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Frictional processes during flank motion at Mount Etna (Italy): experimental characterisation of slip on similar and dissimilar volcanic and sedimentary rocks.

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The edifice of Mount Etna (Italy) is structurally unstable, exhibiting a near continuous ESE seaward sliding along a set of faults due to interplay between regional tectonics, gravity instability and magma intrusion. Continuous seismic and ground deformation monitoring reveals the resulting large-scale flank motion at variable rates. The mechanisms controlling this faulting kinetic remains, however, poorly constrained. Examination of the fault zones reveals a range of rock types along the different fault segments: fresh and altered basalt, clay and limestone. As lithological contrasts can jeopardise the structural stability of an edifice, we experimentally investigate the frictional properties of these rocks using low- to high-velocity-rotary shear tests on similar and dissimilar rocks to better understand episodes of slow flank motion as well as rapid and catastrophic sector collapse events.

The first set of experiments was performed at velocities up to 1.2 m/s and at normal stresses of 1.5 MPa, commensurate with depths of the contacts seen in the Etna edifice. Friction experiments on clay gouge shows the strong rate-weakening dependence of slip in this material as well as the release of carbon dioxide. Friction experiments on solid rocks show a wider range of mechanical behaviour. At high velocity (>0.6 m/s) volcanic rocks tend to melt whereas the clay and limestone do not; rather they decarbonate, which prevents the rock from achieving the temperature required for melting. Experiments on dissimilar rocks clearly show that composition of host rocks affects the composition and viscosity of the resultant frictional melt, which can have a dramatic effect on shear stress leading to fault weakening or strengthening depending on the combination of host rock samples. A series of low- to moderate-slip velocity experiments is now being conducted to complement our dataset and provide a more complete rock friction model applicable to Mount Etna.