Detection of spatio-temporal changes of seismic scattering properties with seismic interferometry: Dike intrusion event on 15 August 2015 at Sakurajima volcano

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In recent years, seismic interferometry has been used to detect spatio-temporal changes of seismic scattering properties (e.g. Obermann et al. 2013a). At Sakurajima, a dike intrusion took place on 15 August 2015, and large ground deformation was observed (e.g. Hotta et al. 2016). Such a dike may work as a new scatter for seismic waves. Therefore, we applied seismic interferometry to detect spatio-temporal changes of seismic scattering properties associated with this dike intrusion. We used the vertical components of ambient seismic noise data at 1 –2 Hz recorded at 6 JMA stations from 1 January 2012 to 31 August 2015. We calculated coherences between reference CCFs (stacked over 2012 and 2013) and daily CCFs, and found that all station pairs showed significant decreases of coherences before and after the dike intrusion. To locate the region where the seismic scattering properties changed, we used sensitivity kernels calculated from 2D radiative transfer model. Parameters of scattering and intrinsic absorption that are needed to calculate sensitivity kernels were estimated by modeling the space-time distribution of energy density of active shot records in 2013. The best-fit parameters were as follows: Mean free path of Rayleigh waves was 1.2 km at 1 –2 Hz, and the value of intrinsic absorption Q was $62.8f$ (f is the frequency). Then, we calculated the differences between mean values of coherence in 2014 (before the event) and those of from 16 August 2015 to 31 August 2015 (after the event) (hereafter called ΔC). Assuming that one seismic scatterer appeared on the surface projection of the dike, we searched the best location of the scatter to explain observed . As a result, such region was located at the same place as the dike determined by using GNSS, tilt, and strain data (Hotta et al. 2016) with an accuracy of about a few km, and the amount of change of scattering coefficient (Δg) was estimated to 1.4 km^{-1}. These results indicate that seismic interferometry is one of useful methods to detect structural changes of volcano.

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