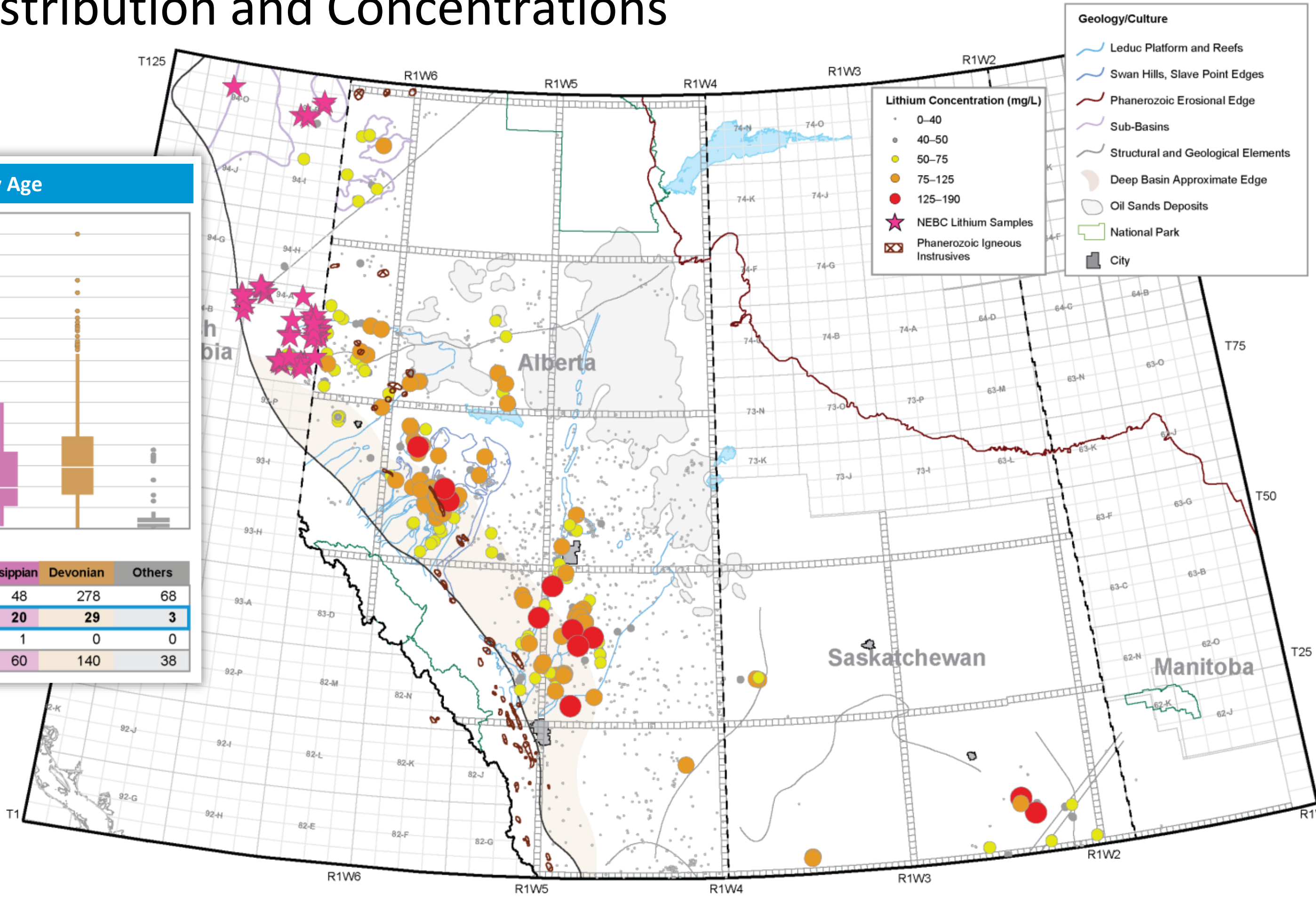
Lithium data sources from the AGS, SGS and the current study; Leduc Reefs from WCSB Atlas, 1994

Lithium Sample Distribution and Concentrations in the WCSB

Alberta Lithium Metrics by Age



	Cretaceous	Jurassic	Triassic	Permian	Mississippian	Devonian	Others
Count	290	24	159	4	48	278	68
Median	**6**	**17**	**48**	**24**	**20**	**29**	**3**
Min	0	1	1	8	1	0	0
Max	48	68	72	45	60	140	38



Lithium data sources from the AGS, SGS and the current study; Leduc Reefs from WCSB Atlas, 1994

NEBC Project Challenges and Outcomes

Challenges

- Sample distribution skewed to areas with largest production and participating operators
- Access to remote producing wells for sampling is logistically difficult and expensive
- A number of under-sampled zones and areas still exist and were characterized by proxy
  - » Using proxy-based analytics for lithium brine concentration prediction has inherent risks for both under and over estimation

Outcomes

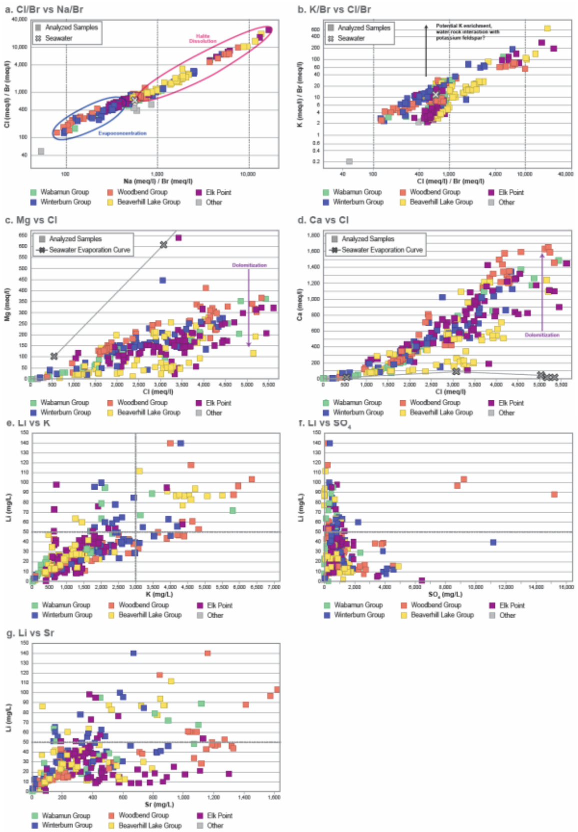
- Report has been completed, peer reviewed and submitted to Geoscience BC for final approval, with an expected release in Q1 2024
  - » The project proponents are grateful to all of the operators that provided samples and site access
  - » The report has benefited substantially from the input of our peer reviewers, technical editors and steering committee
  - » We gratefully acknowledge our project sponsors Geoscience BC, Northern Development Initiative Trust and Lithium Bank
  - » Additional funding and sampling is required

Proxies for Lithium in Saline Brines

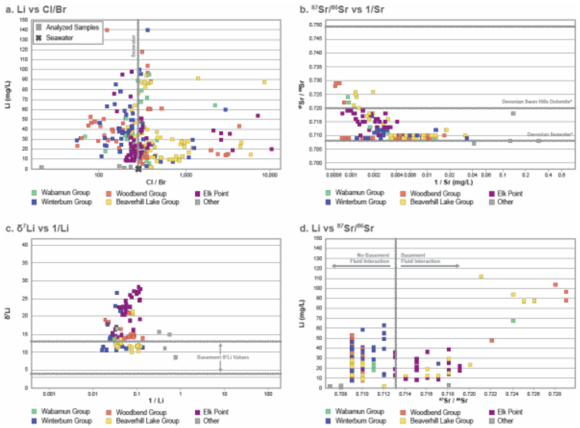
Canadian Discovery Ltd.

