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Potential Triassic and Jurassic CO_2 Storage Reservoirs in the Skagerrak Area

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Based on a screening study for CO_2 storage in the Skagerrak area, we have focused on the Upper Triassic/Lowermost Jurassic Gassum Formation. A large shallow dipping reservoir structure has been identified in the northern Skagerrak area. The current study presents reservoir characteristics of the Gassum formation in the Fjerritslev trough and onto the Skagerrak Kattegat platform, and the corresponding reservoir model. This reservoir model is part of an ongoing interdisciplinary project with the overall goal to establish a basis for large-scale handling of CO_2 in this area, including regional CO_2 source and capture possibilities, transportation and infrastructure, possible storage sites as well as legal aspects relating to the whole CCS chain.
The shallow dipping aquifer is regionally exteded and mapped in the Norwegian-Danish Basin, the Fjerritslev trough, and onto the Skagerrak Kattegat platform, and is found deeper than 800 m below sea level. In the south the formation is affected by salt tectonics (salt pillows, diapirs), while forming gently dipping layer structures towards the north.
The Gassum reservoir consists of mainly shallow marine shoreface sandstones with associated estuarine deposits possibly deposited during sea-level low stands. Thickness of Gassum Formation from Danish wells is 70 – 220 m with sand to shale ratios between 60 - 70%. Based on the study, an injection well is proposed 50 km offshore Norway. The proposed injection depth is 2070 m with the reservoir pinch-out 38 km away towards north where the top reservoir is 117 m below the Quaternary sediments. The southern portion of the reservoir located in Denmark can be characterized from wells drilled for hydrocarbons and geothermal energy.

In order to predict the reservoir facies/parameters and to make a realistic geologic model comprising the area closer to Norway, a regional geological model based on sequence stratigraphic interpretations is imperative. Using thicknesses from seismic data a pseudo-well was generated about 50 km north of an existing well in Denmark with the objective to predict facies. A depositional model with sediments sourced from north was assumed. A 50% thickness erosion of highstand sandstones was assumed at each cycle when sea level fell during a low stand. The removed thickness was compensated by non-reservoir transgressive systems tracts sediments (possible aggrading floodplain or lagoonal sediments). As good reservoir porosities ($\sim$20%) were found in wells in the south, porosities towards north are expected to be higher due to shallower depth of burial. The sealing properties of transgressive shales overlying the low stand sandstones are also important in local trapping and lateral distribution of the injected CO_2. Furthermore the intercalation of shaly layers and permeability heterogeneities developed in prograding sand systems may provide additional trapping capacity to the reservoir. This geologic model is one of the likely scenarios that favors Gassum Formation as a potential CO_2 storage reservoir in Skagerrak area and warrant to evaluate the reservoir using other possible scenarios.