Estimation of subsurface velocity structure beneath Kirishima volcanoes inferred from ambient seismic noise tomography

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Shinmoe-dake, one of Kirishima volcanoes, experienced magmatic eruptions in 2011. The analysis of ground deformation shows that the pressure source locates 5 km to the northwest of the Shinmoe-dake summit at a depth of 8 km, which implies the existence of a magma reservoir. We are trying to resolve the better image by a seismic exploration technique toward ensuring its existence and deriving precise crustal structure.
The technique we employed is the seismic wave interferometry, which extract the seismic wave propagation between two seismic stations by taking a cross correlation of random wavefields, such as the ambient seismic noise or the seismic coda wave, recorded at two stations. The cross correlations of random wavefields recorded at two receivers can be represented as if the source is at one receiver and the recorder is at the other. This technique is suitable for exploring local structure since the extracted wave is sensitive to the internal structure between two stations.
We inferred the crustal phase velocity anomaly using three-component records of the ambient seismic noise recorded by seismic array between April 2011 and December 2013. Rayleigh and Love waves are extracted by taking cross correlations (Rayleigh waves from Z-Z and R-R components of cross correlation functions, and Love waves from T-T component). We derived reference dispersion curves of Rayleigh and Love waves, respectively, using all pairs of stations, then measured a phase velocity anomaly against the reference for each pair in four frequency ranges (from 0.1 to 0.2 Hz, from 0.2 to 0.4 Hz, from 0.3 to 0.6 Hz and from 0.4 to 0.8 Hz) for Rayleigh wave and in two frequency ranges (from 0.3 to 0.6 Hz and from 0.4 to 0.8 Hz) for Love wave.
The inferred Rayleigh wave phase velocity structure shows that the inside of Kirishima volcanic region and nearby region have the characteristics of low velocity against the outside for all frequency ranges. In particular, the Rayleigh wave phase velocity structure in a frequency range from 0.1 to 0.2 Hz (corresponding to around 5-10 km depth) is characterized by two remarkable low velocity regions: one lies at almost same location of the pressure source of the ground deformation, and the other is located beneath the region from Shinmoe-dake to Ohata-ike. Similar characteristics are found from 0.2 to 0.4 Hz (around 3km depth) and from 0.3 to 0.6 Hz (around 2 km depth) for Rayleigh wave. They are also detected in a frequency range from 0.3 to 0.6 Hz for Love wave. The Love and Rayleigh wave velocity structures from 0.4 to 0.8Hz (around 1km depth) show low velocity characteristics right beneath the entire volcanic region.

Keywords: Kirishima volcanoes, surface wave velocity structure, ambient seismic noise

