Physical and chemical state of Fe-phases in Chinese aeolian dust

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Iron supplied by aeolian dust is a factor controlling the biomass of phytoplankton in high nutrient low chlorophyll (HNLC) regions, and dissolved Fe-stimulated biogeochemical activity can consume a large amount of CO_2 in atmosphere, which may have a significant impact on the global C-cycle. In order to understand the physical and chemical state of Fe in the asian dusts, aerosol samples collected in Fukuoka, Japan and Hefei, China in March 2010 have been investigated in detail from nano to bulk scale. The analytical techniques include an inductively coupled plasma mass spectrometry (ICP-MS), X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). A sequential extraction of the Fe-phase was also perfomed based on the previous method [1].

The Fe concentrations in the Hefei and Fukuoka samples during the dust event are 11.8 and 4.31 times higher than that in the Fukuoka sample in the non-dust period. The fraction of Fe-phase (in wt.% = mass of Fe in each Fe-phase/total mass of Fe) in the Fukuoka dust samples determined by the sequential extraction is Fe-bearing sheet silicate (59-61 %), hematite and goethite (23-28 %), ferrihydirte (7.5-12 %), magnetite (3.0-4.3 %). The XRD pattern indicates that illite and chlorite are the major Fe-bearing minerals in all samples. TEM observation reveals that aggregates of nano-sized ferrihydrite are present on the surface of illite.

Based on the the solubilities of clays (4 %) and Fe oxides (<1 %) reported in the previous study [2] combined with our data, it is suggested that the clay minerals in the Chinese dust contribute predominantly to the Fe flux to the HNLC, which can potentially supply >6 times greater amount of Fe than that from Fe oxides [2]. It should be also noted that the ~10 % of Fe present as ferrihydrite may be an important contribution because it is readily consumed by some photosynthetic algae species [3]. Still, quantitative investigation of highly bioavailable and soluble minerals in dust materials such as demonstrated in the present study should be essential to the appropriate evaluation of the impact of atmospheric Fe input into HNLC region.

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Uniqueness of kimberlite magma: Its source characteristics and transportaion systems revealed by isotope signatures

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Since kimberlite magma carries diamonds as xenoliths, it has been regarded to be formed at a depth of at least more than 150km and extruded to the surface within a few hours from the bottom of continental lithosphere. Based on Sr-Nd isotope systematics, kimberlites are classified into Group I and Group II [1]. Among them, Group I kimberlites show especially significant isotope signatures, which would reflect quite unique source characteristics and transportaion systems.

In the Sr-Nd and Nd-Hf isotope diagrams expressed as delta values, Group I kimberlites from different sites cluster close to the Bulk Earth values [2], while chondrite-normalized REE patterns show highly fractionated trend with L-REE enrichment. This implies that such high L-REE enrichment in a kimberlite magma should have occurred in the latest stage of magma transportaion system before eruption. To explain such high enrichment of L-REE, very small amount of partial melting of less than 1% is required. On the other hand, cluster of isotope signatures in Sr-Nd and Nd-Hf diagrams needs homogenization of magma source materials. Those isotope values mentioned above are often regarded to be a result of mixture between depleted (asthenosphere) and enriched (lithosphere) components. However, it seems quite difficult to attribute the cluster of isotope values of kimberlites with different sites and times to the process of small degree of partial melting. Our findings of high $^3He/^4He$ for Greenland kimberlites [3] and Ne isotope systematics for Russian kimberlites [4] definitely suggest that kimberlite (Group I) magma source materials have similar isotope sigantures with those of OIBs and would possibly be located in the lower mantle. Although He and Ne isotopes show a sign of interaction with lithospheric components before eruption, it would be only effective for He and Ne due to their higher diffusivity compared to that of solid elements. Hence, the cluster of Sr, Nd, Hf isotopes of kimberlites (Group I)would reflect the chrataceristics of source materials of magma in the less fractionated deep mantle.

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