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Characteristics of Lower Triassic and Jurassic reservoir and seal formations as depicted from borehole evidence in the eastern part of the North German Basin with regard to CO2 storage

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Projects on the CO2 storage potential in Europe are generally based on regional studies or local case studies. The outcome of completed EU-projects like SACS (Chadwick et al., 2008) and GeoCapacity (Vangkilde-Pedersen et al., 2009) show a considerable storage potential in western and central European onshore and offshore regions within several stratigraphic levels in the main sedimentary basins. One of these basin showing good CO2 storage potential is the North German Basin. For Germany, the Federal Institute for Geosciences and Natural Resources (BGR) developed recently, from 2008 to 2011, together with the state geological surveys a first nationwide overview of suitable reservoir and barrier rocks of the deeper subsurface based on common criteria applicable for CO2 storage. This catalogue led to an areal assessment of general formation availability, depths and thicknesses. Site specific investigations, however, are only available at a few pilot sites run in Germany and more regional and comprehensive investigations on reservoir and seal properties are still needed.
Using deep aquifers for storage both, a suitable reservoir and above laying seal rock must be available at a certain depth (below 800 m). The storage potential is in first instance dependent on the availability of the reservoir formation, its thickness, porosity and permeability. Within the North German Basin especially the Lower Triassic (Bunter Sandstone) and Lower to Middle Jurassic formations are regarded to have potentially good storage conditions.
Since the regional geologic and structural development, i.e. burial depth and subsequent compaction, as well as different paleo-environmental conditions affect the quality of reservoir and seal rocks detailed investigations are necessary for a better understanding of their spatial distribution and usability for storage. Therefore, we selected a suite of boreholes from the eastern part of the North German Basin that comprise Mesozoic formations on the one hand and that are located at different positions within the basin covering different facies domains (i.e. basin margin vs. deeper basin) on the other hand. The Bunter Sandstone formation in the deeper basin is located at depths between 3000 and 3700 m comprising shale to fine sandstones of a lake to playa lake environment compared to more shale- to silt- and sandstones from an alluvial plain to fluvio-lacustrine and eolian environment at depths between 1800 and 2300 m at the basin margin that are both overlain by the Röt salt and shale layers of a salt lake environment as a seal. The Lower to Middle Jurassic formations in the deeper part of the basin (at depths between 2000 and 2200) comprise shaly sediments from a shallow marine to shelf environment while at the eastern realm of the basin (at depths around 800 m) the sediments are more sandy from a brackish marine environment with marine shales as seal layer.
Based on a suite of geophysical logs (GR, Sonic, resistivity and density) and other available data like core descriptions the mineral content (lithology) as well as reservoir characteristic parameters as porosity, permeability and fluid content have been determined by petrophysical methods. As result of these calculations reservoir characteristics have been compared between the two different stratigraphic reservoirs (Lower Triassic and the Jurassic) together with their respective seals at the same location. Then, the properties of the same stratigraphic reservoir have been evaluated against their different position within the basin. Such rock properties as determined by our approach are necessary for future regional modelling studies that aim to assess in better detail CO2 storage conditions at various sites.

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