Seismic exploration using active sources at Kuchierabujima volcano, Japan: 3-D seismic velocity and attenuation structures

Keigo Yamamoto[1]; Iguchi Masato Kuchierabujima Volcano Seismic Experiment Group[2]

[1] D.P.R.I., Kyoto Univ.; [2] -

Kuchierabujima volcano located to the south of Kyushu Island, southwest Japan is an active island volcano. The volcano has repeated magmato-phreatic or phreatic eruptions at a summit crater of Shindake or at a fissure on the east of the crater since 1841, before which no historic eruptions have been recorded. Although no eruptions have occurred after 1980, the increase of volcanic earthquake activities has been repeatedly observed. The hypocenters were located at a depth shallower than 500 m beneath the west and the southwest rim of Shindake crater. The GPS observation and the airborne survey of magnetic intensity detected an anomalous region at a depth of about 1 km on the east of Shindake crater, interpreted as a shallow hydrothermal reservoir. In order to clarify the subsurface structure beneath the volcano, an active seismic survey was conducted during the period from October to November 2004. In this paper, we will show the three-dimensional seismic velocity and attenuation structures determined by using this seismic experiment data and will discuss them along with the results of previous studies.

The seismic experiment was participated by 40 researchers from 9 national universities of Japan and the Japan Meteorological Agency. 183 temporary seismic stations were operated to record the seismic waves excited from 19 chemical explosions using dynamite charges of 10-115 kg. Each station was equipped with short-period seismometers and a data logger with a GPS clock that recorded seismograms at a rate of 250 samples per second.

From the obtained seismic records, P-wave arrival times were picked manually, resulting in 2955 travel time data. We calculated the three-dimensional P-wave velocity structure through the seismic tomography by using these travel time data. The most remarkable characteristics of the resultant structures are that the region with 3.0-3.5 km/s P-wave velocity reaches shallower levels beneath Shindake crater, exhibiting higher velocity from surroundings. Such a mounting of higher velocity region has been found at many other volcanoes by the previous experiments of seismic explorations.

To compute the seismic attenuation structure, the differential attenuation value ($dt*$) was calculated for each P waveform by the spectral ratio method. The three-dimensional P-wave attenuation structure is calculated by the tomographic inversion. The preliminary results suggest the existence of high attenuation regions beneath the volcano.