

A DEEP-SEATED MAGMATIC INTRUSION AT UPPTYPPINGAR, ICELAND, DURING 2007 AND 2008

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Abstract

In February 2007 an episode of earthquake activity started in a previously seismically inactive area north of the Vatnajökull ice cap. The activity is known as the 'Upptyppingar – Álftadalsdyngja activity' after the land features where the activity is occurring. The intense seismic swarms and associated crustal deformation are remarkable in many ways. The earthquakes have deeper sources (14–22 km) than normally observed in Iceland, and the seismic activity has a distinct spatial pattern with time, moving between areas and progressing to shallower depths. More than 9,000 earthquakes were located in the area from February 2007 to April 2008. The swarms comprise brittle-type earthquakes less than 2 in magnitude. The largest earthquakes, of local magnitudes M_l 2.2–2.3, occurred in July 2007 and March 2008. The b -value varied with time, being highest ~ 2.4 in late July to early August 2007, but it remained high during the whole period (Jakobsdóttir *et al.*, 2008; Anaïs Boué and others, to be submitted).

Three continuous GPS (CGPS) sites have been operating 20–25 km west and south of the area since 2005. In early summer 2007 a dramatic change in horizontal velocities equivalent to 30 mm/yr towards S or SSE was observed. In May 2008 the CGPS sites resumed their original velocities. These are the largest velocity changes observed in the CGPS network in Iceland since its initiation in 1999.

The seismic activity was most intense from April 2007 to April 2008. No effusive activity was observed during the unrest. Previous episodes of deep-seated earthquake activity in Iceland have been linked with magma unrest, for example at Mt. Eyjafjallajökull, Vestmannaeyjar islands, and Askja volcano. The seismicity and deformation near Upptyppingar – Álftadalsdyngja are interpreted to be the result of the intrusion of a ~ 0.05 km³ sheet of magma into the lower parts of the crust at 22–12 km depth (Jakobsdóttir *et al.*, 2008).

After the 'Upptyppingar – Álftadalsdyngja activity' stopped, persistent seismic activity started north of

Upptyppingar and south of Hlaupfell. This activity occurred at a depth ~ 5 –8 km and is still ongoing. In July 2009 a swarm was recorded farther north, at depths less than 5 km. This swarm lasted for about two weeks. The b -value for these swarms is ~ 1 . No land deformation has been detected by the GPS-network during with this activity.

References

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- Boué, A., P. Einarsson, Á. R. Hjartardóttir, and the SIL monitoring group. Anomalous high b -value for earthquakes at Upptyppingar in the northern rift of Iceland: evidence for the presence of magma. Manuscript to be submitted, 2009.

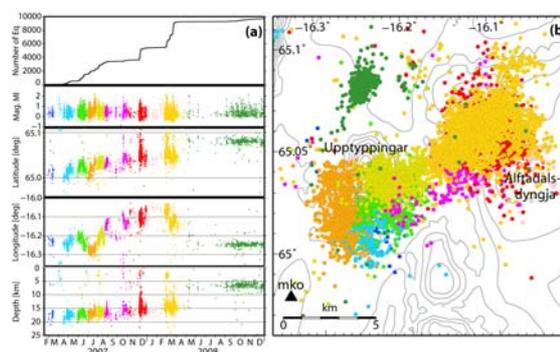


Figure 1: Spatial and temporal view of seismicity at Upptyppingar and Álftadalsdyngja using all available hypocenters from manual single-event locations. (a) Cumulative number of earthquakes, earthquake size (M_l) and temporal changes in latitude, longitude, and focal depth. (b) Map view of the earthquake distribution (colours represent the same events as shown in (a)). The seismic station mko is to the south-west of Upptyppingar.