Geophysical Research Abstracts
Vol. 17, EGU2015-5905, 2015
EGU General Assembly 2015

Quantifying crystal-melt segregation in dykes

Philippe Yamato (1,2), Thibault Duretz (3), Dave A. May (2), Romain Tartèse (4,5)

(1) Géosciences Rennes, UMR 6118 CNRS, University of Rennes1, Rennes, France (philippe.yamato@univ-rennes1.fr), (2) GFD group, Institute of Geophysics, Department of Geosciences, ETH-Zurich, CH-8093 Zurich, Switzerland, (3) Institute of Geology and Palaeontology, University of Lausanne, CH-1015 Lausanne, Switzerland, (4) IMPMC, Muséum National d'Histoire Naturelle, Sorbonne Universités, CNRS, UPMC & IRD, Paris, France, (5) Planetary and Space Sciences, The Open University, Walton Hall, Milton Keynes, MK7 6AA, United Kingdom

The dynamics of magma flow is highly affected by the presence of a crystalline load. During magma ascent, it has been demonstrated that crystal-melt segregation constitutes a viable mechanism for magmatic differentiation. However, the influences of crystal volume fraction, geometry, size and density on crystal melt segregation are still not well constrained. In order to address these issues, we performed a parametric study using 2D direct numerical simulations, which model the ascension of crystal-bearing magma in a vertical dyke. Using these models, we have characterised the amount of segregation as a function of different quantities including: the crystal fraction (ϕ), the density contrast between crystals and melt ($\Delta\rho$), the size of the crystals (A_c) and their aspect ratio (R). Results show that crystal aspect ratio does not affect the segregation if R is small enough (long axis smaller than ~1/6 of the dyke width, W_d). Inertia within the system was also found not to influence crystal-melt segregation. The degree of segregation was however found to be highly dependent upon other parameters. Segregation is highest when $\Delta\rho$ and A_c are large, and lowest for large pressure gradient (P_d) and/or large values of W_d. These four parameters can be combined into a single one, the S_{number}, which can be used to quantify the segregation. Based on systematic numerical modelling and dimensional analysis, we provide a first order scaling law which allows quantification of the segregation for an arbitrary S_{number} and ϕ, encompassing a wide range of typical parameters encountered in terrestrial magmatic systems.