Lithium Indicators and Multivariate Analysis
Looking for the Smoking Gun

Devonian Water Chemistry Crossplots

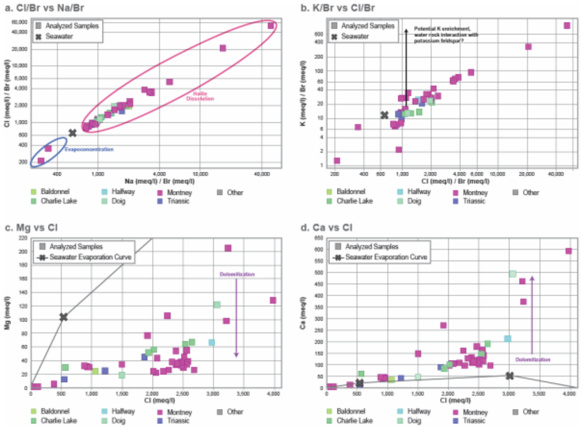


Devonian Isotope Crossplots



* Devonian concentrations taken from Eccles et al., 2011.
** Range from Eccles et al., 2011.

Triassic Water Chemistry Crossplots



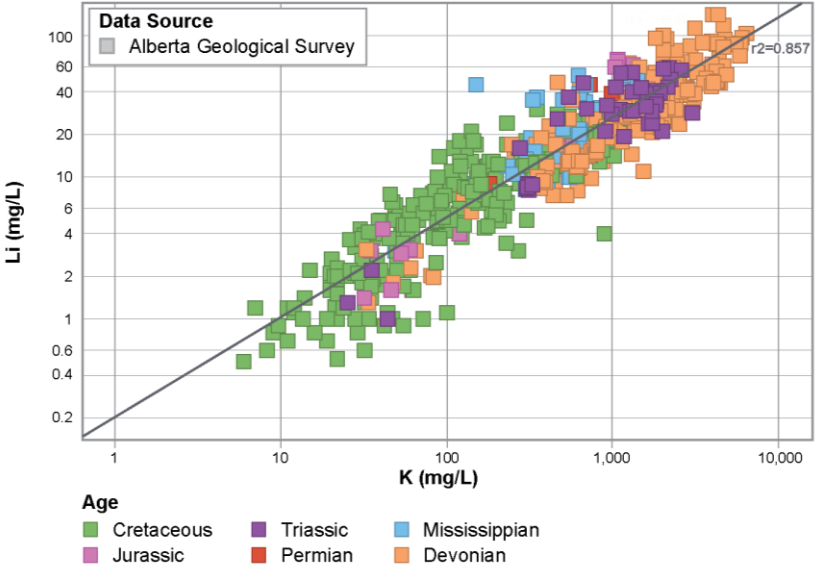
Observations:

- Cl/Br vs Na/Br indicate both halite dissolution and evapoconcentration
- Depleted magnesium in Devonian and Triassic waters – dolomitization
- Depleted lithium in Elk Pt Group
- No clear regional 87Sr/86Sr signature with elevated lithium, except locally within Beaverhill Lk and Leduc

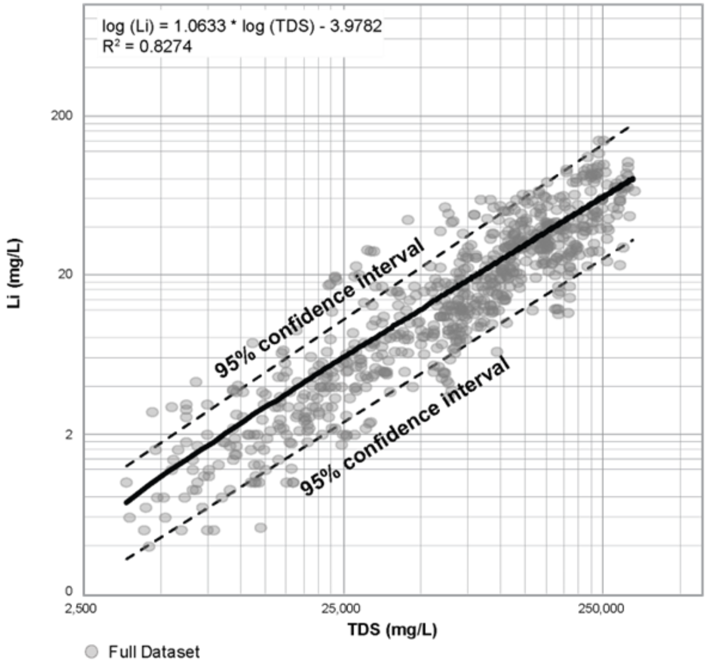
Lithium data sources Lyster et al., 2021. Data source AGS figure annotations from Eccles and Berhane, 2011.

K and Total Dissolved Solids (TDS) as Proxies for Lithium

Li vs. K (AB and GSC Lithium Data)



