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Characterization of transport processes in a heterogeneous aquifer using electrical resistivity tomography (ERT) and numerical modeling

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For the characterization of the spatial and temporal variability of transport in a heterogeneous aquifer tracer experiments were carried out. Monitoring tracer plumes during tracer tests with a grid of multilevel observation wells is often problematic due to large changes of concentrations over small distances. Using geo-electrical imaging methods concentration distributions can be mapped over a wide area. At the Krauthausen test site (Germany) two tracer experiments in a heterogeneous aquifer were conducted to investigate the potentiality of electrical resistivity tomography (ERT) for imaging subsurface transport. Down-gradient of the tracer injection the tracer breakthrough in three image planes, two planes perpendicular and one parallel to the mean flow direction, was monitored with ERT. The spatial variability of the transport process is related to the spatial variability of the hydraulic conductivity. Using cone penetration tests, the spatial distribution of a parameter that is related to the hydraulic conductivity was derived and empirical relations were used to derive the 3-D distribution of the hydraulic conductivity in the tracer test zone. We compared the 2-D spatio temporal information about the transport obtained with ERT in the image planes with three-dimensional numerical flow and transport simulations using the TRACE and PARTRACE numerical models and an aquifer model based on cone penetration data. In order to compare the ERT and numerical simulation data sets, a stream tube model that represents transport in the aquifer by a set of 1D convection-dispersion processes was used.