

Lithium Brine Resources – A Novel Prospect for Saskatchewan

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Presenter:

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BMAC

Battery Metals
Association of Canada

Motive & Background

- Global shift underway to decarbonize energy and transportation
- Electrification and deployment of renewable energy technologies demands a significant increase in raw material output to achieve - lithium one of many critical elements
- Geopolitical landscape experiencing deglobalization pressures

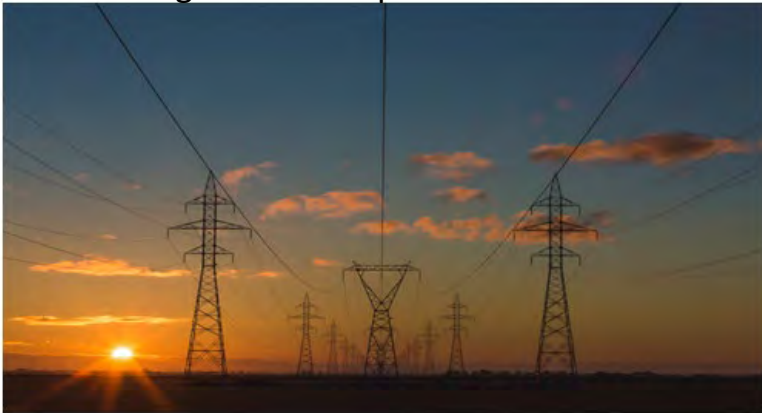


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Motive & Background

Lithium Outlook 2020: The Lithium Decade Begins

Priscila Barrera - January 8th, 2020

Electric vehicles could be as disruptive to oil industry as coronavirus, Suncor CEO says

Five blocks of rights sold for brine minerals, including lithium

Brian Zinchuk / Pipeline News
DECEMBER 20, 2019 11:06 AM



New tech aims to extract lithium from oilfield waste

by Julie Matchett — January 20, 2020

How Alberta's lithium-laced oil fields can fuel the electric vehicle revolution

BY LIZ LAPPIN AND ALISON CRETNEY

July 10, 2020

Lithium in the oil patch could power the global push for EV batteries – if we build back better



Agenda

1. Introduction: Motive/background ✓
2. Lithium Market: Uses, supply/demand
3. Lithium Deposits & Prospects in SK
4. Challenges & Solutions Pathways
5. Closing Thoughts: Transitional industries and key opportunities
6. Questions & Discussion





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Lithium Market:

Uses, supply/demand



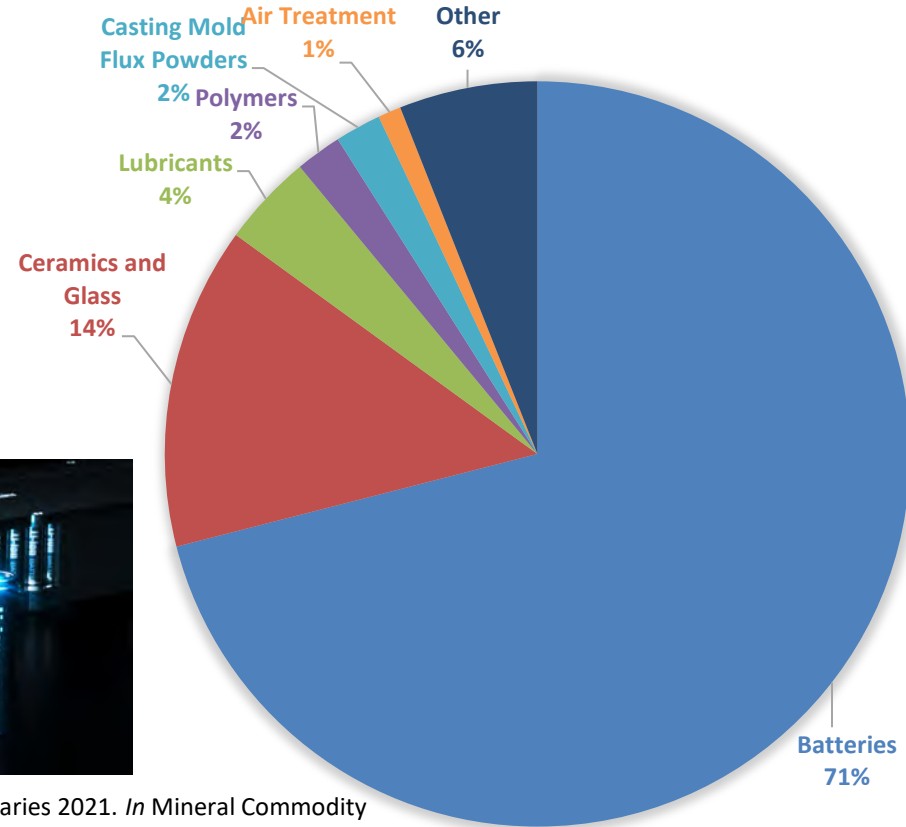
Primary Lithium Uses

- Numerous applications for lithium
- Now ubiquitously associated with Li-ion batteries and energy storage
- From 2015-2017, the end-use market for lithium in batteries increased from 35 percent to 46 percent (Jaskula, 2018).



Data from

USGS. 2021. Mineral commodity summaries 2021. *In* Mineral Commodity Summaries. Reston, VA. doi:10.3133/mcs2021.



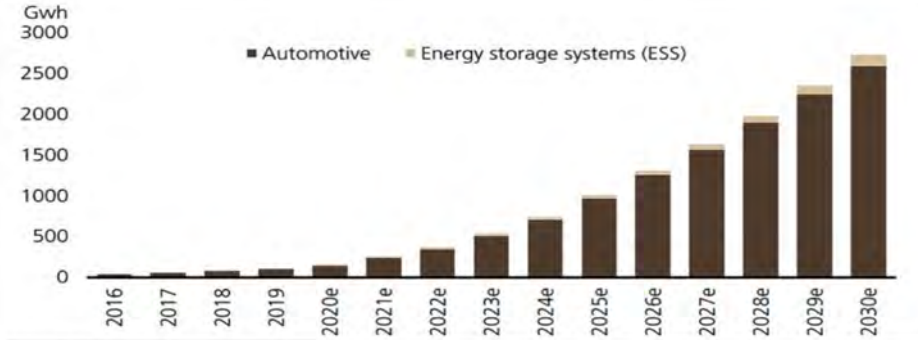
Lithium demand set to grow

- Battery market growing rapidly
 - Use in meeting global emissions reduction targets
 - Use in renewable energy storage in support of decarbonization



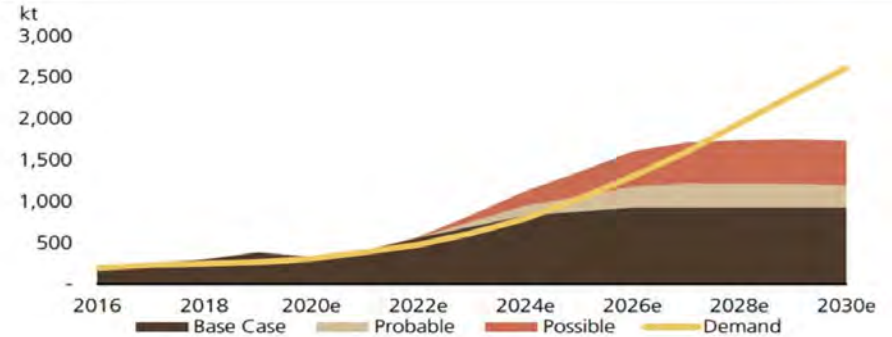
By 2025, EVs hit 10% of global passenger vehicle sales, rising to 28% in 2030 and 58% in 2040.

Electric Vehicle Outlook 2020, BloombergNEF



Source: UBSe.

