Is the lower mantle dry or hydrous? – insight into global-scale water circulation inferred from numerical modeling

TAKASHI NAKAGAWA[1], HIKARU IWAMORI[2] AND TOMOEKI NAKAKUKI[3]

[1]Department of Mathematical Science and Advanced Technology, Japan Agency for Marine-Earth Science and Technology, Yokohama, 236-0001, Japan ntakashi@jamstec.go.jp

[2]Department of Solid Earth Geochemistry, Japan Agency for Marine-Earth Science and Technology, Yokosuka, 237-0061, Japan hikaru@jamstec.go.jp

[3]Department of Earth and Planetary System Sciences, Hiroshima University, 1-3-1 Kagamiyama, Higashi Hiroshima, 739-8526, Japan nakakuki@hiroshima-u.ac.jp

Water distribution in the lower mantle is still debated from high pressure experiments and its theory. Recently a new hydrous phase that can be stable in the lower mantle pressure has been found ('Phase-H') [1], while the intrinsic water solubility of bridgimanite is likely to be less than 0.01 wt. % [2]. Such a large contrast in the maximum water content (MWC) in the lower mantle minerals, ranging from 0.001 to 0.2 wt. % from high pressure experiments [3][4], causes a large uncertainty in the debate solely based on MWC. Recent progress of numerical mantle convection simulations allow us to include the dehydration-hydration processes with the hydrous minerals and dehydration melting in global-scale water circulation within the context of mantle dynamics [5]. Here we perform the parameter survey to check sensitivity of thermo-chemical evolution of the Earth's mantle on MWC in the lower mantle. Preliminary results suggest that disgnostic features on core evolution and thermo-chemical structures in the mantle are not sensitive to MWC in the lower mantle. This result suggests that the hydrous condition in the lower mantle would not be well constrained also from the numerical modeling approach, allowing high or low MWC in the lower mantle minerals. However, we have found that more efficient heat transfer occurs with larger MWC compared to dry mantle cases. This is because enhancement of surface plate activity caused by hydrous oceanic crust can transport more heat from the Earth's deep interior than the dry condition. [5]

[1] Nishi et al. (2014), *Nat. Geo.* **7**, 224-227. [2] Panero et al. (2015), *J. Geophys. Res.* **120**, doi:10.1002/2014JB011397. [3] Bolfan-Casanova (2005), *Mineral Mag.* **69**, 229-257.[4] Murakami et al. (2002), *Science* **295**, 1885-1887. [5] Nakagawa et al. (2015), G-cubed, revised.