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Geothermal Risk Mitigation through CO_2 Storage

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Summary

As a cost competitive zero-emission source of energy production, geothermal projects need to address the risks associated with exploration and early phase development. We present carbon sequestration as a value-added component of a geothermal project, reducing early phase exploration risk and stimulating more investment. By incorporation of carbon sequestration in geothermal projects, it is hoped that early and middle phase investment will be triggered to bring projects to successful commercial fruition. The research is focused on the challenges and issues revolving around co-injection or alternate injection of CO_2 and brine in disposal wells or multiple completions of subsurface formations in Western Canadian Sedimentary Basin (WCSB).

To begin, we defined an area of interest and looked at wells that penetrated deep formations (e.g. Leduc reefs or the Duverney) to identify potential target reservoirs for geothermal energy production and CO_2 storage. The area of focus is around the Alberta No. 1 project area in the Municipal District of Greenview (Figure 1; Hickson et al., 2021). The project is partially funded through the Emerging Renewable Power Program administered by Natural Resources Canada.

We built a petrophysical model based on downhole well logs from the Alberta No.1 well and the selected surrounding wells in the region. We used different well-log analysis to determine rock types end-members and checked the availability of core data in the region for a more refined calibration of the model to cores in a few wells.

After performing data quality check and depth adjustments in some of well logs, the acquired data were imported into a Petrel model. We picked our well tops in the zone of interest and checked the model against the publicly available model from the AER. We used this calibrated geological model as the framework needed for the regional flow model.

Based on our previous experience with CO_2 storage in saline aquifer and deep geothermal projects in WCSB (e.g. Hau et al. 2021; Movahed-Zadeh et al. 2021; Rangriz-Shokri et al. 2019), we explored multiple scenarios of integrating CO_2 storage and geothermal energy production, and investigated the performance of CO_2/brine injection at reservoir and multi-well scales using commercial reservoir simulator (CMG-GEM). These include injection of only CO_2 or brine in wells, co-injection of CO_2/brine in wells, and alternate CO_2 and brine injection in wells. The results help to assess the impacts of multi-horizon injection, reservoir compartmentalization for CO_2/brine, reservoir pressure management, injectivity/storage gain/loss, and higher injection rates in the proposed wells.

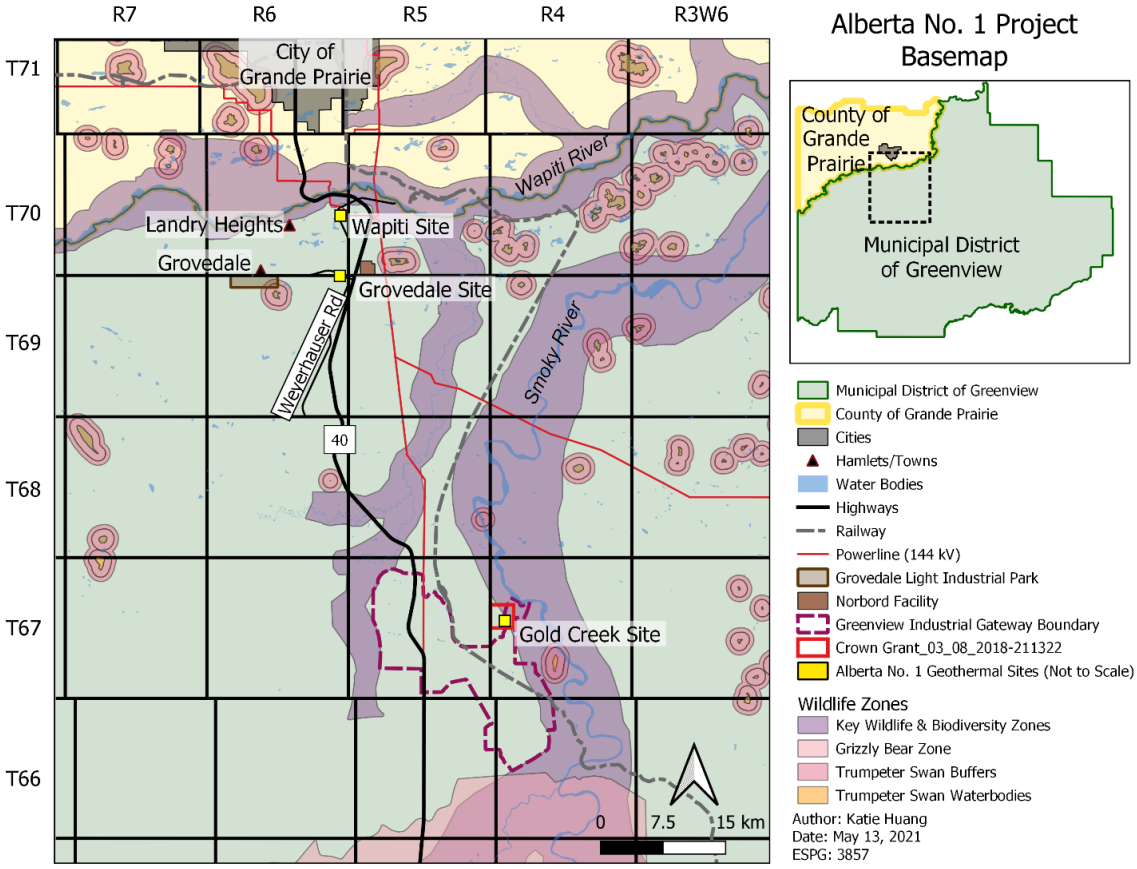

Figure 1: Alberta No. 1 project area south of the city of Grande Prairie. The project is moving forward around the Gold Creek Site, but has other options in the area.

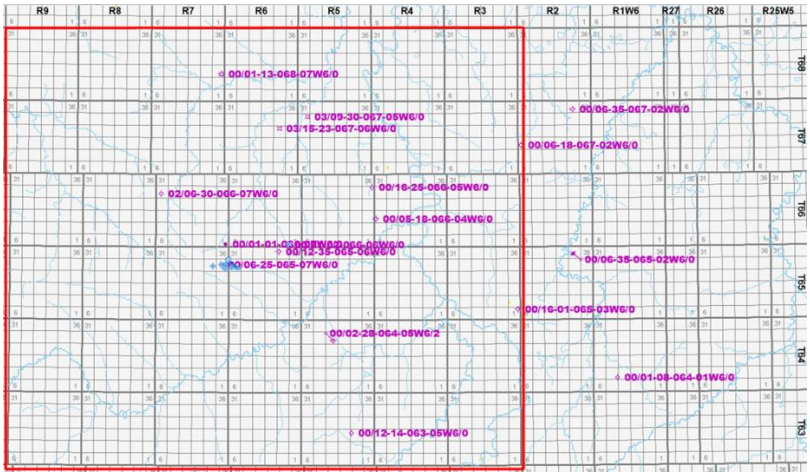

Figure 2: Area of interest to study multiple options of integrating CO2 storage and geothermal energy production; deep wells with available well logs were used to identify target horizons and to build a regional geological model.

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