# Sample temperature effect on cathodoluminescence of shock-metamorphosed quartz

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Cathodoluminescence (CL) has been extensively used for the research in quartz; growth zonation, identification of trace elements and its distributions, radiation-damage halos, and provenance study. So far we have reported on temperature dependence of CL in some quartz and their activation energy of temperature quenching processes (Okumura et al., 2004). In this study CL spectral measurements of shock-metamorphosed quartz were carried out from -192 deg. C to room temperature. The result leads a difference in temperature quenching prosess between shocked quartz and other origin ones.

Samples used for CL spectral measurements were shocked quartz (COC-01) in Coconino sandstone at meteor crater, Arizona, USA. For comparison, quartz (ASM-A7) in pelitic schist from oligoclase-biotite zone (Sambagawa metamorphic belt) and quartz (ABU-01) in biotite granite (Abukuma granite) also were employed. The measurements were carried out using a JSM-5410 SEM combined with an Oxford Instrument grating monochromator (Oxford Mono CL2) in wavelength range of 300 to 800 nm, where operated condition was at 15 kV acceleration voltage and a beam current of 0.03-1.0 nA. The sample temperature was controlled in the range from -192 to 25 deg. C with a cryostage.

At room temperature CL spectra of COC-01 exhibited two broad peaks centered around at 450 nm (2.75 eV) and 630 nm (1.97 eV). ABU-01 also has similar spectral pattern as that of COC-01, while ASM-A7 showed a broad peak around at 630 nm with shoulder at 450 nm. In CL spectral measurements below room temperature, CL spectra of all samples exhibited a doublet peak in blue region around at 450 and 500 nm. Upon heating the CL intensity of COC-01 gradually decreased up to -140 deg. C, and then rapidly reduced above -140 deg. C. The decrease in CL intensity, however, is not so pronounced with the increase of temperature compared with other quartz.

Temperature quenching of the luminescence arises at high temperature because of the increased probability of non-radiative transition from the excited state to ground state. We quantitatively evaluated activation energy of CL temperature quenching process by assuming Mott-Seitz model. The results of modified Arrhenius plots provide an activation energy (E) of 0.071 eV up to -140 deg. C and 0.112 eV from -140 to -30 deg. C for COC-01. The value of E for ASM-A7 is 0.157 eV from -130 to -50 deg. C and that for ABU-01 is 0.238 eV from -110 to -10 deg. C. These facts suggest that such activation energy seems to have a difference with the degree of metamorphism. Therefore activation energy of CL temperature quenching process might be used as an indicator for the record of high pressure metamorphism on quartz.

Reference

T. Okumura, H. Nishido and K. Ninagawa (2004) 32nd Internat. Geol. Cong. Abs, #114-24.