Geological storage of CO_2 in deep saline aquifers – possibilities in Sweden

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Carbon Capture and Storage (CCS) is a technique that is considered by the European Commission to be one of many measures in order to decrease the emissions of green house gases. It comprises three stages, i.e. capture, transport and storage of CO_2.

General introduction

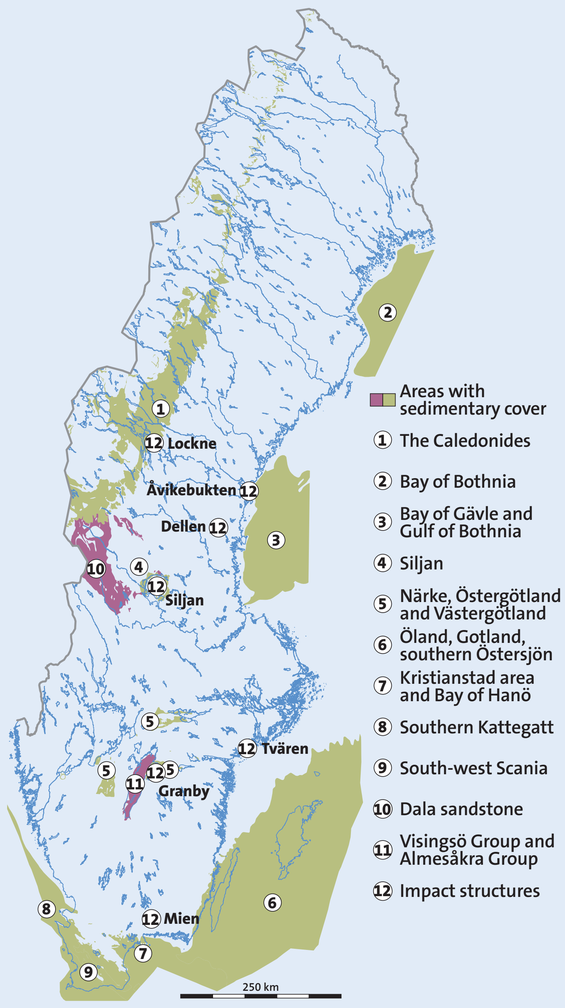
Geological storage of CO_2 is a method that aims to permanently capsule CO_2 within the bedrock. Storage size and boundaries are entirely dependent upon local geological conditions. Hence, knowledge about the geological developmental history and the physical and chemical properties of the bedrock are very important in order to ensure a safe and long term geological storage of CO_2.

Geological storage of CO_2 may include different geological environments, such as coal seams, deep saline aquifers, depleted oil and gas fields, salt diapirs and crystalline bedrock. However, only deep saline aquifers are favoured by Swedish geological conditions.

Deep saline aquifers are found within porous and permeable geological formations present several hundreds of meters below the Earth's surface. The pores between the mineral components are filled with saline formation fluid.

The CO_2 is injected through a well into the geological formation. Before injection, it has been transformed into supercritical condition and behaves like a fluid. After injection CO_2 gathers at the top of the aquifer above the saline formation fluid, and is through time either dissolved in the formation fluid or reacts with present minerals.

Swedish possibilities



In February 2011, the Geological Survey of Sweden published a report on possible storage areas in Sweden, both on and in offshore areas. The report covers areas with well preserved sedimentary bedrock, from Mesoproterozoic sandstones to Cenozoic strata.

Many areas were excluded during an early stage due to, for instance, the absence of caprocks, the potential aquifers are located too close to surface or the porosity and permeability requirements could not be met. In other areas, there is not enough available data to be able to evaluate the storage capacity.

