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Reactive Transport Modelling on the Drill Core Scale, Parameterized by GeoPET/µCT Process Tomography

Tuesday, 15 May 2018 18:00 (15 minutes)

In-situ leaching of ores is considered as an economic and environmentally friendly production method. However, the leaching process is complicated by its dependence on the material's heterogeneity and by retroactive effects over large scales. We developed an experimental procedure which is based on positron emission tomography (PET) during transport experiments with radiotracers (Kulenkampff et al. 2016), supported by µCT, to derive flow and diffusion parameters with molecular sensitivity (picomolar) and with reasonable resolution (1 mm) on samples with drill core dimensions. The procedure directly yields the spatial distributions of flow velocity and effective volume from flow experiments, the diffusion coefficient, and the real geometry of the sample. This approach is validated by using a core sample (L = 10 cm, D= 6 cm) with an induced fracture, obtained from Permian Kupferschiefer sandstone. After the tomographic measurements the core sample was leached stepwise with (1) fresh water to remove salt minerals, (2) acidic solution (H2SO4, pH 1.5) to reduce the carbonate content, and (3) acidic solution with added ferric iron to dissolve the Cu-sulfidic ore.
The measured hydrodynamic and structural parameters from PET and µCT were then directly imported into a reactive transport model using interface Comsol Multiphysics with Phreeqc (iCP, Nardi et al. 2014) to simulate core sample leaching. The geochemical conditions of the simulation were considered consistent to the laboratory leaching experiment. The reactive transport simulation is based on the real geometry of the sample and the observed flow fields on the continuum scale and does not require a high performance computation of flow simulations on pore scale. The results of these economical simulations are compared to the results of the laboratory leaching experiments.

References
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References

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