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Investigation of the pre-eruptive processes of the 2014/15 Holuhraun eruption based on extracted volcanic tremor signals

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During volcanic unrest, multiple subsurface processes can happen simultaneously and may lead to an eruption. The analysis of seismic records in an unrest period before an eruption reveals information about the pre-eruptive processes and might be able to provide hints for a possible future eruption.

The 2014–2015 Holuhraun eruption was the largest one in Iceland in 230 years. It was extensively monitored and studied in a variety of multidisciplinary research approaches. Intense seismicity and ground deformation were interpreted as magma propagation from Bárðarbunga volcano 48 km laterally at 6 km depth over two weeks before an eruption started at Holuhraun. Different processes including vertical and lateral magma migration, dike propagation, caldera subsidence, and subglacial eruptions happened in this period and some models linking these processes are suggested. In the two-week interval preceding the eruption, there is still no clear connection between the observed tremor and pre-eruptive processes. Both the tremor source location and tremor generation process are not well understood yet. While cauldrons as a sign of subglacial eruptions were identified on the glacier surface from aerial photos, these cauldrons might have been formed earlier and there is hence an uncertainty of a few days. A tremor location might help to constrain these dates. However, the simultaneous occurrence of intense seismicity and tremor hinders the study and location of tremor. Here, we use a recent volcanic tremor extraction algorithm (Zali et al., 2020) and extract pre-eruptive tremor signals in order to better locate them using the Seismic Amplitude Ratio Analysis (SARA) method. Furthermore, the occurrence of the tremor could open new insights into ascending magma and fluid migration as well as the timing and duration of the subglacial eruptions.

We also observed short-lived tremors before the eruptions on August 29 and 31, which could be considered as eruption precursors. The primary investigation on the extracted tremor signals is promising while further analysis is on-going.