DGMK/ÖGEW-Frühjahrstagung, Fachbereich Aufsuchung und Gewinnung
Celle, 25./26. April 2019

Lateral Heterogeneity of Reservoir Properties in an Homogenous Lower Triassic Sandstone, Southern Germany

C. Schmidt, B. Busch, C. Hilgers
Structural Geology and Tectonics, KIT Karlsruhe Institute of Technology, Germany

Abstract

Characterizing a subsurface reservoir, the geologist is reliant on core material, which allows for only a small-scale view into the target area. Hence, analytically determined reservoir properties from core material can barely serve as proxy for a large 3D prospect. This analog study of a proposedly homogenous Lower Triassic sandstone in Southern Germany offers a means to fill gaps like sedimentary facies and clearly points out the variability along a lateral section concerning porosity φ and horizontal permeability k_h. Successively, the measured plugs served for petrographic assessment.

The quarry Röttbach is located in Lower Franconia and consists of very fine- to fine-grained, dark red sandstones that are of fluvial origin. Macroscopic observations reveal a homogenous, massive sandstone with few localized features like indistinct, tangential cross beds as well as clusters of silty to clayey rip up-clasts. A striking feature are bleaching phenomena that may occur pervasive, lamina-bound or speckled.

Petrophysical measurements yield φ-values of 11-19 % (avg. 16 %) while k_h ranges from 0.02 to 48 mD (avg. 9 mD). Samples originate from three horizontal profiles of different stratigraphic height within the outcrop. Values for φ and k_h show no correlation of the vertically aligned samples, whilst the NE-SW-striking wall of the quarry is of generally lower permeability (<1.3 mD). Thin section analyses reveal an overall consistent, mainly subarkosic composition. The detritus consists of on average 6 % sheet silicate-bearing lithofragments and abundant iron oxides (avg. 13 %). Their overall content increases to the NW of the outcrop (22-29 %) while the mean grain size remains relatively constant. Partial bleaching is ubiquitous, appears unsystematic and coincides with reduced φ- and k_h-values, strikingly so in the otherwise more porous and permeable SE-part of the locality. At the same time grain sizes are comparatively large with slightly fewer quartz cements (9-13 %, avg. 14 %) and more diagenetic illite, 6-12 % (avg. 7 %).

From detrital clay mineral content, the vicinity of e.g. a flood plain can be inferred influencing reservoir quality although lithological description and mean grain size do not give any such indication. Here, bleaching has a deteriorating effect on porosity and permeability as it gives way to enhanced illitization. Quartz cements appear to prevent this process and stabilize the mineralogical framework instead of reducing porosity and overall reservoir quality.