

Imaging active magmatic systems at Oldoinyo Lengai volcano (Tanzania) via earthquake distribution and seismic scattering and absorption mapping

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Oldoinyo Lengai volcano, located in the Natron Basin (Tanzania), is the only active natrocarbonatite volcano world-wide. As such, it presents an important endmember magmatic system, which occurs in a young rift segment (~3 Ma) of the East African Rift System. At this volcano, effusive episodes of long-duration are interrupted by short-duration explosive eruptions. At the end of February 2019, we installed a dense seismic network and four infrasound stations as part of the SEISVOL - Seismic and Infrasound Networks to Study the Volcano Oldoinyo Lengai - project. The seismic network spans an area of 30 x 30 km and encompasses Oldoinyo Lengai volcano, the extinct 1 Ma-old Gelai shield volcano, the active Naibor Soito monogenetic cone field and surrounding fault population. Here, we present temporal earthquake distributions combined with 2D absorption and scattering imaging.

On average, we report up to 34 earthquakes per day within and in the vicinity of our network. Given the dense station spacing, we are able to lower the detection threshold to -1.0 ML with a MC of -0.3. During the first months of data acquisition, the seismicity is clustered in distinct areas as background seismicity and in intermittent seismic swarms:

1. Most of the events are located beneath the eastern and southern flank of Gelai shield volcano. These events are shallow and close to the dike intrusion that preceded the last explosive eruption of Oldoinyo Lengai in 2007-2008.
2. In April 2019, a seismic swarm of ~262 earthquakes in three days forms a pipe-like structure beneath the north western flank of Gelai.
3. Deeper events cluster beneath the monogenetic cone field located just NE of Oldoinyo Lengai. A distinct gap in seismicity can be traced down to 10 km depth between the monogenetic cone field and Gelai volcano.
4. While there seems to be little seismicity directly beneath Oldoinyo Lengai in the upper 5 km of the crust, we observe a number of different, recurring seismic and infrasound signals at the crater, which are indicative of magmatic activity.

To image the magmatic plumbing system, we map scattering and absorption of the seismic dataset using the MuRAT (Multi-Resolution Attenuation Tomography) code. Our preliminary results show two well-resolved high-absorption and high-scattering anomalies below Oldoinyo Lengai and the Gelai intrusion in 2007 at all frequencies. With decreasing frequency (increasing depth) the anomalies converge, suggesting a link of the plumbing systems at depth.

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