Geophysical Research Abstracts
Vol. 16, EGU2014-6915, 2014
EGU General Assembly 2014

Monitoring volcano fuel in near-real-time. Advances and opportunities.

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Petrology underpins our knowledge of magmatic processes, and thus offers important insights to volcanic risks. Processes like recharge events and changes in magmatic components are recorded within the volcanic material, which represents an opportunity to understand specific eruptions as they evolve. Conventional petrologic and geochemical analysis is time intensive and produces comparatively small datasets, thus limiting it's use during time critical scenarios like volcanic crises. Here we use X-ray micro-computed tomography to rapidly measure crystal chemical populations of olivine, utilising the density contrast exerted by its Fe-Mg solid solution. Olivine is a priority mineral, as it's chemistry is a function of the magma's temperature, pressure and composition history. Using the method described here, a sample containing potentially hundreds of crystals can be rendered in 3D and chemical populations assessed within 2 hours. Using eruption-specific XMT petrologic and geochemical data as inputs to geophysical and ash dispersal models may provide an avenue for fully integrated eruption monitoring. The method also has value in the generation of large datasets of previous eruption sequences, providing a"back catalogue" with which to compare empirical patterns during future events as they unfold.