Annual lithium-ion battery demand - uas

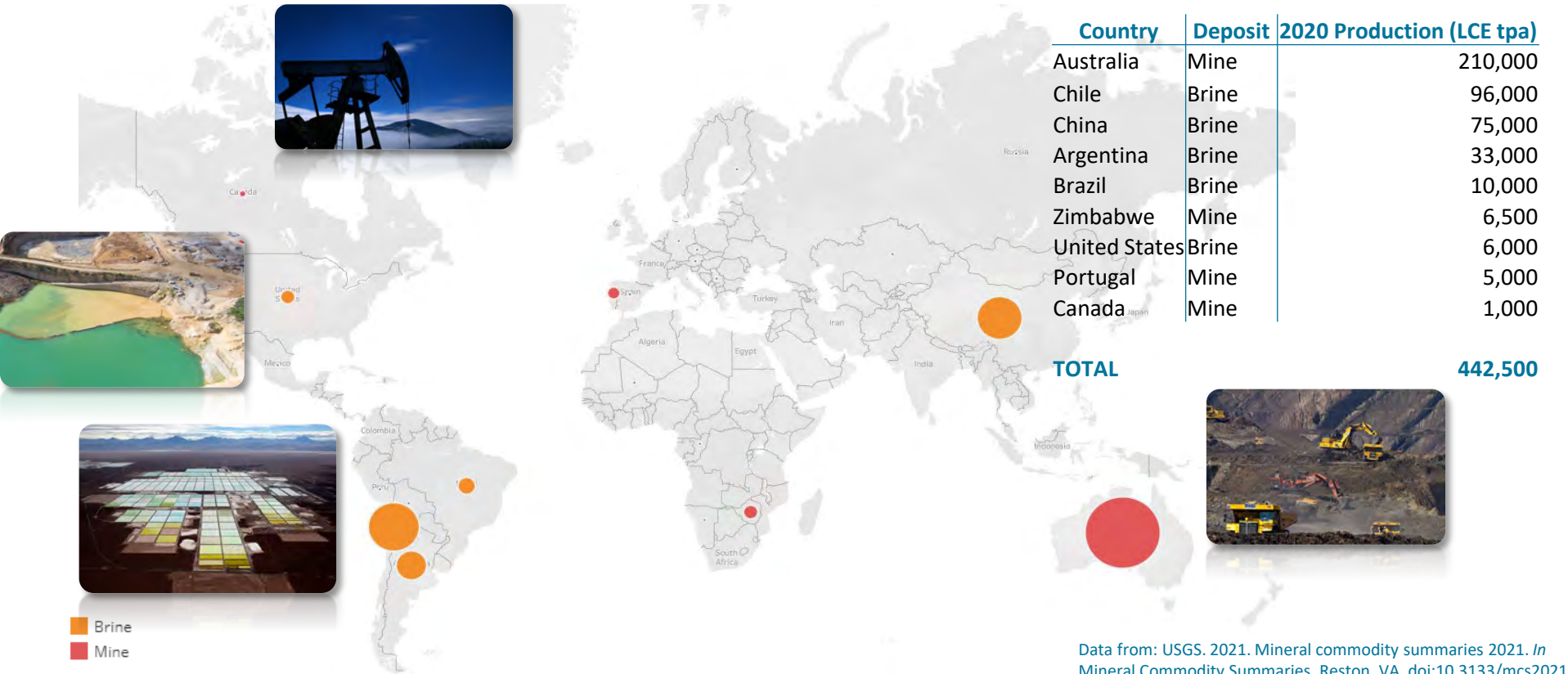


Source: WoodMac, Company Filings, UBSe.

Lithium supply - demand balance - uas



Current Lithium Production

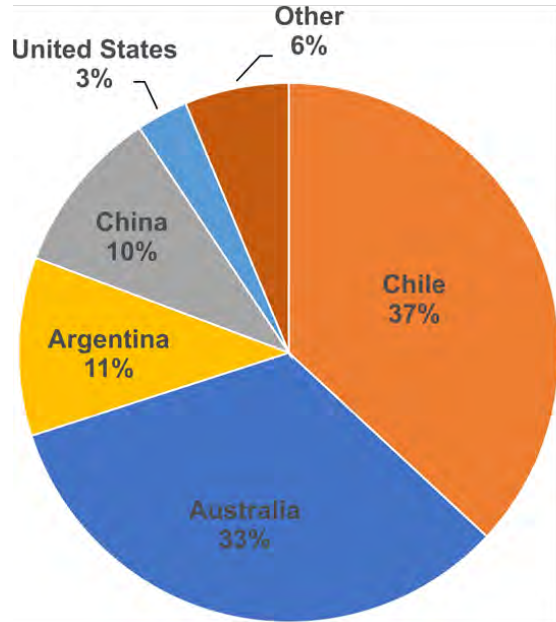


Data from: USGS. 2021. Mineral commodity summaries 2021. In Mineral Commodity Summaries. Reston, VA. doi:10.3133/mcs2021.

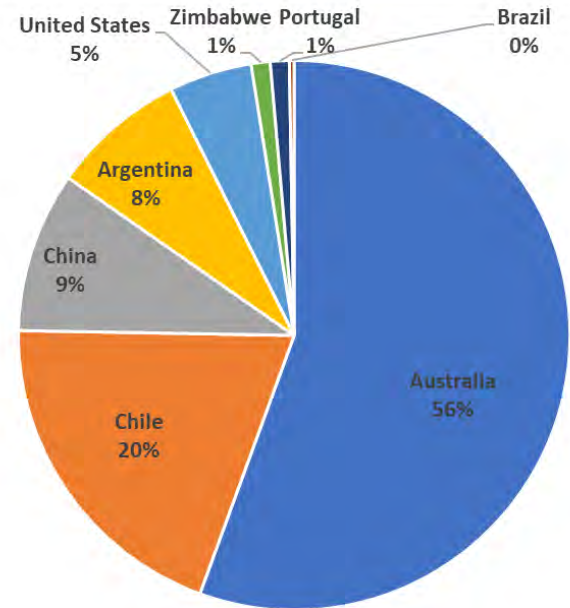


Global Lithium Supply

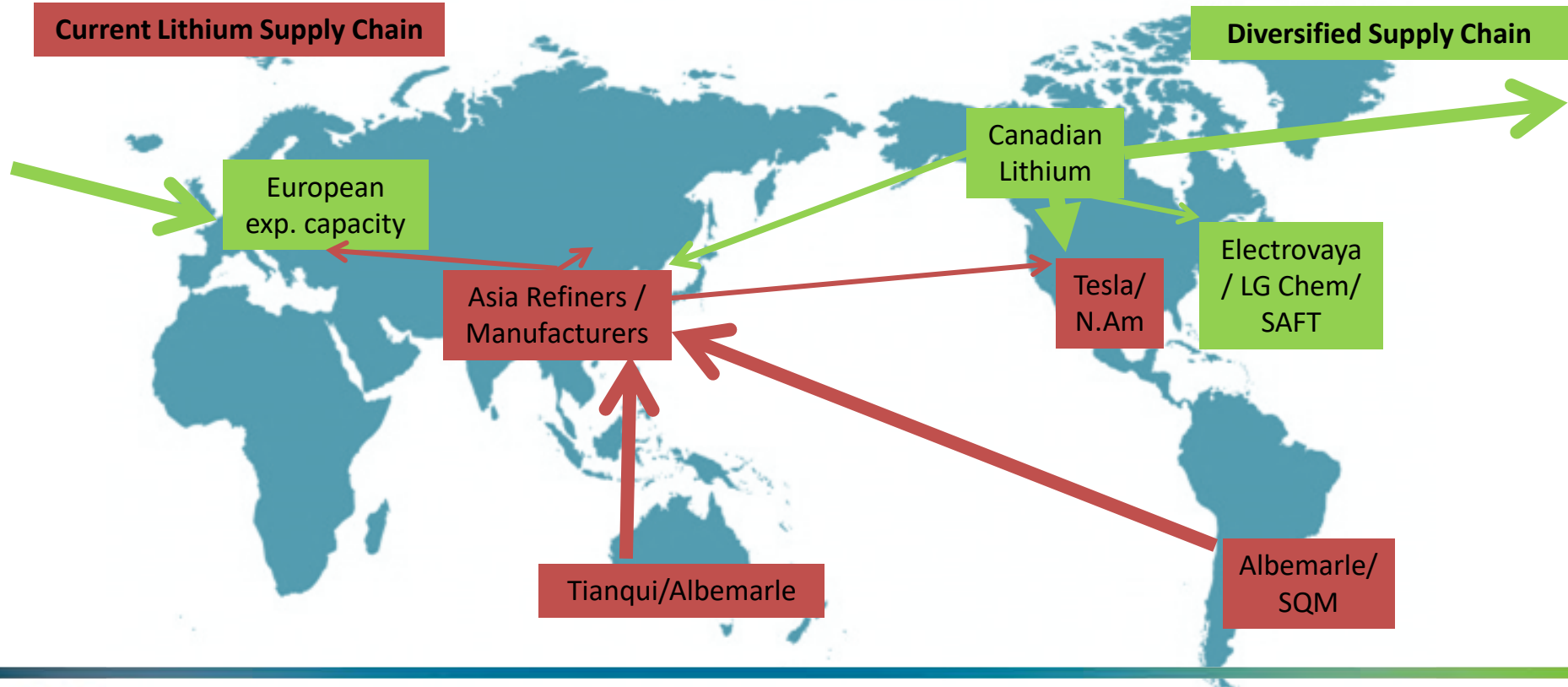
Global lithium supply by country
(2015)



