

EVENT | EVENT | EVENT

[EV-03] Miyake Prize Lecture

Wed. May 24, 2023 1:00 PM - 1:40 PM Exhibition Hall Special Setting (1) (Exhibition Hall 8, Makuhari Messe)

Prof. Eiji Ohtani, recipient of the Miyake Prize in 2018, will give a commemorative lecture.

1:00 PM - 1:40 PM

[E-11-17]Miyake Prize Lecture: Hydration and dehydration in the Earth's interior and hydrogen budget of the Earth*Eiji Ohtani¹ (1. Tohoku University)

Professor Yasuo Miyake bearing the name the Miyake Prize was a pioneer of atmospheric and ocean chemistry and warned the pollution from nuclear tests. We appreciate his memorial contributions to the academic and social issues. Here, I would like to review the recent progress in origin and transport of hydrogen/water in global earth which is the target materials studied by Professor Miyake.

Origin of water in the ocean and inside the earth has been discussed based on the isotopic ratio of D/H, and argued that oceanic water might have delivered from carbonaceous materials or comets. Primordial components such as He and Ne isotopic anomalies have been reported and the origin of the components has been debated intensively. Recent discovery of the water bearing enstatite chondrite which has an isotopic signature of D/H and N similar to the mantle provided a new insight on the origin of water in the earth (1). The entry of primordial hydrogen-rich atmosphere by magma ocean is called as "nebular ingassing" (2,3,4). The interaction of hydrogen-rich nebular gas with the magma ocean in the early stage of the earth's accretion also provided a new estimate on the water budget of the earth (4).

The ocean water is transported into the deep inside the earth by slab subduction. Recent seismological studies provided new observations of the dehydration process in the upper mantle, very high Vp/Vs and high Poisson ratio along the deep zone of the double seismic zone which strongly indicate cracks filled by the dehydrated fluid (5). Discovery of deep seismic swarms in the upper mantle above the slabs indicates the high speed ascent of the dehydrated fluids with a speed of km/hour (6). These observations change of our image on the dehydration process in the upper mantle.

Recent studies on water partitioning between hydrous minerals and nominally anhydrous minerals (NAM) indicated that water is stored in hydrous minerals and coexisting major mantle minerals such as olivine and its high pressure polymorphs are essentially dry indicating a dry kinetics and rheology operate in the water undersaturated wet slabs (7). Dehydration from slabs at the depths of the mantle transition zone and the top of the lower mantle explains several important observations such as water enriched mantle transition zone near the subduction regions (8), low Vs areas at the top of the lower mantle (9), very deep seismology exceeding 690 km depth (10), and seismic reflectors in the upper part of the lower mantle (11).

Recent discovery of hydrous post-stishovite phases (12, 13) provides a possibility that the dehydrated and released water can be trapped by these phases in the upper basaltic layer of the slab and further transported into the base of the lower mantle. Quantification of the amounts of dehydrated and transported water during subduction is an important issue to be studied.

References: (1) Piani et al., *Science*, **369**, 1110-1112, 2020; (2) Olsen and Sharp, *PEPI*, **294**, 106294, 2019; (3) Wu et al., *JGR, Planet*, **123**, 2691-2671, 2018, (4) Young et al., *Nature*, **616**, 306-311, 2023, (5) Bloch et al., *Geochem, Geophys, Geosys*, **19**, 3189-3207 2018, (6) White et al., *EPSL*, **521**, 25-36, 2019, (7) Ishii and Ohtani, *Nat Geosci*, **14**, 526-530, 2021, (8) Karato, *EPSL*, **301**, 413-23, 2011, (9)

Schmandt et al. **Science** 344,1265–68, 2014, (10) Zhao et al., Sci. Rep., 7, 44487, 2017, (11) Niu et al., JGR, 108, 2419, 2003, (12) Liu et al., GRL, e2021GL097178, 2022, (13) Ishii et al., PNAS,119, e2211243119, 2022.