Contribution ID: **229** Type: **Oral Presentation**

Numerical modelling workflow for the assessment of long term CO2 storage in saline aquifers using the Sleipner dataset

Thursday, June 3, 2021 11:00 AM (15 minutes)

CO2 injection in deep saline aquifer formations is a promising scheme to reduce the emissions of CO2 into the atmosphere. The migration of injected CO2 can be characterized as multiphase flow in porous media where CO2 displaces brine in porous reservoir rocks. The migration observed with 4D seismic data often suggests that the shape of a CO2 plume is strongly affected by thin shale layers interbedded within a target reservoir formation —impermeable shale layers often act as a flow barrier against the upward migration of CO2. To capture this migration behaviour, it is necessary to use an extremely high-resolution grid system that explicitly models thin shale layers whose thickness can be less than 1m.

Reservoir simulation software based on Darcy's law is commonly used to study the migration of CO2 at the field scale. However, the use of the Darcy simulator with a fine resolution model takes an extremely long computation time. Another approach to simulate multiphase flow in porous media is to use the invasion percolation theory (IP). This IP simulator determines percolation pathways based on the Young-Laplace relationship. Thanks to the simplification of the physics, an IP simulator is more computationally efficient than a Darcy simulator.

We show a numerical modelling workflow that uses both IP and Darcy simulator using the data obtained in the Sleipner CCS project1. First, we used an IP simulator to match the shape of the simulated CO2 plume with that observed with 4D seismic data. The use of an IP simulator made it possible to explore a wide range of parameter space of reservoir properties with an extremely fine grid system that can explicitly capture thin shale layers in the reservoir. As a result, the simulated CO2 plume distribution showed a good agreement with that obtained with the 4D seismic data. Furthermore, this history matched model was then converted to a Darcy simulator to incorporate additional physics which plays an important role in long term CO2 storage (e.g., the dissolution of CO2 in brine and the diffusion of CO2 in both gas and brine). Using this Darcy model, we performed long-term CO2 storage simulations for more than 1000 years to investigate the change in the CO2 storage mechanism over time.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

"Sleipner 2019 Benchmark Model."2020. https://co2datashare.org/dataset/sleipner-2019-benchmark-model (July 1, 2020).

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