

Historical accounts of pre-eruption seismicity of Katla, Hekla, Öraefajökull and other volcanoes in Iceland

Páll Einarsson

Institute of Earth Sciences, University of Iceland, Sturlugata 7, 101 Reykjavík; palli@hi.is

<https://doi.org/10.33799/jokull2019.69.035>

Abstract — *Detecting unusual activity leading to the outbreak of a volcanic eruption is of vital importance for the short-term warning to the local population of an impending eruption. The varied volcano types of Iceland and range of ambient conditions at which eruptions occur offer an unusually wide spectrum of volcanic phenomena and volcanic hazards during the initial phase of eruptions. A recent study of eruptions in Iceland during the last four decades of instrumental observations has revealed that all the eruptions had a detectable precursory seismic activity, that under favourable conditions can be used to issue short-term warnings to the surrounding communities. Considerable documentary data also exist for pre-instrumental times extending several centuries back in time, that can be compared to the instrumental experience. This is true in particular for two of the most active volcanoes, Katla and Hekla, that are sufficiently close to the populated areas of the country. All seven confirmed eruptions of Katla since 1625 were preceded by felt earthquakes, beginning one to nine hours before the eruption was detected and two to over twelve hours before a jökulhlaup from this partly sub-glacial volcano reached the inhabited areas. The behaviour of Hekla is quite different. Large eruptions from the main edifice of Hekla since 1510 were generally accompanied by rather weak seismic activity. Earthquakes are usually felt only minutes before the first explosion occurs, in the 1947 case even several minutes after the first explosion of the volcano. Eruptions of the Hekla volcanic system outside the main edifice are, on the other hand, accompanied by considerable seismic activity, and the precursor times may be more than three hours, even much longer. The two historical eruptions of Öraefajökull, in 1362 and 1727, were apparently preceded by felt seismicity, sufficient to alarm the local population.*

INTRODUCTION

It has been common knowledge in Iceland for centuries that volcanic eruptions are preceded by earthquakes. Bishop Hannes Finnsson (1739-1796) compiled some of the historical, written documents on eruptions and other catastrophes, and concluded by suggesting that instruments such as barometers and compass needles might be useful for the monitoring of the activity of volcanoes. He also suggested that "...observing the intensity and direction of seismic shocks..." could be used to warn of impending eruptions (Finnsson, in Thorarinsson (1967)). Even though Finnsson was educated in Copenhagen where he was influenced by many prominent natural scientists of the Age of Enlightenment, it is remarkable that these statements were made more than a century before seismographs were invented.

Ever since the settlement of Iceland in the ninth century Icelanders have had to deal with the activity of their thirty, or so, active volcanoes and live with the threat of volcanic hazards such as ash fallout, lava flows, and jökulhlaups (Gudmundsson *et al.*, 2008). The high rate of eruptions is due to a combination of two processes, i.e. a divergence of two major lithospheric plates taking place at a hotspot overlying an upwelling mantle plume (e.g., Bjarnason, 2008). The high magmatic activity generates a crust that is 2–4 times thicker than the normal oceanic crust produced at adjacent segments of the Mid-Atlantic Ridge, the Reykjanes and Kolbeinsey Ridges (Brandsdóttir and Menke, 2008). The thickened crust allows the plate boundary to rise above sea level, exposing the rift volcanoes that are aligned along the boundary, such as Grímsvötn, Bárðarbunga, Askja, and Krafla (Figure 1). Volcanoes also exist that are not directly re-