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Subsurface velocity structure beneath Kirishima volcanoes inferred from ambient seismic noise tomography

NAGAOKA, Yutaka[1*] ; NISHIDA, Kiwamu[2] ; AOKI, Yosuke[2] ; TAKEO, Minoru[2] ; OHKURA, Takahiro[3] ; YOSHIKAWA, Shin[3]

[1]MRI, JMA, [2]ERI, Univ. Tokyo, [3]AVL, Kyoto Univ.

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 it by seismic procedure 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 wavefield 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 the vertical component of the ambient seismic noise recorded by seismic array between April 2011 and December 2013. A Rayleigh wave is extracted by taking cross correlations. We derived its dispersion curve using all pairs of stations as a reference, then measured a Rayleigh-wave phase-velocity anomaly against the reference for each pair in some frequency bands.

The phase velocity anomaly we thus obtained shows that most paths crossing Kirishima volcanic body have negative velocity anomaly for all frequency bands, indicating that the entire volcanic body has the characteristic of low velocity against the outside. The shallower part shows relatively high velocity at the location where the source of the ground deformation is estimated.

Keywords: Kirishima volcanoes, subsurface velocity structure, ambient seismic noise tomography