Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.22176

Evaluation of sorption and mobilization processes utilizing *in situ* positron emission tomography

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Remediation of former industrial or nuclear sites, as well as the evaluation of long-term storage strategies for nuclear and chemical waste, depends highly on a comprehensive understanding of contaminant mobility. This includes not only the hydrodynamics in the particular geomaterials, but also the kinetics of ion retention and mobilization. Although sorption coefficients are known for most materials, studying the in-situ behavior of solutes in natural materials under varying chemical conditions provides results that are crucial for predicting the feasibility of specific strategies for either decontamination or containment.

Utilizing radiotracers, positron emission tomography (PET) is capable of providing three-dimensional tracer concentration data with high temporal resolution. While previous studies using tomographic methods have focused on the acquisition of hydrodynamic parameters [1,2], the method also allows for the *in situ* monitoring of reactive transport experiments while providing spatially resolved data – enabling the possibility of extracting material-specific reactivities from complex natural and technical samples.

In this presentation, we discuss contaminant retention and subsequent mobilization in various materials, induced by changes in the chemical environment. Experiments using ^{86}Y as a radiotracer analog for the lanthanide series, in conjunction with traditional hydrodynamic studies, allow the prediction of spatially resolved surface reactivities as well as gaining a holistic understanding into the transport of contaminants in subsurface environments.

[1] J.L. Pingel, J. Kulenkampff, D. Jara-Heredia, M. Stoll, W. Zhou, C. Fischer, T. Schäfer (2023), *Geothermics* 111, 102705.

[2] T. Bollermann, T. Yuan, J. Kulenkampff, T. Stumpf, C. Fischer (2022), *Chemical Geology* 606, 120997.