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Water transportation into the earth's interior - Oceanic plate and its evolution -

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Plenty of liquid water exists at the Earth's surface. If water is transported from the surface into the Earth's interior, the water affect various processes in the solid Earth, such as mantle convection, generation of earthquakes, and magmatism. The evolution of the Earth cannot be explained without the transportation of water into the Earth's interior from the surface. How is the water transported into the interior? High pressure and high temperature in the deep interior prevent the penetration of water from the surface. Instead, water is transported as hydrous minerals by the subduction of the oceanic plate as part of the global mantle convection. Therefore, the amount of hydrous minerals within the oceanic plate just prior to subduction determine the amount of water transported into the Earth's interior and have an impact on the evolution of the Earth.

Crustal hydration by the hydrothermal circulation at the mid-ocean ridge was formerly considered to be a first-order control on the degree of oceanic plate hydration. However, recent several observations suggest that plate bending-related faults just prior subduction may enhance the hydration of oceanic crust and mantle. If this hypothesis is correct, the amount of water transported by the oceanic plate is much larger than foremerly expected because mantle have a potential to contain much larger amount of water than the crust.

In the last decade, to test this hypothesis, a number of structure studies have been conducted in the trench-outer rise region around the world. We JAMSTEC also have conducted extensive active source seismic structure studies in the northwestern Pacific. We have shown that seismic velocities gradually reduce toward the trench axis accompanied by the development of bend faults. In addition, we have shown that the Poisson's ratio (Vp/Vs ratio) increase toward the trench axis. These observation indicates that water content within the oceanic plate increases toward the trench and suggests that the bend faults just prior to subduction is one of keys to understand the evolutionary history of the Earth.

In this paper, we are going to show the results of our seismic structure studies as well as the other structure studies in the trench-outer rise region. Then we will discuss the remaining issues such as quantitization and spatial inhomogenity in the water amount.

Keywords: oceanic plate, outer rise, hydration, seismic survey, water transportation, Vp/Vs