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Prospect of Co-developing Geothermal Lithium in the Western Canadian Sedimentary Basin

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Summary

Canada's critical minerals sector is rapidly expanding its Li exploration and processing capacity, driven by growing demand for electric vehicle batteries and domestic supply-chain security (BMAC, 2025). Emerging geothermal projects, particularly in Western Canadian Sedimentary Basin (WCSB), are beginning to showcase the region's strong prospects for clean, baseload heat and power. At the same time, rapid progress in direct lithium extraction (DLE) technologies developed for oil-field brine, also within the WCSB, is paving the way for similar applications in geothermal brine systems (Eccles and Berhane, 2011; Morris et al., 2024; Lazowski et al., 2025). Although Canada currently does not produce geothermal power or Li from brine at commercial scale, their near-term, tandem development could position Canada to integrate clean energy production with critical mineral recovery. While Canada's geothermal Li potential is still emerging, international experience demonstrates that co-development of geothermal power and Li extraction is technically and commercially feasible under the right geological and operational conditions.

Geothermal brines have emerged as one of the most promising pathways for the co-production of renewable baseload power and low-carbon Li, although only a small number of projects worldwide have advanced beyond concept into commercial development (Munk et al., 2025). Among these, the Salton Sea Geothermal Field in the United States and the Upper Rhine Graben in Europe (France and Germany) host two of the most advanced and credible geothermal Li co-development projects globally: Controlled Thermal Resources' Hell's Kitchen project and Vulcan Energy's Lionheart project, respectively (Barton et al., 2025; CTR, 2025; Vulcan, 2025). In the Salton Sea, decades of geothermal power production and extensive subsurface characterization have enabled Hell's Kitchen to pair large-scale, baseload renewable electricity with DLE from Li-rich geothermal brines, with staged development targeting up to 350 MW of power and ~152,000 metric tons of lithium carbonate equivalent (LCE) annually before 2030 (Syndacker et al., 2024; CTR, 2025). In parallel, the Lionheart project in the Upper Rhine Graben integrates Li extraction directly into operating geothermal plants at Insheim and Landau, building on successful pilot and demonstration scale production of battery-grade lithium compounds and targeting ~318,000 metric tons of LCE over its initial production period starting in the mid-2020s (Vulcan, 2025). These case studies provide a valuable framework for evaluating similar geothermal Li co-production opportunities within the Western Canadian Sedimentary Basin (WCSB).

Within Canada, the WCSB offers some of the most compelling conditions for geothermal development, owing to its extensive subsurface data coverage, geothermal gradients up to 55°C km^{-1}, and existing energy infrastructure (Banks and Harris, 2018). The Tu Deh-Kah geothermal project in northeastern British Columbia is poised to be Canada's first geothermal plant (Geothermal Canada, 2023). The Tu Deh-Kah project will repurpose the long-producing Clarke Lake gas field in northeast British Columbia, where the Slave Point Formation, a dolomitized carbonate reef within a high heat-flow region, hosts brines exceeding 100°C at depths just over 2 km (Walsh, 2013; Renaud et al., 2021). Decades of reservoir data, including depositional facies analyses, reservoir modeling, and extensive production and flow tests, indicate that wells can deliver ~25 kg s^{-1} of brine with stable temperatures over 25 years (Walsh, 2013). While geothermal development in sedimentary basins has historically faced economic challenges when limited to electricity sales, the Tu Deh-Kah project's brines, containing between 15.3 and 33.6 ppm Li (Lonnee and Machel, 2006), offer a promising opportunity to pair heat production with Li extraction.

Beyond Tu Deh-Kah, several other regions within the WCSB exhibit geological and thermal characteristics that may support geothermal development and, potentially, Li co-production. The DEEP Earth Energy Production (DEEP) project in southern Saskatchewan represents another notable example of sedimentary-basin geothermal development, leveraging deep reservoirs and existing hydrocarbon exploration data to advance toward commercial-scale power generation. Alberta currently hosts ~30 active geothermal leases (not including geothermal applications) with most being in the central/northwest of the province (Brinsky et al., 2022; Alberta, 2025). Among those is the Latitude 53 geothermal project near Hinton being developed by Novus Earth Energy (NovusEarth, 2025). Moreover, the Peace River Arch has long been recognized as a region of elevated heat flow within the WCSB, making it a natural candidate for further geothermal exploration and assessment of brine-hosted Li potential (Banks and Harris, 2018; Lazowski et al., 2025).

Conclusion and Next Steps

The convergence of geothermal energy development and Li extraction presents a compelling opportunity for Canada to advance both clean energy generation and critical mineral supply from a single resource base. Projects such as Hell's Kitchen and Lionheart demonstrate that co-development of geothermal Li is technically feasible. Within the WCSB, projects in British Columbia, Alberta, and Saskatchewan suggest that similar integrated development pathways may be achievable in Canada. Continued progress will depend on targeted subsurface characterization, systematic evaluation of Li concentrations and brine chemistry, and pilot-scale testing of DLE technologies under representative geothermal conditions. Near-term next steps should prioritize surveying the Li distribution in geothermal targets in the WCSB, supported by lab-trials to evaluate DLE effectiveness, and eventual field-scale deployment like those observed globally. Collectively, these efforts could position Canada to leverage geothermal brines as a strategic resource for both renewable energy and low-carbon lithium production.

