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Source locations of continuous tremor by combined analyses of array and network seismometers : A case study for the 2011 eruption of Shinmoe-dake, Japan

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The 2011 eruption of Shinmoe-dake, Japan, was one of the common cases in that geophysical monitoring system was improved after eruption became very active. We used tremor recorded after the main eruption phases by a dense seismic array and many network stations to calibrate the site effects and regional attenuation factor. The calibration was used in estimating the source locations of volcanic tremor before and during the eruption from the amplitude distribution at the limited available seismic stations. The stability of the algorithm was improved by the careful selection of time windows in which signal from a single source dominated.

The result was compared with multi-parametric data including infrasound, tilt, and video records. The tremor source depth beneath the crater varied for one week before the onset of the eruption. Upward motion of the source from a depth to the shallow water table was found on three separate occasions, each of which occurred following shallow inflation sometimes with a minor eruption. This change in depth is interpreted as a result of fluid movement, which transported sufficient heat to trigger a larger eruption. In contrast to the upward motion of the source after the precursory events, the source tends to move downward after explosive eruptions. Such upward/downward movements could be used as indicators of how an eruption proceeds.

Although seismic array processing methods are powerful tools for locating tremor, a dense array with a sufficient performance requires considerable effort to maintain and is rarely available, especially before a noticeable eruption occurs. This study demonstrates that even a seismic array deployed after an eruption is useful in assessing processes preceding the eruption.