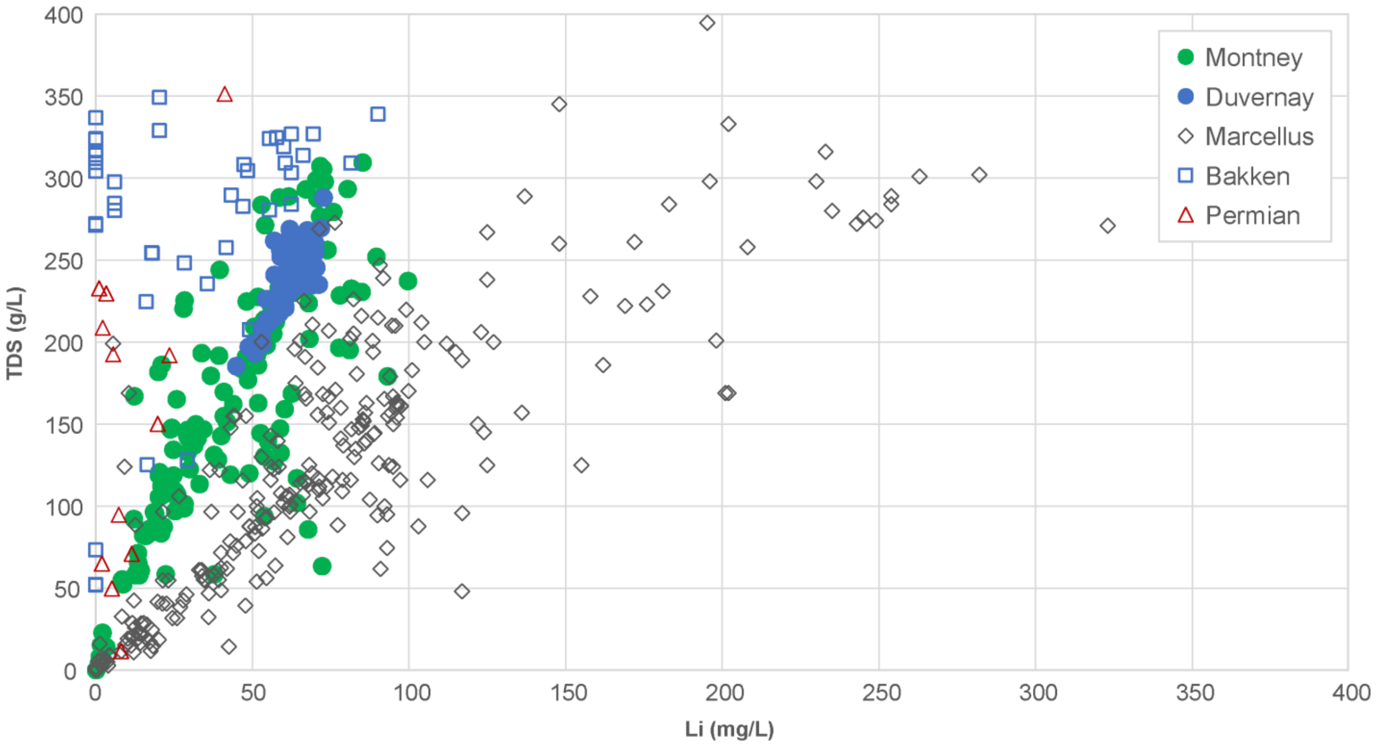
Li vs. TDS (AB and GSC Lithium Data)



Correlation of TDS vs Li provides a R^2 fit of 0.83 in the WCSB, corresponding to a Li value of 30mg/l at 150,000 mg/l TDS

Lithium data from the AGS, GSC, geoLOGIC and the current study

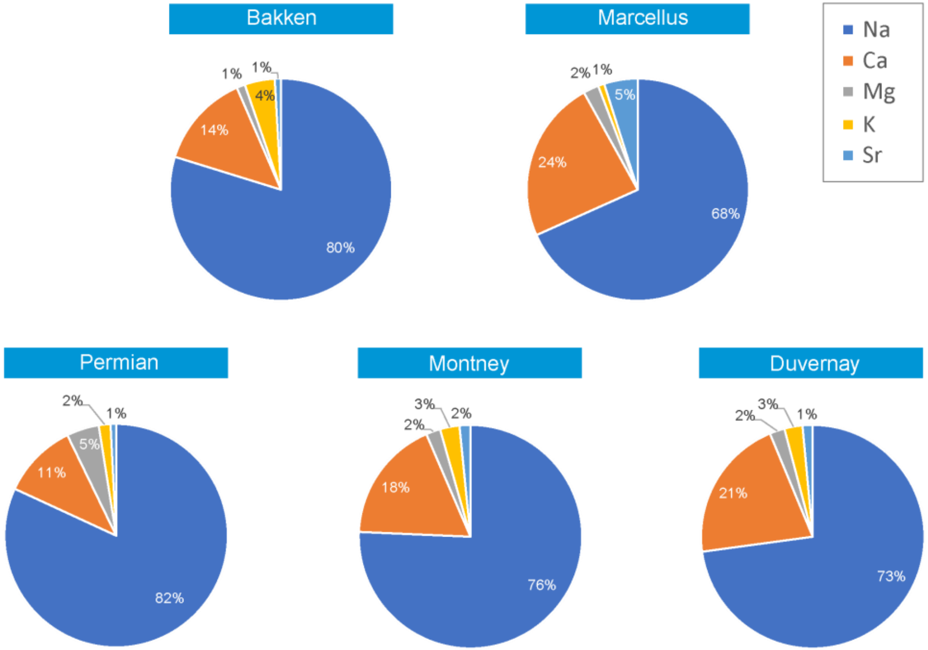
Lithium vs TDS in Produced Waters
Selected N. American Unconventional Plays



- TDS vs lithium relationship is strong for most brines
- TDS to Li varies substantially from basin to basin

Source: Montney and Duvernay - AGS, GSC, geoLOGIC. Permian, Bakken and Marcellus from USGS National PW Geochemical Database (ver. 3.0).

Major Anions in Produced Waters
Selected N. American Unconventional Plays



Ionic composition variances indicative of varying source, evolutionary path and water-rock interaction

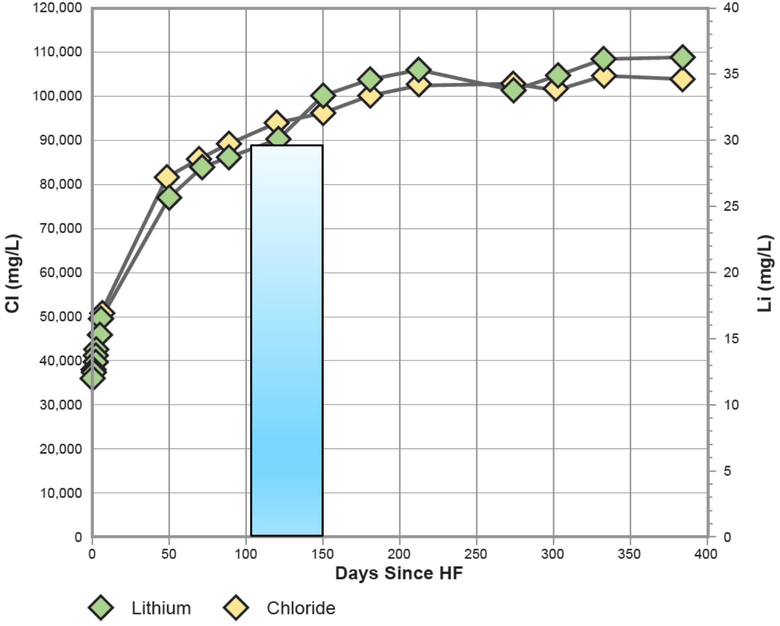
Source: USGS National PW Geochemical Database (ver. 3.0).

