Geophysical Research Abstracts
Vol. 17, EGU2015-6175, 2015
EGU General Assembly 2015

Hindered settling and the formation of layered intrusions

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Layered intrusions are characterized by (often repetitive) layering on a range of scales. Many explanations for the formation of such layering have been proposed over the past decades. We investigated the formation of "mats" by hindered crystal settling, a model that was first suggested by Lauder (1964). The interaction of sinking and rising crystals leads to the amplification of perturbations in crystal density within a magma chamber, a process similar to the formation of traffic jams in dense traffic (Bons et al., 2015). Once these "crystal traffic jams" form they constitute a barrier for further settling of crystals. Between these barriers, the magma evolves in a semi-closed system in which stratification may develop by gravitational sorting. Barriers, and therefore layers, form sequentially during inward cooling of the magma chamber. Barring later equilibration, mineralogical and geochemical trends within the layers are repetitive, but with variations due to the random process of initial perturbation formation.

Layers can form in the transition between two end-member regimes: (1) in a fast cooling and/or viscous magma crystals cannot sink or float a significant distance and minerals are distributed homogeneously throughout the chamber; (2) in a slow cooling and/or low-viscosity magma crystals can quickly settle at the top and bottom of the chamber and crystals concentrations are never high enough to form "traffic jams". As a result, heavy and light minerals get fully separated in the chamber. Between these two end members, crystals can sink and float a significant distance, but not the whole height of the magma chamber before entrapment in "traffic jams".

We illustrate the development of layers with numerical models and compare the results with the layered nepheline syenites (kakortokites) of the Ilímaussaq intrusion in SW Greenland.

References:
Bons, P.D., Baur, A., Elburg, M.A., Lindhuber, M.J., Marks, M.A.W., Soesoo, A., van Milligen, B.P., Walte, N.P. 2015. Layered intrusions and traffic jams. Geology 43, 71-74
Lauder, W. 1964. Mat formation and crystal settling in magma. Nature 202, 1100-1101.