

Reservoir quality heterogeneity in Upper Cretaceous limestones of the Münsterland Basin (Beckum-Fm., Münsterland Basin)

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Carbonates show heterogeneous reservoir properties and a large scale extrapolation of reservoir properties is not always possible. Key factors for the characterization of carbonate reservoirs are the study of mineralogical, geomechanical and petrophysical properties. The formation of authigenic minerals during diagenesis is known to cause porosity loss and affect permeabilities. Likewise, compaction leads to grain rearrangement and porosity loss, as well as deformation. The investigated Upper Cretaceous carbonates (Beckum-Fm.) in the Münsterland Basin (Beckum, North Rhine-Westphalia, Germany) contain small-scale heterogeneities and differences in the diagenetic overprint, which influence reservoir properties. This study extends the understanding of fluid migration pathways and porosities related to depositional porosity and cementation during early and late diagenesis. The helium porosities of the studied samples range from 1.0 to 7.6%, while air permeabilities range from <0.0001 mD to 0.1 mD. The results of ultrasonic measurements (V_p) range from 3938 to 5843 m/s. Porosities correlate negatively with p-wave velocities and positive with bulk density, but do not indicate samples, which have experienced mechanical compaction along clay-rich laminae. Low porosities and permeabilities can be related to compaction and cementation of the limestones composed of calcispheres cemented by iron-calcite. Fractures that could enhance the reservoir quality are filled by separate generations of iron-calcite and/or strontianite associated with marcasite and pyrite at the host rock-vein interface. Reservoir quality in the rock matrix of this study is generally poor and only limited to fractures. Based on petrographic examinations (optical microscope, cathodoluminescence, and SEM-BSE) we assessed the paragenetic history in relation to compaction and propose an indicator for compaction in granular carbonate lithologies containing porous detrital components.