Global lithium supply by country
(2019)



Broadening the Li Supply Chain



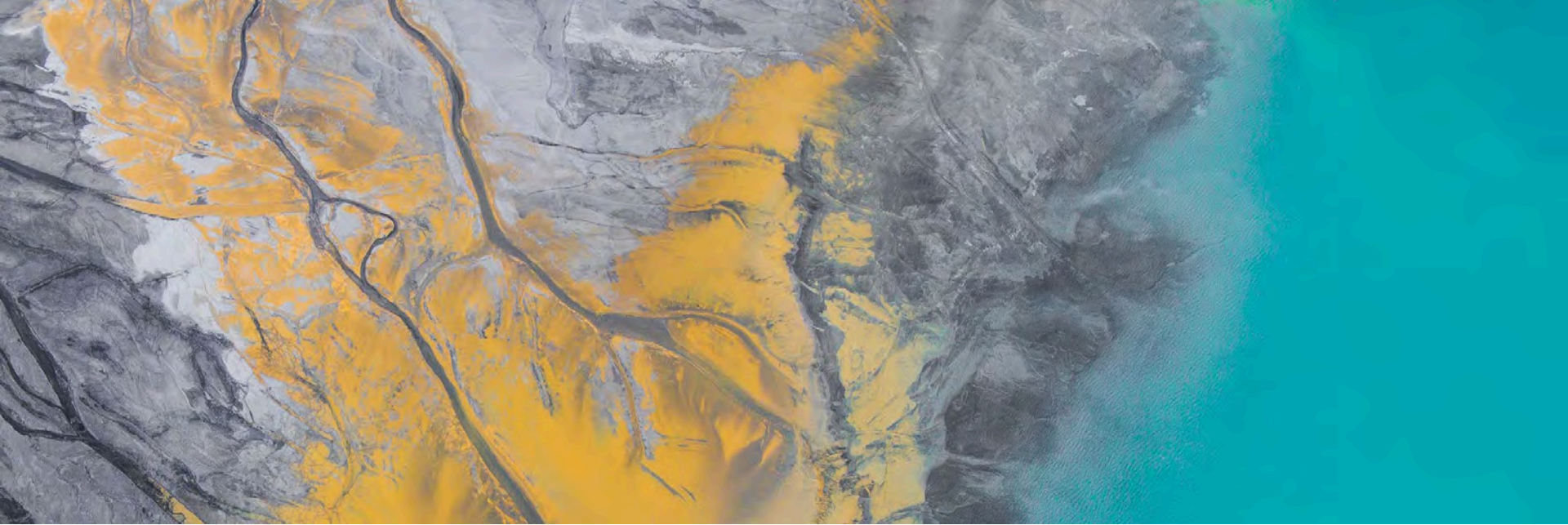


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Saskatchewan Lithium Brine Prospects



Saskatchewan Lithium Brine Prospects



- Unconventional brine resources unlike major Salar brines in South America
- “Subsurface Lithium brines” or “lithium enriched formation waters”
- Coined as “Petrolithium” brines
- Accessed using oil and gas or similar infrastructure
- Presents unique opportunities to leverage existing oil and gas infrastructure and workforce

In the News...

Prairie Lithium Major Land Acquisition in Saskatchewan

May 4, 2021

- Prairie Lithium is the largest active lithium brine proponent in Saskatchewan
- New acquisition covers 220,000 acres of total mineral holdings
- This comes after successful Direct Lithium Extraction proof of process pilot in 2020
- DLE is installed on an active oil and gas site, Lithium can then be extracted from brine and converted into lithium carbonate - a key component used in lithium-ion batteries.



North America Adaptations and Challenges



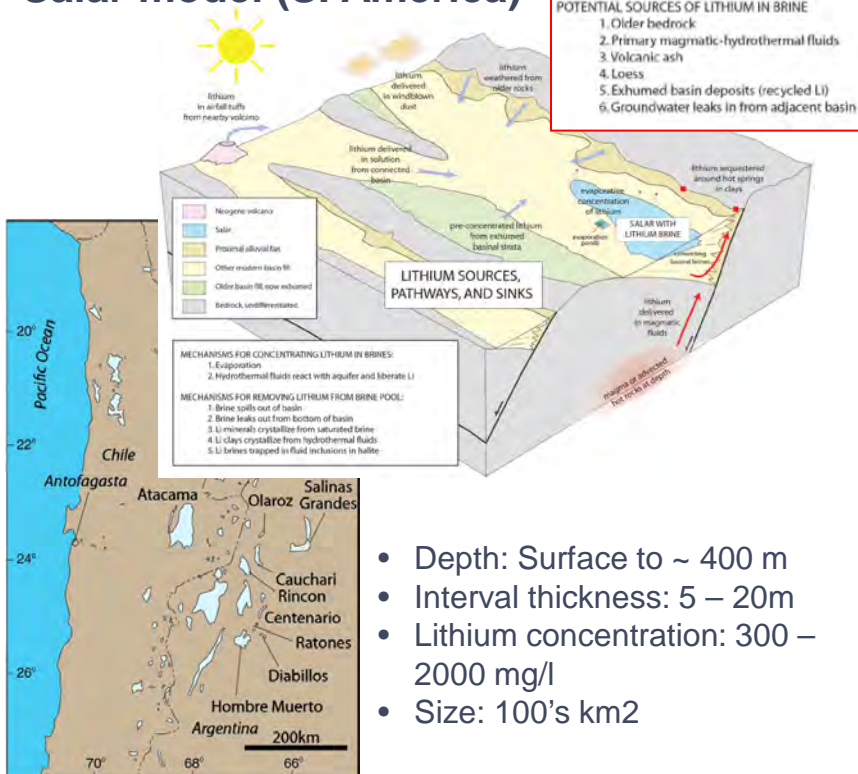
South America

North America



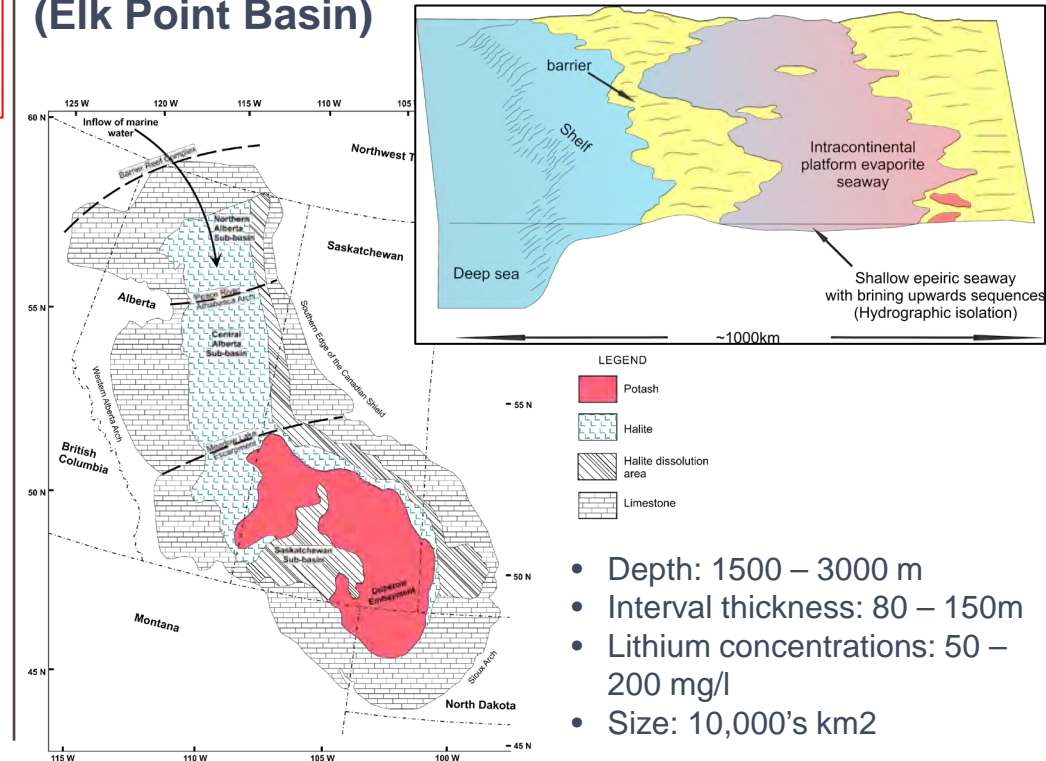
Lithium Brine Depositional Models

Salar model (S. America)

