3D seismic velocity structure of the forearc area in eastern Hokkaido revealed by long-term ocean bottom seismographic observation

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We estimated 3D seismic velocity structure of the forearc region in eastern Hokkaido by using the P and S wave arrival time data recorded by land and offshore seismic stations. We deployed 30 LTOBSs (Long-Term Ocean Bottom Seismographs) for 10 months in the landward slope of the Kuril trench. Travel time data obtained by these LTOBSs and three offshore cabled stations data helped to constrain spatial distribution of hypocenter locations and seismic P and S wave velocities in offshore area.

In the obtained velocity model, the oceanic crust and mantle of the subducting Pacific slab are well imaged as the landward dipping low/high velocity layers, both in Vp and Vs images. Crustal thickness of the overriding plate is more than 20 km in the offshore area, thicker than in the offshore area of the northeastern Japan arc. In the studied area, a large interplate earthquake, the Nemuro-oki earthquake (M 7.4) occurred in 1973. The depth to the plate boundary is expected to be less than 30 km from the obtained velocity model, which indicates that the subducting Pacific slab contacts to the crust of the overriding plate in most of the rupture area of the 1973 earthquake.

The mantle of the overriding plate shows significant low velocity anomaly to the northwestward of the volcanic front, while it has normal Vp and Vs values (~8km/s and 4.5 km/s) beneath the forearc area. This suggests cold and dry state of the forearc mantle. In the rupture area of the 2004 Kushiro-oki earthquake (M7.1), located at downdip side of that of the 1973 Nemuro-oki earthquake, the slab contacts to the forearc mantle. It is speculated that the occurrence of the large interplate earthquake beneath the mantle can be allowed by the low serpentinized state indicated by the obtained seismic velocity distribution.