Mantle hydration along the outer rise faults inferred from permeability of serpentinites

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Recent geophysical surveys suggested that hydration (serpentinizaiton) of oceanic mantle is related to outer rise fault prior to subduction. Serpentinization of oceanic mantle affects intermediate-depth earthquakes and subduction water flux. Since the chemical reactions forming serpentinite is geologically rapid at low temperature, the rate of water delivery to the reaction front likely controls the extent of serpentinization. Therefore, to estimate the extent of serpentinization along the outer rise fault, we measured permeability of low-temperature serpentinites consisted of lizardite and chrysotile, and hydraulic diffusivity was inferred from laboratory determined permeability. Our experimental results indicate that serpentinization is spread to 8.6 km in the direction normal to the outer rise fault at the uppermost oceanic mantle (7 km depth), while serpentinization is limited to 1.2 km at the tip of fault zone (~12 km depth). We calculate that the global water flux carried by the serpentinized oceanic mantle is estimated to be 2.2×10^{12} kg/year, which is twice as high as water flux by the 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 400 million years.

Keywords: permeability, serpentinite, outer rise fault, hydraulic diffusivity, water transport

