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Hydraulic behavior of major discontinuities located in the black consolidated marl formation of Draix (French Alps)

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We aim at describing how water is transported inside subsurface discontinuities located in the black consolidated marl formation of Draix (France). Since these discontinuities are located at the basis of a large landslide, they potentially play an important role over the rheology of the sliding mud, as they are the major water conducting elements. This changes the pressure and redistributes the load in the moving mass.
We first study the geometry of major open fractures sampled from a shallow borehole (20m deep). Topography of surface pairs of the fractures are sampled using a laser profilometer. Voxel resolution is of the order of 40 μm x 40 μm x 1μm. Scaling invariance of the fracture surface morphology is studied at the core scale. Fracture apertures are then reconstructed from correlation and geometrical arguments. The topography of both sealed and fresh fracture surfaces closeby along the core, are as well measured for comparison. From the knowledge of the fracture aperture at the laboratory scale, we propose an upscaling of the fracture permeability to large scales on the basis of the scaling invariance property (self-affine geometrical model) and finally consider the permeability of several parallel fractures (parallel to the bedding). A modeling of the hydraulic flow is obtained with a finite-difference code, at low Reynolds number in permanent regime, which shows the significant channeling of the flow. The link between overpressure zones where the normal effective pressure decreases and nucleation areas of possible mudslides is discussed.