Geophysical Research Abstracts
Vol. 19, EGU2017-9276, 2017
EGU General Assembly 2017

Textural evidence of the significance of compaction in the formation of adcumulates in the Skaergaard intrusion, East Greenland

Zoja Vukmanovic (1), Marian Holness (1), and Elisabetta Mariani (2)

(1) Cambridge University, Earth Sciences, England, United Kingdom (zv211@cam.ac.uk), (2) University of Liverpool, School of Environmental Sciences

It has been argued that the upwards decrease in incompatible element concentration in the Skaergaard Layered Series is due to an upwards increasing significance of compaction driven by gravitational loading. The suggested mechanisms for compaction are dislocation creep and dissolution-reprecipitation creep. Localised elongate zones of strong modal banding in the upper part of the Layered Series, known as trough bands, have also been interpreted as the result of localised recrystallization during compaction. In this study we examine the microstructures of Skaergaard gabbros to determine whether their fabrics (foliations and lineations) preserve a record of compaction. The most common microstructures formed by dislocation creep are low angle boundaries and, as a result of ongoing recovery processes, new grains. The (010)[001] slip system in plagioclase is commonly observed to be a “soft” orientation, creating a crystallographic preferred orientation (CPO) defined by the alignment of (010) planes, with [001] parallel to lineation. Previous work on dissolution–reprecipitation creep, shows a CPO with (010) planes aligned parallel to the principal compressive stress, and preferential mineral growth on (010) planes to form an SPO defined by grains elongated perpendicular to (010).

In the Skaergaard Layered Series, the shape of cumulus plagioclase grains (as viewed in thin section) changes systematically up through the stratigraphy from highly tabular to equant. Foliations, defined both by a plagioclase SPO (with tabular grains aligned horizontally) and an associated CPO ((010) parallel to foliation), are strongest lower in the stratigraphy and reduce in strength upwards. Evidence for crystal plasticity is limited to bending of some plagioclase crystals and small numbers of low angle boundaries in all phases. There are no signs of recovery associated with dislocation creep. Compositional zoning is present on all plagioclase growth faces in the lower part of the stratigraphy, inconsistent with preferential dissolution–reprecipitation during compression. There are no fabrics or microstructures that can be attributed to solution–reprecipitation, and evidence for only minor microstructural modification by dislocation creep throughout the entire stratigraphy.

The trough bands are characterised by strong lineation of elongate grains, an almost complete absence of microstructures caused by deformation, and euhedral plagioclase grains with concentric compositional zoning. These observations rule out recrystallization driven by compaction, and support the hypothesis that the modal banding in the trough bands is a result of grain sorting by magmatic flow.

Our observations suggest that the Skaergaard fabrics throughout the Layered Series, are primary and formed at or close to the magma-mush interface as a consequence of particle re-arrangement by magmatic current, with only minor deformation-related fabric modification deeper in the mush. The Skaergaard adcumulates cannot therefore be attributed to compaction.