



## The seismic sound of deep volcanic processes

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Deep volcanic processes and magma intrusion episodes through the crust are typically accompanied by a variety of seismic signals, including volcano-tectonic (VT) seismicity, very long period (VLP) signals and deep low-frequency (DLF) events. These signals can reveal the migration of magma batches and the resonance of magma reservoirs and dikes. The recent 2018-2019 unrest offshore the island of Mayotte, Comoros archipelago, represents the first case of a geophysically monitored magmatic intrusion from a deep sub-Moho reservoir through the whole crust reaching the surface. At Mayotte, a huge magma movement and the following drainage of a deep reservoir were accompanied by a complex seismic sequence, including a massive VT swarm and energetic long-duration very long period (VLP) signals recorded globally. The identification and characterization of ~7000 VTs and ~400 VLPs by applying waveforms-based seismological methods allowed us to reconst the unrest phases: early VTs, migrating upward, were driven by the ascent of a magmatic dike, and tracked its propagating from Moho depth to the seafloor, while later VTs marked the progressive failure of the reservoir's roof, triggering its resonance and the generation of long-duration VLPs. At the Eifel, Germany, weak DLFs earthquakes have been recorded over the last decades and located along a deep channel-like structure, extending from sub-Moho depth (~40-45 km) to the upper crust (~5-10 km). While not showing any clear migration, they reveal a different way of fluid transfer from depth towards the surface, possibly marking intermediate small reservoirs along a feeding channel. Here, brittle failure occurring in the vicinity of the reservoirs may cause their resonance. The Mayotte and Eifel observations are example of end member models for deep fluid transfer processes through the crust. These examples show that, by listening to seismic signals at different distances and by analysing them with modern waveform based methods, we can provide a detailed picture of deep magmatic processes and enable future eruption early warning.