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Linking Laboratory Fracture Behavior to Field-Scale CO_2 Injection at Aquistore

Noga, Vaisblat
NRCan - Canmet Energy

Jakob Brandl, Richard J. Chalaturnyk
University of Alberta

Summary

Since 2015, the Aquistore CO_2 storage site in southern Saskatchewan (Fig. 1a) has been injecting CO_2 that is captured from the nearby SaskPower coal-fired power plant. CO_2 is injected into multiple zones within the Cambro - Ordovician Deadwood and Winnipeg formations and to date (as of January 2026), approximately 680 kt of supercritical CO_2 has been injected at rates that have varied over time and currently average about 50 tons of CO_2 per day.

The Aquistore site comprises an injection well and an observation well, spaced 150 m apart. The injection well is perforated over four perforation intervals, all characterized by low gamma-ray responses, indicating a clean reservoir (Fig. 1b). Repeated pulsed neutron decay (PND) surveys between 2015 and 2018 show that CO_2 predominantly enters one particular perforation interval (Hawkes and Sohail, 2019). Spinner logs acquired in 2015 indicated roughly equal CO_2 distribution between perforation 2 and perforations 1 and 3 combined, whereas the 2019 spinner log showed that approximately 90% of the injected CO_2 was entering perforation 2, highlighting an increasing concentration of flow into this interval over time.

Part of the preferential flow into the second perforation is attributed to salt precipitation in the wellbore, which nearly completely blocked the lowermost perforation (perforation 4) (Talman et al., 2020). This interval was initially considered to have the highest reservoir quality at the start of injection. However, the reason the second perforation is overperforming to such an extent remains unclear.

Theory / Method / Workflow

Minimal core was recovered during drilling of the Aquistore wells, and only two sidewall plugs were collected at the depth of the second perforation from the injection well. The nearest well with core from the interval of interest is the Deep Project geothermal well (DGW), located approximately 25 km southwest of the Aquistore site. The DGW provides continuous core coverage across the entire Deadwood–Winnipeg interval. Previous studies interpreted the Cambro - Ordovician succession in the Williston Basin as having been deposited in a shallow, open-marine environment, suggesting that stratigraphic variability between the Aquistore and DGW may be limited. This interpretation is supported by machine-learning–driven geophysical modeling that indicates lateral stratigraphic continuity across southern Saskatchewan (Vaisblat et al., 2022).

Detailed core description of the DGW core revealed the presence of a cemented fracture network within the interval corresponding to the Aquistore second perforation. Investigation of sidewall

plugs and cutting samples from the Aquistore well suggest similar fractures exist in Aquistore, but the data (cutting size and image quality) is of low quality and inconclusive.

With the assumption that the fractures do exist in the Aquistore well, this study evaluates the contribution of local stresses, injection pressure, fracture opening pressure and thermal cooling effects on injection performance. To evaluate near well-bore fracture opening pressure intact samples, as well as samples containing fractures were hydraulically fractured in the lab. Results were incorporated into a 1D earth model and compared with injection CO_2 pressure.

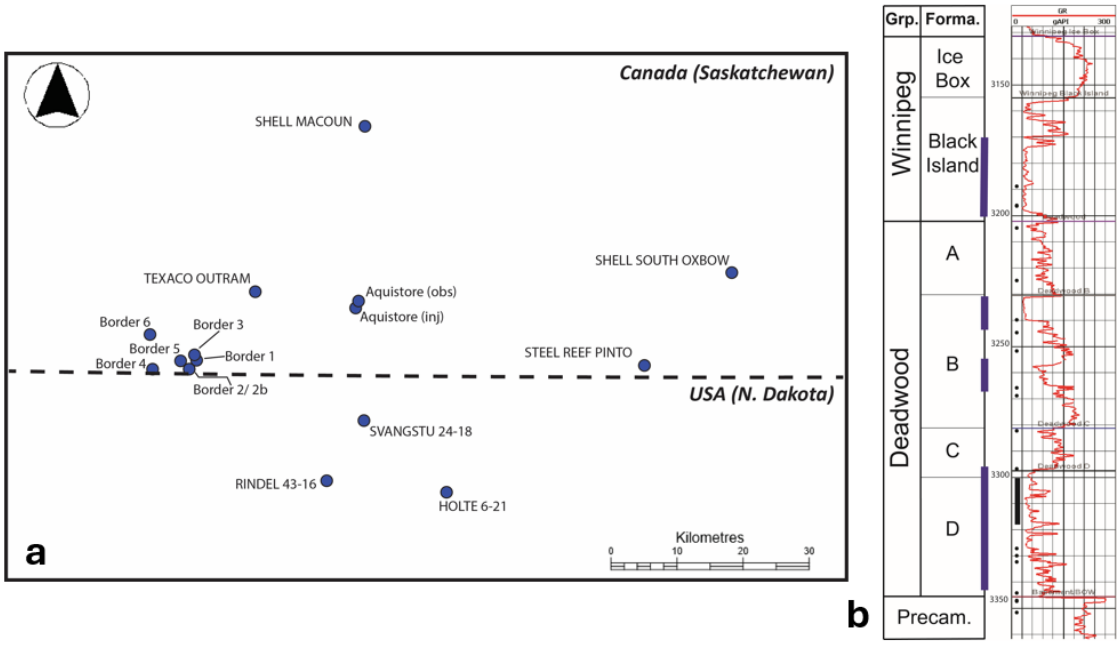


Figure 1 The Aquistore and Deep Project. (a) Map of southern Saskatchewan showing the location of the Deep Project wells (border wells) and the Aquistore wells. (b) Stratigraphic column of the project target formations (left track). Purple lines indicate the locations of perforations in the Aquistore well, numbered from 1 (top) to 4 (bottom). The Deadwood subdivision is informal and shown as used internally within the project. The gamma-ray log and locations of the core (black line) and sidewall plugs (black dots) are shown in the right track. Note the low GR signature of the perforated zones.

References

- Hawkes., C. and Sohail. G. (May 2019). Interpretation of CO_2 Saturations in the Aquistore Observation Well using Pulsed Neutron Logs. Williston Basin Petroleum Conference, Regina, May 29, 2019 to May 29, 2019.
- Talman, S., Shokri, A. R., Chalaturnyk, R., & Nickel, E. (2020). Salt precipitation at an active CO_2 injection site. *Gas injection into geological formations and related topics*, 183-199.
- Vaisblat, N., Deisman, N., & Chalaturnyk, R. J. (2022, October). Petrophysical and Thermo-Hydro-Mechanical Study of a deep hypersaline CO_2 reservoir. In *Proceedings of the 16th Greenhouse Gas Control Technologies Conference (GHGT-16)* (pp. 23-24).