Serpentinized oceanic mantle and global water budget

*Ikuo Katayama[1], Kohei Hatakeyama[1]

1.Department of Earth and Planetary Systems Science, Hiroshima University

Hydration of oceanic mantle can occur along outer-rise faults that relate to the plate bending at close to the trench (Faccenda et al. 2009). This contributes an additional source of water into the Earth's interior, which might have larger water flux than that transported by hydrated oceanic crust. Recent seismic reflection survey has shown that seismic velocity in the oceanic lithosphere decreases at where bending-related faults are observed (e.g., Ranero et al. 2003; Fujie et al. 2013). Although these seismic data is not enough to image what extent of hydration occurs along the outer-rise faults, we modeled the thickness of serpentinization based on fluid percolation. When the reaction kinetics is much faster than the fluid access to the reaction front, the reaction rate is controlled by permeability through the hydrated layer (Macdonald and Fyfe 1985). Using laboratory measured permeability, the reaction thickness of serpentinization is estimated as thick as 18 km for a period from the initiation of outer-rise fault to the trench axis assuming a plate velocity of 10 cm/year. If outer-rise faults occur at depths shallower than 12 km, subduction water flux is estimated to be 2.5×10^{12} kg/year by hydrated oceanic mantle lithosphere, which is approximately twice as larger as that carried by hydrated oceanic crust. Since the subduction water flux is markedly larger than the output flux through magmatic degassing, the amount of present-day ocean is now decreasing and might be disappeared within 100 million years.

Keywords: serpentinite, oceanic mantle, water budget

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