Geophysical Research Abstracts
Vol. 21, EGU2019-17509, 2019
EGU General Assembly 2019

Simple hydraulic model of the horizontal groundwater flow coupled with the evolution of erosion conduits along preferred directions.

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One of the modelling approaches to the flow-induced inner erosion and channel formation, or piping, in the bulk of porous media, uses the continuous description of the flow (Darcy's equation) coupled with the model for the evolution of hydraulic conductivity. While this continuous approach seems well justified on scales larger than the scale of the considered conduits, its advantage is that it allows to focus on the important feedback between the conduits evolution processes on one scale, and the hydraulics of the flow on a larger scale. Various forms of the coupling have been discussed in the literature, including not only the different approaches to characterise the erosion mechanics itself, but also to involve the transport and deposition of the detached material, etc.

We discuss a particular model within this framework, motivated by the fast evolving conduits observed in the sandstone quarry in Střeleč, Czech Republic, where an underground conduit network developed over no more than a few years by the groundwater flow due to the rapid pumping during the quarrying. The sandstone bodies were highly fractured, including small permeable displacement faults, and a number of conduits developed along the fractures. We consider an approximate 2D model which couples the horizontal (Dupuit-Forchheimer) flow with the evolution of the anisotropic hydraulic conductivity, where the erosion, transport and sedimentation is considered separately in the predefined directions.