Reviewed research article

A peculiar cluster of microearthquakes on the eastern flank of Katla volcano, southern Iceland

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Abstract — *A peculiar cluster of seismicity near the tip of Sandfellsjökull on the eastern flank of Katla volcano in southern Iceland has been analyzed in detail using data from a temporary seismic network. A total of 300 events were detected between July 2011 and August 2013, most of them from a swarm between December 4th and 12th, 2011. The sparser permanent network detected a small fraction of these events, but also a larger swarm in November 2010. When seismic activity started in this area is uncertain because of changes in the detection capability of the network over time. The events are of low magnitude (-0.5 < ML < 0.5) and the b-value of their magnitude distribution is high (1.6±0.1). Based on their frequency content (4–25 Hz) and clear P and S arrivals, the events are classified as volcano-tectonic. Two multiplets probably with different source mechanism are identified in their population. The events locate at approximately 3.5 km depth. Most of them are tightly clustered according to double difference relative locations in a volume that is only about 400 m in diameter in all directions. Several events are scattered up to 800 m beneath this volume. There is some suggestion of elongate structure in the cluster with a NNE/SSW strike and a dip of 60 degrees. We argue that these events cannot be due to a glacial or a broad tectonic process. Possibly, a localized source of fluid pressure, e.g., a small magma body at depth may be the source of these events.*

INTRODUCTION

Seismic signals are almost always recorded before and during eruptions. This makes real-time monitoring of the seismicity around an active volcano an important tool both for developing forecasting methods and as part of an early warning system. Furthermore, the seismicity provides information about the volcano's processes (e.g., magma movement, pressure changes, and subsidence) as well as its internal structure. At sub-glacial volcanoes, the analysis of seismic signals becomes even more important, as direct observations may be problematic because of the ice cover. At the same time, the interpretation of seismic signals can be difficult because waveforms originating from glacial and volcanic sources may have similar features.

The Katla volcanic system in southern Iceland (Figure 1) is a prime example of an active glacier covered volcano in need of real-time monitoring. Katla is known to be one of the most active volcanoes in the country's written history, with volcanic activity dominated by phreatomagmatic eruptions (the last occurring in 1918) accompanied by tephra fallout as well as glacial floods (jökulhlaup).

Katla is characterized by intense seismicity that has been recorded since the first sensitive seismometers were installed in Iceland (Tryggvason, 1973). A seismic network was installed in South Iceland in 1973–1974 that included 5 stations within 50 km of the volcano (Einarsson and Björnsson, 1987). The current, permanent seismic network, the SIL network, operated by the Icelandic Meteorological Office