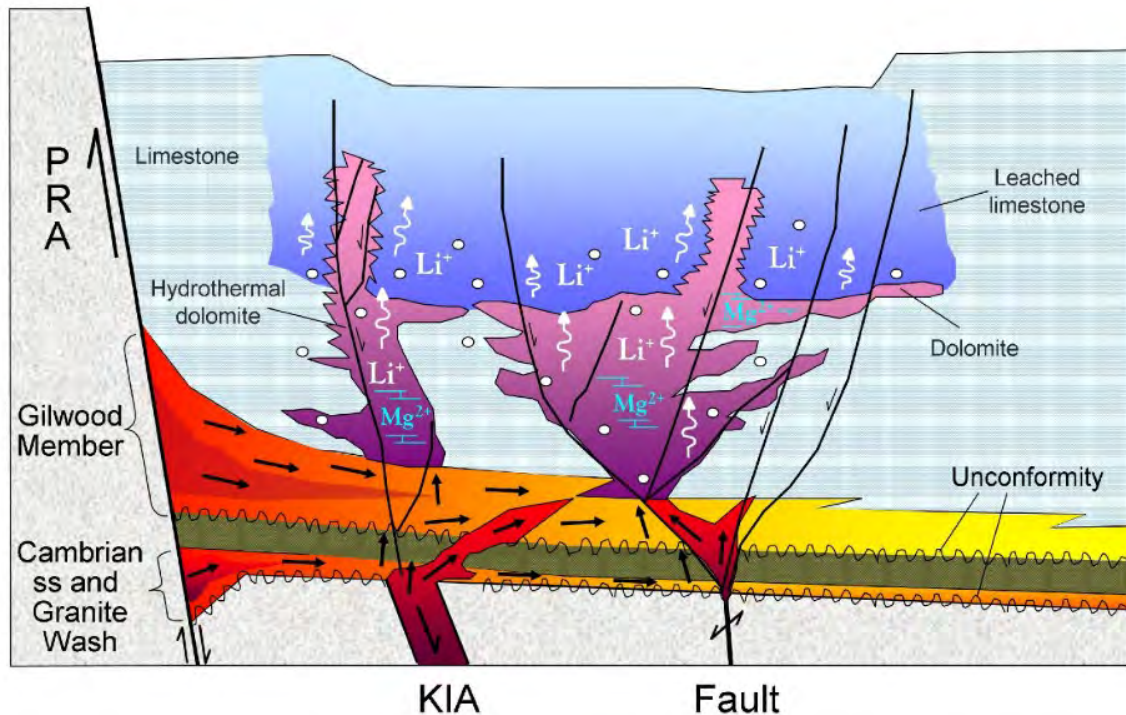


- Depth: Surface to ~ 400 m
- Interval thickness: 5 – 20m
- Lithium concentration: 300 – 2000 mg/l
- Size: 100's km²

Epicontinental sea model (Elk Point Basin)



Lithium Concentration Mechanisms



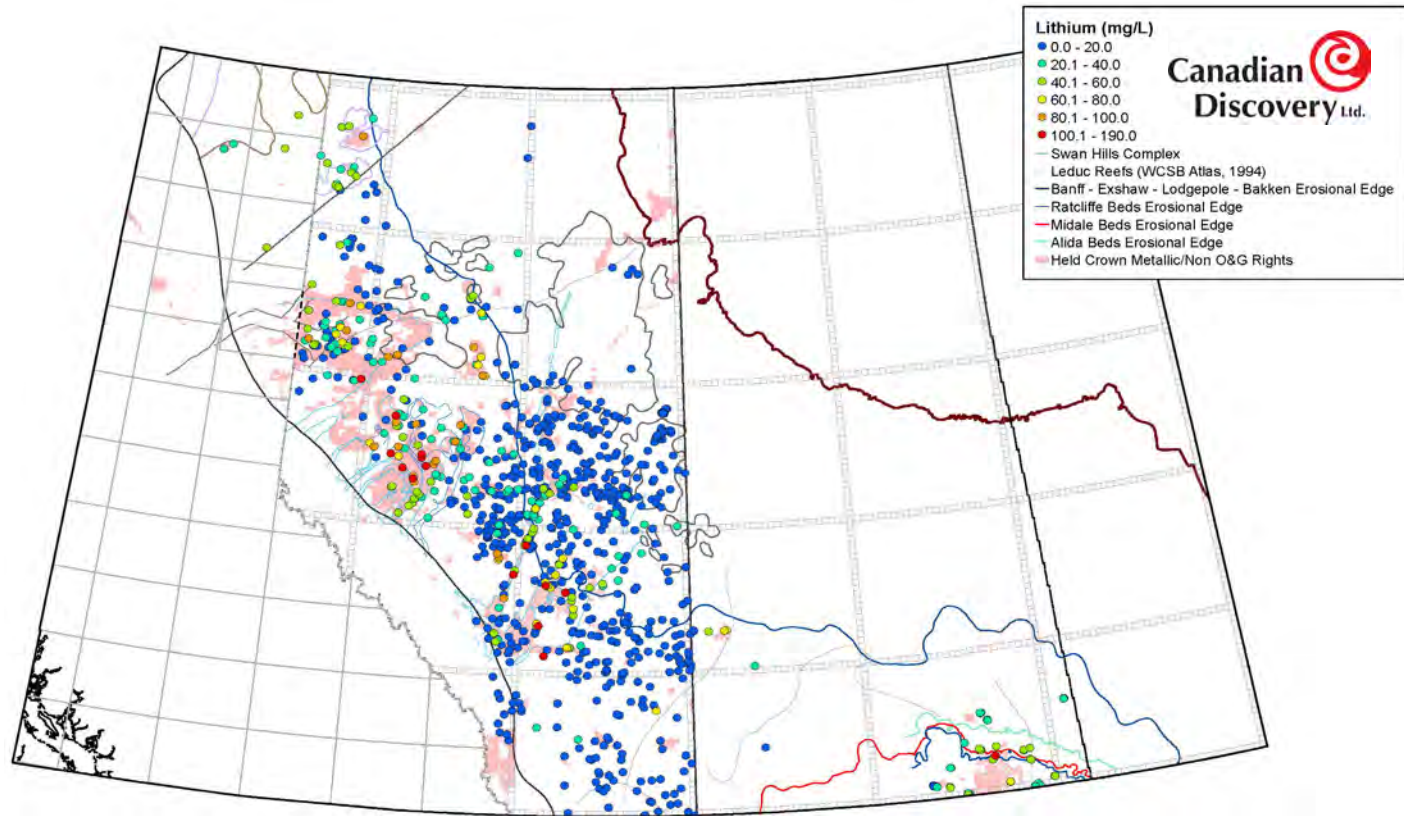
Geological criteria favourable to lithium enrichment have been identified including:

- (1) Tectonically driven subsidence,
- (2) Associated igneous, volcanic or geothermal activity,
- (3) Periods of restricted basin conditions,
- (4) Interactions with basement derived hydrothermal fluids
- (5) Proximal felsic bedrock and volcanic terranes
- (6) Arid to semi arid paleoclimates often recorded by evaporite deposits
- (7) Presence of adequate aquifer units

Eccles, R., and Berhane, H. 2011. Geological Introduction to Lithium-Rich Formation Water with Emphasis on the Fox Creek Area of West-Central Alberta (NTS 83F and 83K). ERCB report 2011-10. Available from http://www.ag.gov.ab.ca/publications/ofer/pdf/ofer_2011_10.pdf.

