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Deformation bands at andesitic stratovolcanoes and their impact on permeability

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The edifice-forming andesitic rocks at Volcán de Colima (Mexico) host a multitude of curious planar to subplanar deformation features. During a recent field campaign (May/June 2014) we collected 14 blocks from different localities around the volcano (from debris-flow tracks and parasitic dome “Volcancito”), chosen to represent the variety of observable features. First order observations suggest that, while some of these bands (usually distinguished by a difference in colour) are essentially planar, others have undergone various degrees of post-formation viscous deformation. In the most extreme cases, the bands have been twisted and stretched to the point were they are preserved as wispy lenses. Scanning electron microscopy has shown that the different bands are characterised by very different microstructural textures, suggesting fundamentally different mechanisms of genesis. For example, some features are bands of higher porosity than the surrounding host rock in which the groundmass appears to have been removed by the movement of hydrothermal fluids along pre-existing cracks or in thicker (1-2 cm) zones now characterised by pervasive microporous textures. Some bands, observable because macropores (1 mm) have been filled by secondary mineralisation, contain a lower porosity than the adjacent host rock. We also find evidence of variably efficient bubble elongation, possibly indicating "frozen" decompression events within pumiceous samples. We cored cylindrical samples from the blocks to contain bands either parallel or perpendicular to the fluid (gas) flow direction in our laboratory permeameter setup (other samples were cored to contain no bands; i.e. the host rock). Our permeability measurements show that some features act as conduits while others serve as barriers to fluid flow. The importance of such features is emphasised by their large impact on permeability; changes in permeability can be as high as two orders of magnitude for certain bands. These data do not only provide information regarding the permeability of the edifice country rock, a key factor in the governance of explosivity, but shed light on the wide array of processes occurring within the edifice.