Rare earth elements and other trace elements in Greenland aerosols

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Aerosols in ice-core and snowpit samples provide information on past atmospheric conditions and change in aerosol sources. Environmental pollution is can be measured by investigating trace element which is contained in ice-core and snowpit samples. Rare earth elements (REE) as a one part of trace elements reflect the original site feature. REE is a useful tool for estimating source regions (Kang et al., 2007; Soyol-Erden et al., 2011).

The sampling was collected on June 2009 at a site located 2461 m (77°26′81″ N, 51°56′78″ W, NEEM, Greenland) (Fig. 1). Total samples are 70 which collected a 3.2 m depth snowpit.

Figure 1. Sampling site

The frozen samples (-20℃) were transported to the Korea Polar Research Institute (KOPRI) in Korea. At KOPRI, the samples were melted, then, cation and anion were measured by ion chromatography. Stable water isotopes ($\delta^{18}O$ and δD) were measured by wavelength scanned cavity ring-down spectroscopy. Trace elements and REEs were measured by inductively coupled plasma sector field mass spectrometry in a clean booth (class: 10).

Ratio of $\delta^{18}O$ and δD is changed with temperature variation, precipitation and origin of vapor (Svensson et al., 2000). Ion concentrations show seasonal features (Kang et al., 2007). Summer and winter are calculated by result of $\delta^{18}O$, δD and concentration of ion. Samples present 5 winters and 6 summers during 2003 to 2008.

All REE data was normalized using by Post-Archean Australian Shale (PAAS) for interpreting a REE pattern. Normalized REE data varied from 0 to 0.45. Most of REE data is belongs range 0.02 to 0.2. Samples show very similar PAAS-normalized REE patterns characterized by MREE enrichment and positive Eu anomalies. There are 3 types of REE pattern in whole period (2003-2008) (Fig. 2). In Figure 2, the (a) shows high and stable value and (b) has parallel shape with graph (a) but value is lower than graph (a). Graph (c) represent clear peak at Eu and Tb that is general pattern in this research. When unique pattern was appeared (a) and (b), Alaska volcanic activity was being occurred.

In this study, features of variations on trace elements can be indicate to sources of aerosol in Greenland.
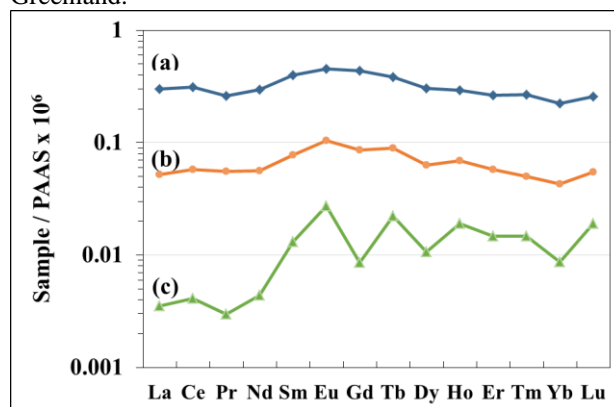

Figure 2. Typical PAAS-normalized REE patterns: (a) volcanic activity, (b) MREE enrichment and (c) MREE and HREE enrichment

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