Geophysical Research Abstracts
Vol. 20, EGU2018-2429, 2018
EGU General Assembly 2018

The lithological control on the brittle-ductile transition in volcanic areas

Francesco Parisio (1), Sergio Vinciguerra (2), Olaf Kolditz (1,3), Thomas Nagel (1,4)

(1) Helmholtz Centre for Environmental Research - UFZ, Department of Environmental Informatics, Germany (francesco.parisio@protonmail.com), (2) Dipartimento di Scienze della Terra, Universitá di Torino, Turin, Italy, (3) Applied Environmental Systems Analysis, Technische Universitaet Dresden, Dresden, Germany, (4) Department of Mechanical and Manufacturing Engineering, School of Engineering, Trinity College Dublin, College Green, Dublin, Ireland

Volcanic complexes are composed of a variety of lithologies spanning from volcanic rocks to thick sedimentary sequences. We have formulated a constitutive model that takes into account the rheological behavior of contrasting lithologies from volcanic settings at representative temperatures and pressures. The goal is to explore how the combination of lithology, pressure and temperature controls the rheological behavior of rocks and specifically the brittle-ductile transition conditions in active volcanic areas. To do so, we have developed a plastic surface that can take into account both yielding and failure in a pressure and temperature-dependent manner. We have calibrated the surface to reproduce the results of rock deformation laboratory experiments representative of two main end terms for volcanic settings, i.e. the mid-ocean ridge basalt and the Comiso limestone, which have been extensively studied and are available in literature (e.g. Violay et al., 2012, Bakker et al., 2015). Our results show the lithological influence on the brittle-ductile transition depth in volcanic areas by analyzing a first scenario of a purely basaltic setting and comparing it to another scenario, typical of strato-volcanoes settings with a basaltic sequence overlying a carbonatic basement. Our findings show that if the brittle-ductile transition is defined as the transition between dilatant and compacting volumetric inelastic deformation, then a discrete transition can indeed be identified. Finally, by correlating the brittle-ductile transition depth to seismic data in active volcanoes, it can be evidenced that seismic attenuation at depth is not necessarily related to melting and/or magmatic gas, but instead it could be purely caused by rheological phenomena.