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Facies distribution, heterogeneity study and numerical 3D modeling of a multilayered Rhaetian–Lower Cretaceous aquifer succession in the Höllviken Halfgraben, SW Skåne, Sweden – assessment of suitability for storage of CO_2

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Several variably thick sandstone beds are found within a 200–300 m thick Rhaetian–Lower Cretaceous succession in the Höllviken Halfgraben. Many of these are considered as potential aquifers for geothermal energy and possibly also for CO_2 storage. One of the challenges in evaluating this potential lies within the task to assess the frequency and distribution patterns of the sandstone units in the multilayered succession. For this purpose biostratigraphic analyses, lithofacies investigations and numerical modeling have been conducted. The main part of the investigated succession along the margins of the Danish Basin, including the Höllviken Halfgraben reflects a highly dynamic coastline, which along with differential subsidence, and possible multiple sediment sources has resulted in a difficulty to correlate lithological units between boreholes. Four main lithofacies, of which one is fine-grained sandstone, are identified by use geophysical wire line logs and a few cored reference boreholes. The gradual transition between the identified lithofacies implies a genetic relation between the different facies, related to relative sea level fluctuation coupled with tectonic activity. This has, thus, yielded high degree of heterogeneity regarding distribution and frequency of the different facies. The four defined facies can be assigned to a tide dominated deltaic setting, which could further be divided into sub-environements based on proximity to the shoreline. There are only 2–3 sandstone units which have a regional distribution and that can be defined from a sequence stratigraphic analysis and correlated by use of the biostratigraphic results. The majority of beds have, however a local interfingering distribution pattern. A frequency study of the different facies in five wells indicate that the sandstone facies is more common adjacent to the bounding fault zones, thus indicating syndepositional surrounding highs generating eroded clastics entering the Höllviken Halfgraben. Relatively less sand in wells away from the main faults imply a distal position and/or a lack of accumulation space. In this study special emphasis is in building a 3D site model by using the simulation software Petrel, evaluating geostatistical data as well as stochastic simulations by using different geostatistical algorithms and evaluating the benefits in this. The primary aim has been to produce a 3D model of the distribution patterns of the different facies and the porosity. The results will be used for CO_2 injection simulation purposes in the continuing work of CO_2 Mustang (EU Fp 7 project).