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Deforming Etna's Basement: Implications for Edifice stability.

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At over 3 kilometers in height, Mt. Etna (Italy) is the largest volcano of continental Europe. The volcano formed on top of the alpine fold and thrust belt, with basaltic outflows lying unconformably on top of an alternation between sandstones, limestones and clays.

Presently Etna's eastern flank is moving with speeds up to 2cm/yr to the east [Tibaldi and Groppelli, 2002]. It is the sequence of layers below the volcano that is thought to provide a complex, structurally controlled, mechanism to the volcano deformation as a whole. This is due to the interplay of gravitational forces, volcanic pressurization, and regional tectonics, which combine to play a complex role that remains poorly understood, especially when the physical and mechanical properties of the rocks are considered.

In this study, we concentrate on the rock mechanical component, and in particular the formation known as Comiso Limestone. This limestone forms of one of the key lithologies of Etna's basement. The formation has been suggested to be affected by thermal weakening [Heap et al., 2013]. Previous work on Comiso Limestone suggests brittle behavior for the range of temperatures (up to 760 ˚C) and a significant reduction in strength with higher temperatures. [Mollo et al., 2011]. Chiodini et al [2011], speculate carbonate assimilation. This implies that the Carbondioxide created by decarbonatization, is able to escape.

Using an internally heated "Paterson" type pressure vessel, we recreated conditions at 2-4 km depth (50-100 MPa) and using an anomalously high geotherm, as expected in volcanic settings (ranging from room to 600 ˚C). With the addition of confining pressure, we show a brittle to ductile transition occurs at a relatively low temperature of 300 ˚C. A significant decrease in strength occurs when the rock is exposed to temperatures exceeding 400 ˚C. In addition, we observe a significant difference in mechanical behavior between vented and unvented situations when decarbonatization is active (>500 ˚C).

As shown by Gudmundsson [2011] a large contrast in mechanical properties between two formations could cause dyke arrest or deflection. Contacts between the Comiso Limestone (overall ductile at depth) and extruded basalt flows (overall brittle) could very well facilitate such a locality, and such 'layering' will form part of future laboratory investigations.

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