World Academy of Science, Engineering and Technology
International Journal of Geological and Environmental Engineering
Vol:17, No:05, 2023

Assessment of Reservoir Quality and Heterogeneity in Middle Buntsandstein Sandstones of Southern Netherlands for Deep Geothermal Exploration

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Abstract : In recent years, the Lower Triassic Main Buntsandstein sandstones in the southern Netherlands Basins have become a point of interest for their deep geothermal potential. To identify the most suitable reservoir for geothermal exploration, the diagenesis and factors affecting reservoir quality, such as porosity and permeability, are assessed. This is done by combining point-counted petrographic data with conventional core analysis. The depositional environments play a significant role in determining the distribution of lithofacies, cement, clays, and grain sizes. The position in the basin and proximity to the source areas determine the lateral variability of depositional environments. The stratigraphic distribution of depositional environments is linked to both local topography and climate, where high humidity leads to fluvial deposition and high aridity periods lead to aeolian deposition. The Middle Buntsandstein Sandstones in the southern part of the Netherlands shows high porosity and permeability in most sandstone intervals. There are various controls on reservoir quality in the examined sandstone samples. Grain sizes and total quartz content are the primary factors affecting reservoir quality. Conversely, carbonate and anhydrite cement, clay clasts, and intergranular clay represent a local control and cannot be applied on a regional scale. Similarly, enhanced secondary porosity due to feldspar dissolution is locally restricted and minor. The analysis of textural, mineralogical, and petrophysical data indicates that the aeolian and fluvial sandstones represent a heterogeneous reservoir system. The ephemeral fluvial deposits have an average porosity and permeability of <10% and <1mD, respectively, while the aeolian sandstones exhibit values of >18% and >100mD.

Keywords : reservoir quality, diagenesis, porosity, permeability, depositional environments, Buntsandstein, Netherlands
Conference Title : ICGG 2023 : International Conference on Geology and Geochemistry
Conference Location : Amsterdam, Netherlands
Conference Dates : May 04-05, 2023