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Modelling the leaching process of potash seams: an approach to describe dissolution kinetics at the water-rock interface

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Potash salts belong to the most soluble minerals and their unintended dissolution can result in a safety risk for the construction and utilisation of salt caverns and mines [1]. One main challenge in modelling the formation of leaching zones within potash seams is the representation of fluid-rock interactions within regions exhibiting highly varying porosities. Chemical reactions cannot take place if small porosities inhibit the inflow of solution, although present solutions may be undersaturated with respect to certain minerals. These porosity variations only occur at the dissolution front in binary systems, such as NaCl solution and solid halite. Its progress can be described by a mass transfer rate, depending on the concentration of present solutions or by assuming a saturated interface between dry rock and solution, subtracting out the diffusive mass transport. In contrast, the dissolution of potash salt results in the formation of a porous rock matrix, consisting of undissolved and precipitated minerals that can further react with the surrounding solution. Accordingly, fluid-rock interactions and largely varying porosities also occur remote from the dissolution front. The interchange approach [2] was developed to describe these interactions. Coupled with a reactive transport model including PHREEQC [3] and TRANSE [4] this approach is capable to quantify, e.g., the leaching process of carnallite-bearing potash seams due to natural density-driven convection. The dissolution rate is essential for both, the timely progress and geometric shape of evolving leaching zones in the potash seam. Therefore, the interchange approach has been adapted in the scope of the present study to consider saturation-dependent dissolution rates for each mineral. In this contribution, we discuss the feasibility and limitations of our approach to represent fluid-rock interactions between brine and different types of potash salts at the metre scale.

[1] Steding, Zirkler, & Kühn (2020), *Chemical Geology* 532, 119349 (https://doi.org/10.1016/j.chemgeo.2019.119349)

[2] Steding, Kempka, Zirkler, & Kühn (2021), *Water* 13, 168. (https://doi.org/10.3390/w13020168)

[3] Parkhurst & Appelo (2013), *U.S. Geological Survey*, Book 6, 497 pp (https://pubs.usgs.gov/tm/06/a43/)

[4] Kempka (2020), *Adv. Geosci.* 54, 67–77.(https://doi.org/10.5194/adgeo-54-67-2020)