Geophysical Research Abstracts
Vol. 15, EGU2013-4271, 2013
EGU General Assembly 2013

Magma chamber processes inferred from plagioclase composition: The Sept Iles layered intrusion, Canada

Olivier Namur
University of Cambridge, Dpt of Earth Sciences, Cambridge, UK

The Sept Iles intrusion (Quebec, Canada) is dominated by a basal Layered Series made up of troctolites and gabbros, and by anorthosite occurring at the roof of the magma chamber (100–500 m-thick) and forming the Upper Border Series. Plagioclase composition and plagioclase compositional profiles from the Layered Series and the Upper Border Series will be used to (1) investigate the origin of anorthosite in Sept Iles and (2) evaluate the mechanism of intercumulus liquid mobility in the Layered Series.
Anorthosite rocks are made up of plagioclase, with minor clinopyroxene, olivine and Fe–Ti oxide minerals. Plagioclase displays a very restricted range of compositions for major elements, trace elements and Sr isotopic ratios. This compositional range is identical to that observed in troctolites, the most primitive cumulates of the Layered Series, whereas plagioclase in layered gabbros is more evolved. The origin of Sept Iles anorthosites is investigated by calculating the density of plagioclase and that of the evolving melts. The density of the FeO-rich tholeiitic basalt parent magma first increased from 2.70 to 2.75 g/cm3 during early fractionation of troctolites and then decreased continuously to 2.16 g/cm3 with fractionation of Fe–Ti oxide-bearing gabbros. Plagioclase (An69–An60) was initially positively buoyant and partly accumulated at the top of the magma chamber to form the roof anorthosite. With further differentiation, plagioclase (<An60) became negatively buoyant and anorthosite stopped forming. Blocks of anorthosite (autoliths) even fell downward to the basal cumulate pile.
Bulk-rock compositions in the Layered Series indicate high intercumulus liquid fractions in troctolites and low intercumulus liquid fractions in Fe-Ti oxide-bearing gabbros. Using plagioclase compositional profiles together with geochemical modeling, it is suggested that the mobility of intercumulus melt results from both compaction and compositional comvection. However, the efficiency of those processes evolves with differentiation. The saturation of Fe-Ti oxides is shown as a very important event where intercumulus mobility changes from a channel flow convection-dominated mechanism to a porous flow compaction-dominated mechanism. Change from channel flow to porous flow is shown to significantly affect bulk-rock compositions, especially for incompatible elements.