Geophysical Research Abstracts
Vol. 20, EGU2018-3107, 2018
EGU General Assembly 2018

Long-period seismicity reveals magma pathways above a laterally propagating dyke during the 2014-15 Bárðarbunga rifting event, Iceland

Jennifer Woods (1), Clare Donaldson (1), Robert S. White (1), Corentin Caudron (1,2), Bryndís Brandsdóttir (3), Thomas S. Hudson (1), and Thorbjörg Ágústsdóttir (1)

(1) University of Cambridge, Department of Earth Sciences, Cambridge, United Kingdom (jw845@cam.ac.uk), (2) Department of Geology, Ghent University, Ghent, Belgium, (3) Institute of Earth Sciences, University of Iceland, Reykjavík, Iceland

The 2014-15 Bárðarbunga-Holuhraun rifting event comprised the best-monitored dyke intrusion to date and the largest eruption in Iceland in 230 years. A huge variety of seismicity was produced, including over 30,000 volcano-tectonic earthquakes (VTs) associated with the dyke propagation at $\sim$ 6 km depth below sea level, and large-magnitude earthquakes accompanying the collapse of Bárðarbunga caldera. We here study the long-period seismicity associated with the rifting event. We systematically detect and locate both long-period events (LPs) and tremor during the dyke propagation phase and the first week of the eruption. We identify clusters of highly similar, repetitive LPs, which have a peak frequency of $\sim$ 1 Hz and clear P and S arrivals, followed by a long-duration coda. The source mechanisms are remarkably consistent between clusters and also fundamentally different to those of the VTs. We accurately locate LP clusters near each of three ice cauldrons that were observed on the surface of Vatnajökull glacier above the path of the dyke. Most events are in the vicinity of the northernmost cauldron, at shallower depth than the VTs associated with lateral dyke propagation. At the two northerly cauldrons, periods of shallow seismic tremor following the clusters of LPs are also observed. Given that the LPs occur at $\sim$ 4 km depth and in swarms during times of dyke-stalling, we infer that they result from excitation of magmatic fluid-filled cavities and indicate magma ascent. We suggest that the tremor is the climax of the vertical melt movement, either comprising rapid, repeated excitation of LPs, or arising from related sub-glacial eruption processes. This long-period seismicity therefore represents magma pathways between the depth of the dyke-VT earthquakes and the surface. To our knowledge, this is the first detailed study of LPs occurring during lateral propagation of a dyke. Notably, we do not detect tremor associated with the southernmost (and largest) cauldron, despite melt reaching the base of the overlying ice cap, a concern for hazard forecasting.