Lithium and Produced Waters

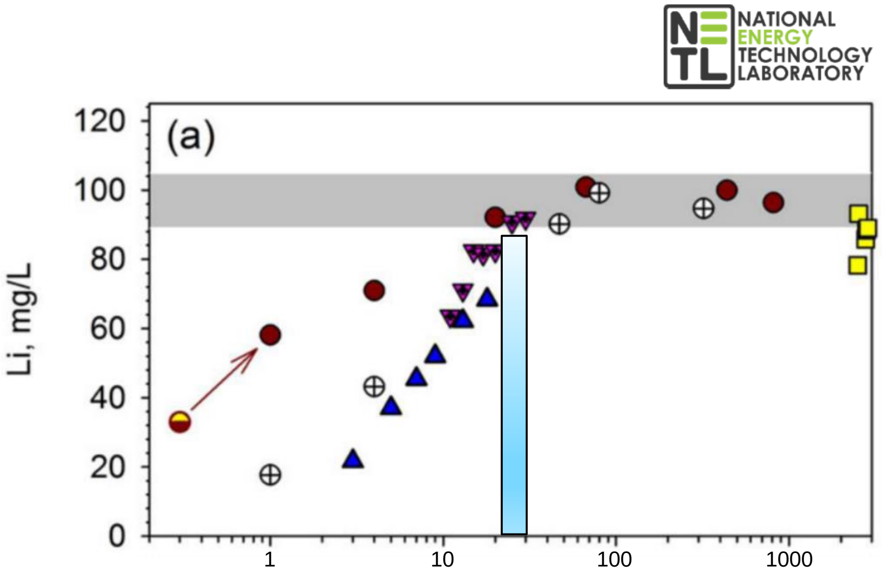
Canadian Discovery Ltd.

TDS of Flowback Waters vs Time

Li and Cl vs Days Since Hydraulic Fracturing (HF)



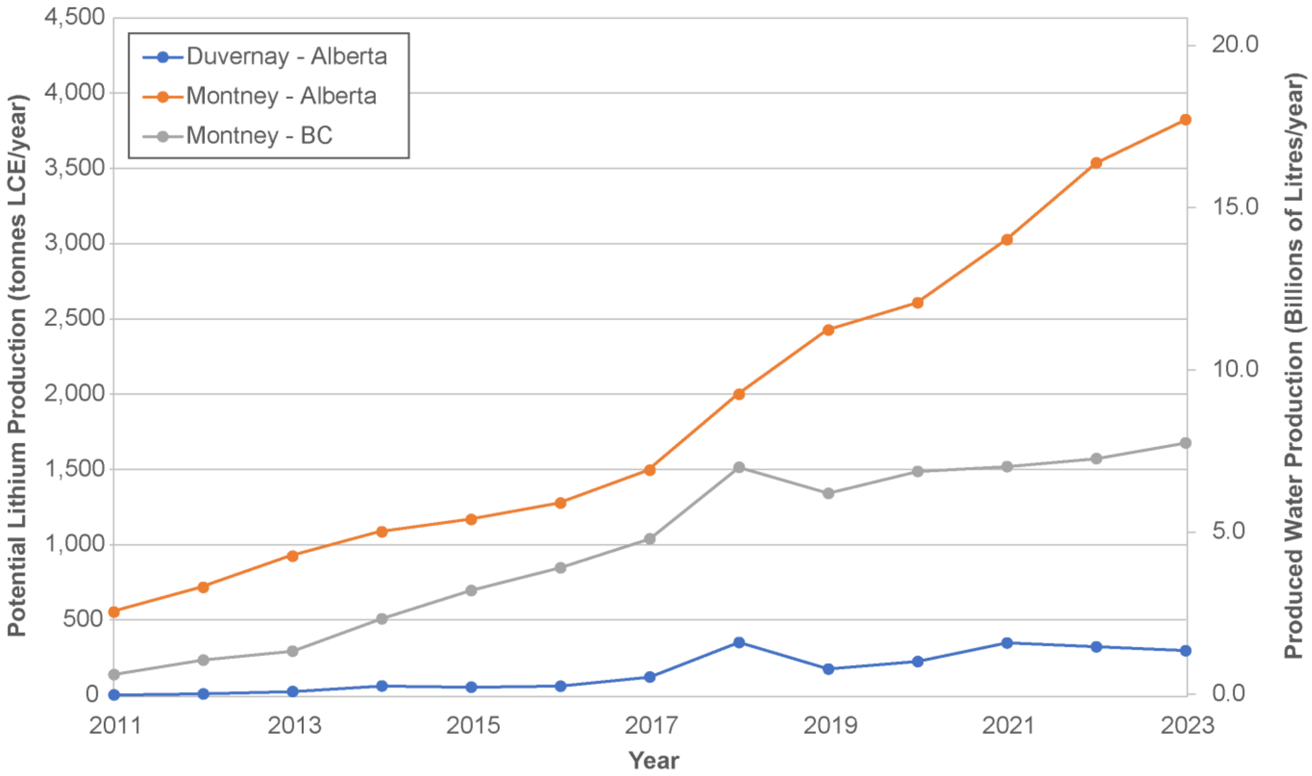
Marcellus Shale



- 90 % of wells have TDS stabilize after 100 days of production in Montney and 30 days in Marcellus
- Implies Li concentrations stabilize rapidly, but may vary from play to play

Data from geoLOGIC and current study. Figure f Li and Cl data from Kingston et al., 2023. Right image from National Energy Technology Laboratory

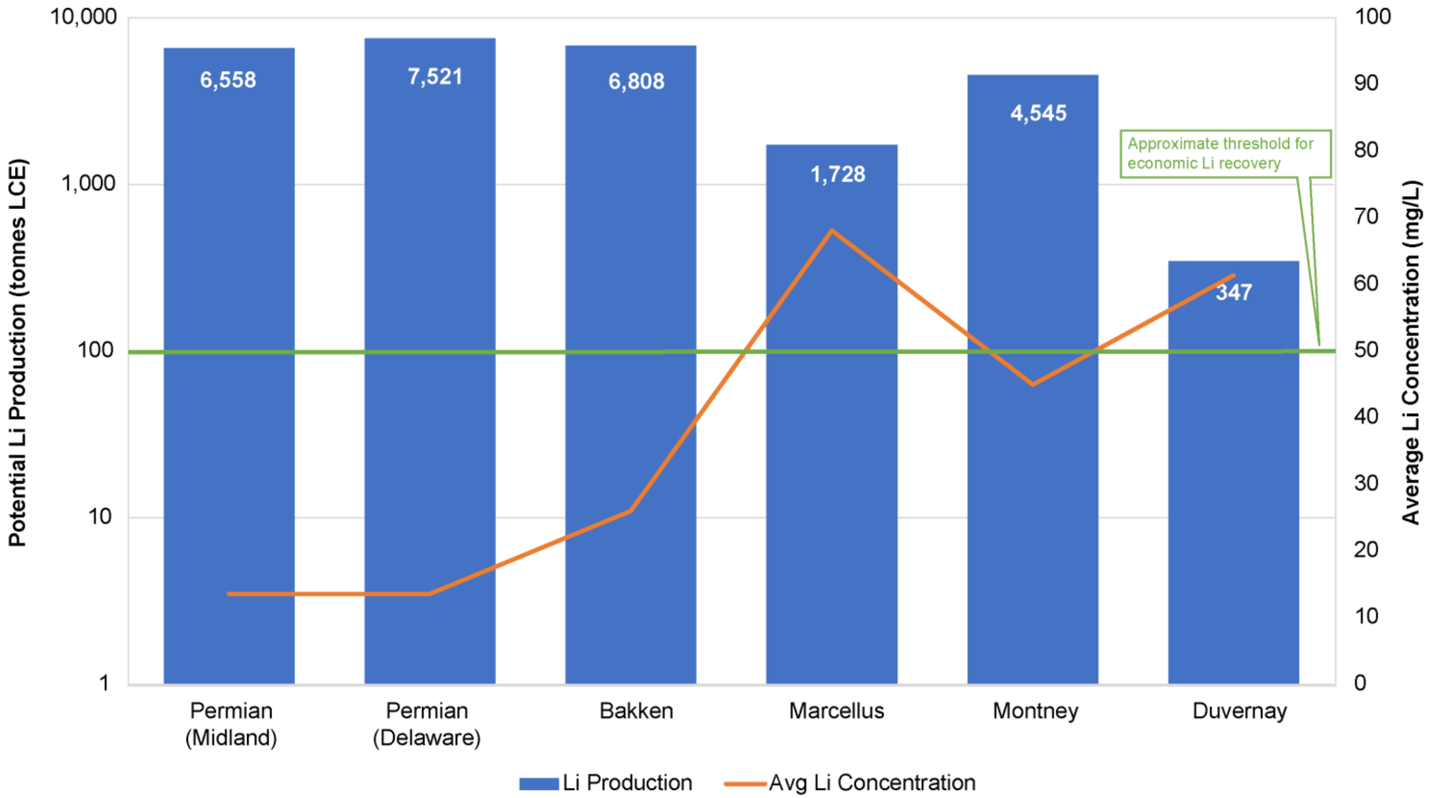
WCSB Produced Water Volumes and LCE Potential



