Possible key materials to unravel the chemical state of the deep mantle-Noble gases, kimberlites and E-chondrites

ICHIRO KANEOKA[1]

[1] Earthquake Research Institute, Uiversity of Tokyo, Bunkyo-ku, Tokyo 113-0032, Japan (ikaneoka@aol.com)

The chemical state of the deep mantle (lower mantle) has been generally estimated by the combined knowledges of chemical and isotope signatures for mantle-related materials and CI-chondrites. It may be a prevalent image that the convection prevails the whole mantle and the lower mantle would also keep a relatively depleted chracter as observed in MORBs and oxidized state[1].

However, we should not neglect signatures which seem to be incompatible with such images. Noble gas isotopes (*e.g.*, $^{3}He/^{4}He$) definitely indicate that OIB magma sources should be less degassed than those of MORBs. It requires the existence of world-wide less degassed region in the nonconvective mantle through the Earth's history, possibly in the deeper part of the lower mantle[2].

In addtion, kimberlites show quite notable characteristics. Kimberlites are effusive diamond-bearing ultramafic rocks, enriched with alkali elements and volatiles, formed under a rather reduced condition at a depth of more than 150km until the uppemost part of the lower mantle. Initial ratios of Sr, Nd and Hf isotopes for kimberlites (group I) concentrate to a rather narrow range close to the bulk Earth value [3]. Ne isotopes suggest its magam source to be similar to the OIB-type[4]. Such kimberlite magmas seem to reflect properties of a less fractionated and reduced part in the deep mantle.

Furthermore, oxygen isotope systematics of CI-chondrites (highly oxidized) show the different trend with that of terrestrial materials, while E-chondrites have the same one like lunar samples with terrestrial materials[5]. Hence, E-chondrites, which are highly reduced, might be related to the chemical properties of the Earth at least partly. The deep mantle might be more reduced than what has been inferred from a model based on CI-chondrites.

Thus, noble gases, kimberlites and E-chondrites suggest the possible existence of less-degassed, less-fractionated and reduced part in the lower mantle. To unravel the properties of the deep Earth, they should be examined in more details.

[1]*ex.)* White (2015) *Geochem. Perspect.* **4**, 95-251, [2]*ex.)* Kaneoka (2008) *Geochem. J.* **42**, 3-20, [3] *ex.)* Schmidtberger *et al.* (2001) *GCA* **65**, 4243-4255, [4] Sumino *et al.* (2006) *GRL* **33**, L16318, [5] *ex.)* Clayton and Mayeda (1984) *JGR* **89**, C245-C249.