# Seismic velocity structure in southern Hokkaido deduced from ocean-bottom seismographic and land observations

*Yoshio Murai[1], Kei Katsumata[1], Tetsuo Takanami[2], Tomoki Watanabe[3], Tadashi Yamashina[4], Ikuo Cho[5], Masayuki Tanaka[6], Ryosuke Azuma[7]

1. Institute of Seismology and Volcanology, Faculty of Science, Hokkaido University, 2. Department of Terrestrial Magnetism, Carnegie Institution of Washington, 3. Marine Works Japan LTD, 4. Kochi University, 5. National Institute of Advanced Industrial Science and Technology, 6. Meteorological Research Institute, 7. Research Center for Prediction of Earthquakes and Volcanic Eruptions, Graduate School of Science, Tohoku University

The Kuril arc collides with the northeast Japan arc in the southern part of Hokkaido, Japan. Such a collision results in building the Hidaka Mountains and is related to the seismic activity and large earthquake occurrence such as the Urakawa-Oki earthquake (Ms 6.8) on March 21, 1982. It is important to image the three-dimensional crustal structure in order to clarify the collision tectonics and understand the patterns of earthquake occurrence and the mechanism of large earthquake occurrence. A group of seismologists from eleven universities operated a dense temporary network of land stations from 1999 to 2001 in and around the Hidaka Collision Zone [Katsumata *et al.* (2002, Bull. Earthq. Res. Inst., **77**)]. In addition, we conducted ocean-bottom seismographic observations in 1999 and 2000 in the south off Hokkaido region. Murai *et al.* (2003, GRL **30**) estimated P-wave velocity (Vp) structure by the 3-D tomographic inversion [Zhao *et al.* (1992, JGR **97**)] of seismic travel time data obtained from networks of ocean-bottom seismographs (OBSs) and land stations in 1999. However, their spatial resolution was poor for the deep crustal structure and they could not obtain S-wave velocity (Vs) structure because of limitation of the number of data. Murai *et al.* (2016, JpGU) estimated structure of both Vp and Vs by the tomographic inversion of travel time data from OBSs and land stations in 1999 and 2000. We found a problem in the reduction of the travel time residuals due to errors of station corrections in their analysis. Here we estimate Vp and Vs structure again after correcting their errors.

The results from the tomographic analysis are as follows.

1. A high-velocity body seems to be obducted toward the crest of the Hidaka Mountains from east beneath the land area, which is interpreted as the obducted lower crust of the Kuril arc. The high-velocity region extends to the east of the Hidaka Mountains at depths of 15-35 km. A low-velocity region is located to the west of the Hidaka Mountains so as to contact with the high-velocity region at the Hidaka main thrust. It is interpreted as the northeast Japan arc. These results are consistent with those obtained by previous tomographic studies.

2. We found a distinct low velocity region dipping southwestward from beneath the Hidaka Mountains to the source area of the 1982 Urakawa-oki earthquake at depths of 35-45 km which was imaged only by the tomographic analysis using the data from OBSs. It is interpreted as the lower part of the delaminated Kuril arc lower crust, which has an area of about 50 km wide by 50 km long.

3. The colliding low-velocity crustal material disappears in the southeast of Cape Erimo. Moreover many microearthquakes occurred in the low-velocity region whereas the seismic activity was low outside it. These results suggest the effect of arc-arc collision is reduced abruptly in the offshore area as the southeastward extension of the Hidaka Mountains.

 

4. The hypocenter of the 1970 Hidaka earthquake (M 6.7) is located at the boundary between the high and low velocity regions. The fault plane of the 1982 Urakawa-oki earthquake is located at the western boundary of the high Vp anomaly faster than 8.0 km/s. Thus these M7 class inland earthquakes occurred at material boundaries, which is consistent with Kita *et al.* (2012, JGR **117**).

5. The overriding plate above the seismogenic asperity of the 2003 Tokachi-oki earthquake (M 8.0) is characterized by high Vp/Vs on the northeast side of Cape Erimo. This result is consistent with Machida *et al.* (2009, Tectonophysics **465**).

Acknowledgments
We thank the crew of the R/V Kofu Maru of the former Hakodate Marine Observatory for their cooperation during deployment of OBSs. We thank D. Zhao for permitting us to use his computer program for 3-D tomographic inversion.

Keywords: ocean-bottom seismograph (OBS), seismicity, tomography, Hidaka Collision Zone, delamination, Hokkaido

 