Geophysical Research Abstracts
Vol. 18, EGU2016-8658-1, 2016
EGU General Assembly 2016

Linking magma reservoir processes to the frequency and magnitude of volcanic eruptions

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The frequency of volcanic eruptions is fundamentally related to processes controlling the accumulation of eruptible magma at depth and the pressurisation of the magmatic reservoir. Here we present a combined statistical-empirical approach to link the frequency and magnitude of volcanic eruptions observed in different arcs to important parameters controlling the growth of subvolcanic reservoirs of eruptible magma. Such understanding is important for two reasons; firstly it presents an insight into how and why the frequency of eruptions varies between different groups of volcanoes; and secondly, it provides constraints for models that are used to interpret geochemical and geophysical data. To perform the analysis we further develop an analytical model that uses a Monte Carlo sampling approach to simulate the accumulation and eruption of magmatic reservoirs (Caricchi et al., 2014). By inverting the geological record of volcanic eruptions we can solve the Monte Carlo model to quantify parameters such as magma input and frequency of magma injection. Our results indicate systematic variation in the frequency of eruptions of various magnitudes between exchangeable groups of volcanoes, which can be related to variations of parameters such as average magma fluxes and thickness of the crust.

Caricchi, L., C. Annen, J. Blundy, G. Simpson, and V. Pinel, 2014, Nature Geoscience, v. 7, no. 2, p. 126–130, doi:10.1038/ngeo2041.