- As a reference the E3 Clearwater project is designed for a 51 billion liter/yr brine input producing ~17,550 tonnes LCE/year

Source: PW production volume – geologic; Potential lithium production based on average lithium concentration and 90% recovery efficiency.

Illustrative Lithium Brine Resource from Produced Waters in Select N. American Unconventional



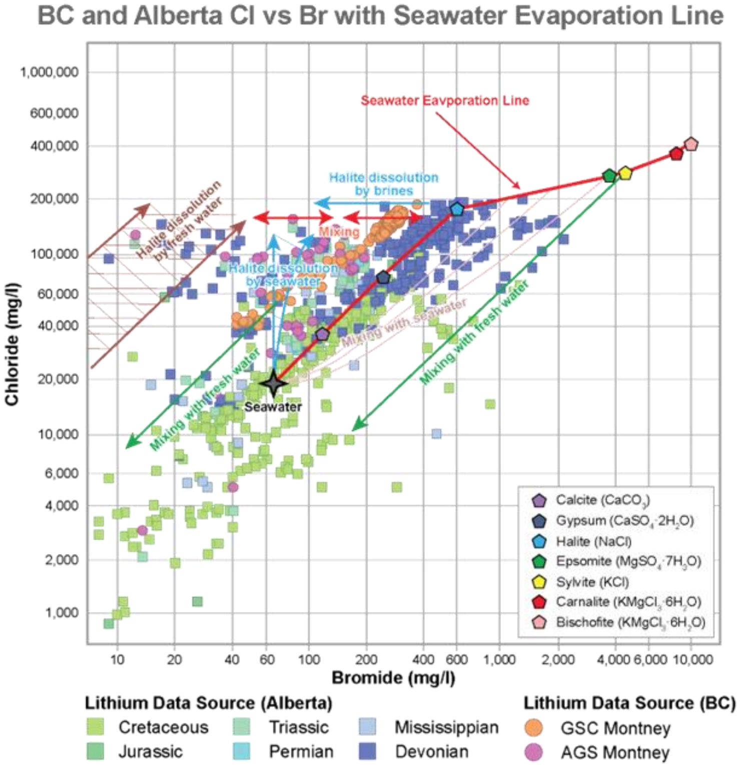
Source: Based on 2017-2021 PW data, NETL, geoLOGIC, AGS, GSC, Scanlon et al, 2020.

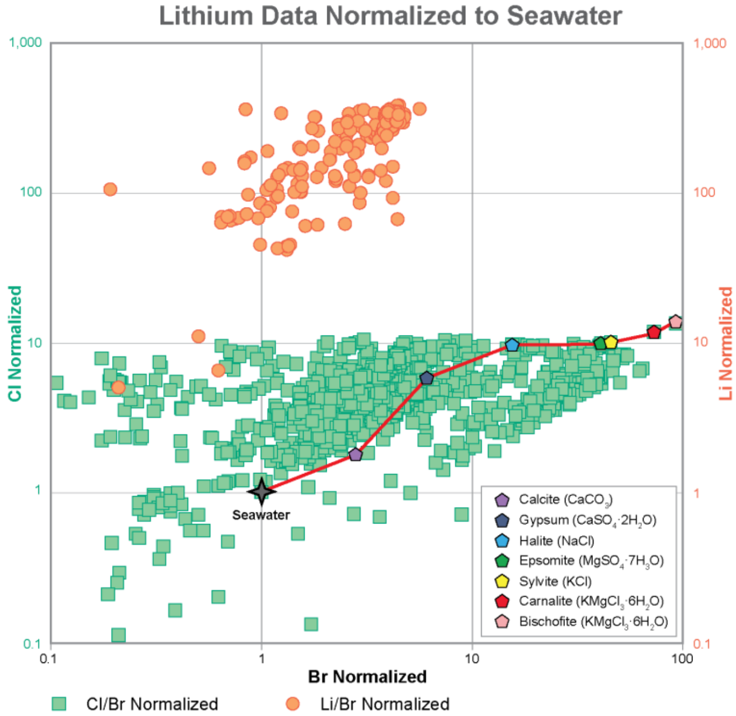
Lithium Concentration Mechanisms

Canadian Discovery Ltd.

Concentration Mechanism Seawater Evaporation
(Halite Dissolution and Freshwater Dilution Dominant, Li Concentration Exceeds Cl 10 – 50 x)

Seawater Evaporation Process and Normalized Chloride, Lithium and Bromine Concentrations



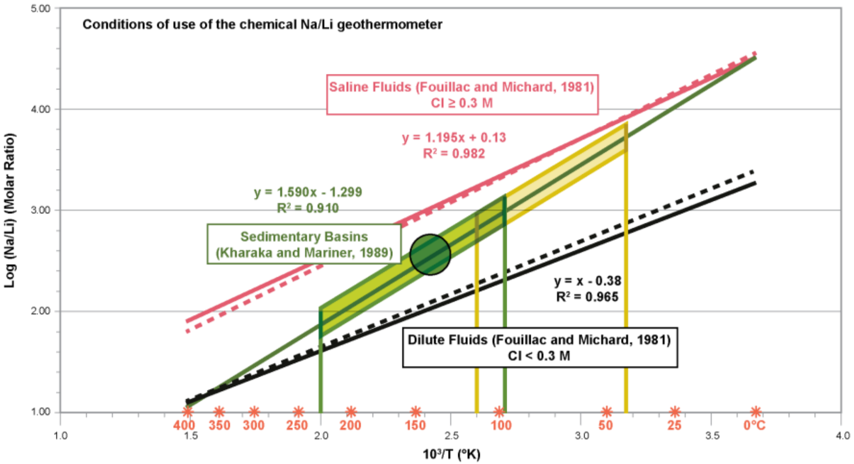


Lithium data from the AGS, GSC, geoLOGIC and the current study. Shouakar-Stash, O., 2008.

