**S231-P008** **Room: Poster Session Hall** **Time: May 23**

# Seismic tomography from hypocenter data by hybrid method using waveform and travel time

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Recent seismic tomography images propose that the lateral heterogeneities in seismic velocity structure correspond to lateral variations of interplate seismic coupling at the subducting plate interface[Kodaira et al., 2000; Mishra et al., 2003; Yamamoto et al., 2006]. Because these results were obtained from the active source profiling by ocean-bottom seismometers (OBS) [Kodaira et al., 2000], or the seismic tomography that were calculated from the natural earthquakes observed with both OBS and landward seismic stations [Yamamoto et al., 2006], the target regions were restricted within the OBS network. In general, sub-ocean earthquakes whose hypocenters are calculated by only onshore seismic network are not used in regional seismic tomography because of low accuracy of their estimated location, especially depth. Mishra et al. (2003) investigated a velocity structure in the forearc region of northeast Japan from the Pacific coast to the Japan Trench, using the sub-oceanic earthquakes that were located with sP depth phase data. They demonstrated that asperities of great interplate earthquakes were located outside the low-velocity zone. Thus it is important to use many sub-oceanic earthquakes in the seismic tomography in order to image the velocity structure in a forearc region. Here we report the velocity structure that is calculated from sub-oceanic earthquakes, whose depths are located by a centroid moment tensor inversion approach, around the focal area of the 2003 Tokachi-Oki earthquake, Hokkaido, Japan.

Many aftershocks occurred around the focal area of the 2003 Tokachi-Oki earthquake. However, it was difficult to calculate accurate locations of them by ordinary approaches using P- and S-wave travel times because a majority of the aftershocks occurred beneath the ocean, that is, there were no seismic stations just above the epicenters. Ito et al. (2004) obtained the aftershock distribution calculated by a moment tensor inversion analysis. Their results suggested that a majority of the aftershocks were distributed around the plate interface between the subducting Pacific Plate and the overriding landward plate.

In this study, we first apply a method that is referred to as the hybrid method that employs both the observed waveform and travel times of P- and S-waves in order to determine the hypocenter. We then perform the 3D seismic tomography around the focal area of the 2003 Tokachi-Oki earthquakes using hypocenters by the hybrid method. Matsubara et al. (2006) have been performed 3D seismic tomography of P- and S- wave speed around Hokkaido region. They have used the 16051 earthquakes occurring beneath the NIED Hi-net stations. In the tomography analysis, we used the 16,320 earthquakes including the aftershocks that are calculated by the hybrid method; 370464 P-wave and 246959 S-wave arrivals include 21525 P-wave and 12093 S-wave arrivals from the aftershocks. We use the method of seismic tomography by Matsubara et al. (2004, 2005); they introduced spatial velocity correlation into the method of seismic tomography by Zhao et al. (1992).

New seismic tomography imaged the low velocity zone of P-wave around the subducting plate interface at depths between 20 and 30 km. However, the distribution of S-wave speed shows no clear low velocity zone in the same region. The low Vp/Vs zone corresponds to the high seismicity of the aftershocks occurring at the plate interface. Large after slip was estimated in this region while the co-seismic slip of the main shock is small.