

Monitoring of volcanic systems with MT, first results from Mt. St. Helens, Stromboli and Iceland

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SUMMARY

Detection of geophysical signatures associated with volcanic eruptions is key to understanding the underlying physical processes preceding these events and for accurate hazard assessment. Magma reservoirs are the main storage regions for eruptible magma and characterizing their temporal evolution requires the ability to detect and interpret changes in the magmatic system from surface measurements. Traditionally, monitoring of active magmatic systems has been carried out with seismic and geodetic approaches, both of which require dynamic 'active' changes within the magmatic system. Magnetotellurics which measures subsurface electrical properties has an increased sensitivity to the physical properties or temperature of the magma stored within a reservoir, making it a promising additional monitoring technique able to detect 'static' phase changes within the evolving magma and the thermal structure of the magma reservoir. Thus, magnetotellurics is sensitive to both 'magma on the move' and the changes in the physical properties of magma that occur within the magma reservoir. Mount St Helens (MSH) was the site of a detailed magnetotelluric survey completed during the most recent dome building eruptive phase 2005-06, and is now in a period of quiescence. We use MSH as a case study and compare the original measurements from 2005-06 to repeated measurements at the same locations in 2022-23 to develop a temporal analysis approach and test the use of magnetotelluric measurements for monitoring applications. In addition to the repeat campaign we have deployed 4 long-term monitoring stations with continuous data streaming at MSH and Stromboli volcano. We compare the continuous MSH time series with the continuous magnetotelluric station network at Stromboli volcano, a system in a persistent state of eruptive activity. Finally we will show some very first results from a new installation on the Reykjanes peninsula, Iceland. Here, fissure eruptions produce significant amounts of magma and assessing the locations of future activity is essential for hazard assessment. The data collected for these volcanoes will allow us to compare the dynamics of magma reservoirs, and the induced magnetotelluric signal, in active and quiescent volcanic systems.

Keywords: magnetotellurics, monitoring, integrated modeling
