Abstracts

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Rates of magma transfer in the crust: Insights into magma reservoir recharge and pluton growth

Thierry Menand [1], Catherine Annen [2] and Michel de Saint Blanquat [3]

[1] Laboratoire Magmas et Volcans, Université Blaise Pascal–CNRS–IRD, OPGC, 5 rue Kessler, 63038 Clermont-Ferrand, France, [2] School of Earth Sciences, University of Bristol, Wills Memorial Building, Bristol BS8 1RJ, UK, [3] Geosciences Environnement Toulouse, Université de Toulouse, CNRS, IRD, OMP, 14 avenue Edouard-Belin, 31400 Toulouse, France

Abstract

Plutons have long been viewed as crystallized remnants of large magma reservoirs, a concept now challenged by high-precision geochronological data coupled with thermal models. Similarly, the classical view of silicic eruptions fed by long-lived magma reservoirs that slowly differentiate between mafic recharges is being questioned by petrological and geophysical studies. In both cases, a key and yet unresolved issue is the rate of magma transfer in the crust. Here, we use thermal analysis of magma transport to calculate the minimum rate of magma transfer through dikes. We find that unless the crust is exceptionally hot, the recharge of magma reservoirs requires a magma supply rate of at least ~0.01 km3/yr, much higher than the long-term growth rate of plutons, which demonstrates unequivocally that igneous bodies must grow incrementally. This analysis argues also that magma reservoirs are short lived and erupt rapidly after being recharged by already-differentiated magma. These findings have significant implications for the monitoring of dormant volcanic systems and our ability to interpret geodetic surface signals related to incipient eruptions.

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