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Hydrodynamic changes of saturated porous media due to biomass growth

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Changes in hydraulic properties of soils and aquifers as a result of biogeochemical transformations, such as bacteria growth and mineral phase precipitation/dissolution, may lead to significant modifications of the groundwater flow field. This affects in turn the migration pathways and transport rates of solutes, and consequently their spatial distribution. The aim of this work is to investigate different aspects of the field-scale evolution of porosity, hydraulic conductivity and dispersivity in saturated porous media due to bacteria development in the pore space. A new module has been developed for PHWAT to add the capability of modeling clogging. PHWAT is a general flow and multi-component reactive transport computer code based on SEAWAT and PHREEQC-2. The new model incorporates several constitutive equations to convert porosity changes to hydraulic conductivity. Biomass attachment/detachment coefficients dependent on pore water velocity have been implemented also. Spatial distributions of simulated porosity and hydraulic conductivity changes were compared both against published laboratory data and previous modeling results. We concluded that the model is able to reproduce the clogging process in a reasonably accurate way. Nevertheless, the choice of the constitutive equations and selection of their parameters is problematic. Further research needs to be devoted to understand the pore-scale processes contributing to permeability changes. Recent literature shows that a significant modification of the medium dispersivity is often associated to biomass development and porosity changes. We investigate this aspect by means of numerical modelling, showing the effect of different processes and initial conditions on the extent of disper-

sivity change.