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Imaging Slow Failure in Triaxially Deformed Etna Basalt using 3D Acoustic-Emission Location and X-ray Computed Tomography

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We have deformed basalt from Mount Etna (Italy) in triaxial compression tests under an effective confining pressure representative of conditions under a volcanic edifice (40 MPa), and at a constant strain rate of 5 x 10-6 s-1. Despite containing a high level of pre-existing microcrack damage, Etna basalt retains a high strength of 475 MPa. We have monitored the complete deformation cycle through contemporaneous measurements of axial strain, pore volume change, compressional wave velocity change and acoustic emission (AE) output. We have been able to follow the complete evolution of the throughgoing shear fault without recourse to any artificial means of slowing the deformation. Locations of AE events over time yields an estimate of the fault propagation velocity of between 2 and 4 mm.s-1. We also find excellent agreement between AE locations and post-test images from X-ray microtomography scanning that delineates deformation zone architecture.