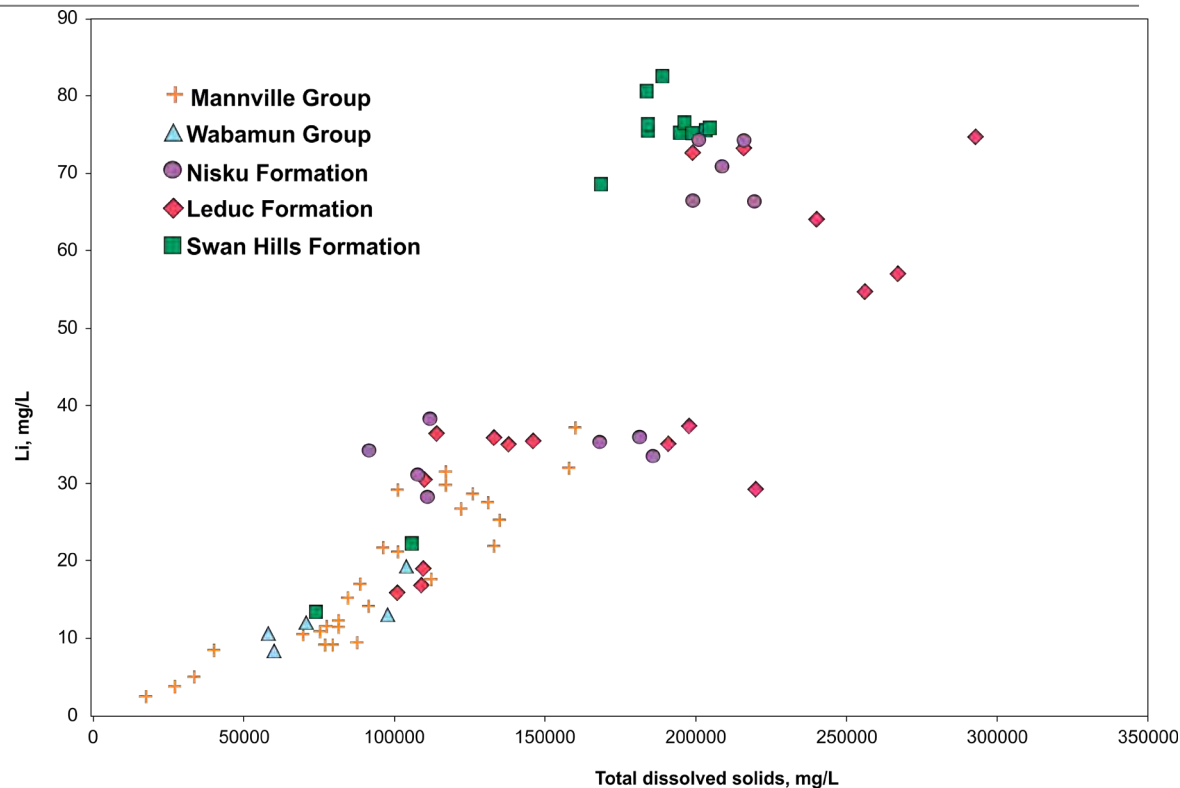
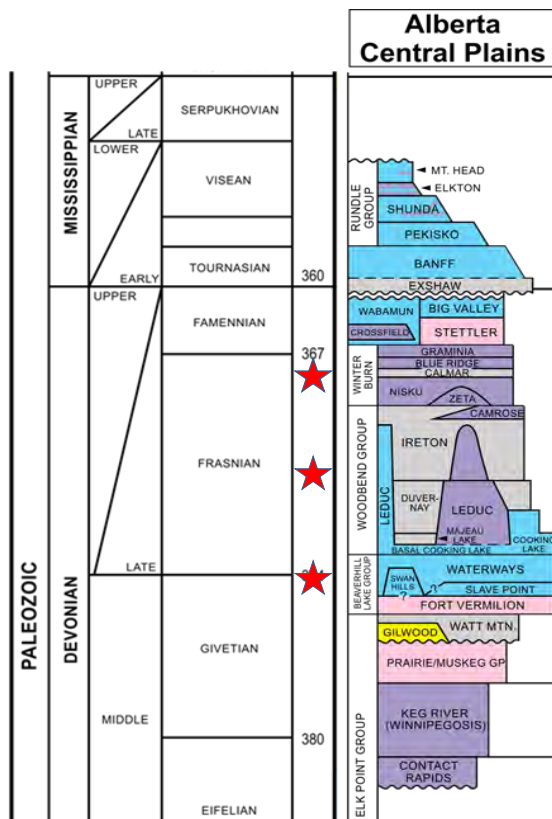


Lithium Distribution



Used with permission – MATRIX / CDL - NE BC Brine Sampling Project – Data Gap Analysis

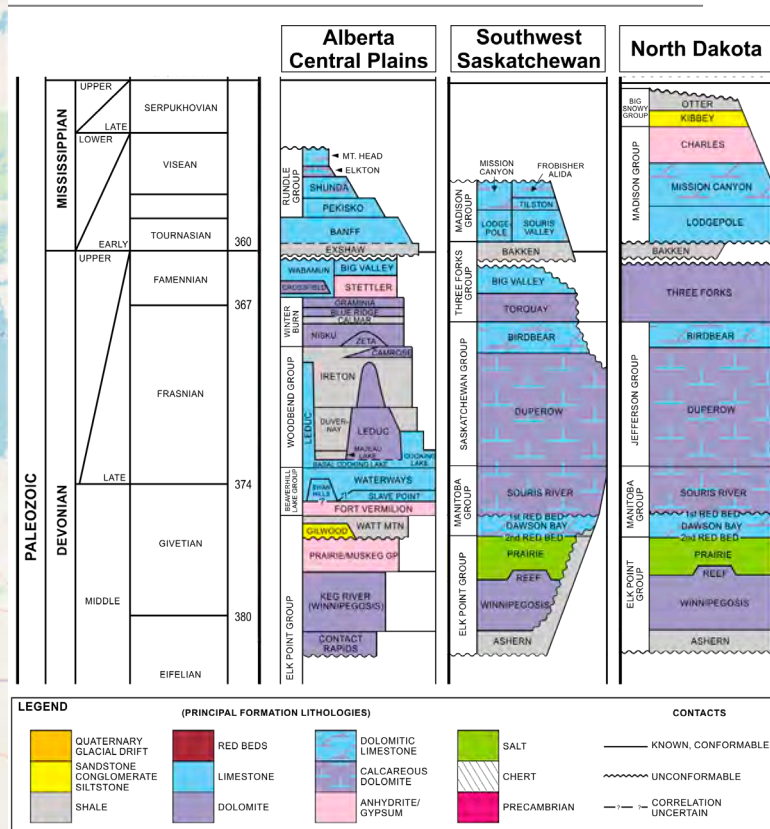
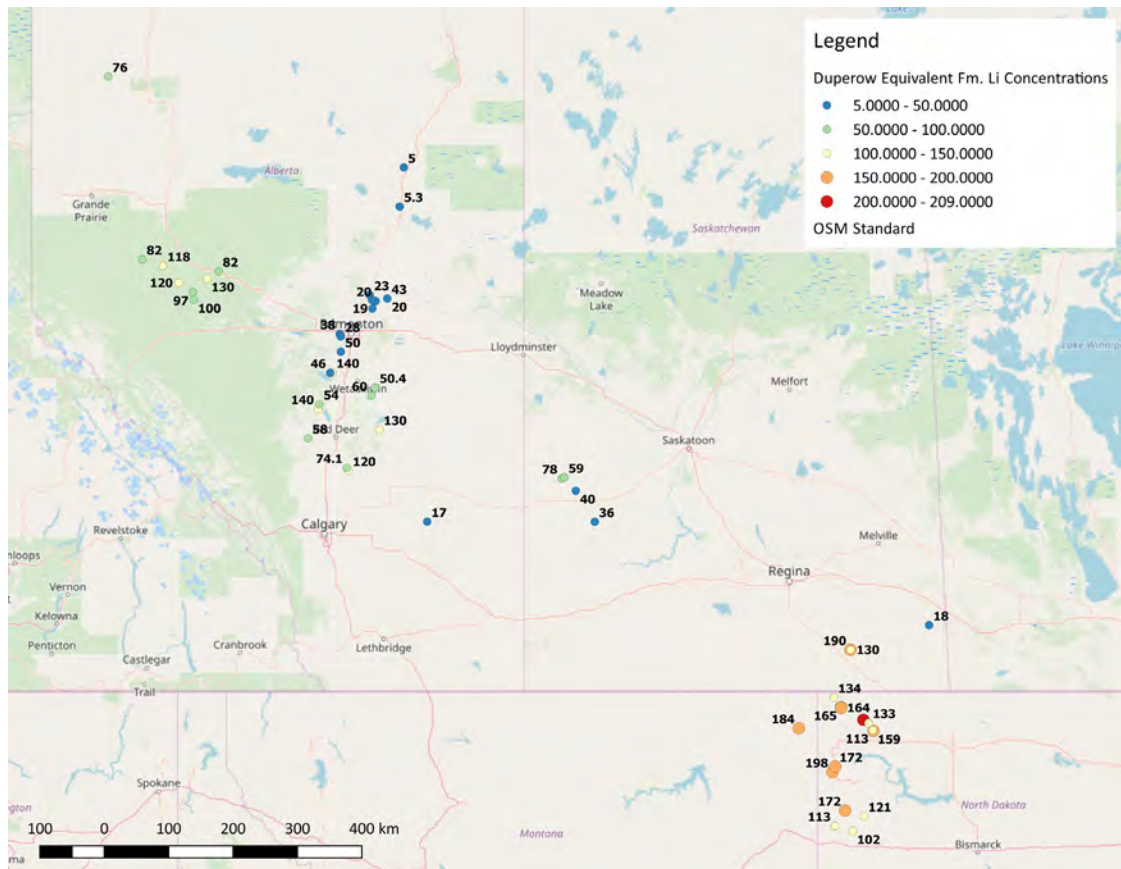
Sub Surface Brines of Western Canada



Huff, G.F. 2016. Evolution of Li-enriched oilfield brines in Devonian carbonates of the south-central Alberta Basin, Canada. Bulletin of Canadian Petroleum Geology, . doi:10.2113/gscpgbull.64.3.438.