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References

Alberta Government (Alberta). (2025). *Geothermal Resource Development*. https://www.alberta.ca/geothermal-resource-development. Accessed August 23, 2025.

Banks, J. and Harris, N.B. (2018). Geothermal potential of Foreland Basins: A case study from the Western Canadian Sedimentary Basin. *Geothermics* **76**, 74-92.

Barton, C., Pettitt, W., Salter, T., Meyer, E., Harper, C., Nasir, E., Moradi, A., Alt, R., Likrama, F., Sims, D., Osborn, W. (2025). Next Generation Reservoir Modeling for Geothermal Energy and Lithium Recovery. *PROCEEDINGS 50th Workshop on Geothermal Reservoir Engineering*. Stanford, California, February 10-12, 2025.

Battery Metals Association of Canada (BMAC). (2025). Towards A Western Canadian Battery Value Chain – Assessing Industrial Gaps and Opportunities for Economic Development. Version 1.0, June 2025.

Brinsky, J, Singh, A., Hauck, T.E., Grobe, M. and Palombi, D. (2022). Temperature mapping of select Devonian strata in Alberta; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Open File Report 2021-05, 28 p.

Controlled Thermal Resources (CTR) (2025). *The power of California's Lithium Valley*. https://www.cthermal.com/projects. Accessed June 26, 2025.

Eccles, D.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)*. Energy Resources Conservation Board/ Alberta Geological Survey (ERCB/AGS) Open File Report 2011 10.

Geothermal Canada (2023). *How the First Canadian Geothermal Plant Will be Run by an Indigenous Community*. January 18, 2023. https://www.geothermalcanada.org/news/2023/1/19/how-the-first-canadian-geothermal-plant-will-be-run-by-an-indigenous-community. Accessed December 8, 2025.

Lazowski, C.N., Kalderson-Asael, B., Asael, D., Arizaleta, M.L., Melnyk, S., Wilson, S., Alessi, D.S., Planavsky, N.J., Konhauser, K.O., Gingras, M.K. (2025). Lithium isotopes of the Peace River Arch in the Western Canadian Sedimentary Basin: A framework for resolving deep basin lithium sources. *Geological Society of America Bulletin*.

Lonnee, J., Machel, H. G. (2006). Mixing of halite brines with meteoric water in the Clarke Lake gas field, Canada. *Journal of Geochemical Exploration* **89**, 243-246.

Morris, N.J., Kennedy, J., Pugh, K.A.Y., Saha, P., Anaya, I., Mashava, M. (2024). *Back to the Future: Lithium Analyses of Devonian Brines*. Geoconvention. Calgary, Alberta, Canada.

Munk, L.A., Boutt, D., Butler, K., Russo, A., Jenckes, J., Moran, B., Kirshen, A. (2025). Lithium Brines: Origin, Characteristics, and Global Distribution. *Economic Geology* **XX**, pp-pp.

Novus Earth Energy (NovusEarth). (2025). *Latitude 53 Project, Hinton, Alberta*. https://www.novusearth.ca/latitude53project/. Accessed August 23, 2025.

Renaud, E., Weissenberger, J. A. W., Harris, N. B., Banks, J., Wilson, B. (2021). A reservoir model for geothermal energy production from the Middle Devonian Slave Point Formation. *Marine and Petroleum Geology* **129**, 105100.

Seip, A., Safari, S., Pickup, D. M., Chadwick, A. V., Ramos, S., Velasco, C. A., Cerrato, J. M., Alessi, D. S. (2021). Lithium recovery from hydraulic fracturing flowback and produced water using a selective ion exchange sorbent. *Chemical Engineering Journal* **426**, 130713.

Shivakumar, K. R., Zolfaghari, A., Safari, S., Wu, F., Bishop, B. A., Chen, N., Robbins, L. J., Alessi, D. S. (2025). Lithium extraction using zirconium oxide coated lithium manganese oxide ion-exchange sorbents. *Chemical Communications* **61(59),** 11013-11016.

Snydacker, D., Bouzalas, P., Indranada, A. (2024). *Technical White Paper - Unlocking lithium brine production with ion exchange.* Lilac Solutions, Inc. September 2024. Accessed May 14, 2025.

Vulcan Energy Resources (Vulcan). (2025). *Adsorption-Type Direct Lithium Extraction (A-DLE) Summary Presentation.* https://api.investi.com.au/api/announcements/vul/6be2a66a-e0d.pdf. Accessed June 23, 2025.

Walsh, W. (2013). Geothermal resource assessment of the Clarke lake gas field, Fort Nelson, British Columbia. *Bulletin of Canadian Petroleum Geology* **61**, 241-251.

Wu, F., Shivakumar, K.R., Konhauser, K.O., Alessi, D.S. (2025). Lithium resources and novel strategies for their extraction and purification. *npj Materials sustainability* **3(30)**, 1-21.