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ALKALI FELDSPAR MEGACRYSTS FROM THE KARKONOSZE MASSIF – DIFFERENCES IN CRYSTALLIZATION CONDITIONS REVEALED BY MEANS OF CATODOLUMINESCENCE AND GEOCHEMISTRY

INTRODUCTION

Alkali feldspar megacrysts appear in granites (mostly in porphyritic facies) and granodiorites within Karkonosze pluton (Sudetes, NW Bohemian Massif). The data on thermal condition of the granite feldspar crystallization as well as some remarks on their growth morphology have been published recently (Słaby et al., 2002; Słaby & Galbarczyk-Gąsiorowska, 2002). The megacrysts usually show rapakivi texture. Feldspars surrounding the K-megacrysts are not the only ones included in the texture. Plagioclase laths trails occur within megacryst checking off various stages of its formation. Despite of their heritage (internal or rapakivi rim) plagioclase crystals usually show growth morphology pointing to dissolution – reprecipitation (Słaby & Galbarczyk-Gąsiorowska, 2002). The lack of equilibrium during mineral growth could be correlated with stepwise change of the melt composition and thermal regime in the system. The facts argue in favour of magma mixing as a process responsible for rapakivi feldspar occurrence.

Rapakivi feldspars from granodiorites haven't been until now subject of detailed research. The occurrences of granodiorites are mainly located within the Czech part of the pluton in Fojtka (F) and Rudolfov (R) inoperative quarries. The samples of megacrysts from both granodiorite quarries as well as from Michałowice (MI) and Szklarska Poręba Huta (SPH) quarries have been collected for comparative cathodoluminescence study.

GRANODIORITE AND GRANITE MEGACRYSTS

The geochemistry of granite and granodiorite megacrysts shows distinct differences. The differences especially concern trace element pattern. Uniform trace element concentration along crystal profile is usually found in R megacrysts. Granite megacrysts show in contrary to R samples stepwise trace element pattern, with the highest value for core part and the lowest for marginal part. The most complicated trace element pattern is that of the F megacrysts, which indicates no regularity. The profiles along K-megacrysts from F granodiorite display increase and decrease of element concentration regarding core or marginal part. The variations in the concentration are high. Strong increase is sometimes accompanied with immediate deep decrease.

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CL investigations obeyed textures observed within megacrysts: of rapakivi rim as well as internal plagioclase inclusions. Matrix minerals have been additionally studied. Plagioclase inclusions in R, SPH and MI samples exhibit the same luminescence characteristic. The rim on MI and R megacrysts seems to have similar genesis (reciprocal activators). The crystallization of rapakivi rim on SPH megacrysts proceeded under different conditions. Although R, MI and SPH megacrysts show some similarities, especially in core crystallisation path, there are visible differences in crystallization of their marginal part. Also the nucleation process of rim plagioclases is different for R and SPH – MI samples. F megacrysts comprise plagioclase inclusions of variant origin. The origin of the inclusion and of the rapakivi rim is reciprocal only in F samples. The luminescence of the inclusion is additionally very much alike the rim plagioclases from the R sample.

Noteworthy is the habit of matrix minerals associated with R, F, SPH and MI megacrysts. Some of the matrix plagioclases in MI samples show textures compatible with lack of equilibrium (Fig. 1a-a'). K-feldspars from granodiorites reveal inconstant kinetic during their growth (Fig. 1b-b'). The same minerals in granites are homogeneous. Apatites in both granite and granodiorite record the change of the melt composition (Fig. 1c-c'), (Kempe, U. & Götze, J., 2002).

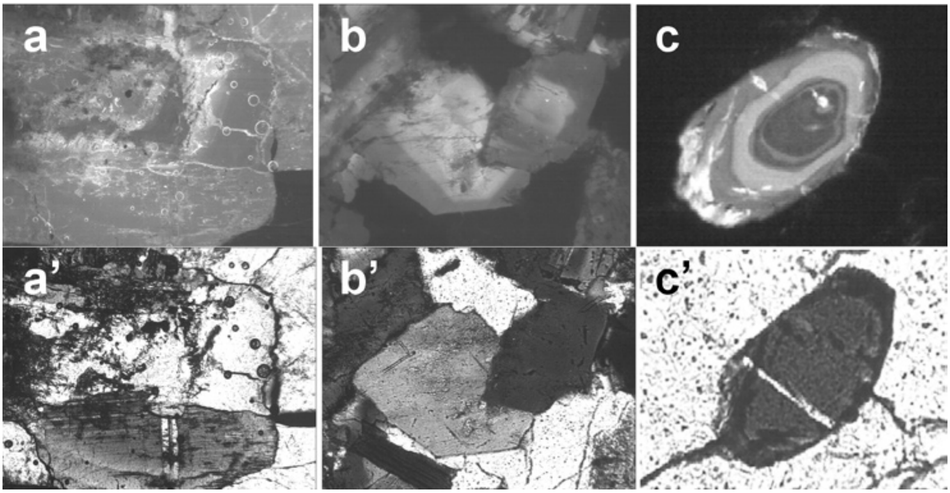

Fig. 1 Matrix minerals imaged by cathodoluminescence (CL) and crossed polarized images: a) plagioclase from MI sample – CL, a') crossed nicols image – 38x; b) matrix alkali feldspar from granodiorite – CL, b') crossed nicols image – 50x; c) apatite from MI granite – CL, c') crossed nicols image – 150x.

FINAL REMARKS

Although R, SPH and MI megacrysts appear in rocks showing different modal and geochemical composition, their core parts nucleated and grew under similar conditions. The growth dynamics are different in all three environments. The most kinetically fluctuating environment is recognised in R samples. The R granodiorites show also field evidence for magma mingling and mixing. The records of environment fluctuations have been preserved in megacrysts and in matrix minerals. K-megacrysts and K-matrix feldspars display zoning (visibly only under CL) caused by different structural defect densities. The R megacrysts growth timing might be compared with the first stage of SPH and MI K-megacrysts formation. The chemistry of the cores of all of the samples is similar in term of trace elements concentration. The duration of SPH and MI K-megacrysts formation obeys next stages, absent in R samples. Each stage is preceded by loss of equilibrium due to the change of magma composition. The marginal parts of SPH and MI megacrysts show basic differences reflected in CL images. The heritage of plagioclase attached as a rim in both samples is different. Plagioclases from the rims of MI megacrysts show affinity to R and F samples. Their growth is interrupted many times. In the contrary, plagioclases from the rim of SPH megacrysts show signs of equilibrium growth. Generally, F megacrysts show weak relation to the origin of R, MI and SPH samples. The F granodiorite similarly to R display field evidence for magma mingling and mixing.

The cathodoluminescence method allowed to identify similar heritage of some of the megacrysts despite different rock composition. The feldspars seem to crystallise under magma mixing conditions. Consequently their parent rocks are items formed due to the same process. CL investigation argues also for crystal transport within the magma chamber. The idea has been introduced by Cloos and developed by Mierzejewski (see for instance Mierzejewski, 2002). Taking into account the position of feldspars Mierzejewski reconstructed funellike structures, the ways used by magma pulses.

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