Geophysical Research Abstracts, Vol. 7, 02007, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02007

Crustal structure and seismicity of the Torfajokull volcano, Iceland

H. Soosalu, R. Lippitsch and R. White

Department of Earth Sciences, Bullard Laboratories, University of Cambridge, U.K.

(soosalu@esc.cam.ac.uk)

Torfajokull is one of about 30 active volcanoes forming the neovolcanic zones in Iceland. It is a large rhyolitic volcano massif with a 12-km-diameter caldera and an extensive geothermal field. It is located at the junction of the eastern rift zone, the transform-like South Iceland seismic zone and the intraplate flank zone of south Iceland. The latest eruption at Torfajokull took place about 500 years ago.

We operated a temporary net of twenty three-component broadband seismometers at Torfajokull between May and November 2002. Its observations were combined with data from adjacent stations of the permanent Icelandic SIL (South Iceland Lowland) network, maintained by the Icelandic Meteorological Office. Earlier seismic data were used in addition. This data set provides a general picture of the structure and seismic features of Torfajokull.

To image the crustal structure beneath the volcano we used 3D local earthquake tomography and receiver functions. The tomographic image confirms the existence of rhyolitic intrusions surrounded by volcanic sediments down to about 2 km depth. It also indicates the presence of water and mainly steam circulating at shallow depths in the porous rocks in the western part. We interpret the observed relatively high Vp/Vs values at 6 km depth to mark the boundary to a layer with intrusions of basaltic magma, responsible for the high-temperature geothermal system. Receiver functions image an area of low velocities between 8 and 10 km depth and indicate that the Moho is at about 20 km.

Torfajokull is a source of persistent small-scale seismicity, with both high-frequency (4-9 Hz) and low-frequency (1-3 Hz) earthquakes. They do not overlap temporally

or spatially, and no intermediate forms of events have been observed. With a close network both sorts of events were recorded on a daily basis, often in small swarms. The high-frequency events occur in the western part of the volcano. Their magnitude seldom exceeds 2. The 2002 experiment showed that they cluster mainly in the uppermost 3 km. Earlier studies resolved a 4-km-diameter aseismic area under the locus of this cluster, with a centre at 8 km depth. This has been interpreted as a cooling magma chamber.

Low-frequency earthquakes are also small in magnitude, typically below M_L 1. Because of their small size and emergent phases they are difficult to locate. However, they cluster in a restricted area in the southern part of the Torfajokull caldera. Their epicentral concentration coincides with the location of the hottest geothermal springs within the volcano. Our tentative interpretation is that they are related to a cryptodome, a dome-shaped structure created by the accumulation and ascent of viscous magma at shallow depth.