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Numerical simulation of salt cementation in the porous rocks adjacent to salt diapirs

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Porosity and permeability are among the most important petrophysical properties of reservoirs rocks in oil systems. Observations during exploration indicate that in the vicinity of salt domes the porosity of reservoir rocks is often reduced by halite cementation. In this study we present results of simulating the process of salt precipitation near salt diapirs by using a schematic model of a Zechstein diapir in the North Sea basin. The numerical simulation is based on solving the transport equations for heat, porous flow and dispersive and reactive chemical species. Chemical reaction and equilibrium is based on the PHREEQC computer code.

In our model over-pressured brine is entering from below and is deflected towards the diapir due to an intermediate layer of low permeability. The high thermal conductivity of salt yields a lateral temperature gradient starting from the diapir. Due to this effect the simulated temperature profile shows lower temperatures close to the salt dome than in comparable depths further away. Caused by the temperature-controlled solubility of NaCl in the brine and supplied ions by the diapir, halite first precipitates near the salt diapir by cementing the pore spaces and thus reducing the porosity. Salt-precipitation in the simulation starts after 840 000 years and reduces the porosity from 10 % to 5.5 % after 19 Mill. years. The permanent influx of brine causes growth of the cementation area and the related reduction of porosity in the reservoir.