The relationship between alumimium contents and cathodoluminescence in hydrothermal quartz veins

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This study has focused on a series of quartz ± carbonate ± base metal mineralized veins from Cornwall, southwest England. These extensional veins are characterized by multiple phases of incremental quartz growth and there are a variety of quartz textures present. The dominant texture is of prismatic, growth-zoned crystals, although fine-grained, cloudy quartz, sometimes with an unusual lath-like morphology, spherulites of cryptocrystalline silica and quartz cement micro-breccias can also be seen.

Desktop cathodoluminescence (CL) studies of these veins show that the prismatic quartz has a short-lived blue-green luminescence and displays growth zoning at a range of scales. This CL zonation can also be seen on a smaller scale (down to <20microns) using a Jeol 8900 electron microprobe equipped with a cathodoluminescence (CL) detector. This zonation appears to be strongly linked to the Al concentrations of the quartz. CL light bands have Al contents ranging from 400ppm to <200ppm, whereas CL-dark bands have between 1000ppm to over 8000ppm. Fourier Transform Infra-Red studies of the veins confirms that that the prismatic quartz contains appreciable quantities of Al balanced hydroxyl groups as structural defects in the crystal lattice.

Temperature quenching effect on cathodoluminescence (CL) of Ca-Mg series carbonate minerals

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Introduction

So far little is known about a quantitative evaluation of temperature quenching effects a marked change in the CL emission spectra of the carbonates. The aim of the present work is to investigate the effects of sample temperature on the intensity, wavelength and bandwidth of CL in Ca-Mg series carbonates. The results can provide important information on paleotemperature estimation and TL dating of a carbonate-bearing rock.

Sample and experimental method

Two calcite (C1 and C2), magnesite and dolomite are used for CL measurements. Their Mn contents are 9170, 129, 555 and 547 ppm, respectively. CL spectra was obtained employing a SEM-CL with a temperature control stage in range between -192 and 400 ^{o}C, at acceleration voltage: 15 kV and beam current: 0.05~0.15 nA.

Result and discussion

Calcite (C1 and C2) and magnesite exhibit single broad CL emission peaks at 620~650 nm in the wide temperature range. CL spectra of dolomite at low temperature have two peaks at 590 and 670 nm, which can be assigned to Mn^{2+} activators in calcite and magnesite, respectively, while becoming broad single peak with an increase in temperature.

C1 shows a rapid decrease in the CL intensity on heating, but not obvious above -90 ^{o}C, where the luminescence efficiency evaluated by a Gaussian peak fitting signifies a typical temperature quenching phenomena. We obtained activation energy of 0.04 eV in this process by a least-square curve fitting of the Arrhenius plot.

On the other hand C2 did not follow temperature quenching process mentioned above, but tends to increase the CL intensity with the rise of temperature up to 200 ^{o}C. Magnesite and dolomite also have a complicated feature in the change of the CL intensity with an increase in temperature.

All sample show an approximately liner relationship between peak wavelength as well as bandwidth and sample temperature. It implies that sample temperature affects an alteration in crystal field related to Mn^{2+} impurity and energy level of the electrons at excited state in a similar manner among these minerals.