Concentration - Devonian Prospects



Data from AGS, academic sources and SGS publications





Challenges & Solution Pathways

Challenges

1. Data Paucity & Resource Quantification
2. Permitting and Regulatory Frameworks
3. Production Requirements for Technology Deployment

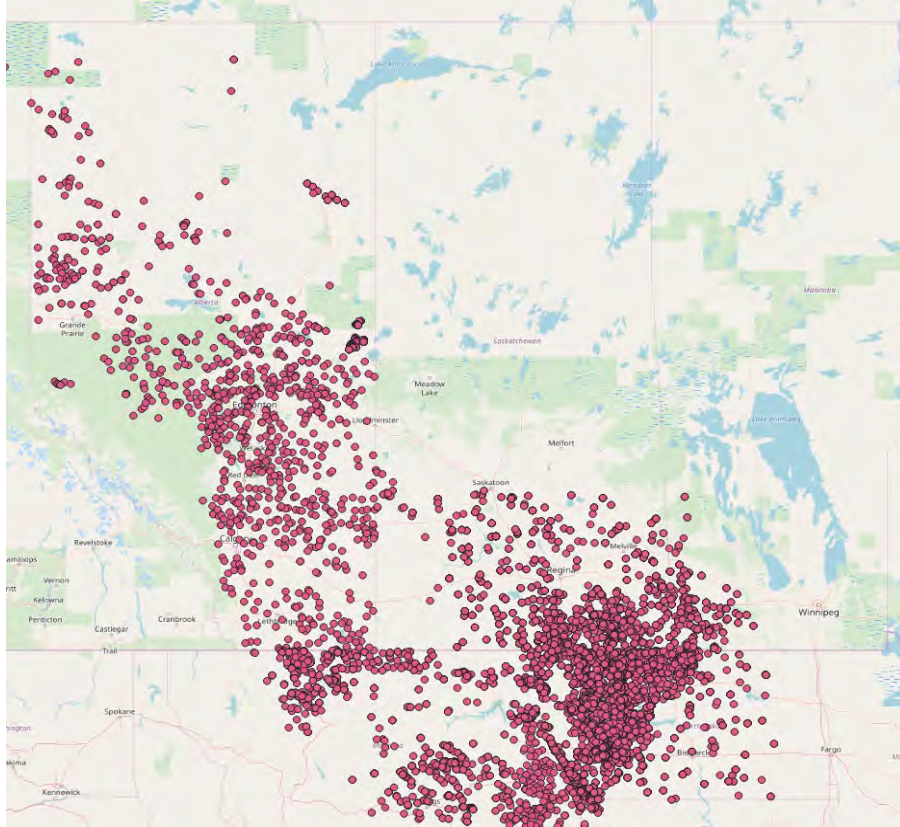


Challenges

1. Data Paucity & Resource Quantification
2. Permitting and Regulatory Frameworks
3. Production Requirements for Technology Deployment



1. Data scarcity & Resource Quantification



- Lithium not routinely tested for as part of oil and gas fluid analyses.
- Brines which have been tested for lithium have had to be re-sampled for this express purpose.
- Can be difficult to upgrade brine resources under NI-43-101 framework given data density

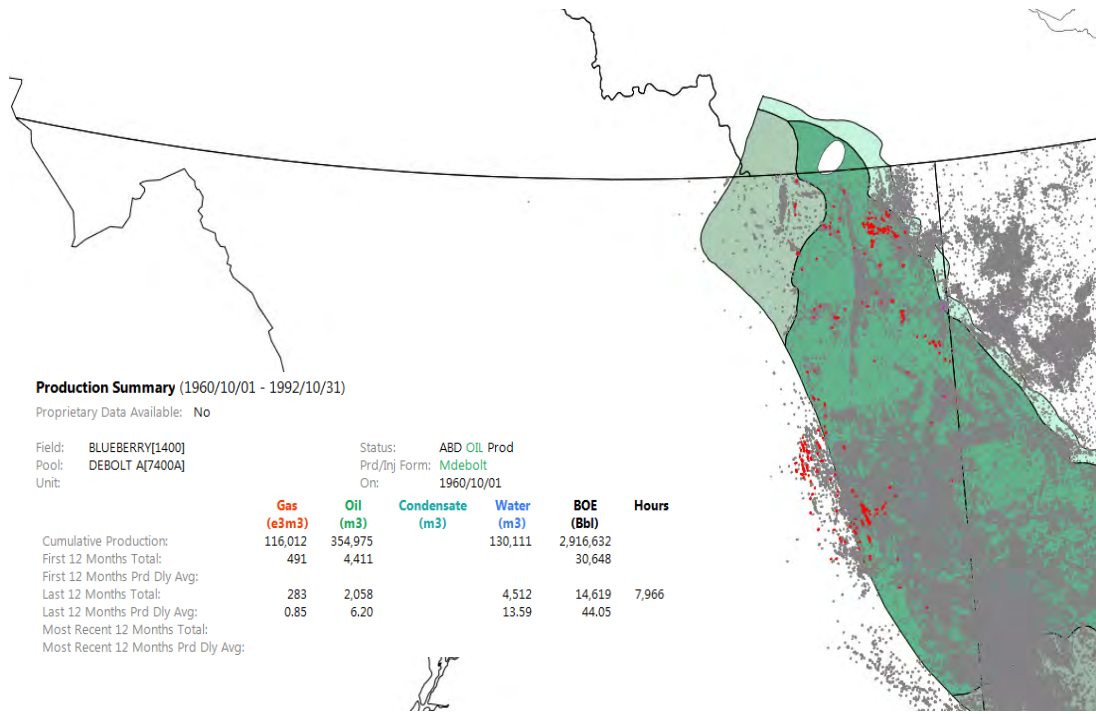
	~ # wells in database	Samples w/ Lithium analysis	Percentage
USGS Produced waters database	115,000	7,200	6%
Alberta Lithium sample database	450,000	1,577	0.4%
Saskatchewan Lithium sample database	115,000	115	0.1%



Solution Pathway: Brine Sampling Programs

Front end logistics and project management

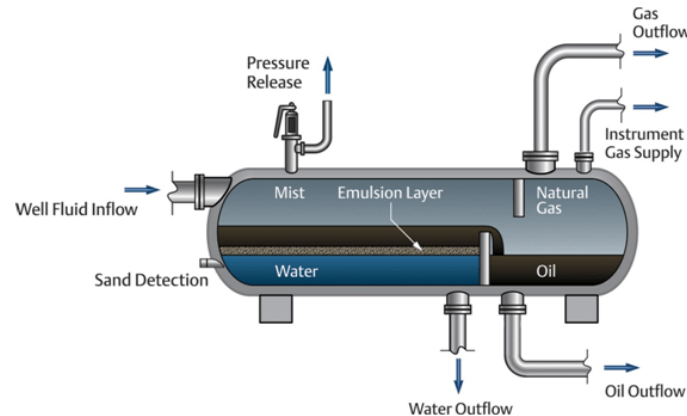
- Desktop preparation work
- Sampling program scope and necessary coverage
- Target well identification, zones of interest and access



