Cathodoluminescent characterization of exsolution texture in alkali feldspar

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In this study cathodoluminescence (CL) imaging and spectroscopy of alkali feldspar have been performed to investigate low and high-temperature feldspar/fluid interaction in syenite.

Alkali feldspar in a quartz syenite from the Patagonian Andes, Chile was used for CL measurements. This feldspar (sanidine) with a primary composition of $Or_{40}Ab_{59}An_1$ with ˜0.2 wt.% Fe_2O_3 crystallized from magma at higher than 750 ^oC, showing clear and featureless (CF) observed under petrographic microscope. The Ca-Fe zoning was formed by high-temperature feldspar/fluid interaction at 600-700 ^oC. The hydrothermal reaction around at 250 ^oC yields characteristic patch microperthite (PMP). Finally, Ab-lense (Ab-L) and Or-rich vein were formed during successive lower-temperature hydrothermal reactions at lower than 200 ^oC.

A cathodoluminescence scanning microscopy (SEM-CL), SEM (JEOL: JSM-5410) combined with a grating monochromator (OXFORD: Mono CL2), was used to measure CL spectra in the range from 300 to 800 nm. CL images were obtained with a MiniCL detector (Gatan) equipped with SEM-CL, where monochromatic CL image can be recorded through a band-pass filter.

CL spectra of CF, PMP, Ab-L and Or-vein have a broad peak at 750-760 nm. This red emission is attributed to Fe^{3+} impurity center, and its intensity depends on the texture. Integrated CL intensity of this spectral peak indicates a positive correlation with Fe_2O_3 content. CL spectra of CF only have a broad band peak at around 400 nm in blue region, which can be assigned to Al-O^--Al defect center. On the other hand, the CL intensity in blue region shows a negative correlation with Fe_2O_3 content.

Monochromatic imaging by the use of emission at 750 nm reveals high-resoluted CL zonal structure corresponding to Ca-Fe chemical zoning in EPMA composition map. Furthermore, the density of CL intensity can be related to the concentration of Fe_2O_3 demonstrated by EPMA compositional mapping. Monochromatic CL image at 450 nm shows bright emission in CF. It implies that the feldspar/fluid interaction eliminate Al-O^--Al centers, which cause blue CL emission. Additionally, this CL image clarifies the distribution of fluorite particle (1 micro meter) in CF and its absence in the rim. Fluorite particles in the feldspar were formed at high temperature and decomposed by feldspar/fluid interaction.