P- and S-wave 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.Carnegie Institution of Washington, 3.Marine Works Japan, 4.Kochi University, 5.AIST, GSJ, 6.Meteorological Research Institute, 7.RCPEVE, Tohoku Univ.

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 (Ms6.8) 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)]. In addition, we conducted ocean-bottom seismographic observations in 1999 and 2000 in the south off Hokkaido region. Murai et al. (2003) estimated P-wave velocity structure by the 3-D tomographic inversion [Zhao et al. (1992)] 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 structure because of limitation of the number of data. Here we estimate P- and S-wave velocity structure by the tomographic inversion of travel time data from OBSs and land stations in 1999 and 2000.

From the tomographic images, distinct low-velocity anomalies are detected at the western side of the Hidaka Main Thrust (HMT). They are considered to be the crust of the northeast Japan arc. In the eastern side of it, we find high-velocity anomalies, which are considered to be the crust of the Kuril arc obducted towards the west. The low-velocity anomalies appear to reach a depth of the upper boundary of the subducting Pacific plate. These results are similar to Murai et al. (2003). Murai et al. (2003) considered the low-velocity anomalies deeper than 30 km as the delaminated Kuril arc lower crust because the velocity inversion occurs at around 30 km depth. However we cannot image the delamination structure clearly although the velocity inversion is also detected. From the vertical cross section along the subducting direction of the Pacific plate, the depth of the upper boundary of the high-velocity anomalies increases towards the northwest, which represents the upper boundary of the subducting Pacific plate. The low-velocity anomalies beneath the western side of the HMT disappear in the offshore area southeast of Cape Erimo. Moreover many microearthquakes occurred in the low-velocity anomalies whereas the seismic activity was low outside them. These results suggest arc-arc collision has little influence on the offshore area as an extension of the Hidaka Mountains. S-wave velocity structure shows similar features to P-wave velocity structure.

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.

References

Katsumata et al., 2002, Bull. Earthq. Res. Inst., 77, 199-223.

Murai et al., 2003, G.R.L., 30(9), 1490, doi:10.1029/2002GL016459.

Zhao et al., 1992, J.G.R., 97, 19909-19928.

Keywords: ocean-bottom seismograph (OBS), seismicity, tomography, Hidaka Collision Zone, Hokkaido, 1982 Urakawa-Oki earthquake

