Measurement of thermoluminescence efficiencies induced by alpha, beta, gamma and X-ray using synthetic calcite

*Manabu Ogata[1], Noriko Hasebe[2], Keisuke Fukushi[2], Naoki Fujii[3], Minoru Yamakawa[3], Tsutomu Sato[4]

1.Graduate School of Natural Science and Technology, Kanazawa University, 2.Institute of Nature and Environmental Technology, Kanazawa University, 3.radioactive Waste Management Funding and Research Center, 4.Faculty of Engineering, Hokkaido University

In comparison to quartz thermoluminescence, characteristics of calcite thermoluminescence is less understood, thus, thermoluminescence dating was not often applied to calcite in recent years. Earlier studies suggested that characteristics of calcite thermoluminescence depend on impurity concentrations, however, it is not quantitatively understood and the difference in characteristics of luminescence response against different kinds of radiation is not clear.
By analyzing chemical composition and luminescence efficiencies induced by alpha, beta, gamma and X-ray of natural calcites, it is suggested that luminescence efficiency factors are a function of Mg, Mn and Fe concentrations. In this study, synthetic calcites with controlled impurity concentrations were analyzed to evaluate relationship between multiple impurity concentration and thermoluminescence efficiencies by each radiation (alpha-ray, beta-ray, gamma-ray and X-ray) quantitatively.
In Kanazawa University, X-ray is used as artificial radiation source to prepare calibration curve. A known dose was given by each radiation source (alpha-ray; ^{241}Am, beta-ray; ^{90}Sr and gamma-ray; ^{60}Co) and then estimated by the SAR method using X-ray. The luminescence efficiencies by each radiation normalized to X-ray (a-x-value, b-x-value and c-x-value) were calculated with given dose and measured dose.
The c-x-values of Mn doped calcites are lower than that of non-doped and Mg doped calcites, and the c-x-values are negatively related with Mn concentration. The c-x-value of Mn-Mg and Mn-Fe doped calcites are slightly lower than that of Mn doped calcite, however, are independent of Mg or Fe concentration. As a result, Mn works to decrease c-x-value, and contributions of Mg and Fe to c-x-value are negligibly small.
Results of a-x-value and b-x-value also will be presented on our poster.

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