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Impact of the lithographic discontinuities on the karst conduit development - insights from modelling

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Karst formation is controlled by the processes of the fluid flow and reactant transport coupled to the chemical erosion of the limestone rock [1]. The coupling between these processes can lead to a number of different instabilities, resulting in the formation of dissolutional voids, caverns and conduits.

Arguably the simplest systems of this kind are solution pipes, in which gravitationally driven water movement carves vertical conduits in limestone rocks. In the homogeneous rocks these conduits are often cylindrical, with almost a constant diameter along their length. However, in a stratified medium, the morphology of the pipes changes. For example, if a number of less porous layers is introduced in an otherwise homogeneous medium, then the pipes are observed to narrow as they cross the layers and then widen up to form bulbous caverns as they emerge from the layer [1].

In this communication, we investigate these effects more closely, considering different kind of lithographic discontinuities to be present in the system: the layers of increased/decreased porosity and/or permeability as well as the solubility which is different from the rest of the system. Using a Darcy-scale numerical model we analyze the effects these layers have on the shape and growth of solution pipes and compare the results on the piping morphologies observed in nature. Finally we comment on the possible relevance of these results to the cave-formation phenomena and the inception horizon concept [3].

References:
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