



A model for the longitudinal patterns shaped by water on erodible rocks

Matteo Bernard Bertagni and Carlo Camporeale

Politecnico di Torino, DIATI, Torino, Italy (matteo.bertagni@polito.it)

The interactions between water and rocks create an extensive variety of marvelous patterns, which span on several classes of time and space scales. In this work, we provide a mathematical model for the formation of longitudinal erosive patterns commonly found in karst and alpine environments. The model couples the hydrodynamics of a laminar flow of water (Orr-Sommerfeld equation) to the concentration field of the eroded-rock chemistry. Results show that an instability of the plane rock wetted by the water film leads to a longitudinal channelization responsible for the pattern formation. The spatial scales predicted by the model span over different orders of magnitude depending on the flow intensity and this may explain why similar patterns of different sizes are observed in nature (millimetric microrills, centimetric rillenkarren, decametric solution runnels).