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Implementing fluid dynamics obtained from GeoPET in reactive transport models

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Flow and transport simulations in geomaterials are commonly conducted on high-resolution tomograms (μCT) of the pore structure or stochastic models that are calibrated with measured integral quantities, like break through curves (BTC). Yet, there existed virtually no method for experimental verification of the simulated velocity distribution results.

Positron emission tomography (PET) has unrivaled sensitivity and robustness for non-destructive, quantitative, spatio-temporal measurement of tracer concentrations in body tissue. In the past decade, we empowered PET for its applicability in opaque/geological media – GeoPET (Kulenkampff et al.; Kulenkampff et al., 2008; Zakhnini et al., 2013) and have developed detailed correction schemes to bring the images into sharp focus. Thereby it is the appropriate method for experimental verification and calibration of computer simulations of pore-scale transport by means of the observed propagation of a tracer pulse, $c_{PET}(x, y, z, t)$.

In parallel, we aimed at deriving velocity and porosity distributions directly from our concentration time series of fluid flow processes in geomaterials. This would allow us to directly benefit from lab scale observations and to parameterize respective numerical transport models. For this we have developed a robust spatiotemporal (3D+t) parameter extraction algorithm. Here, we will present its functionality, and demonstrate the use of obtained velocity distributions in finite element simulations of reactive transport processes on drill core scale.

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