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Hydrogen (H2) and CO2 storage potential, Lotsberg Formation, Alberta

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Summary

The Lotsberg formation in Alberta, Canada, had been identified as a candidate for large-scale hydrogen storage. The Lotsberg Formation is a laterally extensive evaporitic formation of the Lower Devonian, extending through east-central Alberta. The evaporitic salt consists of an upper and lower unit, having an approximate thickness of 120 meters, and in the Bruderhiem area, overlies the Basal Red Beds The Lotsberg is overlain with anhydrite and interbedded shales. A cavern has been created using solution mining, with an estimated volume of 335,000 cubic meters and is currently filled with brine. Given the depth, the stable tectonic environment, and the proximity to infrastructure, we believe this formation is a prime candidate for large-scale and long-term hydrogen storage. In this study, the suitability for Hydrogen storage requires more stringent geological conditions when compared to crude oil, natural gas, or CO2. We will evaluate the Lotsberg Formation salt cavern itself, the cap rock, and the geological conditions of the surrounding area.

Method

The salt cavern was created using solution mining (Figure 1.). The top of the cavern is at a depth of 1770 meters and is capped by impermeable anhydrite and shale. The salt is contained within a stable tectonic system, therefore has not been subject to any major faulting or salt diapirism. The volume of the cavern (now filled with brine) is 1.5 million barrels (240000 cubic meters). The salt cavern can be expanded in volume with additional solution mining.

Observations

There are existing hydrogen storage facilities in Keil, Germany, and Spindletop, Texas. Both these facilities have removed salt by solution mining. They are both situated within salt diapers; care must be taken to not breach the cap rock, and pressures must be monitored to ensure salt or overburden movement,

The Lotsberg Formaion at Bruderheim differs from these previous examples in that the salt has not been subject to post-depositional movement. The caprock consists of anhydrite and shale, impermeable to gas movement.

Additive Information

Given the hydrostatic gradient pressure and downhole temperature, the cavern has an estimated storage volume of 63 million cubic meters (at hydrostatic pressure).

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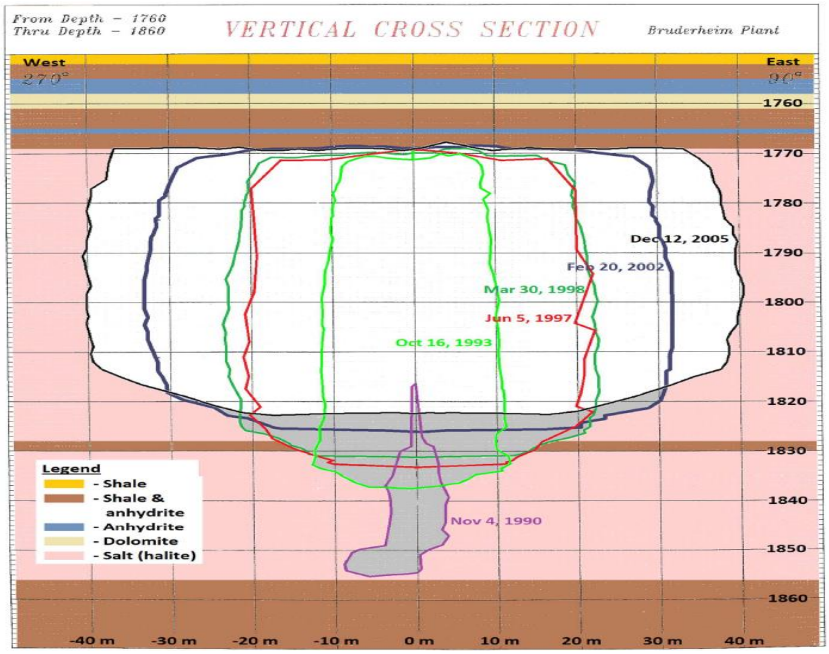

Figure 1. Sidescan sonar plot of the existing salt cavern, 09-33-55-20W4. The colored lines indicated the progression of the cavern growth.

References

Bayerisches Staatsministerium für Wirtschaft Verkehr und Technologie (2001) Rohstoffe in Bayern, BayStMWV, Munich

Grobe, M. Distribution and thickness of salt within the Devonian Elk Point group, western Canada sedimentary basin. Earth Sciences Report 2 (2000): 1-12.

Alexander, Alexi Shkarupin, and Karen Sharp. "Geologic feasibility of underground hydrogen storage in Canada." International Journal of Hydrogen Energy 45, no. 56 (2020): 32243-32259.

Meijer Drees, N. C., 1986, “Evaporitic Deposits of Western Canada,” Geological Survey of Canada Paper 85-20, 118 p.

Texas Water Development Board (2006) Report 365 – Aquifers of the Gulf Coast of Texas, http://www.twdb.state.tx.us/publications/reports/numbered_ reports/doc/R365/Report365.asp

Wackerl, Jürgen, Martin Streibel, Axel Liebscher, and Detlef Stolten. "Geological storage for the transition from natural to hydrogen gas." *Transition to Renewable Energy Systems* (2013): 629-657.