

Petro-Lithium and Helium Resources of Western Canada: The State of the Basin

*W. Steven Donaldson
Canadian Discovery Ltd.*

Introduction

The Western Canada Sedimentary Basin (WCSB) has been an oil and gas exploration and development area since the early 20th century that has generated and continues to generate immense wealth for all Canadians. Recently there has been a pivot to new types of subsurface resources, which include what are called critical or strategic minerals. Among these are lithium (from oilfield brines) and helium (found trapped within deep strata overlying Precambrian structural highs). Lithium demand is rising worldwide and is expected to increase significantly by 2030 from current levels. This is primarily because of increased demand for energy storage applications using rechargeable lithium-ion batteries. Concurrently, the imminent closure of the United States Federal Helium Reserve in Texas in late 2021 requires the identification of new and secure sources of helium, which is used in cryogenic applications for MRI scanners, during the manufacture of semiconductor chips and to purge and pressurize the propulsion systems of missiles and rockets. The pivot to lithium is driven by forecasted steadily-increasing demand, whereas the search for helium is driven by a risk of decreasing supply in the future. Western Canada is well positioned to become a secure source for both of these elements, not only because of its favorable geology, but because exploration for and development of both lithium and helium in the subsurface leverages the knowledge, expertise and infrastructure that currently exists for oil and gas in the WCSB.

Fairways and Operators

Lithium

During the 1990s and into the 2000s, the Alberta Geological Survey identified elevated levels of lithium and other elements in saline brine (formation water) associated with oil and gas reservoirs deep in the subsurface. An examination of lithium concentration in formation waters reveals some marked geographic and stratigraphic trends (figure 3 and table 2). The highest lithium concentrations have been historically documented by both government and industry to occur in Devonian-age units, specifically the Beaverhill Lake (Swan Hills), Woodbend (Leduc), Winterburn (Nisku) and Wabamun groups/formations. Devonian production is mature (some of these units have been producing petroleum for over 70 years) and consequently, most wells now produce far more brine than petroleum.

In Western Canada, a handful of larger operators are currently developing lithium resources within the areas where this element is enriched in Devonian reservoirs. Over the past few years, E3 Metals, Prism Diversified, Prairie Lithium and LithiumBank have acquired metallic and industrial mineral rights in Alberta and northeastern BC and are at different stages of project development. In March 2021, Highwood Asset Management (previously Highwood Oil) acquired significant

acreage with lithium rights. A number of smaller operators and individuals have also staked lithium rights.

Helium

The dominant isotope of helium (4He) is radiogenically sourced from the decay of uranium (U) and thorium (Th) in the crust. Basement rocks and cratons of Proterozoic- and Archean-age are predominantly metamorphic or granitic and contain crustal average or higher concentrations of U and Th. Younger Phanerozoic sediments with crustal average U and Th contents have an equal capacity to produce helium; however the greater age of Precambrian rocks has allowed more time for its production and accumulation through radioactive decay. Once generated, the helium migrates out these source rocks into overlying reservoirs overlain by tight sealing caprocks, often draping Precambrian structural closures.

Helium exploration and the development of helium resources is most advanced in Saskatchewan, where four operators are now active in multiple areas across the southern part of the province. These are North American Helium, Royal Helium, Canadian Helium and the Weil Group. North American is the most active driller (over 20 wells) and has the largest helium land position in Canada. The company also started up its first helium production facility at its Cypress Field in July 2020. The City of Medicine Hat was active in Saskatchewan helium exploration, but has stepped away because of perceived exploration risk.

In Alberta, three operators dominate the helium industry. Thor Resources is active at Knappen in the southeast, First Helium is exploring along the northern flank of the Peace River Arch and Imperial Helium recently acquired land in the Princess area of south-central Alberta.

References

Donaldson (2018). Nowhere to Go But Up: The Rising Helium Potential of Western Canada. Accessed March, 2021. <https://digest.canadiandiscovery.com/article/5336>

Donaldson (2018). Can Lithium Fuel Alberta's Future? Petro-Lithium in Alberta. Accessed March, 2021. <https://digest.canadiandiscovery.com/article/5343>