Provenance study of Asian dust using cathodoluminescence spectra of single quartz grains

K. NAGASHIMA[1], H. NISHIDO[2], AND M. KAYAMA[3]

[1] JAMSTEC, Yokosuka 237-0061, Japan, nagashimak@jamstec.go.jp
[2] Okayama Univ. of Science, Okayama 700-0005, Japan, nishido-rins.ous@nifty.com
[3] Kobe Univ., Kobe 657-8501, Japan, kayama0127@gmail.com

Recently, zircon U-Pb ages using single grains have been successfully applied to estimate the provenance of Loess sediments in China. However, its adaptation is limited to the areas adjacent to the deserts because the zircon is preferentially removed from the air due to its high density, whereas the methodology using a single-grain sample is highly valued for the most diagnistic way to trace the provenance. In this study we developed a new provenance tracing method by means of cathodoluminescence (CL) of single quartz grains, which is widely applicable to the dust-fall samples, marine sediments, and ice cores far from the Asian deserts.

The CL spectroscopy easily detects crystal-chemical features in quartz, such as impurities and native imperfections (e.g. vacancies, self-interstitials, and dislocations) with high-spatial resolution of a few micrometers. The type and amount of such impurities/imperfections change depending on the conditions of its formation (e.g. igneous, hydrothermal and diagenesis origins) and geological background after the formation (e.g. metamorphic pressure and temperature). Therefore, the CL characteristics of quartz vary with the host rocks with different origins, suggesting a benefit to be used for a provenance study. Systematic CL analysis was intended for quartz grains from Mountain Loess samples near Tarim Basin (aeolian dust emitted from the Taklimakan Desert) and surface sediments at Gobi desert in southern Mongolia to evaluate the difference of CL spectral features between the quartz grains from Taklimakan and Gobi deserts.

Most of the quartz grains from the two deserts show two CL emission bands in a red region and in a blue region. The CL spectral deconvolution using a Gaussian-curve fitting reveals various types of emission components, of which ratios are variable with respect to quartz grains with different host rocks. The statistical analysis using the ratios of emission components exhibits different ratios of clusters between the quartz grains from two deserts, probably reflecting mixing ratios of different host-rocks (volcanic, plutonic and metamorphic rocks) constituting two deserts.