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CO_2 Storage Atlas Norwegian Sea - a case study from the Froan Basin

Rita Sande Rød and Van T. H. Pham
Norwegian Petroleum Directorate, Stavanger, Norway (rita.roed@npd.no)

The CO_2 storage atlas of the Norwegian Sea has been prepared by the Norwegian Petroleum Directorate at the request of the Ministry of Petroleum and Energy. The main objectives have been to identify the safe and effective areas for long-term storage of CO_2 and to avoid possible negative interference with ongoing and future petroleum activity. We have built on the knowledge we have from the petroleum industry and from the two ongoing CO_2 storage projects, Sleipner and Snøhvit, on the Norwegian Continental Shelf.

Five aquifers and six prospects have been evaluated in terms of storage capacity and safe storage of CO_2. One identified storage potential is the Froan Basin Garn and Ile Formations. The Froan Basin is a NE striking Jurassic syncline on the southwestern part of the Trøndelag Platform.

The aquifers in the southeastern part of the Norwegian Sea typically have a consistent dip of 1-2 degrees from the Norwegian coast to the basinal areas. In the case of permeable beds occurring along the dip slope there is a risk that CO_2 injected down dip can migrate up to where the aquifer is truncated by the Quaternary glacial sediments.

A simulation study was performed in order to identify possible trapping mechanisms and to understand the timing and extent of long distance CO_2 migration. The storage mechanisms considered were both structural and stratigraphic trapping.

A simulation sector model of the Garn/Not/Ile Formations was build covering about 10% of the total expected communicating aquifer volume. The CO_2 injection well was located down dip, but alternative locations and injection zones have been simulated, with different injection rates. The injection period is 50 years, and the migration of the CO_2 plume was simulated and monitored for 10.000 years.

CO_2 will continue to migrate upwards as long as it is in free, movable state. Migration stops when CO_2 is permanently bounded or trapped, by going into solution with the formation water or by being residually trapped, or becoming structurally trapped (mineralogical trapping not considered).

Based on simulation results about 400 mill tons CO_2 can be stored in the Garn and Ile aquifer (8 mill tons/year over 50 years). This will require 4 injection and give acceptable pressure increase (<20bar). Within 10000 years most of the gas will have gone into solution with the formation water or being residually trapped.