Karlsruhe Institute of Technology

Institute of Applied Geosciences
Division of Hydrogeology
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## 2017 Darcy Lecture

# A Tale of Two Porosities: Exploring Why Contaminant Transport Doesn't Always Behave the Way It Should

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Transport through preferential flowpaths is important in a broad range of scientific disciplines. In hydrology, the ability to quantify subsurface transport is an issue of paramount importance due to problems associated with groundwater contamination. Observational challenges and complexity of hydrogeological systems lead to severe prediction challenges with standard measurement techniques. One important example of a prediction challenge is "anomalous" solute-transport behavior, defined by characteristics such as concentration rebound, long breakthrough tailing, and poor pump-and-treat efficiency.

These phenomena have been observed at research and aquifer-remediation sites in diverse geologic settings, and are not predicted by classical theory. Numerous conceptual models have been developed to explain anomalous transport, such as the presence of two distinct populations of pores — one where solutes are highly mobile and another where they are not — but verification and inference of controlling parameters in these models in situ remains problematic, and often estimated based on data fitting alone. Recent tests using simple electric geophysical methods directly measure the process of mobile-immobile mass transfer and allow estimation of parameters controlling anomalous transport.

This lecture presents a rock-physics framework, an experimental methodology, and analytical expressions that can be used to determine parameters controlling anomalous solute transport behavior from colocated hydrologic and electrical geophysical measurements in a series of settings, including groundwater and surface water/groundwater systems. The long-term goals of this work are to contribute toward improving the predictive capabilities of numerical models and enhancing the fidelity of long-term groundwater monitoring frameworks.

NGWA The Groundwater Association

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