geoconvention
Virtual Event
September 13 - 15
2021

Helium 101 – A Lightweight Application of Subsurface Skills

Brad J. Hayes, Petrel Robertson Consulting Ltd.

Introduction

Helium is a key commodity with important applications in many areas of our modern high-tech economy. In fact, Natural Resources Canada recently listed helium as one of the 21 Critical Minerals – essential to Canada's economic security, and required for Canada's transition to a low-carbon economy.

What makes helium so critical? Its key properties – an inert, non-toxic gas that is lighter than air, with a very small molecular size and the lowest boiling point (-272^{o}C) – are important in many applications, and cannot be replaced effectively by any other substance. Controlled environments for high-tech manufacturing, super-cooling for advanced devices such as MRI scanners, lifting, and pipeline / pressure vessel leak detection and purging are leading applications.

World Markets

The United States used to regard helium as a strategic commodity, and maintained a large inventory that exerted control on world markets. However, the U.S. strategic reserve has now been blown down, and continually-increasing global demand has exposed users to the possibility of shortages. Additional supply from countries with minimum geopolitical risk – a status that Canada still enjoys for many non-petroleum commodities – is highly sought after, opening the door for helium exploration and development in western Canada.

Helium Exploration and Development

Helium occurs in small amounts in gas reservoirs, so exploration is very similar to natural gas exploration. We use our subsurface geoscience skills to assess the same risk factors – source and migration, reservoir, trap and seal. The only big difference is that helium source rocks contain radioactive elements that break down with the emission of an alpha particle – which is a helium nucleus. Thus, source rocks are commonly crystalline basement rocks containing uranium and thorium, instead of organic-rich shales. We also look for very effective seals, ideally evaporites, as very small helium molecules are not effectively trapped by conventional shales and other fine-grained low-permeability rocks.

Because helium occurrences rely on radioactive source rocks, the best shows are often deep, close to the crystalline basement. Other non-hydrocarbon gases such as nitrogen and CO_2 are commonly associated, and in extreme cases methane and natural gas liquids are only minor components. Even a rich helium accumulation is only 1-2% helium, with 0.3% being a common rule of thumb as a minimum economic limit.

The Western Canada Sedimentary Basin is an excellent helium exploration province. Our massive public petroleum databases are ideal for locating helium shows and mapping prospects

(Fig. 1). Helium was produced in Saskatchewan in the 1950's, and significant exploration programs by private operators are now yielding new production. More private operators are working behind the scenes and new ideas and assets are being announced regularly.

Explorers around the world are looking for helium to meet the huge anticipated demand. But as always happens, we are seeing more dubious schemes come out of the woodwork. Exploration is being promoted on the basis of surface shows and other sketchy criteria, without proper regard for fundamental geoscience-supported exploration strategies. The skills geoscientists have learned over decades of petroleum exploration will ultimately bring success in the helium game.

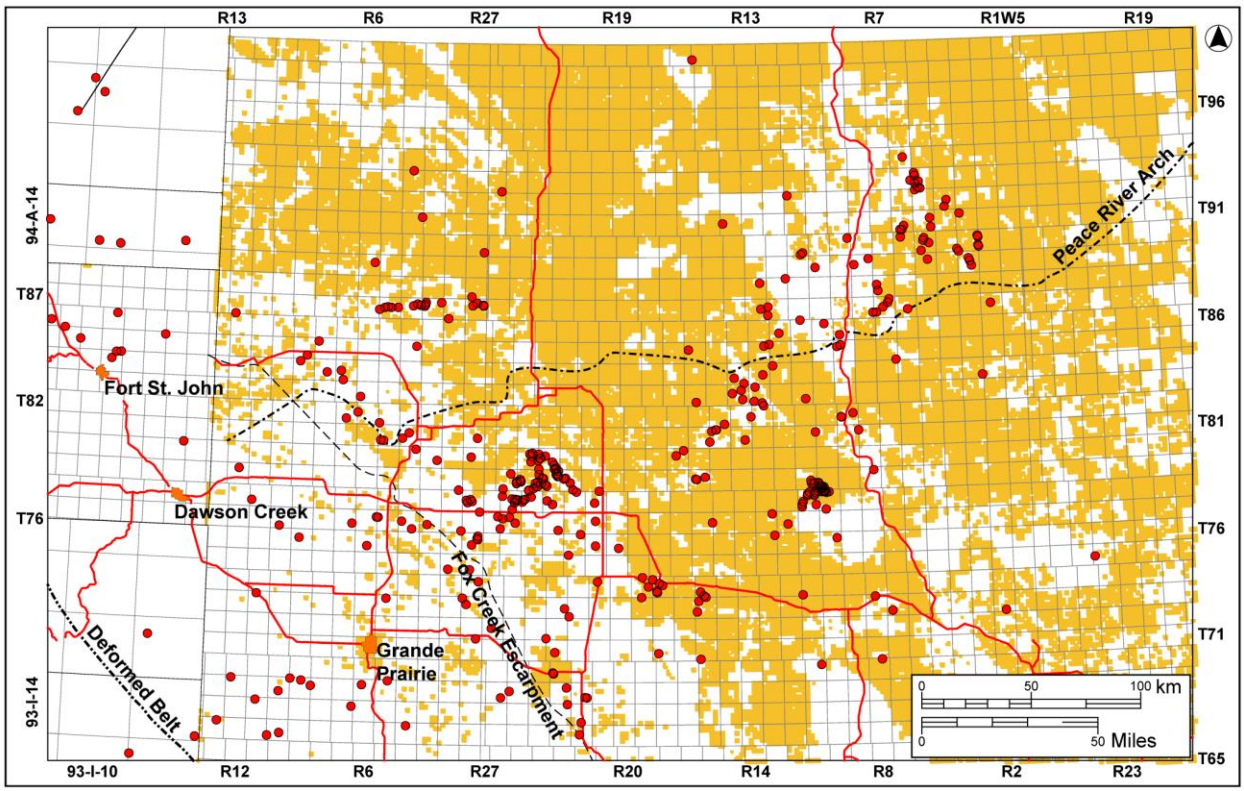

Figure 1. Helium shows in west-central Alberta and adjacent British Columbia

Acknowledgements

I am very grateful to the founders and investors in First Helium, Imperial Helium, and Alpha Helium for engaging Petrel Robertson Consulting in exploration for and appraisal / development of new helium resources in western Canada. I would also like to thank Kain Michaud for his pioneering ideas that turned our skills to helium exploration.