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Adventures in Pore Space: Shared Reservoirs in New Energy

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Emerging Resources: The New Race for Pore Space

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Abstract

The Western Canada Sedimentary Basin (WCSB) has been an area of oil and gas exploration and development since the early 20th century. It has generated and continues to generate immense wealth for all Canadians. However, there has been a recent pivot to develop new types of subsurface resources. These resources include critical or strategic minerals such as lithium (from oilfield brines) and helium (found trapped within deep strata overlying Precambrian structural highs); geothermal energy (from deep hot formation brines), as well as carbon capture and sequestration (storing waste carbon dioxide within deep porous and permeable strata overlain by tight caprocks).

Critical Minerals: Lithium and Helium

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 closure of the United States Federal Helium Reserve in Texas requires the identification of new and secure sources of helium, which is used in cryogenic applications for MRI scanners, 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 demand, whereas the search for helium is driven by a risk of decreasing future supply.

Lithium

From the 1990s to the present, the Alberta and Saskatchewan Geological Surveys have identified elevated levels of lithium and other elements in saline brines (formation water) associated with oil and gas reservoirs deep in the subsurface. The highest lithium concentrations have been documented by both government and industry to occur in Devonian-age units, specifically the Beaverhill Lake (Swan Hills), Woodbend (Leduc and Duperow), Winterburn (Nisku) and Wabamun groups/formations.

Although many large and small operators have acquired metallic and industrial mineral rights across the WCSB, only operators E3 Lithium in Alberta, as well as Prairie Lithium, Grounded Lithium and Hub City Lithium in Saskatchewan have spudded new wells to characterize the lithium resource on their permits.

Helium

The dominant isotope of helium is sourced from the radioactive decay of uranium (U) and thorium (Th) in the Earth's crust. Basement rocks and cratons of Proterozoic- and Archean-age are predominantly metamorphic or granitic and contain elevated concentrations of U and Th, which provide a helium source. Once generated, the helium migrates from these source rocks into overlying reservoirs, which often drape Precambrian structural closures, and are overlain by tight sealing caprocks.



Helium exploration and development is most advanced in Saskatchewan, where several operators are active in multiple areas across the southern part of the province. These operators include North American Helium, Royal Helium, Canadian Helium, and the Weil Group. North American is the most active driller (over 50 wells) and has the largest helium land position in Canada. The company recently brought its sixth helium production facility into service.

In Alberta, multiple 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, Royal Helium has drilled three wells in the Princess area of south-central Alberta, and Global Helium recently spudded a well near Medicine Hat. Avanti Helium is successfully developing helium prospects in Montana.

Geothermal

Geothermal projects are also progressing in the WCSB. Tu Deh-Kah in the Fort Nelson area of NEBC is proceeding with the design and permitting of an electrical generation facility. In Alberta, FutEra Power has partnered with Razor Energy in the Swan Hills in a cogeneration pilot (geothermal and natural gas). Alberta company Eavor has begun construction of an Eavor-Loop in Geretsreid, Germany for heat and power. Saskatchewan operator DEEP has confirmed a geothermal resource in southeastern Saskatchewan and is now starting the first phase of a 30 MW geothermal power project.

Carbon Capture and Sequestration (CCS)

Alberta is issuing carbon sequestration rights through a competitive process that enables the development of carbon storage hubs. A carbon storage (sequestration) hub is a volume of pore space managed by an operator that can effectively plan and enable carbon sequestration of captured carbon dioxide (CO₂) from various emission sources.

There have already been two application rounds; six successful applicants for the first, located in the Industrial Heartland area of central Alberta. A second competition, with 18 successful applicants, was held to provide carbon storage services to regions across the rest of the province not covered by the first process. A third round is currently underway, accepting tenure applications from small-scale and remote carbon sequestration proponents for scenarios that may not be met through a hub.

Biography



W. Steven Donaldson is a professional geologist (P.Geol.) with 24 years of experience and is currently a Senior Geologist with Canadian Discovery Ltd. (CDL). Here he writes articles for the Discovery Digest publication with a recent emphasis on low carbon opportunities and clean technology. Steve earned his Ph.D. and B.Sc. Honours degrees in Geology from Western University in London, Ontario.

