



Magma sources and melt evolution during the 1875 volcanotectonic episode at Askja volcano, north Iceland

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The 28th-29th March 1875 silicic explosive eruption at the Askja central volcano, north Iceland, was preceded and superseded by basaltic volcanism on the Askja volcanic system. These basaltic eruptions are: Holuhraun, a fissure eruption ~20 km south of Askja, that occurred in the period 1867-75; several basaltic eruptions within the Askja caldera in the period 1860-75, including two tuff cones, and Nyjahraun, a fissure eruption ~60 km north of Askja constructed in at least six eruptive episodes between February and November 1875.

Current debate on Icelandic volcanotectonic episodes that simultaneously activate the central volcano and the associated fissure swarm is focused on two contrasting ideas. The lateral flow hypothesis suggests that magma replenishment, pressurisation of a shallow crustal chamber and subsequent lateral injection of shallow crustal dykes into the fissure swarm as the driving mechanism of rifting on the volcanic system. The magma reservoir hypothesis postulates that volcanotectonic episodes are driven by magma pressurisation in large and elongate reservoirs at the base of the crust (>20 km depth) and subsequent injection of subvertical dykes into the upper crust.

Previous studies of the 1875 activity on the Askja volcanic system, e.g. [1], noted a strong major and trace element compositional similarity between Nyjahraun and Askja 20th century basalts. It was therefore proposed that the Nyjahraun lavas were fed by lateral flow from a shallow crustal holding chamber beneath the Askja central volcano. However, detailed study of new and existing major and trace element data lend support to the magma reservoir hypothesis.

New geochemical data indicates that Holuhraun, Askja and Nyjahraun were derived from separate magma storage regions and arrived at the surface via separate plumbing systems. The Askja and Nyjahraun sources appear to be chemically similar, but the Askja basalt appears to have evolved via mixing with partial melts in the crust while the Nyjahraun magma evolved without such interactions. By contrast, Holuhraun is thought to have a different source composition to the Askja and Nyjahraun magmas and an entirely separate plumbing system.

References

- [1] Sigurðsson, H. and Sparks, R.S.J. (1978), Bull. Volcanol., 41, 149-167.