Dynamic simulation for two aquifers in southern Sweden

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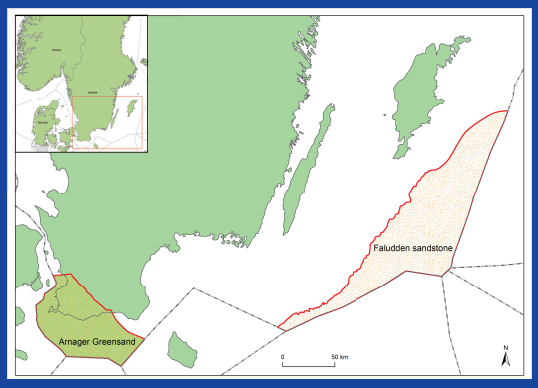
Introduction

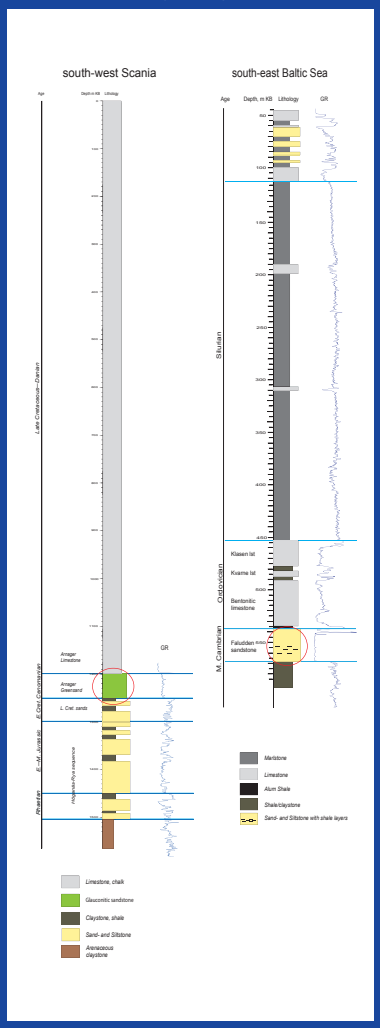
In the frame of NORDICCS, eight potential storage sites were mapped in southern Sweden. Two storage sites had sufficient amount of data to conduct dynamic simulations for injection of CO_2. The selected storage sites are the Middle Cambrian Faludden sandstone in the south-east Baltic Sea, and the Lower Cretaceous Arnager Greensand in south-west Scania and adjacent offshore area. Both units comprise regional distributed, gently dipping open saline aquifers. In one study, storage capacities for the reservoir units were modelled using the commercial software ECLIPSE 100 for reservoir simulation.



Physical parameters and estimated capacities based on the U.S.DOE for formations

Name	Depth	Thickness	Net/Gross	Porosity	Permeability	2% Capacity Mt
Faludden sandstone	830	45	0,90	14	147	745
Arnager Greensand	946	39	0,80	26	400	521

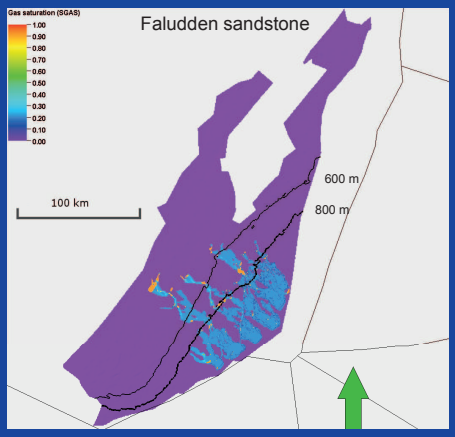
Generalized lithological logs

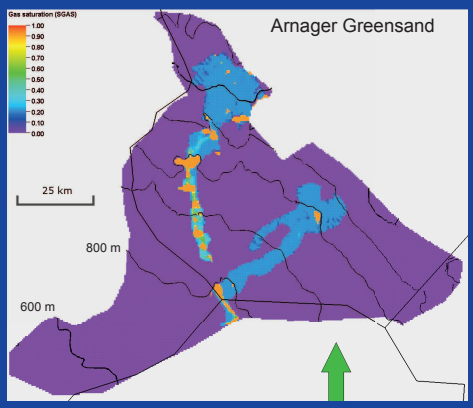


Results

In order to control the injection pressure, five water production wells were placed down flank from the injection wells in both storage units.

In the Faludden sandstone simulation, six CO_2 injection wells were placed in the deepest part of the storage unit, close to the Swedish territorial border. Two wells had injection rates of 0.5 Mt/year, four wells injected 1 Mt/year. Different injection scenarios were tested, and one injecting 250 Mt CO_2 over a period of 50 years, illustrating the migration pattern after 6000 years, showed that only a minor amount of the CO_2 migrated to areas shallower than 800 m depths.





In the Arnager Greensand simulation, a series of tests were conducted in order to optimize number and position of CO_2 injection wells and rates. This resulted in four injection wells placed in the deepest part of the storage unit, close to a confining fault zone situated to the north-east. Two wells had injection rates of 0.5 Mt/year, the other two had 1 Mt/year. The model illustrates the migration pattern after 6000 years when a total of 250 Mt CO_2 was injected over a period of 100 years.

Conclusions

Because of few structural traps in both storage units, the main trapping mechanisms were capillary trapping as residual gas and trapping by dissolution into formation water.

In the Faludden sandstone, the model indicated that most of the CO_2 migrating to depths shallower than 800 m were retained in small structural traps occurring in the north-western part of the storage site, thereby preventing further migration. In the Arnager Greensand case a small amount of CO_2 migrates across the Swedish territorial border, enlightening crossborder problematics.

Limited data due to 2D seismics and few offshore wells causes large uncertainties following modelling, and assumptions were to a high degree taken into account. In spite of this, the models are considered to be representative in relation to data availability.

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