Hydrogen isotope study of serpentinite from the Happo-O'ne area: Implications for the water cycle in subduction zone

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Dehydration, hydration and melting processes in subduction zones and mantle wedge are critical in understanding the movement of water into the mantle and the arc-related magmatic activity. Tracing the movement of water is a tough task, however hydrous minerals help in this matter. In order to understand the water circulation systematics in the mantle wedge, hydrogen (dD) and oxygen ($d^{18}O$) isotopic compositions of serpentinite rocks from Happo- O’ ne area, Nagano Prefecture was studied. Happo-O’ ne serpentinite is one of the largest serpentinite bodies belonging to the Omi-Renge Belt of the Hida Gaien Zone, which was associated with Paleozoic subduction zone. Based on thin section observations and XRD analysis, serpentinite occurrences were subdivided into several zones based on mineralogical association, consistent with previous study (Nozaka, 2005). Rock samples were crushed and serpentine minerals were separated by isodynamic separator and heavy liquid methods. Hydrogen and oxygen isotopes of the separated minerals and whole rocks were analyzed by TCEA–IRMS at Tokyo Institute of Technology.

The dD values of serpentinite ranges between −135‰ and −47‰. Considering equilibrium isotopic fractionation between serpentine and water (Saccocia et al., 2009), at the formation temperature of Antigorite, these serpentinite rocks are clearly not originated from modern seawater (0‰). Serpentinites having lower dD (c. −125‰) is rather derived from meteoric water in this area (dD = −90‰; Suda et al., 2014). This is consistent with the geology: serpentinite having lower dD is mainly associated with talc, which was contact metamorphosed by intrusive granite. On the other hand, dD value of the water which was equilibrated with serpentinite having higher dD values, intermediate between seawater and present day meteoric water. These serpentinite rocks are relatively away from the granite intrusion and may still preserve pristine information of water in the mantle wedge. If so, our results imply intensive dehydration from subduction slab.

References

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