Temperature quenching effect on cathodoluminescence of quartz from high pressure metamorphic rocks

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Introduction

We have reported on temperature dependence of cathodoluminescence (CL) in quartz of various origin (e.g. Okumura *et al.*, 2004). In this study temperature quenching effect on CL of quartz in high pressure metamorphic rocks was examined, and activation energy of CL temperature quenching process was quantitatively evaluated.

Samples and procedures

Samples used for CL spectral measurements were quartz in eclogite from Mt. Gongen, Japan (Q1) and in jadeite schist from Horokanai, Japan (Q2).

The measurements were carried out using a JSM-5410 SEM combined with an Oxford Instrument grating monochromator in wavelength range of 300 to 800 nm, where operated condition was at 15 kV acceleration voltage and a beam current of 0.05 nA. The sample temperature were controlled in the range from –192 to 25 ^{o}C by employing a cryostage.

Results and discussion

CL spectra of both samples exhibited a doublet peak in blue region at around 450 nm (2.75 eV) and 500 nm (2.48 eV) below –50 ^{o}C while no obvious peak was observed above –30 ^{o}C. Upon heating the CL efficiency of both quartz gradually decreased up to –130 ^{o}C, and then rapidly reduced above –130 ^{o}C.

Temperature quenching of the luminescence arises at high temperature because of the incresed probability of non-radiative transition from the excited to ground state. We quantitatively evaluated activation energy of CL temperature quenching process by assuming Mott-Seitz model. As the results of modified Arrhenius plot, activation energy (ε) of Q1 is 0.045 eV up to –130 ^{o}C and 0.153 eV from –110 to –50 ^{o}C, and that of Q2 is 0.040 and 0.178 eV, respectively. These values of activation energy differ from those of hydrothermal and plutonic quartz, which shows that 0.030 eV up to –110 ^{o}C and 0.227 eV from –110 to –10 ^{o}C. Consequently activation energy of CL temperature quenching process might be used as an indicator for the record high pressure metamorphism on quartz.

References

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