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Helium Fallacies? Ten assertions are examined to explain the truth behind the hype

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Summary

Helium is a key element in the energy transition. The world's supply of helium is running out. New helium discoveries have changed the script. Helium concentrations need to be more than 0.3% to be pay. Helium plays exist in Alberta and can be economic.

Helium is one of the buzzword topics of the 2020s energy scene. Many articles have been written on this gas, yet the same phrases pop up again and again – see above. But how true are these statements? Ten key "facts" about helium have been chosen to shed some light on the helium gas industry, whether supplies are really running out, how to explore for this gas, where you can expect to find it and whether discoveries are likely to be commercially viable.

Question 1 Is helium a key element in the energy transition?

Helium-3 is a light, non-radioactive isotope of helium with two protons and one neutron. Although it's relatively rare on Earth, it is believed to be abundant on the moon's surface, where it is deposited by solar winds. It is also a potent energy source, but makes up only 2 parts per million compared to helium-4. This paper will concentrate on Helium-4 (radiogenic helium), which is far more common and of much greater interest economically. However Helium-4 is not considered a viable alternative source of energy at this time.

Question 2 What is helium used for?

Because it is very unreactive, helium is used to provide an inert protective atmosphere for making fibre optics and semiconductors, and for arc welding. Helium is also used to detect leaks, such as in car air-conditioning systems, and because it diffuses quickly it is used to inflate car airbags after impact. Its most important use is in MRI (magnetic resonance imaging) due to its very low boiling point. It is also used in high-speed Internet services, computer chips and hard drives. It is used for cleaning rocket fuel tanks and in microscopes. Less than 10% of helium production is used to inflate balloon animals.

Question 3 Is helium running out? Should we be boycotting balloon animals?

Most of the helium trapped in the Earth started off as a different, heavier element. Exposure to radioactive elements, such as uranium or thorium, led to the decay of other nearby elements. Helium is formed during this process and will leak off the Earth, due to its extremely light mass, unless trapped underground.

The US has sold off its stockpile of helium but, because helium is sourced mainly as a byproduct of natural gas, the increase in gas production has meant that we are producing more and more helium. In addition, the recycling of helium has improved, retaining more helium rather than it dissipating in the atmosphere. The Earth's reserves of helium are plentiful and production could potentially be increased significantly should demand increase.

In 2017, around 165 MMm3 of helium were produced, with 55.3% from the US (mainly from the Cliffside Helium Reserve in Texas); 23.2% from Qatar; and 10.6% from Algeria. Russia, Canada, Poland and Australia produced from 2 to 4% each.

Question 4 Where are the world's existing helium reserves?

The short answer is the US, Algeria, Qatar and Russia. The US held the whip hand in the 20th Century, with significant reserves concentrated around the Texas Panhandle, an area that made up the National Helium Reserve until the government's decision to sell it off in 1996. At that point the reserve held around a billion cubic metres of the gas.

Algeria produces helium as a byproduct from the giant Hassi R'Mel gas field, reported to have up to 0.19 percent helium. New fields have been added to the inventory of around 37 MMm3. Qatar produces helium from the world's largest gas field, the North Field. While the concentrations are low (around 0.04%), the helium is economic as a secondary product. The LNG process helps to separate the gases. Russian fields are generally low in helium, but discoveries like the Kovykta Field in Siberia may exceed 0.6%. It is believed by some (Russian) authors that Russia will dominate the market in the coming decades, while others think that the US will continue to rule the market.

Question 5 Have new helium discoveries allayed fears of a global shortage?

A series of new helium discoveries have reduced concerns of a global shortage. A huge find in the Tanzanian East African Rift Valley in 2016, initially estimated at more than 54 Bcf, could meet global demand for several years. The helium deposits are situated near Lake Rukwa in Tanzania's Rift Valley region. Volcanic activity in the Rift Valley releases helium buried in ancient crustal rocks, which then rises up and becomes trapped in shallower gas fields. The discovery is based on British survey reports of high gas content made in the 1950s. Further work indicates that the reserves may be double the earlier estimates.

Another "discovery" was made in South Africa, where Archean gold bearing deposits often contain anomalously high uranium concentrations. Decay of this element yields helium, which is commonly dissolved in groundwater and transported towards the surface along faults. Conctrations may reach

Question 6 Is 0.3% helium enough to be pay?

Many publications indicate that a helium concentration of 0.3% is enough for a gas field to be commercially viable. However common sense dictates that this would depend on the productivity of the wells. The truth is that 0.3% or more of helium renders it the most valuable component, exceeding the value of the associated natural gas production. In at least one field, extracting the helium present at 0.04 percent concentration has proven economically feasible.

