Cathodoluminescence spectra properties of recrystallized quartz in mylonite.

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Quartz has characteristics of cathodoluminescence (CL) emission due to structural defects in the crystal and presence of impurity elements. Previous studies have been reported that emission intensity decreases due to mylonitization based on the observation of CL images (Shimamoto et al., 1991; Morales et al., 2011; Kidder et al., 2013). However, no research has been reported on examining the influence of mylonitization by separating the CL spectrum for each emission factors. In this study, CL spectra of quartz grains in mylonite were measured using SEM-CL in order to elucidate the influence of quartz on the CL spectrum by shear deformation. CL spectra of quartz grains in the mylonites from Iragawa mylonite zone (Aomori Prefecture, NE Japan) and along the Median Tectonic Line (MTL) in Mie Prefecture, SW Japan were measured and examined characteristics of each separated spectra. Spectra of quartz grains have two peaks (around 420 nm and 620 nm) or only one peak (around 620 nm). Principal component analysis (PCA) of CL spectra data was examined in order to extract potential factors which influence the CL spectra. As the result of the PCA, the first principal component (PC1) and the second principal component (PC2) represent the emission intensity and the intensity ratio between the blue side (380–450nm) and the red side (580–650nm), respectively. Since the PC2 score is influenced by the overall emission intensity, the spectra of each sample are normalized as the areas become equal. The normalized spectrum was multiplied by the eigenvector of PC2 to obtain the score (PC2') as PC2 score. After that, measured spectrum was fitted by nine Voigt functions (mixed Voigt function) and parameters of each Voigt functions were estimated by the least squares method and calculated mixing coefficients for each peak. The center wavelength of each Voigt function was set to nine (380, 420, 450, 500, 580, 620, 650, 705 and 730-800 nm) whose emission factors are summarized by Hunt (2013).
PC2’ score and the mixing coefficients indicated that the emission intensity on the red side are increasing together with decreasing grain size of recrystallized quartz across the Iragawa mylonite zone and the MTL mylonite zone. The deformation temperatures estimated by quartz LPO do not show conspicuous change across the Iragawa mylonite zone (Watanuki et al., 2017), so the clear change of PC2’ does not depend on the change in the deformation temperature. The PC2’ results can be therefore interpreted by the effects of the lattice defects (e.g. Al or Ti substitute decrease, or non-brigding oxygen hole center: NBOHC increase associated with strengthening mylonitization. Especially NBOHC is attributed to OH^- bonding defect (Götze et al, 2001). Therefore, this defect was presumably increased by mylonitization. We need to clarify exact kind of lattice defects in recrystallized quartz in strongly deformed mylonites.

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Keywords: Quartz, Cathodoluminescence, Mylonite

