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Single- and dual-porosity modeling of flow in reclaimed mine soil cores with embedded lignitic fragments

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Lignitic mine soils represent a typical two-scale dual-porosity medium. The open-cast mining operation eliminates the original sediment layers and creates overburden spoil piles with inclined dumping structures and sediment masses that are characterized by small-scale variability. The effect of local heterogeneity in form of embedded porous lignitic fragments on flow was experimentally studied in multistep in/outflow experiments on soil cores. Results were analyzed using either mobile-immobile or mobile-mobile type dual-porosity models and with a 3D numerical model assuming that it describes the representative local scale geometry. Simulations were compared with outflow time series' and matric potentials measured in two depth using miniature tensiometers. Comparisons of simulation results using high-resolution 3D model with outflow time series' and matric potentials measured in two depth using miniature tensiometers showed that it was not possible with independently determined parameters to describe both outflow and matric potentials curves. A fit with both data sets was only possible if two permeable domains (i.e., mobile-mobile) were assumed. By visual inspection of the system containing mostly isolated embedded fragments, however, a mobile-immobile type model should be more representative. One hypothesis is that there may exist a more continuous pore region in the vicinity of the lignitic fragments possibly formed by a lignitic dust interface-region between the two domains. Identification of the assumed flow paths using neutron tomography and imaging techniques is subject of a related contribution.