MTHEK Project: MagnetoTelluric Assessment of the HEKla Volcano

Duygu Kiyan[1], Ásdís Benediktsdóttir[2], Gylfi Páll Hersir[2], Magnús T. Guðmundsson[3], Christopher J. Bean[1], Colin Hogg[1], Þorsteinn Jónsson[3] and Jón Einar Jónsson[2]
[1]Dublin Institute for Advanced Studies, duygu@cp.dias.ie
[2]Iceland GeoSurvey, asdis.benediktsdottir@isor.is
[3]University of Iceland, mtg@hi.is

SUMMARY

Hekla is one of Iceland's most active and dangerous volcanoes having had 18 summit eruptions in the last 1,100 years, with the most recent eruption in 2000. Hekla volcano has been studied extensively using various geodetic methods. The most recent deformation studies (InSAR) in relation to the 2000 eruption of Hekla have addressed the proposed location of a deep-seated magma reservoir at approximately 10 km (Sturkell et al., 2013), where other studies indicate a greater depth (Ofeigsson et al., 2011). A regional-scale magnetotelluric (MT) survey (Eysteinsson and Hermance 1985) conducted in 1982 suggested the estimated depths for the magma chamber beneath the volcano to be between 5 and 24 km. The objectives of the MTHEK project are to (1) study the present electrical resistivity structure of the volcano through exploiting deep-probing broad-band MT data and (2) identify low-resistivity zones at depth, which may be a proxy for melt accumulation and migration pathways and thus, may constrain the location of the proposed magma reservoir. The geoelectrical models obtained will enable us to highlight potential real-time electromagnetic monitoring locations which may complement the current real-time seismic/deformation monitoring. In September 2020, broadband MT data were acquired at 20 stations around and to the south of Hekla volcano. The horizontal electric field components were recorded using 50-60 m dipoles, and the three components of the magnetic field were measured using induction coils. MT data were collected for a minimum of 13 hours up to a maximum of 53 hours. A distant remote reference site (approximately 100 km away) was recording during the whole survey. The period range of good quality data obtained is about 300 Hz to 1,000 - 2,000 s. In addition, at 17 MT stations central loop transient electromagnetic (TEM) data were collected using a transmitter loop of 200 m × 200 m and a 1 m^2 receiver loop with 100 windings (effective area 100 m^2). The TEM data are used to correct the MT data for static shift effects caused by near surface inhomogeneities or steep topography. State of the art data processing and analysis methods were applied to the data. Preliminary inversion models will be presented and provide a first idea of the resistivity structure of the volcano.

Keywords: Magnetotellurics, Electrical conductivity, Hekla Volcano, Iceland