Li, Be and B in plagioclase phenocrysts from Nisyros, Greece

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Chemically zoned phenocrysts represent archives of magmatic processes. In particular, plagioclase crystals often show abrupt compositional changes reflecting significant changes in chemical potentials that are commonly attributed to magma mixing, ascent and degassing. This study deals with different types of plagioclase phenocrysts from rhyodacitic to rhyolitic lavas and pyroclastics from Nisyros volcano, Aegean arc, Greece. Selected crystals were analyzed for major and trace elements including Li, Be and B using EPMA and Secondary Ion Mass Spectrometry (SIMS).

While most phenocrysts are characterized by normal oscillatory zoning (An_{30-40}), others show high-An cores (An_{60-50}) overgrown by more sodic rims (An_{40-30}). The abundances of light elements are relatively low in the cores (10-12 µg/g Li, 0.5-0.7 µg/g Be, 0.1-0.2 µg/g B) but higher in the rims (up to 25 µg/g Li, 2 µg/g Be, 0.5 µg/g B). The transition from core to rim domains is typically abrupt, and rim compositions of these crystals are similar to those of oscillatory zoned phenocrysts. In principle, such an increase in the concentrations of incompatible elements can be explained by a change in melt composition in equilibrium with plagioclase or, alternatively, by a composition-dependent change of partition coefficients. While it is well known that $K_{Be}^{Pl/Liq}$ has a maximum value of ~1.8 at $An_{\sim 30}$ [1,2], $K_{Li}^{Pl/Liq}$ is nearly independent of An content [3]. Nothing is known for $K_{B}^{Pl/Liq}$. We interpret the abrupt changes from core to rim compositions as being due to magma mixing. Limited diffusive relaxation between low-Li cores and high-Li rims implies extremely short magma residence times for the complex plagioclase phenocrysts.

In some volcanic units, the outer zones of plagioclase phenocrysts display a smooth decrease towards the rim in Li concentrations, while those of Be and B remain constant. This decrease in Li towards the rim may be explained by (1) a cooling-induced diffusive relaxation between the outer zones of plagioclase and surrounding melt/matrix or (2) a degassing-related loss of Li from the melt during growth of the outer plagioclase rims. Bearing in mind the observed abrupt core-to-rim changes in Li concentrations in complexely zoned plagioclase phenocrysts, we prefer the latter alternative.

References

[1] Bindemann IN, Davis AM, Drake MJ (1998) GCA **62**, 1175-1193

[2] Bindeman IN, Davis A M (2000) GCA **64**, 2863-2878

[3] Evensen JM, London D (2002) GCA **66,** 2239-2265