Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02352, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02352
EGU General Assembly 2008

Phase equilibria testing of a multiple pulse mechanism: a case study of the Shiant Isles Main Sill, NW Scotland

R. Latypov (1,2) and S. Chistyakova

1. Geological Institute, Kola Science Centre, Apatity, Russia, (2) Department of Geosciences, University of Oulu, Oulu, Finland (rais.latypov@oulu.fi/Fax: +358 85531484)

The Shiant Isles Main Sill (SIMS) is widely regarded as a classical example of a multiple, picrite-picrodolerite-crinanite alkaline sill formed by several olivine phenocryst-rich pulses of magma, which were successively emplaced into their almost solidified predecessors. Such an intrusive mechanism ("liquid into solid") is a random process in which many parameters vary independently and unpredictably. Among them are: the number, relative volume, and bulk composition of magma pulses and their place, sequence, and timing of emplacement, as well as modal abundance, phase composition and distribution of intratelluric phenocrysts in magmas upon emplacement. In terms of these variables, one can envisage countless different profiles through alkaline sills produced from only three randomly intruded magma pulses of picritic, picrodoleritic and crinanitic composition. Such sills can readily be distinguished from those formed from a single pulse of magma by anomalous compositional profiles with several prominent breaks in crystallization and compositional sequences. The compositional profile of the SIMS is remarkably similar to an M-shaped profile expected from fractional crystallization of a single pulse of olivine-saturated magma along a crystallization path *Ol+Sp+L* (picrite), *Ol+Pl±Sp+L* (picrodolerite), *Ol+Pl+Cpx+L* (crinanite). The probability of the accidental formation of such a compositional profile by multiple intrusion of "liquid into solid" is exceedingly small, even for the single case of the SIMS. The probability approaches zero when considering that exactly the same sequence of intrusive events must have been repeated in $\sim$20 neighbouring alkaline sills with similar compositional profiles. This can only be achieved by some

universally operating differentiation process. The best candidate for this is the classical fractional crystallization of magma in a closed chamber constrained by liquidus phase equilibria. This suggests that the best, if not the only, interpretation of the SIMS is its formation from a single pulse of magma under closed system conditions. Further progress in our knowledge of intrachamber magma fractionation processes will probably enable us to interpret many “anomalous” textural, compositional and even isotopic features of mafic-ultramafic sills in the frame of a single magma pulse model.