Geophysical Research Abstracts
Vol. 12, EGU2010-13169, 2010
EGU General Assembly 2010

Microstructure evolution in magmatic alkali feldspar with oscillatory zoning

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Oscillatory zoning with respect to the albite- and orthoclase components was observed in the feldspar megacrysts from the Weinsberg granite (Moldanubian Zone). All growth zones show perthitic exsolutions in the form of albite-rich precipitates in an orthoclase-rich host. The structure of the precipitates depends on the mean bulk composition. Namely, an intermediate bulk composition (Or50Ab41An09 - Or80Ab18An02) results in a large number of relatively small precipitates, whereas in more orthoclase-rich zones (Or88Ab11An01) the precipitates are smaller in number but larger in size.

In this work we investigate the relation between observed microstructure and integrated bulk composition using numerical simulation of the phase decomposition dynamics. Our results suggest that exsolution and subsequent coarsening occurred by different mechanisms in the respective growth zones.

Qualitative numerical simulation was performed using the Cahn-Hilliard model equation for an idealized two-component system. We considered phase separation (1) in a spinodal region in which an uphill diffusion occurs and (2) in a metastable region where nucleation can be initiated only by a sufficiently large fluctuation. Modeling shows that rapid long-time growth of precipitates and attainment of relatively large final size is favored in the metastable region with the oversaturated host. In contrast, rapid short-time growth of precipitates which still remain relatively small corresponds to an unstable spinodal region.