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Short-term spasmodic switching of volcanic tremor source activation in a conduit of the 2011 Kirishima eruption

S. Matsumoto, H. Shimizu, T. Matsushima, K. Uehira, Y. Yamashita, M. Nakamoto, M. Miyazaki, and H. Chikura
Institute of Seismology and Volcanology, Kyushu University, Shimabara, Japan

Volcanic tremors are seismic indicators providing clues for magma behavior, which is related to volcanic eruptions and activity. Detection of spatial and temporal variations of volcanic tremors is important for understanding the mechanism of volcanic eruptions. However, temporal variations of tremor activity in short-term than a minute have not been previously detected by seismological observations around volcanoes. Here, we show that volcanic tremor sources were activated at the top of the conduit (i.e. the crater) and at its lower end by analyzing seismograms from a dense seismic array during the 2011 Kirishima eruption. We observed spasmodic switching in the seismic ray direction during a volcanic tremor sequence. Such fine volcanic tremor structure suggests an interaction between tremor sources located in both deep and shallow depths. Our result suggests that seismic array observations can monitor the magma behavior and contribute to the evaluation of the activity's transition.