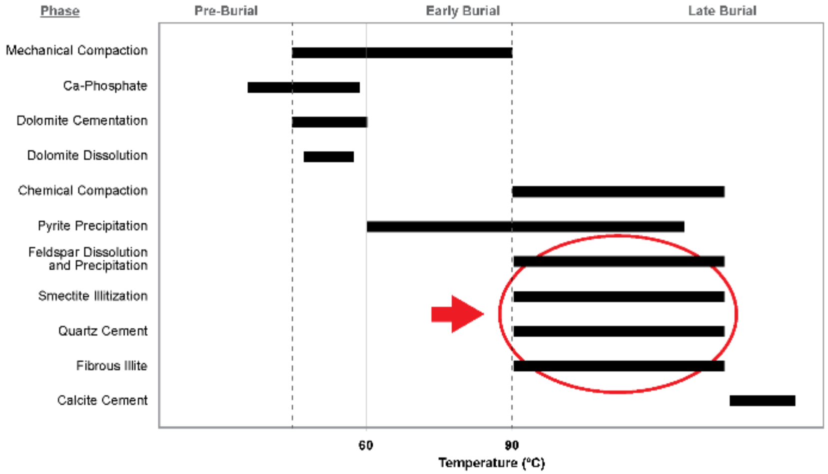
Empirical Na/Li Geothermometer for Sedimentary Brines

- Measured Na/Li ratios match max burial temperature (green bar observed range) vs current temperature (orange bar), suggesting liberated Li at max burial did not resorb upon cooling, possibly due to irreversible smectite to illite conversion at > 90C

Na/Li Thermometer



Empirical Na/Li geothermometer with measured Montney log Na/Li ratios. Data denoted observed lithium concentrations not in equilibrium or controlled by current day temperature.

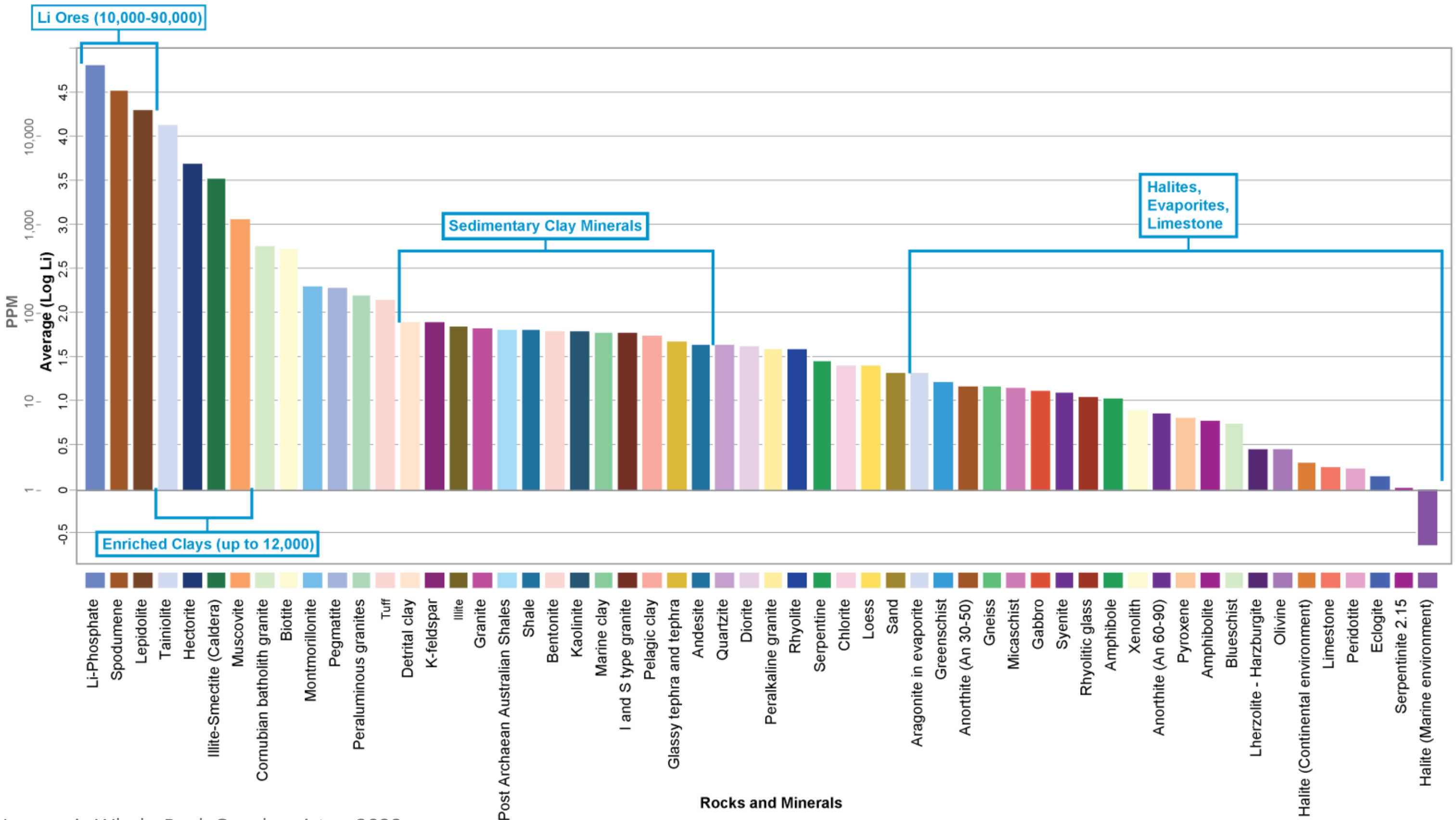


The paragenetic sequence for the Montney Formation in the deep basin, northeastern British Columbia.

Source: Modified from Sanjuan, B. and Millot, R., 2009

Paragenetic sequence, Vaisblat et al, 2017

Lithium Concentration in Various Rock Types
Y-axis is Log Scale 1 – 100,000 ppm

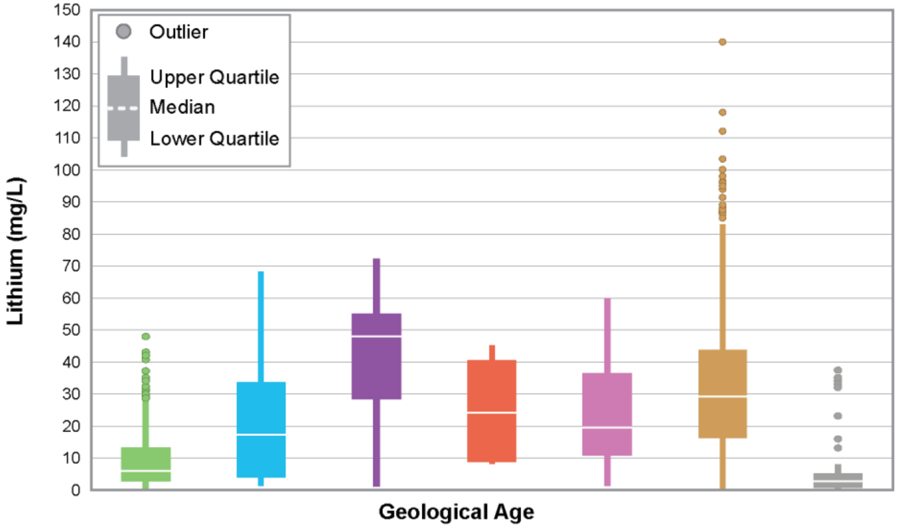


Source: AGS, Inorganic Whole-Rock Geochemistry, 2023.

