



Lower-crustal earthquakes reflect magma movements beneath the north Iceland rift near Askja

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We believe that we have caught magma in the act of moving in the lower crust along the north Iceland rift near the active volcano of Askja by recording the seismicity it causes while opening melt channels. We have discovered persistent earthquakes occurring in small swarms at 13–27 km depth in the otherwise aseismic lower crust beneath the rift zone. In a two-month survey in summer 2006 with 20 Guralp 6TD broadband seismometers of a 30-km long segment of the rift we recorded ~1700 shallow earthquakes with a sharp cut-off at 6–7 km depth marking the brittle-ductile boundary. The depth of the brittle-ductile boundary decreases slightly towards Askja, which is consistent with Askja being a source of shallow level intrusion and basaltic extrusion. In the hotter and otherwise aseismic lower crust, and separated from the shallow seismicity, we recorded more than 100 small-magnitude ($M_L < 1.5$) earthquakes in 2006, with a similar rate of occurrence in the same locations recorded by a repeat survey in summer 2007. We interpret the deep earthquakes as caused by melt moving along the rift zone away from the magma source feeding the Askja central volcano. We suggest that they represent bursts of magma motion opening cracks or dykes over distances of the order of a few metres, facilitated by the extensional setting of the rift zone. This is consistent with gravity, GPS and satellite radar interferograms, which all suggest that melt is draining away from crustal magma chambers beneath Askja.