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Helium in Alberta – Bringing a Critical Commodity On Stream

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Introduction

The helium industry in the Western Canada Sedimentary Basin has evolved from a few producing wells near Swift Current in the 60s and 70s, followed by little activity for several decades, to an exciting and rapidly-growing business with a number of new players within the past decade.

Today, the Canadian helium focus remains in southern Saskatchewan, where first production happened 50 years ago. Several companies, led by North American Helium and Royal Helium, have pursued helium prospects in Cambrian sandstone and Devonian carbonate reservoirs associated with structural features on the Precambrian basement. Helium has been tested in a number of locations, and production volumes are growing rapidly (Yurkowski, 2021).

The Move to Alberta

After the initial rush in Saskatchewan, explorationists turned their attention westward to Alberta, seeing opportunities to extend Saskatchewan exploration models westward and to develop new play ideas as well.

Thor Resources was an early mover in southern Alberta, producing helium from a location offsetting old helium shows on the northeastern flank of the Sweetgrass Hills. Systematic exploration over broader areas of southeastern Alberta began in 2018, led by Imperial Helium, a 100% owned subsidiary of Royal Helium, and Avanti Helium prospecting for basement structures like those in Saskatchewan. Imperial discovered a new field at Steveville, while Avanti focused their exploration activities just south of the Montana border. Other competitors have joined the game and activity is accelerating.

However, southern Alberta exploration was hindered until recently by questions around land availability. Crown P&NG rights in Alberta include oil and gas, helium, and pore space ownership for waste disposal and CO_2 sequestration. For a period of time, the Crown did not allow rights below the Leduc Formation to be posted, reserving them for possible future sequestration operations. This issue appears to have been resolved, as large lease blocks have been posted for auction in the Skiff – Foremost area in early 2023.

"Green" Helium vs "Grey" (?) Helium

Helium produced in Saskatchewan has been labelled "green" helium, as it is extracted from gas streams composed largely of inert gases – primarily nitrogen and carbon dioxide – lacking in hydrocarbons. Green helium also occurs in southeastern Alberta in the deep Paleozoic section of the northwestern Williston Basin, which is isolated from conventional source rocks above by mid-Devonian evaporites, and is instead charged primarily by inert gases originating in the basement.

However, helium in most parts of the world is co-produced with hydrocarbons – which we could call “grey” helium, taking a page from the hydrogen colouring book. Helium shows in the remainder of Alberta are invariably associated with hydrocarbons, including First Helium’s discovery at Worsley on the northern flank of the Peace River Arch.

Some investors not wanting to be associated with oil and gas favour green helium over grey, thus impacting the potential investor pool for Alberta prospects outside the Williston Basin.

Steveville – Discovery and Development

Sound geological detective work led to the discovery of helium at Steveville, about 30 km northeast of Brooks. Regional geological mapping defined several high-quality and relatively continuous carbonate reservoirs within the Leduc through Ordovician Red River section. The basal Cambrian sandstone section is not as well developed as in Saskatchewan, and reservoir quality is variable in the relatively few basement penetrations.

Intensive mapping of legacy seismic data defined a subtle structural closure at the Cooking Lake level, although individual reservoirs in the underlying Beaverhill Lake cannot be distinguished. The clinching evidence was actually found on the front page of the Calgary Herald on March 8 1940, describing a huge blowout from Standard Oil Princess 13-22-20-12W4, flowing a 50 MMCF/D gas stream consisting largely of nitrogen and other inert gases. Imperial drilled and tested the modern discovery well immediately offsetting the blow-out and drilled two additional wells, defining sufficient reserves to justify putting the pool on production.

Current mapping shows the Steveville pool defined on seismic tied to modern well control as a distinct structural closure (Figure 1).

At the discovery well 03/10-22-20-12W4, two lower Beaverhill Lake reservoirs Imperial calls the Blow-Out Zone (BOZ) and Sub-Salt Zone (SSZ) tested high-rate gas on long-term production tests.

Cores of the reservoir intervals at offsetting locations show moderate to good reservoir quality in recrystallized dolomites variably degraded by evaporitic cements (Figure 2). Evaporite-rich regional Beaverhill Lake strata deposited in shallow restricted settings provide excellent seals, sufficient to trap helium. The Davidson Salt, a two- to three-metre thick halite-rich interval lying between the BOZ and the SSZ is most consistently developed.

