Evaluation of the grade of mylonitic rocks using cathodoluminescence

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Cathodoluminescence (CL) microscopy and spectroscopy provide useful information on existence and distribution of impurity elements related to crystal chemistry and lattice defects produced by destruction or distortion of atomic linkages with a high-spatial resolution, which should be more informative to characterize the crystal-chemical features of minerals. In this study, we have conducted to characterize CL features of the minerals in mylonitic rocks distributed in the Ryoke metamorphic belt along the Median Tectonic Line for the evaluation of mylonitization.
Mylonite, protomylonite and their source rocks (Hiji tonalite) were collected from the outcrops around an eastern part of Iida City, Nagano Prefecture. CL imaging was carried out using the Luminoscope with a cooled CCD camera. CL spectra were obtained by an SEM-CL system consisting of SEM with a grating monochromator. CL Spectral data were corrected for total instrumental response.
Color CL imaging of the mylonitic rocks shows yellow for plagioclase, blue for K-feldsper, purple to red for quartz and occasionally cream to yellow for minute zircon and apatite. In CL spectroscopy, the plagioclase with a yellow CL gives a broad band at 730-740 nm in a red region, a broad band at 570-580 nm in a yellow region and weak broad bands from 330 nm up to 430 nm in a blue region, which well correspond to the optical CL. The K-feldsper with a blue CL gives a broad band at 730-740 nm in a red region and a broad emission band at around 420 nm in a blue region. The quartz with purple to red CL gives a broad band at 640-750 nm in a red region and a broad emission band at around 390 nm in a blue region.
In the quartz, the emission intensity in the blue region around 390 nm can be assigned to structural defects related to Al^{3+}-M^{+} (M: Li^{+}, Na^{+}, K^{+} or H^{+}). Its intensity decreases with the progress of the mylonitization in host rocks, accompanied with its peak shift to the shorter wavelength side (higher energy side). Further more, the emission intensity at 640-750 nm in a red region due to structural defects of NBOHC and/or substitutional Fe^{3+} shows a slight increase with the mylonitization. The decrease of blue-emission intensity related to the mylonitization suggests that structural defects originally existed in the quratz for a blue-CL emission were eliminated by shear stress and/or elevated temperature during the formation of mylonite. CL characterization of the quartz could be used as an indicator for the evaluation of the mylonitization process.

Keywords: Cathodoluminescence, Mylonite, Mylonitic rocks

