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Critical evaluation of an Upper Carboniferous tight gas sandstone reservoir analog: Diagenesis and petrophysical aspects

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Abstract

Upper Carboniferous sandstones are one of the most important tight gas reservoirs in Central Europe. We present data from an outcrop reservoir analog (Piesberg Quarry) in the Lower Saxony Basin of Northern Germany. This field-based study focuses on the diagenetic control on spatial reservoir quality distribution.

The investigated outcrop consists of fluvial 4th-order cycles, which originate from a braided river dominated depositional environment. Westphalian C/D stratigraphy, sedimentary thicknesses and exposed fault orientations (NNW-SSE and W-E) reflect tight gas reservoir properties in the region further north. Diagenetic investigations revealed an early loss of primary porosity by pseudomatrix formation. Present day porosity (7 % on average) and matrix permeability (0.0003 mD on average) reflect a high-temperature overprint during burial. The entire remaining pore space is occluded with authigenic minerals, predominantly quartz and illite. This reduces reservoir quality and excludes exposed rocks as tight gas targets. The correlation of petrographic and petrophysical data show that expected facies-related reservoir quality trends were overprinted by high-temperature diagenesis. The present day secondary matrix porosity reflects the telogenetic dissolution of mesogenetic

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