Thermoluminescence and impurities of quartz from Sambagawa metamorphic belt, central Shikoku

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Quartz is an essential constituent in igneous, sedimentary and metamorphic rocks and is a major phase in veins. The crystallization of quartz under various geological environments allows it to enclose a varirty of trace element impurities, which play an important role in its Thermoluminescence (TL) emission. The TL emission of quartz shows great variety in intensity and wavelength. Blue to green TL emission at high temperature range has been commonly detected in quartz originated from plutonic rocks and hydrothermal veins. The orange to red TL emission with high temperature peaks ranging between 300 to 350 °C has been generally observed in quartz extracted from volcanic ash layers and archaeological burnt materials. Nevertheless, characteristics of TL emission in metamorphic quartz, as well as its relation to trace element and metamorphism have been poorly understood. In order to clarify these issues, the TL emissions and trace element compositions in quartz grains extracted from samples of pelitic and siliceous schist and their associated quartz vein were studied. Samples from different metamorphic grades (e.g. chlorite zone, garnet zone, albite-biotite zone and oligoclase-biotite zone) were collected from the Sambagawa Metamorphic Belts in central Shikoku, Japan.
The purified quartz grains were irradiated with a ^{60}Co gamma irradiator, using a dose of 5 kGy. TL emissions were measured at Okayama University of Science and Akita University. Trace element concentrations in the grains were measured by Agilent 7500 Series LA-ICP-MS. Paramagnetic defects were determined using JEOL PX-2300 SER spectrometer at Okayama University of Science.
A high intensity of the peaks below 200 °C favors the lower metamorphic grade. On the other hand, TL emissions at above 200 °C tend to increase with the higher metamorphic grade. There is an obvious decreasing tendency in Al content with increasing metamorphic grade, while no significant difference in concentration of Ti. It was measured that Al center is presented in all samples, whereas E´ center and Peroxy center are commonly existed in the higher metamorphic grade samples. It is reasonable to consider that the declenation of Al content, and the existance of E´ center and Peroxy center with increasing metamorphic grade presumably influences the characteristics of the TL temperature peaks in the samples.

Keywords: Gamma radiation-induced thermoluminescence, Sambagawa Metamorphic Belt

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