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Estimation of three-dimensional velocity structure in and around Hakone volcano by using dense seismic station network

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Hakone volcano is located in the northern boundary zone of the Izu-Mariana volcanic arc in central Japan, where the Izu Peninsula on the Philippine-sea plate has been colliding into the Japan island arc and subducted beneath it at the Suruga and Sagami Trough. Within the caldera of Hakone volcano, there has been fumarolic activity around the Owakidani area. Although there is no historical record of eruptive activity, Kobayashi et al. (2006) indicated that a phreatomagmatic eruption might have occurred at the Owakidani area between the latter half of the 12th and 13th centuries.
Many intense swarms activities have occurred in the caldera, which have been reported since 1786 (Hiraga, 1987; Mannen, 2003). Strong ground motion and fumarolic activities have occasionally been accompanied by intense swarm activities (Mannen, 2003). Oki and Hirano (1970) and Mannen (2003) interpreted that the hydro thermal fluid derived from a deep-seated magma beneath Hakone volcano trigger the swarm earthquake. However, there is no evidence to show existence of the hydro thermal fluid and a deep-seated magma. To understand the process of swarm earthquake occurrence, we tried to estimate three-dimensional velocity structure in and around Hakone volcano, by using tomographic inversion.
We used the data obtained by the routine seismic network in the Hot Springs Research Institute (HSRI) of Kanagawa prefecture. This network consists of permanent stations, which are operated by HSRI, the Earthquake Research Institute, University of Tokyo, and the National Research Institute for Earth Science and Disaster Prevention (Hi-net). Additionally, we used the data of 14 temporary stations installed in and around the caldera of Hakone volcano. The method of the double-difference tomography method (Zhang and Thurber, 2003) was applied.
High-velocity body for P-wave is estimated in the depth rage from 0 km to 6 km in the caldera. Most of the swarm earthquakes occur within the depth range. Low-velocity anomaly exists under the central corn of caldera, around the 7 km depth. The low-velocity zone is corresponding to the position of Mogi source estimated by Daita et al., (2009). The low-velocity zone might reflect the hydro thermal fluid or magma body related to the swarm earthquake occurrence.

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Keywords: three-dimensional velocity structure, Hakone volcano, Izu collision zone, tomography, swarm earthquake, dense seismic station network