Seismic exploration of Komagatake volcano with active sources in 2002: Three dimensional P-wave velocity structure

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Komagatake is an active volcano located in southwestern Hokkaido and explosive magmatic eruptions and phreatic explosions have been recorded in historic time. Recently, small phreatic eruptions have occurred in 1996, 1998 and 2000, and future magmatic eruptions have been expected. It is important to reveal mechanical properties as a background field of magmatic activities and eruptive activities. It is also important to know properties of medium for enhancing accuracy of parameters such as seismic and ground deformation sources inferred from monitoring made on the ground surface. We conducted artificial seismic experiment at Komagatake volcano on September to October, 2002 in order to reveal shallow seismic velocity structures. In this paper we show preliminary results of P-wave velocity analyses.

In the experiment, seismic signals excited by five shots were recorded by 221 temporal seismic stations deployed on and around the volcano. We made data set by picking first arrivals on the records for P-wave velocity analysis. The analyses were carried out by the following steps; (1) making traveltime curve, (2) inferring basement velocity and basement depth by time term method, and (3) inferring three-dimensional velocity structure by inversion.

The basement velocity was determined as 5.7 km/s by the time term method, when we used traveltime data of which epicentral distance is greater than 8 km where the traveltime curve can be approximated as a linear line. Although uncertainty of the depths is still remaining, general characteristics can be recognized. These are (1) the basement depths beneath Komagatake volcano are deeper then those at surrounding mountain area, but (2) a NW-SE trending basement ridge is extending from southeastern mountain area to the summit of Komagatake volcano. The three-dimensional velocity inversion was started from an initial model constructed from the result of the time term method. Velocity grids are set as 1.5 and 3 km intervals in vertical and horizontal directions, respectively. As a result of the inversion, following characteristics are recognized at 0 km and 1.5 km b.s.l.; 1) low velocity regions at western, northern and eastern foots of the volcano, 2) high velocity regions at western and southeastern surrounding mountain area, and 3) a NW-SE high velocity belt elongating from the southwestern mountain to the summit of the Komagatake volcano.

5.7 km/s of the basement velocity inferred from the time term method is comparative to that of upper crust velocity inferred by previous seismic experiment conducted in southwestern Hokkaido. The depth variation of the basement and results of the inversion are fairly consistent with Bouguer anomaly in this region. Quaternary volcanic rocks and sediments cover from summit to foot of Komagatake volcano, while Neogene rocks expose at the surrounding mountain area. Many geothermal well up to 1000 m depth have been drilled southern foot of the volcano. Pre-Tertiary basement have been found at about 400 m b.s.l. beneath the NW-SE high velocity belt elongating from the southeastern mountain to the summit of Komagatake volcano, while at west and east of the belt, the wells do not reach to the basement even at the bottom (about 1000 m b.s.l.) and thick Neogene rocks have been found. The results of the velocity analyses reflect such geological structures.