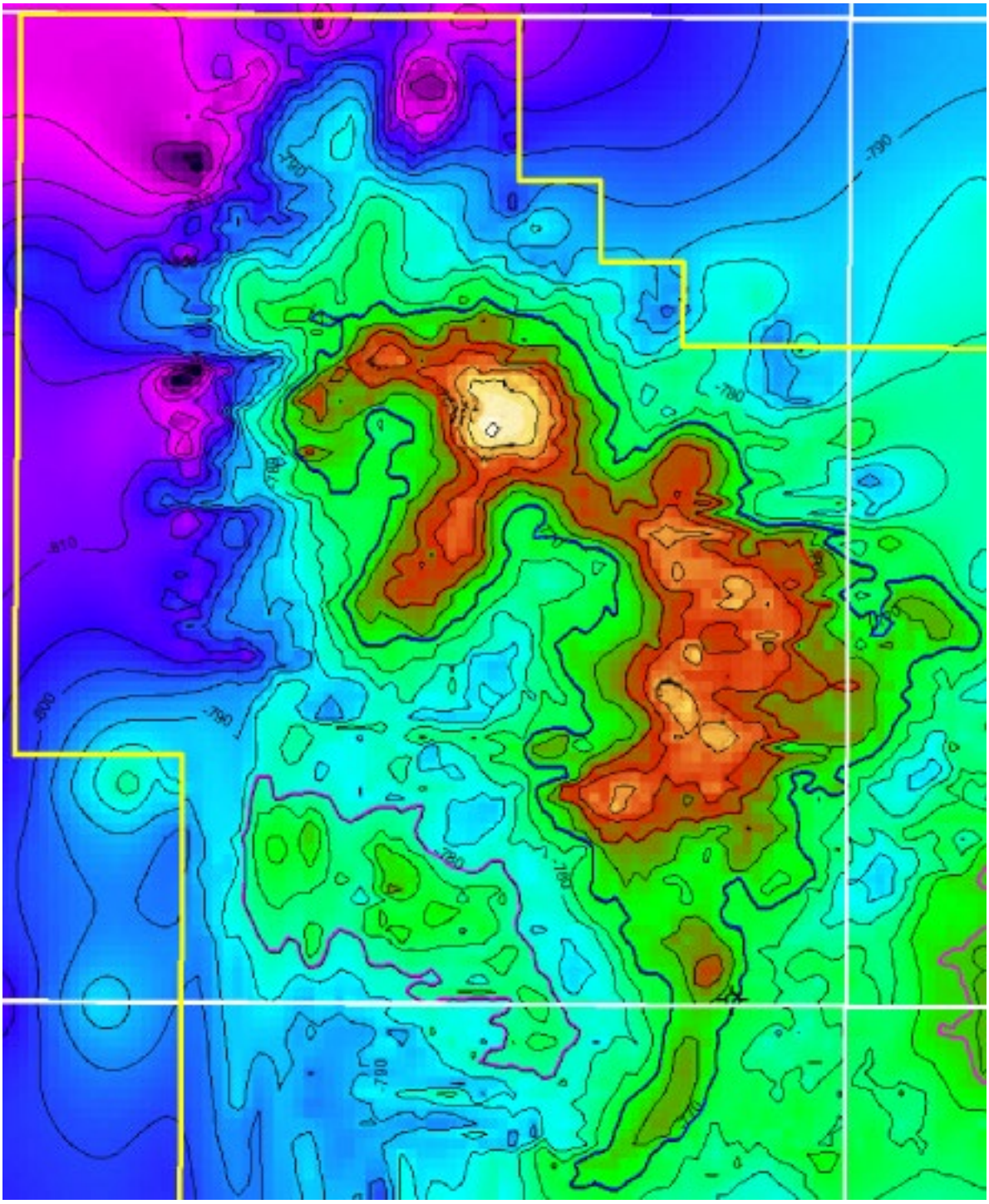

Figure 1. Structure map on top Beaverhill Lake. Red colours define the Steveville helium pool.

Figure 2. Interbedded porous recrystallized dolomite reservoir with tight anhydritic intervals in lower Beaverhill Lake pay

Steveville – Facilities and Production

Steveville is an isolated discovery at this time, lying 200 km north of Thor's helium pool at Knappen, and 270 km west of the closest Saskatchewan helium production. So while the Steveville area is densely developed for conventional shallow gas production, Royal Helium will be building a stand-alone helium extraction facility to service the planned 15 MMCF/D raw gas production. Construction is underway, and Steveville is scheduled to be producing high-purity helium in the second quarter of 2023.

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References

Yurkowski, M.M., 2021. Helium in Southern Saskatchewan: Geological Setting and Prospectivity. Saskatchewan Geological Survey Open File Report 2021-2.