Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

SVC55-P23 Room:Poster Time:May 1 18:15-19:30

Long-period seismic waves propagating over Kyushu as associated with the Sakurajima eruption of August 18, 2013

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We found long-period seismic waves propagating over Kyushu after the explosive eruption from Showa crater of Sakurajima volcano at 16:31JST on August 18, 2013. The eruption is one of the most significant ones that Showa crater has experienced since 2006, and the volcanic plume rose approximately 5000 m high. Showa crater is currently very active, causing more than 1000 eruptions a year.

The broadband seismic network F-net recorded the long-period seismic waves traveling in a very wide area covering Amami and the whole Kyushu region. The dominant periods are longer than 5 s. The apparent propagation velocity is approximately 2.75 km/s. In data recorded by Hi-net tilt meters at shorter intervals of around 20 km, the long-period seismic waves arrived earliest at the station AIRH that is the closest to Sakurajima volcano, and propagated with the almost same apparent velocity as observed by F-net. The long-period seismic waves are, therefore, likely to have been radiated from Sakurajima volcano. Assuming that the source is located at Showa crater, we rotated two horizontal components of the F-net and Hi-net data to transverse and radial components. The long-period seismic waves were observed in the radial and transverse components, and the apparent propagation velocity is slightly faster in the transverse component than the radial one. The waves observed in transverse and radial components can be Love and Rayleigh waves, respectively.

For previous eruptions of Sakurajima volcano, we also examined whether or not long-period seismic waves were recorded by F-net. From 5057 eruptions in the period between 2006 and 2013, we selected 43 eruptions that have large amount and height of a volcanic plume as well as large deflation volume. Long-period seismic waves were found for five eruptions including ones from Minami-dake crater. The maximum distances with the observations of long-period seismic waves range from 150 to 331 km, which are much shorter than for the 2013 eruption. Therefore, the 2013 eruption could excite long-period seismic waves more remarkably, compared to the other five eruptions. Observations of long-period seismic waves, on the other hand, did not have clear dependence on the amount and height of a volcanic plume or the deflation volume.

We observed significant transverse components of the long-period seismic waves associated with the 2013 eruption, which are considered Love waves. We also had similar observations for the five eruptions accompanied by long-period seismic waves in F-net data. Eruptions of Sakurajima volcano have been explained by isotropic explosion and contraction of a vertical cylinder (Uhira and Takeo, 1994; Tameguri et al., 2002), and these models cannot excite Love waves. A model for explaining Love waves observed in the present study is to be investigated.