Estimation of 3D velocity structure in Kyushu region by the seismic tomography

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1. Introduction
A high-resolution crustal structure in the volcanic zone is basic information for prediction of volcanic activity in the future. Therefore, in this study, we carry out preliminary research in Kyushu region aiming at the estimation of three-dimensional (3D) velocity structure in the volcanic zone by the 3D seismic tomography. In this region, it is suitable for this study because a large number of earthquake records of the main shock and aftershocks of the Kumamoto earthquake that occurred in April 2016 can be used and there are many volcanoes such as Mt. Aso and Mt. Unzen. Thus, we perform the 3D seismic tomography in Kyushu region for the estimation of 3D velocity structure, and consider problems on application to the volcanic zone.

2. Data and Method
We used arrival time data downloaded from the website of National Research Institute for Earth Science and Disaster Resilience (NIED). We selected 59011 earthquakes observed at 141 stations from April 2016 to March 2017. The selected area is 129.3°E ~ 132.1°E, 30.9°N~ 34.0°N, 0 ~ 50 km in depth. And, for P-wave arrivals, we added 804 earthquakes observed at 4 V-net stations at Mt. Aso and travel time data obtained by explosion seismic observations in the Hinagu fault area, Kyushu (The Research Group for the 2003 Hinagu Fault Seismic Expedition, 2008) and Eastern Kyushu (RESEARCH GROUP FOR EXPLOSION SEISMOLOGY, 1999). In total, our selection result in 871,690 P-wave arrivals and 840,633 S-wave arrivals.
We estimate 3D seismic velocity structure using the Fast Marching Tomography (FMTOMO) method of Rawlinson et al. (2006). This program uses the fast marching method via finite difference solution of the eikonal equation (Sethian, 1996) for calculation of synthetic travel times. The model area is 129.2°E ~ 132.2°E, 30.8°N~ 34.1°N, -4 ~ 52 km in depth. The horizontal grid spacing is 0.1°(about 10 km) and the vertical is 4 km (the number of grids is 34×31×15 for three coordinate axis). An initial velocity structure model is JMA2001 (Ueno et al. 2002) and we set six iterations of the tomographic inversion scheme. Then, we examined the resolution of the tomographic inversion using a checkerboard resolution test (CRT). The size of checker is 2×2×2 in grid number, and the velocity perturbation for the initial velocity structure model is ±0.1 km/s. As a result of the CRT, we confirmed that checkerboard pattern is well resolved up to about 20 km deep in the Kumamoto area.

3. Results
Figure 1 shows plan views of the P-wave velocity and the S-wave velocity structures obtained here at 4 km depth. The pattern of velocity variation is similar to each other and pronounced low velocity area exists in the southern Kumamoto. At 0 ~ 1 km depth, low velocity area exists in the Kumamoto Plain. However, in this study, pronounced velocity variation is not seen beneath Mt. Aso and other volcanic zones. So, for improving the resolution, we are going to add earthquakes in the area with less them and stations (K-net, V-net and so on).

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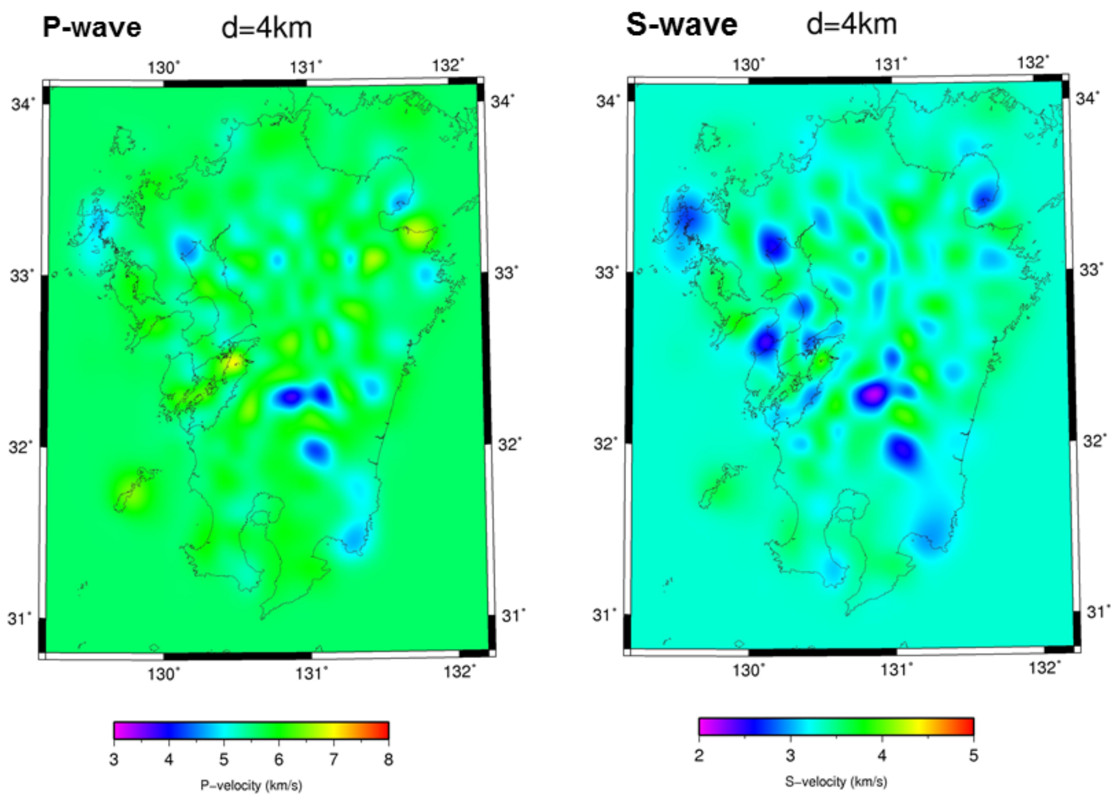

Fig. 1. Plan views of velocity structure for Vp (left), velocity structure for Vs (right)