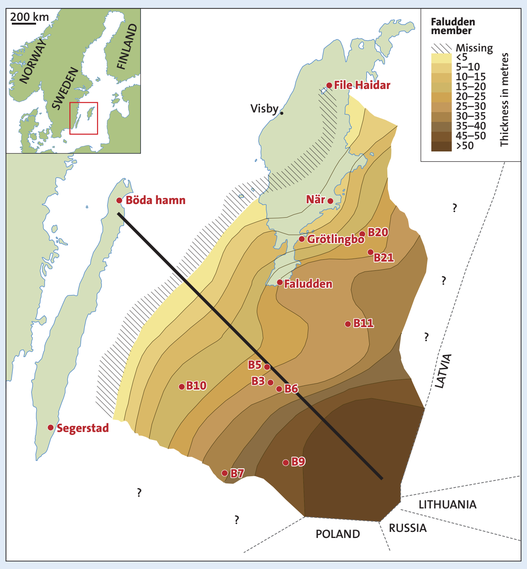
CCS Requirements

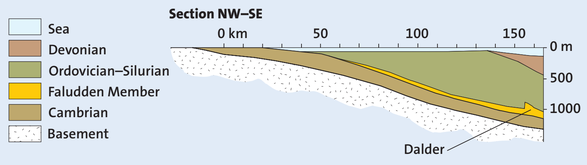
Feature	Value	Comment
Storage capacity	>100 Mt	
Aquifer depth	800–2500 m	In order to keep the CO_2 in supercritical condition
Aquifer thickness	>20 m	Relates to storage capacity
Aquifer porosity	>10%, preferably more than 15%	Relates to storage capacity
Aquifer temperature	>31,1°C	In order to keep the CO_2 in supercritical condition
Aquifer pressure	>73,9 bar	In order to keep the CO_2 in supercritical condition
Aquifer permeability	>(10) – 300 mD	Relates to storage capacity
Caprock thickness	>100m	In order to prevent leakage

Baltic Sea Basin

The geological formations beneath the Baltic Sea that may be suitable for geological storage of CO_2 are the Cambrian File Haidar Formation and Borgholm Formation, and the Faludden Member in particular. Cambrian strata dip gently towards the south-east and reach desirable depths south-east of Gotland close to the border of the economic zones of Latvia, Lithuania, Poland and Russia. There are several closed structures in this area and storage in a gently dipping aquifer may also be possible.

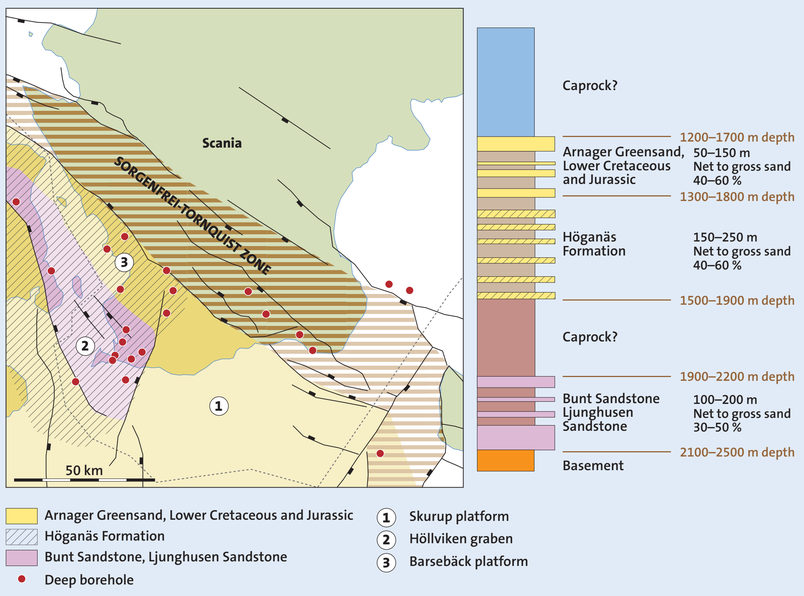
The caprock in this area is the overlying Alum Shale Formation (6 m) and Ordovician limestones (65–125 m). However, the physical and chemical properties of the caprock are poorly known and further studies are required in order to evaluate the potential of this area for geological storage of CO_2.





South-west Scania

Potential deep saline aquifers, suitable for geological storage of CO_2, in Scania are present within strata deposited during the early Triassic to the early Cretaceous. The sedimentary sequence is referred to as the Danish Basin and continues across the border to Denmark. The aquifers are present at depths between 1200 m and 2500 m below the surface. The caprocks in this area are mainly composed of clay rich limestones, mudstones and siltstones. There are no known closed structures in this area.



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