Simulation of the physical impacts of large scale CO_2 sequestration (at the Aquistore injection site, near Estevan, SK)

R Safaei[a] and B Rostron[a]

[a] *Earth and Atmospheric Sciences, University of Alberta, AB, Canada*

This study represents the approaches to investigate the physical impacts of large scale CO_2 injection into the Aquistore injection site in southeast Saskatchewan, Canada. These impacts include pressure build up and brine migration in both lateral and vertical directions. To address these issues quantitatively, a two dimensional CO_2 storage model was built by using TOUGH2-ECO2N simulator to evaluate the CO_2 plume distribution, pressure build up and brine migration within the storage formations. The reservoir includes the Deadwood Formation and the Black Island Member of the Winnipeg Formation with more than 3000 meters deep consists of sandstone with some interbedded shale capped by the Icebox shale. The injection was designed through one injection well with a rate of 1000 tonnes per day for a 30 year period. In addition, a 70 year post injection period was also defined to cover a time period of 100 years. According to the results, thirty years after injection starts, the lateral pressure build up at the base of the storage is about 3.2 bar (0.32 MPa) at the injection well. The built up pressure decreased and reached the initial hydrostatic pressure at the model boundary located at 50 kilometres away from the injection well. Simulations also showed that 70 years after injection stopped, almost the entire system will reach the hydrostatic conditions. However, about five hundred meters away from the injector (correspond to the area of 0.8 km^2) will still retain a very small amount of excess pressure. The vertical pressure build up was also evaluated at different radial locations and simulation did not show any built up pressure above the Ordo-Silurian Aquifer, indicating that the pressure plume will be stopped before reaching the Prairie Formation. The lateral and vertical brine migrations were also evaluated in this study. According to the results, the brine leakage into the shallow fresh water aquifers (e.g., Belly River Formation) is very unlikely. In addition, there will be no CO_2 leakage from the reservoir into the overlying formations and CO_2 will be safely trapped under the Icebox Aquitard.

Corresponding author: saafaeif@ualberta.ca