Brine Sampling Programs

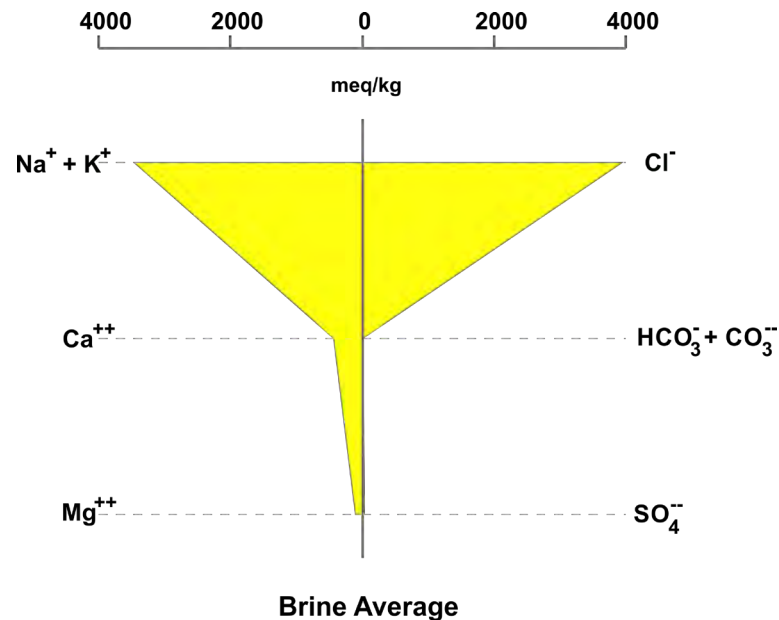
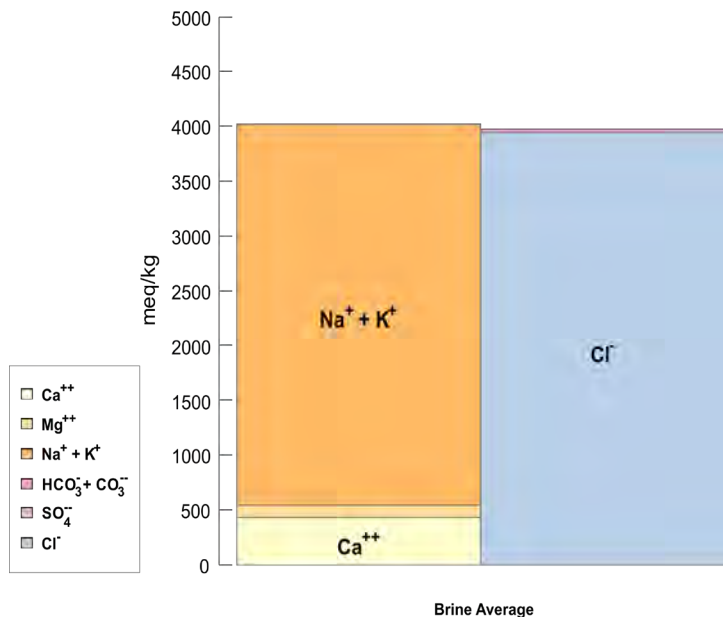
Field sampling program

- brines sampled from producing oil and gas fields leveraging existing infrastructure and workforce
- standardized sampling and testing QA/QC procedures
- Common infrastructure types from which to attain samples



Brine Geochemical Characterization

- Robust brine characterization is important when considering DLE technologies
- Chemistries can vary and some elements which occur in small quantities can present significant hurdles to effective technology deployment



Data Acquisition and Integration

- Use of extensive oil and gas legacy databases and expertise
- Reservoir and hydraulic parameters derived from available data types:
 - Core analysis
 - DST
 - Well logs
 - Seismic
 - Brine sampling programs
- Supports Resource quantification through incorporation into robust geological modelling

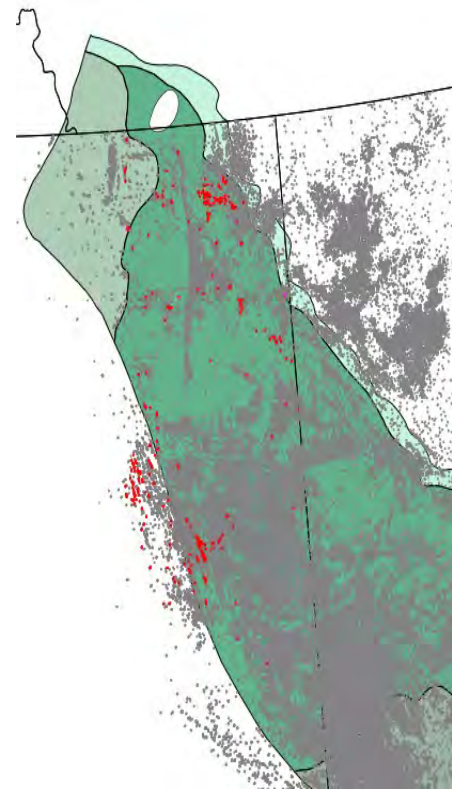
Production Summary (1960/10/01 - 1992/10/31)

Proprietary Data Available: No

Field:
Pool:
Unit:

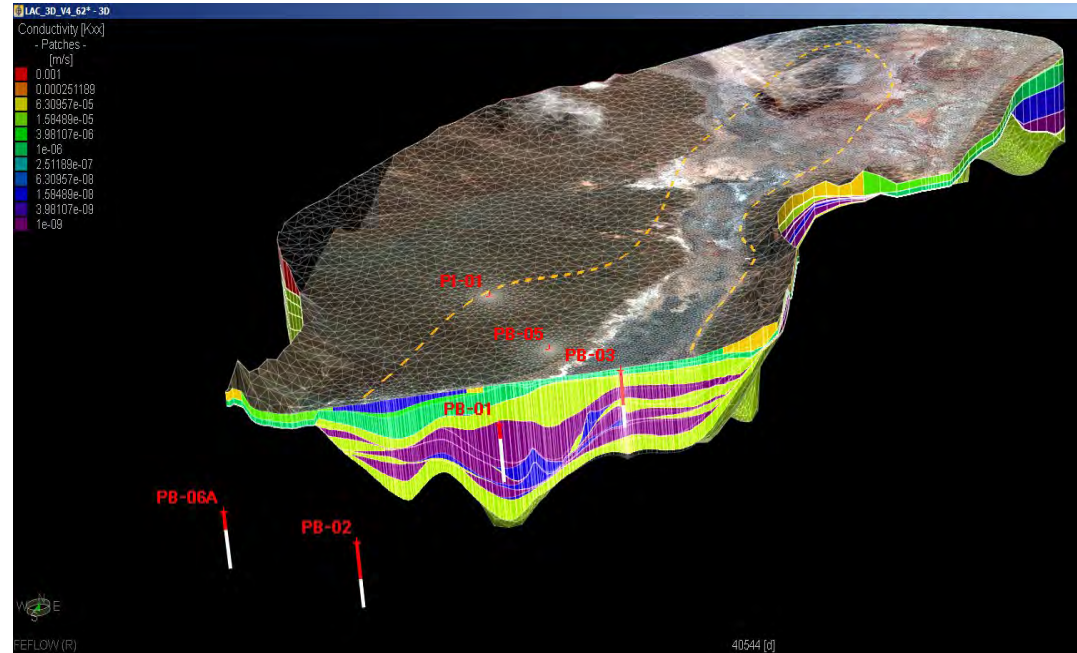
Status: ABD OIL Prod
Prd/Inj Form: Lithium Bearing
On: 1960/10/01

	Gas (e3m3)	Oil (m3)	Condensate (m3)	Water (m3)	BOE (Bbl)	Hours
Cumulative Production:	116,012	354,975		130,111	2,916,632	
First 12 Months Total:	491	4,411			30,648	
First 12 Months Prd Dly Avg:						
Last 12 Months Total:	283	2,058		4,512	14,619	7,966
Last 12 Months Prd Dly Avg:	0.85	6.20		13.59	44.05	
Most Recent 12 Months Total:						
Most Recent 12 Months Prd Dly Avg:						



Modelling and Quantification

1. Data processing and analysis – incorporation into broader geologic framework
2. Reporting and deliverables (processed data, maps, reports)
3. Resource quantification and NI-43-101 support



Challenges

1. Data Paucity & Resource Quantification
2. Permitting and Regulatory Frameworks
3. Production Requirements for Technology Deployment



2. Permitting and Regulatory Frameworks

Emerging technologies in energy:
Environmental and regulatory considerations
for Western Canada

Lithium

 **Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

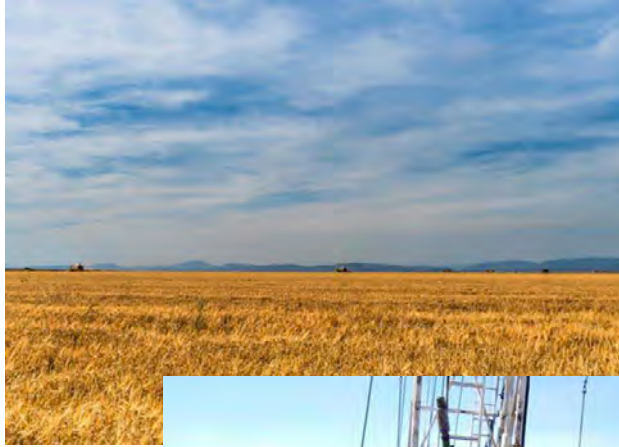
OSLER

- Variations across jurisdictions can complicate best approaches
- Opportunity to inform this process with expertise from work on previous projects and sound scientific practice and understanding
- Important to recognize the nascent state of these projects and work to form regulations which support their development
- Recognize synergies with other emerging technologies including oil & gas, CCUS, Geothermal and hydrogen
- Fine balance – treating prospects as mature industries at early stages will serve to discourage investment and development