Lithium Brine and Whole Rock Li Concentrations

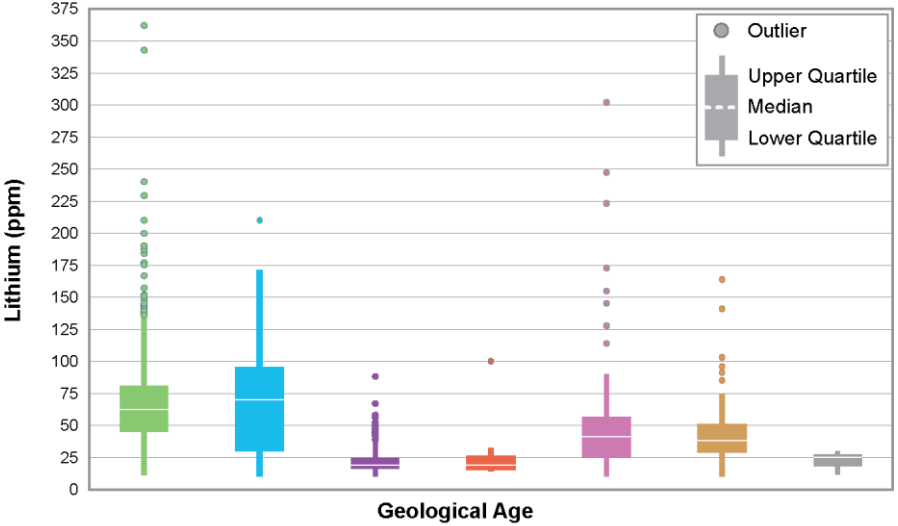
(note Cretaceous and Jurassic have high whole rock but low brine Li concentration)

Lithium Brine Concentration Alberta



	Cretaceous	Jurassic	Triassic	Permian	Mississippian	Devonian	Others
Count	290	24	159	4	48	278	68
Median	**6**	**17**	**48**	**24**	**20**	**29**	**3**
Min	0	1	1	8	1	0	0
Max	48	68	72	45	60	140	38

Whole Rock Lithium Concentration Alberta



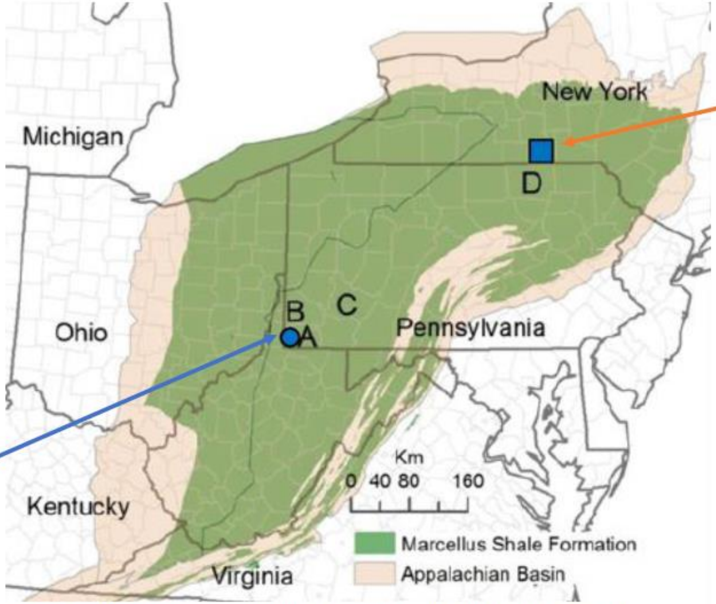
	Cretaceous	Jurassic	Triassic	Permian	Mississippian	Devonian	Others
Count	689	340	177	7	71	367	3
Median	**62**	**70**	**19**	**19**	**41**	**38**	**25**
Min	11	10	10	14	10	10	12
Max	362	210	88	100	302	164	30

source: AGS

Marcellus Shale Li in Whole Rock and Produced Waters
(Dissolved Lithium Greater than Whole Rock Concentration)

Phan, T. T., et al. (2016). Chemical Geology **420**: 162-179

- *Clay minerals are the main sources of Li in organic-rich shale rock*
- *Li-rich formation water resulted from long-term alteration of volcanogenic ash*



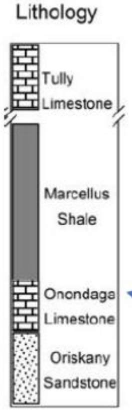
Produced water samples are from Greene Co., (A),Washington Co. (B), Westmoreland Co. (C), and Tioga Co., PA (D).
Core samples are from Greene Co, PA (blue circle); and dry-drilled rock cuttings from Tioga Co., NY (blue square).

