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BARIUM IN ALKALI FELDSPAR MEGACRYSTS FROM SZKLARSKA PORĘBA HUTA PORPHYRITIC GRANITE: POSSIBLY INDICATOR OF MAGMA MIXING

INTRODUCTION

Alkali feldspar megacrysts from porphyritic granite type of Karkonosze pluton show rapakivi texture. The crystals are euhedral or appear as ovoids of a few centimetre size. Plagioclase mantle is usually no more than a few millimetres thick. In the first comprehensive description of the feldspars as well as of the porphyritic granite Borkowska (1966) concluded, that the feldspars were products of magmatic crystallization and that they crystallized prior to the alkali feldspars matrix generation. Mantled crystals are often considered a record of mixing processes in an open system (see for instance Hibbard 1981). Rapakivi texture could be formed also due to decompression processes during ascent of felsic magma (see for instance Nekvasil, 1991). The aim of this paper is to show facts in favour of the first theory. One of the observations is the pattern of barium concentration in the megacrysts.

BARIUM CONCENTRATIONS IN MEGACRYSTS

Barium distribution in the alkali feldspar is non-uniform, although barium shows more or less explicit normal zoning (Fig. 1). The concentration changes generally stepwise. Some of the steps could be correlated with plagioclase inclusions in the megacrysts. Some of the inclusions are arranged in a rim, some of them have been spread irregularly within the crystal. All plagioclases display diversified growth morphologies. Core and some internal zones are anhedral. Signs of dissolution and re-growth from the melt of alternated composition are widespread. The last zone, mostly enriched in albite component, is euhedral. Plagioclase, locally together with biotite and quartz, forms rims dividing megacryst into central part (core) and some zones framed from both sides with inclusions. The last rim is plagioclase mantle. The mantle is created by intergrowths of plagioclase with alkali feldspar. The texture observed on the marginal part of the megacryst points to inward growth of plagioclases accompanied by abundant relics of resorbed crystals.

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The highest barium concentration is determined for the core (usually more than 1000 ppm). The distribution of barium in there is not homogenous. Domains enriched in Ba form patches connected with barium poor, irregular zones. Sometimes the concentration of Ba decreases towards the inclusions rims, sometimes beyond the rim. The change in the concentration is from 400 to 500 ppm. The marginal part of the alkali feldspar is almost barium free.

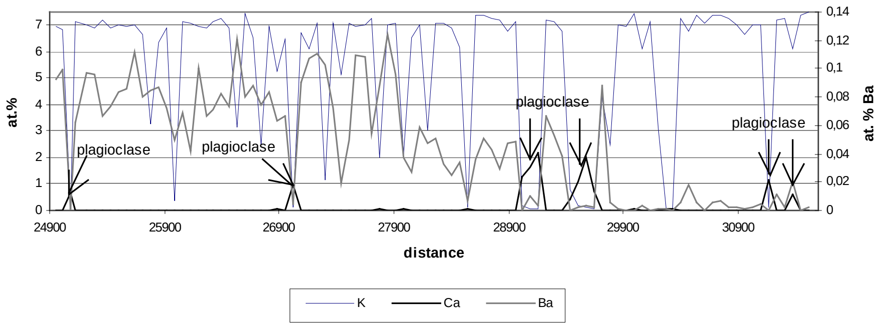

Fig. 1 Barium, calcium and potassium concentrations in alkali feldspar megacryst; core (left) - marginal part (right) profile.

DISCUSSION AND CONCLUSIONS

Barium concentration in alkali feldspar depends first of all on its concentration in melt. During crystallization it behaves like compatible element, reflecting timing of alkali feldspar formation (Long, Luth 1986). Although mostly the $D_{Ba}^{af/liq} > 1$, its value depends on order of phase crystallisation in felsic melt. The order of minerals crystallization depends in turn among others on temperature and water content in the melt. In the case of simultaneous crystallisation of plagioclase together with alkali feldspar and quartz barium behaves like incompatible element, gathering in residual liquid. Due to differences in barium retention, once it forms normal zoning, once reversal zoning in the K-feldspar. The priority in feldspar crystallization could determine water content in the melt. Melt with low water content stimulates plagioclase nucleation prior to K-feldspar, reducing the ability of barium intake by the last one. Barium included into feldspar structure displays low diffusivity. Its concentration does not change also due to post-magmatic coarsening process.

Because of barium behaviour in alkali feldspar structure, the pattern of its concentration could be recognised as primordial, pointing to crystallization conditions from the melt. Presence of inner plagioclases rims within alkali feldspars megacrysts indicates changes in nucleation order in the melt. It is clear, that the core of the megacryst crystallized prior to plagioclase, gathering barium. Simultaneous crystallization of the first inner plagioclase rim on alkali feldspar should lower the barium content in the K-feldspar. There is however no clear connection between the change of barium concentration in the K-feldspar and plagioclase appearance. Both schemes are present i.e. parts of K-feldspar close to inner plagioclase are enriched in barium compeering with the previous zone or impoverished in the element. The change in the concentration is never continuous between zones.

Emplacement processes can't explain changes in crystallization order leading to formation of few inner plagioclases rims as well as abrupt change in barium concentration along K-feldspar profile. The phenomena however could be explained by mixing processes. Impulses of basic magma introducing into the chamber would cause both stepwise changes in barium concentration as well as different nucleation order. Partial remelting of alkali feldspar (Ba-rich and Ba-poor zones in the core) and plagioclase and their re-growth due to new equilibrium conditions can't be the sign of decompression, but might point to magma mixing. An additionally prove for mixing is presence of dioritic enclaves in the porphyritic granite. The enclaves are of oval shape, with the longer diameter few anywhere from ten to twenty centimetres big and only few cm thick. The margin of the enclaves shows signs of hybridisation. Alkali feldspar crystals gather on the border between enclaves and granite. Some of them crystallise within the enclaves. Very probably the enclaves are remnants of basic magma batches.

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