Geophysical Research Abstracts
Vol. 13, EGU2011-8413, 2011
EGU General Assembly 2011

Tracking the seismicity preceding and during the March 2010 Fimmvörðuháls fissure eruption and April 2010 summit eruption of Eyjafjallajökull, Iceland

Jon Tarasewicz (1), Bryndis Brandsdottir (2), Robert White (1), Martin Hensch (2), and Bergthora Thorbjarnardottir (3)

(1) Bullard Laboratories, University of Cambridge, United Kingdom (jptt2@cam.ac.uk), (2) Institute of Earth Sciences, Science Institute, University of Iceland, Reykjavik, (3) Icelandic Meteorological Office

Using Coalescence Microseismic Mapping (CMM) we have located over 9,000 earthquakes in the period starting two weeks prior to the Fimmvörðuháls fissure eruption at the northeastern margin of the Eyjafjallajökull stratovolcano, South Iceland. CMM is an automatic earthquake detection and location program developed at Cambridge University which performs a search in time and space for a best-fit earthquake location. This is done by migrating both P and S wave energy from each seismometer location back into the subsurface and finding an optimum event location where the back-projected energy coalesces within a specified search volume by fitting it to a grid for which P- and S-wave travel times have been calculated from each point in the grid to every seismometer.

Following a prolonged period of escalating seismicity we deployed six temporary, three-component, broad-band seismometers around the Eyjafjallajökull volcano on 5th March 2010. These data are augmented by data from the nine closest seismometers of the permanent network operated by the Icelandic Meteorological Office (IMO).

The most intense seismic activity was observed during March, concentrated primarily between 3-6 km depth under the northeastern flank of the Eyjafjallajökull volcano. To first order, seismicity is observed to migrate eastwards away from the Eyjafjallajökull caldera and towards the first eruption site at Fimmvörðuháls during the two weeks prior to eruption, which we attribute to melt movement within the crust. However, multiple discrete clusters on the northeastern flank are observed to have been active simultaneously, or with activity alternating between locations, suggesting magma movement was more complex than a single dyke propagating towards the Fimmvörðuháls eruption site.

Seismic activity decreased markedly in the two days prior to the onset of the fissure eruption on March 20th. The fissure eruption continued until 12th April and was a pre-cursor to the more explosive, sub-glacial Eyjafjallajökull eruption which started on 14th April in the summit crater some 8 km west of the initial fissure eruption at Fimmvörðuháls. Seismicity only increased again two to three hours before the second eruption, this time located vertically beneath the summit crater. We also observe evidence for fresh magma migrating from much greater depth (>20km) during the summit eruption in May.