



Frictional Melt Generated from Similar & Dissimilar Volcanic and Sedimentary Rocks.

Thomas Mitchell (1), Michael Heap (2,3), Yan Lavallee (3), Takehiro Hirose (4), Donald Dingwell (3), Sergio Vinciguerra (5), Jörg Renner (1), and Andrea Cavallo (5)

(1) Experimental Geophysics Laboratory, Institute for Geology, Mineralogy, and Geophysics, Ruhr-University Bochum, D-44780, Bochum, Germany. (tom.m.mitchell@btinternet.com), (2) Ecole et Observatoire des Sciences de la Terre, Université de Strasbourg, 5 rue René Descartes, Strasbourg 67084, France, (3) Ludwig-Maximilians-University, Section for Mineralogy, Petrology and Geochemistry, Theresienstr. 41, 80333 München, Germany. , (4) Kochi Core Center, JAMSTEC, Kochi, Shikoku, Japan. , (5) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy

In recent years, frictional melts generated in localized slip zones have been shown to exert control on coseismic earthquake dynamics and earthquake magnitude, where melting has been shown to occur at slip velocities greater than 0.1ms⁻¹. Other geological settings in which frictional melts could be generated have been speculated on, for example landslide mechanics, caldera lid deflation and flank collapse, but not studied in any great detail. Such faults are capable of undergoing very large displacements during single slip events due to fact that they are not pinned at the ends.

Catastrophic flank collapse and instability in volcanic edifices are likely to be controlled in part by the high velocity frictional melt properties of the rock comprising the edifice and subsequent slip zone. Knowledge of the frictional properties of a host of representative volcanic lithologies is therefore important for volcanic hazard mitigation. However, there is currently a paucity of high-velocity frictional melt data on volcanic rocks and, as a result, current understanding of the formation of pseudotachylyte in volcanic systems is both poorly documented and poorly understood. In addition, most high velocity rotary frictional studies to date focus on similar rock types sheared against each other, and have not explored the effect of shearing dissimilar materials, subsequent melt mixing and variations in shear stress.

In this study, we present a series of high-velocity experiments investigating the frictional properties of a number of similar and dissimilar (mixed) rocks that form potential slipping zones in the edifice at Mt Etna (basalts, subsurface limestones & clays). Experiments were performed at velocities up to 1.2 m/s at normal stresses of 1.5 MPa, commensurate with depths of contacts seen in the Etna edifice. We clearly show that composition of host rock of dissimilar materials rotated against each other has an important effect on melt composition and mixing and subsequent melt viscosity, which can have a dramatic effect on shear stress leading to fault weakening or strengthening depending on the combination of host rock samples.