Geophysical Research Abstracts
Vol. 13, EGU2011-1907, 2011
EGU General Assembly 2011

Brittle faulting and inelastic compaction in Alban Hills tuff: microstructural observations and micromechanical modeling

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An understanding of how tuff deforms and fails is of importance in the mechanics of volcanic eruption, as well as geotechnical and seismic applications related to the integrity of tuff structures and repositories. Previous rock mechanics studies have focused on the brittle strength. We conducted mechanical tests on nominally dry and water-saturated tuff samples retrieved from the Colli Albani drilling project, in conjunction with systematic microstructural observations on the deformed samples so as to elucidate the micromechanics of brittle failure and inelastic compaction. The phenomenological behavior was observed to be qualitatively similar to that in a porous sedimentary rock. Synthesizing published data, we observe a systematic trend for both uniaxial compressive strength and pore collapse pressure of nonwelded tuff to decrease with increasing porosity. To interpret the compaction behavior in tuff, we extended the cataclastic pore collapse model originally formulated for a porous carbonate rock to a dual porosity medium made up of macropores and micropores or microcracks.