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Experimental investigation of long-term CO2 exposure to brine-saturated reservoir chalk core material

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A potential and cost-effective way to reduce the environmental impact of Danish CO2 emissions would be to store CO2 in the depleted chalk oil reservoirs in the North Sea. The North Sea chalk is mainly composed of calcite (CaCO3), of which the solubility in water is strongly enhanced by carbonation. Thus, introducing CO2 into the formation water can shift the equilibrium between CaCO3 and CO2 in aqueous solution, and therefore the extent of rock contact with carbonated water in the worst-case scenarios needs to be investigated. This could alter the dynamic reaction between CaCO3 and CO2 in aqueous environments. The potential risks associated with CO2 storage in chalk fields need to be identified before planning future field trials. Addressing these challenges will unlock a significant storage capacity for CO2 storage. The knowledge gained through static long-term CO2 exposure experiments can help de-risk CO2 storage in chalk reservoirs and will be helpful to de-risk CO2 storage in other types of carbonate reservoirs. In this study, we present an investigation of long-term exposure of chalk to CO2 under different in-situ conditions including characterization of the response of chalk dissolution enhancement by CO2 exposure over time. The experiments are conducted on core material from a specific Danish North Sea reservoir. These core plugs are saturated with representative formation water and then mounted in pressurized cells at elevated temperature. Supercritical CO2 is put in contact with the core and brine, and the chemical composition of the brine is monitored. The brine samples are analyzed for Calcium, Magnesium, and Sodium content, and show the extent of calcite dissolution in the core plugs as well as other minerals being produced as a consequence of CO2 exposure. These static experiments are presented where brine-saturated core plugs are stored for three months in contact with CO2 directly and in contact with brine in equilibrium with CO2. The core material is investigated by CT scanning before and after the experiments to measure the extent of any rock material alteration. The dissolution of chalk and the corresponding porosity change in a reservoir sample are shown in the figures below.