Question 7 Is helium common in gas reservoirs?

Studies of gas samples from gas fields in the US show that more than half of all gases contain < 0.1% He. Only 17.6% of all gases contain > 0.3% He and some gases substantially more. The major natural gas reserves, with economically interesting helium content (> 0.3%), are concentrated in the midwestern United States (Texas, Kansas, Oklahoma). High nitrogen reservoirs, with higher He content, occur in Colorado, New Mexico, Utah and Arizona.

Question 8 How can you explore for helium?

The standard method is to sample produced gas from gas fields to see if helium exceeds 0.1%. The second method is to drill adjacent to known helium accumulations. This approach is somewhat haphazard at best.
A second approach is to treat helium as a hydrocarbon resource. Mapping out the major play elements required to generate a helium resource would include: granite basement; evaporite seal; host gas fields. Mapping out each of these elements and overlaying the maps should indicate the common risk segments i.e. those areas with common characteristics. The most prospective areas will have the highest Chance of Success (COS).

What may be a more robust methodology is to consider how helium forms. Generally, helium is generated in areas where Precambrian (Archaen ideally) granites and metamorphic rocks occur beneath them. Helium is liberated from thorium and uranium decay. It then needs to be transported and trapped. Helium is often (but not always) associated with high nitrogen values. Hence seeking ancient granitic basement, or extraordinary occurrences of uranium, may be a better predictor of high helium potential than gas field sampling. Such exploration can be supplemented by re-examining old reports.

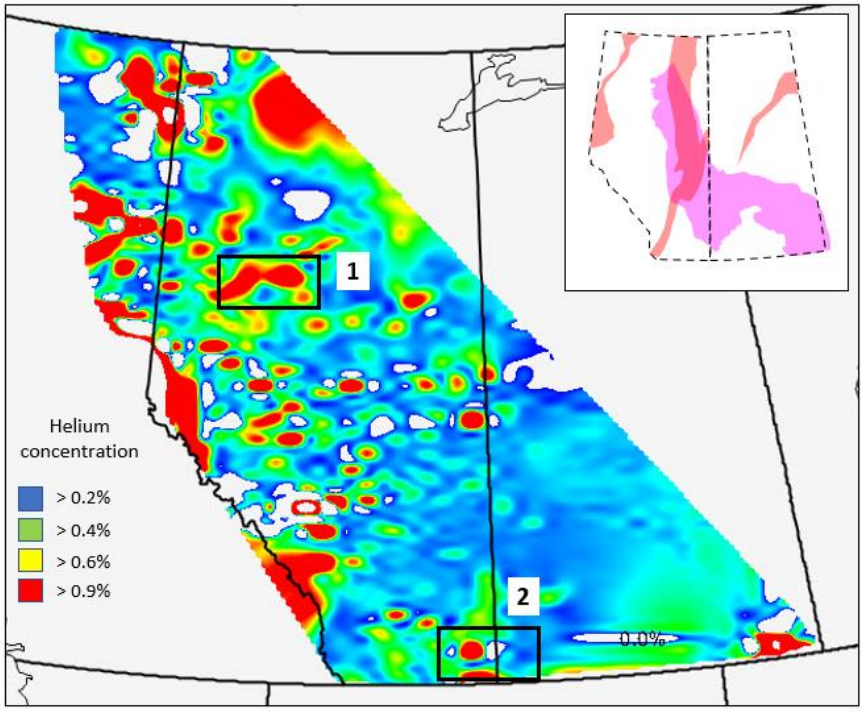
Question 9 What is the potential yield of helium from granites?

Published data indicates that around 360 cm3 of helium is produced per cubic metre of magmatic rock every million years. One gram of thorium produces 24,600 atoms of He; one gram of uranium

around 103,000 atoms. Annually around 1125 x 10E30 He atoms are created in the mantle and crust, of which 7 x 10E30 He atoms escape to the atmosphere. Helium is constantly accumulating in the crust.

Question 10 Is there helium potential in Alberta?

Helium is already being produced in the Medicine Hat area, and further wells targeting helium are planned in the region. Much of the production is owned by the City. A project was undertaken in 2018 to map out the potential reserves across the Province, using gas analyses from existing well data. This identified a second potentially economic accumulation in the Seal Field in Peace River, with helium hosted in Devonian sediments underlying the main oil sands reservoir interval. The map shows many other potentially economic helium concentrations.



Map from Noad and Santos 2018

Conclusions

While many commercial discoveries have yet to be made, the market is not suffering a shortage of helium Prices are relatively stable now that the US reserves have been sold (for the most part). Alberta holds significant potential as a major helium producer.

Acknowledgements

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