[Osler_Emerging-technologies-in-energy_Lithium.pdf](#)
(Google: “Osler Lithium”)



Regulatory Support and Risk Management



- Risk based approach devised to alleviate regulatory burden while ensuring ESG excellence
 - Leverage Canadian Resource Industry strengths and robust frameworks
 - Form specific metrics and methods to assess performance
- Early advantage present in that many areas with prospective brines are already considered brownfield as a result of their historical oil and gas production



Challenges

1. Data Paucity & Resource Quantification
2. Permitting and Environmental Assessments - Regulatory uncertainty
3. Production Requirements for Technology Deployment



Technology Developments

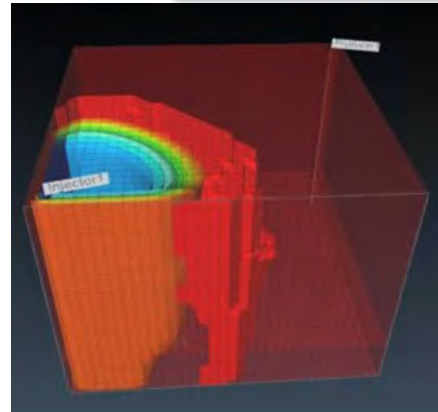
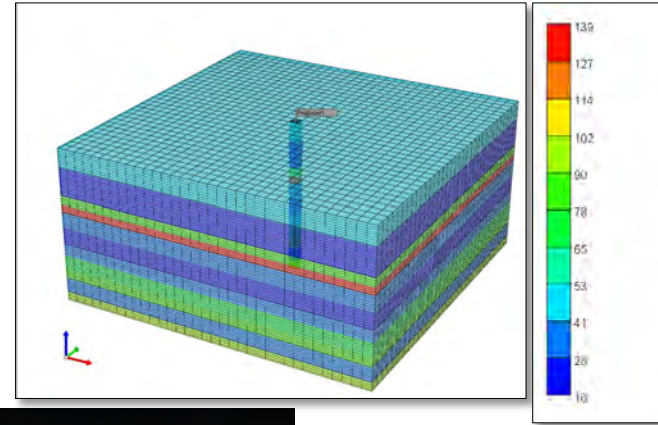
- Current technological limit for brine processing is approaching 60mg/L Li but not yet commercial
- Advancements are happening quickly in this space as there are numerous players involved
- US-Canada strategic mineral declaration ensures this will continue to be a top priority
- Preferred methods include
 - Membrane filtration using various nano materials
 - Ion exchange – solvent extraction
 - Molecular Recognition Technology
 - Electrochemical
 - Hybrids
- Many of these efforts are from Canadian companies – opportunity to lead in this space



Production optimization

Production optimization and high grading

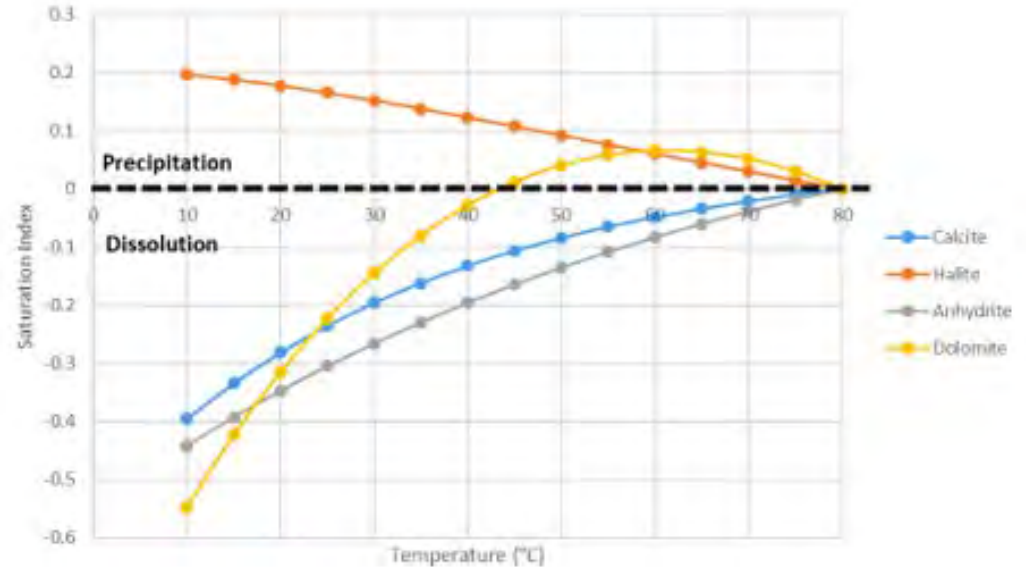
- Plan for sustained production
- Anticipate and plan for dilution effects w.r.t. injection pressure support
- Optimize for variations in reservoir parameters (compartmentalization)
- Detailed reservoir modelling
- Leverage existing natural reservoir zones to optimize for large volumes
 - Doubling conc = doubling volume = doubling well #'s
 - Production matters...



Production optimization

Production risk management

- Anticipate scaling issues
- Suggest workover schedules as mitigation measures



Feasibility and Operation



Similar impact to conventional oil field with a central processing battery, though with less wells:

- Weyburn oil field example: $\sim 450,000 \text{ m}^3/\text{d}$ water
- Often 8 wells / section



- At 80mg/L Li or 0.08Kg/m^3
- To fill a 25,000 tpa LCE plant would require $\sim 160,000 \text{ m}^3/\text{d}$
- Subsurface brine lithium play – ~ 5 twps., 2 wells (producer/injector pairs) / section

Feasibility and Operation

A 25,000 tpa LCE plant could supply the equivalent of the Tesla Gigafactory 1 (50 GWh, 21,000 tonnes LCE/annum).



Example - Lanxess Br Brine Production , AR



Brine production and processing facility

- Commercial brine operation historically producing Br out of the Smackover Fm. (1960)
- Currently employs 500 people from three brine plants and 100's of peripheral service jobs sharing oil and gas expertise and skills
- Standard Lithium Partnership aims to produce 20,000 tpa LCE over 25 years



Brine production well



Photo by [Karsten Würth](#) ([@karsten.wuerth](#)) on [Unsplash](#)

Summary & Closing Thoughts:

Transitional industries and key opportunities



The Lithium Opportunity

- Lithium demand growing faster than supply
- Window of opportunity for Canada to capture part of the growing energy storage and electric transportation market
- Lithium brine resource potential is only beginning to be understood yet preliminary work has made significant discoveries
- Technology is in development and advancing quickly
- Solutions to identified challenges are actionable today
- Pandemic catalyst or restraint

Maximizing Canada's Battery Metals Sector

Building a thriving "mines to mobility" supply chain

Report for free download

Demand for lithium-ion batteries surges as the world races towards enabling clean mobility and energy storage.

Sponsored by:

https://www2.jwnenergy.com//Maximizing_Canada's_Battery_Metals_Sector



Key Ingredients in Canada & Saskatchewan

Natural Resources

a preferred mining jurisdiction with environmental performance

Strategic Location

ideal to serve emerging north american supply chains leveraging significant green tech deployment potential

Innovation Culture

from raw materials to cathodes to battery production and recycling

People

a trained, technically skilled and entrepreneurial workforce

Lithium Value Spectrum

- Provides a transitional platform for E&P talent and technical expertise
- Exemplifies visible GHG reduction initiatives and ESG leadership
- Repurposes existing infrastructure and skilled workforce into transitional industries
- Potential to align with existing oil and gas industry as value added products and geothermal power
- Long lead times for conventional mining – regulatory jump start
- Possible leapfrog leveraging oil and gas and potash solution mining synergies



Closing Thanks



BMAC

Battery Metals
Association of Canada



<https://www.linkedin.com/company/bmacanada/>



@BMAC_Canada

If this topic interested you and you would like to stay informed – possibly get involved – please visit the Battery Metals Association of Canada! www.bmacanada.org



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Questions & Discussion