Reviewed research article

Delimiting Bárðarbunga and Askja volcanic systems with Sr- and Nd-isotope ratios

Olgeir Sigmarsson[1,2] and Sæmundur Ari Halldórsson[1]

[1]*Institute of Earth Sciences, University of Iceland, Sturlugata 7, 101 Reykjavík, Iceland*

[2]*Laboratoire Magmas et Volcans, CNRS – Université Blaise Pascal, 63670 Clermont-Ferrand, France*

olgeir@hi.is, saemiah@hi.is

Abstract — *Volcanic systems represent a fundamental component of the neovolcanic zones in Iceland. They are composed of a central volcano and a fissure swarm, or a combination of the two. The 2014–2015 rifting event at the Bárðarbunga volcanic system produced basaltic lava approximately 40 km to the north of the central volcano, within a fissure swarm commonly attributed to the Askja volcanic system, highlighting the complex tectonic structure of a region, directly above the Iceland mantle plume. New analyses of Sr- and Nd-isotope ratios from the new lava (Holuhraun), and the underlying older Holuhraun lava, show that they have identical values to those of the Bárðarbunga-Veiðivötn lavas and tephra erupted during the Holocene. Moreover, comparison with published high-precision radiogenic isotope data, reveals that Holocene lavas and tephra from the Bárðarbunga and Askja systems are characterized by contrasting Sr- and Nd-isotope ratios, with the notable exception of the Þjórsárhraun lava and two early Holocene lavas from the extreme west and east of the Veiðivötn fissure swarm. The $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ isotope ratios can thus be utilized to define the provenance of lava flows north of the Vatnajökull ice cap, ascertaining that the large lava fields of Krepputunguhraun and Fjallsendahraun (Frambruni) must also have originated within the Bárðarbunga volcanic system.*

INTRODUCTION

The neovolcanic zones in Iceland are composed of volcanic systems that, in turn, are composed of a fissure swarm, a central volcano or both (e.g. Sæmundsson, 1978). Examples are the Reykjanes fissure swarms without central volcanoes, Eyjafjallajökull central volcano without an associated fissure swarm and finally, the Krafla central volcano and its fissure swarm (e.g. Jóhannesson and Sæmundsson, 1998). Associating any particular eruption unit to a given volcanic system is of an importance when discussing eruption frequency and magma production rates for volcanic systems. It is also central when forecasting volcanic activity from real-time measurements. However, it is not always straight-forward to associate a lava flow or a tephra layer to its point of origin (e.g. Óladóttir *et al.*, 2011), especially when a large portion of the volcanic system is covered by a glacier (e.g. Einarsson and Björnsson, 1990). Additionally, volcanic systems in Iceland have been defined differently over the last decades. The extensive mapping of the Neogene volcanic pile in eastern Iceland revealed complex architecture of the central volcanoes with associated dike swarms that together formed a unity named volcanic system (summarized in Walker, 1974). Tectonic criteria and fissure mapping were applied by Sæmundsson (1978) when discussing active analogues for central volcanoes and fissure swarms within the neovolcanic zones of Iceland. A different approach based on major element composition of basalts and magma suites of each volcano were utilized by Jakobsson (1979) when defining the