EGU2020-2334, updated on 26 Oct 2020
https://doi.org/10.5194/egusphere-egu2020-2334
EGU General Assembly 2020

Differential migration of interstitial immiscible liquids in the Skaergaard Layered Series

Marian Holness[1], Victoria Honour[1], and Gautier Nicoli[1,2]
[1]University of Cambridge, Earth Sciences, Cambridge, United Kingdom of Great Britain and Northern Ireland (marian@esc.cam.ac.uk)
[2]University of Potsdam, Institute of Geosciences, Karl-Liebknecht Str. 24-25, 14476 Potsdam-Golm, Germany

The liquid line of descent of the Skaergaard magma intersects a binodal creating an immiscible conjugate pair comprising a dense Fe-rich liquid and a buoyant Si-rich liquid. These two liquids have different wetting properties: the Si-rich liquid wets plagioclase, whereas the Fe-rich liquid wets oxides, pyroxene and olivine. The two liquids may therefore undergo differential migration within a gabbroic crystal mush: the Fe-rich liquid sinks and accumulates in mafic layers, while the Si-rich liquid rises and accumulates in plagioclase-rich regions.

Field-scale evidence of metre-scale differential migration of unmixed immiscible interstitial liquids is provided by paired felsic and mafic lenses spatially associated with gabbroic pegmatite bodies in the Skaergaard floor cumulates. These represent small batches of late-stage liquids rising from the pegmatite bodies into the overlying mush, and their subsequent separation into immiscible conjugates. The paired lenses form irregular, approximately layer-parallel clusters in thick mush, but thin concordant dendritic structures within strongly foliated thin mush. Invariably the melanocratic component lies stratigraphically below the felsic component.

Differential migration within the floor cumulates is also recorded by mm-scale mafic and felsic rims developed on the top and bottom margins of anorthositic blocks derived from the roof. Highly tabular blocks have an upper mafic rim and a lower leucocratic rim. As the block aspect ratio decreases, the rims disappear, with the mafic rim retained at lower aspect ratios than the leucocratic rim. We interpret rim formation as a consequence of trapping migrating unmixed interstitial liquid against the relatively impermeable blocks: tabular blocks are most effective at trapping these liquids.

On a smaller scale, the different wetting properties of the two immiscible conjugates result in post-accumulation pattern formation in rapidly deposited modally graded layers, imposing cm-scale internal layering on the overall modal grading. The tops of the modally-graded layers may also develop felsic flame-like structures interpreted as a consequence of upwards-migration of the immiscible Si-rich conjugate from high-porosity rapidly deposited layers into the overlying cumulates.

These observations demonstrate the complexity of behaviour in a crystal mush containing a two-

phase interstitial liquid. Understanding cumulate evolution necessitates a consideration of the scale of migration of interstitial liquid and the possibility of the differential loss of one of the two conjugates.