Southwestern PA

- ***Shale rock Li: 36-48 mg/kg***
- ***Li concentration: 18-233 mg/L***

North-Central PA and NY

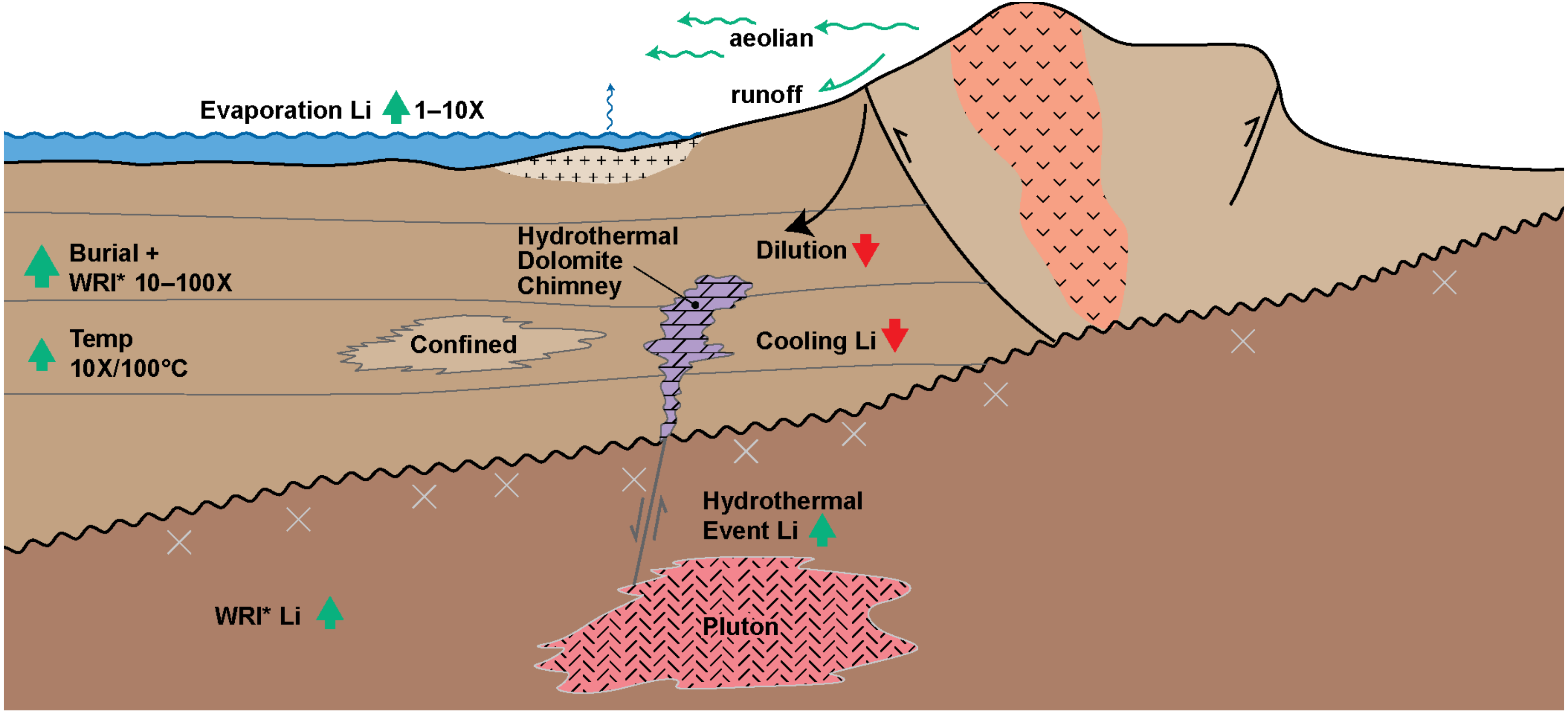
- ***Shale rock Li: 19-85 mg/kg***
- ***Li concentration: 169-282 mg/L***



Tioga ash layer and other ash layers

Source: U.S. Department of Energy

Lithium-Enrichment Processes

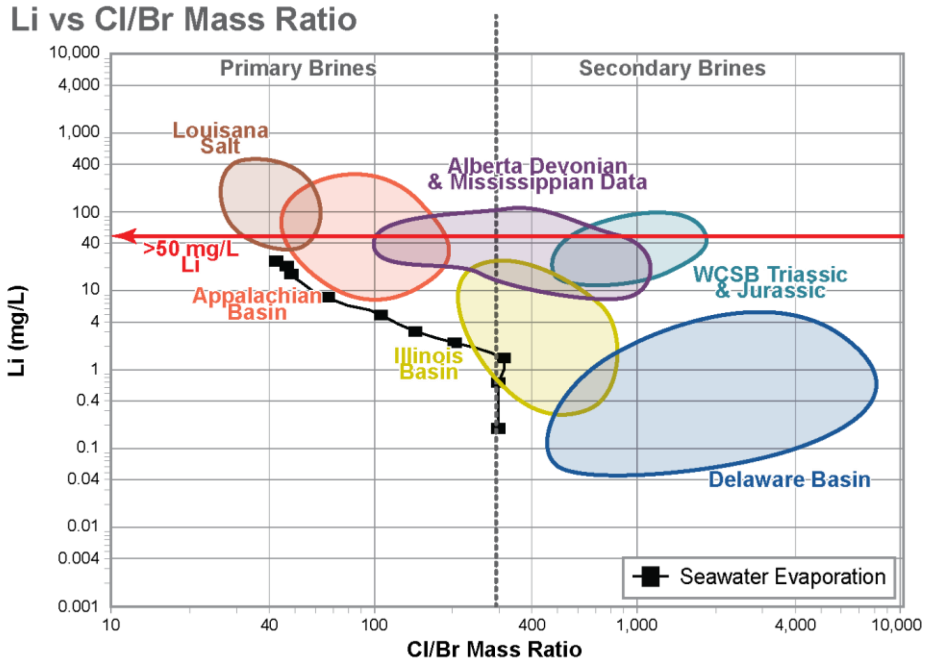


*Water-rock interaction

After Dugamin et. al., 2023

Lithium Concentrations in Selected Basins in North America

- WCSB Triassic and Devonian have lithium concentrations competitive with many US Basins
- The greater than 50 mg/l lithium brine concentrations are of economic interest
- Lithium brine extraction schemes are advancing in Arkansas and Alberta
- As of 02/2024 we are unaware of any active produced water lithium extraction schemes



Source: CDL, and Dugamin et al., 2023

Key Findings and Future Work

Canadian Discovery Ltd.

NEBC Project Challenges and Outcomes

Challenges

- Sample distribution skewed to areas with largest production and participating operators
- Access to remote producing wells for sampling is logistically difficult and expensive
- Under-sampled zones and areas not well characterized
  - Using proxy-based analytics for lithium brine concentration prediction has inherent risks for both under and over estimation

Outcomes

- Report has been completed, peer reviewed and submitted to Geoscience BC for final approval, with an expected release in Q1 2024
  - Additional sampling is required to obtain a more robust characterization
  - Resource ownership and regulatory framework need clarity

Knowledge Gaps and Future Work

- Mechanism controlling lithium concentration and availability in tight rocks poorly understood
  - » Ion exchange, diffusion
  - » Free water component
  - » Impacts determination of resource in place and therefore project economics
- Calibrating lithium in formation water to whole rock analysis required to advance exploration models and identify the most important contributing factors
  - » Burial depth and temperature
  - » Mineralogy (illite/smectite, feldspars, clay minerals)
  - » Sea water evaporation
  - » Sources (continental overland waters, volcanics etc.)
- Technological advancement of direct lithium extraction technologies (DLE) for small scale projects could allow for fast tracking projects with modest capital commitments

What’s Next for Canadian Discovery

- Canadian Discovery is dedicated to leveraging its multi decade knowledge and experience in sedimentary basin hydrogeology and geochemistry to:
  - Advance the understanding of factors controlling lithium in sedimentary brines
  - Continuing to develop the most robust methods of determining the resource in place
  - Working with DLE technology developers for field testing
  - Partnering with the industry to commercialize lithium brines in produced waters

Contact Details

- Kaush Rakhit, Executive Chairman
  kaush@canadiandiscovery.com
- Rob Pockar, CEO
  rpockar@canadiandiscovery.com
- Christa Williams, VP Business Development
  cwilliams@canadiandiscovery.com
- Matt Scorah, VP Decarbonization
  mscorah@canadiandiscovery.com
- Marielle Hopf, Geologist
  mhopf@canadiandiscovery.com
- Meridee Fockler, Senior Geologist
  mfockler@canadiandiscovery.com
- Allison Gibbs, Senior Hydrodynamicist
  agibbs@canadiandiscovery.com
- Tessa Wilson, Geologist
  twilson@canadiandiscovery.com

For inquiries with respect to this presentation, or to learn more about Canadian Discovery's other offerings, please contact us at: **info@canadiandiscovery.com**

Thank you!

Canadian Discovery Ltd.