Pore-scale quantification of calcite cement reaction kinetics

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Mineral dissolution is crucial for practically all geosciences and many industries including, hydrocarbon exploration and CO_2 sequestration. Of particular importance, is the understanding and quantification of mineral dissolution rates and their connection to porosity and permeability evolution in reservoir rocks. Calcite is one of the most abundant and studied minerals on earth, and the most readily dissolved minerals in most natural rocks. We focused on the study of calcite cement dissolution by using an innovative technique based on vertical scanning interferometry (VSI) and Raman spectroscopy that can produce high vertically and laterally resolved topografical data [1]. The calcite cement is directly analysed on natural samples of a Rotliegend sandstone. Detailed petrographic analysis including light microscopy, SEM, EMPA and cathodoluminescence revealed different types of calcite cement (different cation composition). Flow-through experiments were caried out by using a 80 µL fluid-cell for different reaction times at room temperature. VSI topographical data of the samples before and after the experiments were used to contruct reaction rate maps that reveal the bandwith of surface rate variability and its location. Ultimately, the rate maps will complement and extend the less spatially resolved pore scale of techniques such as micro-CT and FIB-SEM.

[1] Fischer C., Arvidson R.S., Lüttge A. (2012), *Geochimica et Cosmochimica Acta* 98, 177-185