Aseismic subduction in the NE Japan and materials at the plate boundary

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In order to understand the physical basis of earthquake generation along subduction plate boundaries, it is important to know the asperity distribution, the physical properties of rocks, and the presence of water and hydrous phases at the plate boundary. Two seismic experiments in the Japan Trench were carried out in 1996 and 2001.

The experiment in 1996 suggested the strong correlation between seismicity and PP reflection intensities from the plate boundary. The seismic travel-time tomography and the evaluation of reflection intensity suggested a possibility of layer with Vp=2-4km/s and a few hundred meter thickness at the subduction plate boundary. The experiment in 2001 carried out in the same region to map the seismic reflection intensity over the aseismic zone. The results in 2001 also suggested the same correlation between seismicity and PP reflection intensities. However, the reflection intensity is extremely high at the plate boundary with the depth of 18km from the ocean surface.

In order to evaluate the characteristics of seismic records and the effect of incident angles to the plate boundary, we computed synthetic seismograms using the FDM method. We used 5Hz Riecker wavelets and an appropriate Q structure. We applied 1/r correction to the synthetic seismograms to compare them to the observed records. As results, we obtained the necessity of Vp=2-4km/s and 100m thickness layer at the subduction plate boundary.

If the layer has Vp=2km/s, we should think what materials have such low Vp. Water, clay and extremely altered rooks and nano-plankton shells with water can be candidates for that. We also need to explain no SS reflection from the plate boundary even though we observed large pS converted waves and intense PP reflections along the line 3 parallel to the Japan Trench axis.

Such materials may have small mechanical strength and release strains caused by the plate subduction movement. As conclusion, the region with intense PP reflection from the plate boundary may correspond to non-asperity region, and is difficult to generate large interplate earthquakes.