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Permeable structures at Ceboruco lava dome, Mexico: the challenge of upscaling laboratory measurements to field constraint

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Lava domes are, in their lifespan, variably permeable volcanic structures. During magma ascent, construction of a permeable network is facilitated by the coalescence of vesicles and fractures, which regulates magma outgassing and control whether eruption proceeds effusively or explosively. Here, we present a combined laboratory and field study of dome rock permeability, focusing on a ca. 19th century lava dome at Ceboruco, Mexico.
The lava dome has a perfectly rounded shape with a diameter of $\sim$80 metres and a height of $\sim$35 metres. The dome consists of blocks ranging in size between centimetres and 5 metres, which reveal a range of porous structures: the rocks are commonly dense, but porosity occasionally reach 38%; some blocks are entirely massive, whilst others display tensile and shear fractures. Microscopic analysis reveals and equally intricate fracture networks.
Permeability measurements are currently being performed on 4 rocks (with different porosities) in a hydrostatic pressure vessel at confining pressures of 6, 10, 15, 20, 30 and 40 MPa and averaged pore pressure of 5 MPa (with differential of 1 MPa). For each sample, the uniaxial compressive strength will be determined and permeability will be measured on samples, which have undergone fracture damage due to loading at different fractions of the uniaxial compressive strength (e.g., 80%, 90% and 100%).
The laboratory study will be complemented by an electrical resistivity survey of the dome structure (to be undertaken this coming February-March 2015). We will optically measure the density of fractures (i.e. spacing), and width. The resistivity study will be performed at different scales (1-200 metres) to assess the extent of fractures in individual blocks as well as through the entire dome and its underlying root. Mesoscale permeability measurements will be attempted by introducing salinated water into cracks on metre-size blocks whilst performing 3D electrical resistivity tomography. We aim to discuss differences in permeability as a function of scales and permeability.