Plate bending-related faulting just prior to subduction and subduction zone seismicity in NE Japan

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Water transported by the subducting oceanic plate plays key roles in various process in the Earth's interior, including generation of intermediate depth earthquakes. The amount of transported water is accounted for by the hydration of the oceanic plate before subduction. Many factors, such as hydrothermal circulation at the spreading ridge, fracture zones, and the plate bending-related faulting near the subduction trench, can affect the hydration of the oceanic plate. Of these, plate bending-related faulting (hereafter, bending faulting) recently comes to draw attentions because it has a potential to promote the hydration of the oceanic mantle as well as the crust. However, the actual contribution of the bending faulting to the plate hydration is still poorly understood, because it is not easy to separate the contribution of bending faulting from other factors.

In this presentation, we show results from controlled-source seismic survey around a junction of Japan and Kuril trenches. This is a good place to investigate the impact of the bending faulting because the same oceanic plate have experienced different bending faulting at both trenches. We modeled seismic velocities (Vp and Vs) by a traveltime inversion and observed reduction of seismic velocities and increase of Vp/Vs ratio toward trench, suggesting fracturing and water penetration (hydration) caused by the bending faulting. Although the same oceanic plate is subducting into both subduction zones, structural changes are more remarkable in the Japan trench than that in the Kuril trench, suggesting more hydration in the Japan trench than in the Kuril trench. This observation is consistent with the distribution of the dehydration induced intermediate depth earthquakes; intermediate depth earthquakes are much more active in the subduction zone of the Japan Trench than that in the Kuril Trench (Kita et al, 2006). If the difference in the activities of the intermediate depth earthquakes between both trenches is mainly dependent on the hydration of the subducting oceanic plate, the development of the bending faulting is the primary controlling factor on the oceanic plate hydration here.

The difference in the seismic structure changes can be attributed to the difference in the bending faulting. Generally, the bending faulting can be divided into two types dependent on the angle between the strike of the trench axis and the abyssal-hill fabrics, which represents the strike of the ancient ridge axis. When the trench-ridge angle is small (less than about 30 degree), the abyssal-hill fabrics are reactivated as the bending faults, otherwise, bending faults are newly formed crossing the abyssal-hill fabrics (Billen et al., 2007). In the outer slope of the Kuril trench, the abyssal-hill fabrics are reactivated as the bending faults. In contrast, new faults are formed in the outer slope of the Japan trench. Our observations suggest that the trench-ridge angle might be a controlling factor of the plate hydration, at least, in this old plate subduction zone.

Keywords: plate bending-realted faulting, controlled-source seismic survey, hydration

