FIELD DESCRIPTION

Vatnsdalsfjall is composed of an exposed series of up to 1000 m of predominantly sub-horizontal basalt flows. Many flowtops show topographic relief, typically developed by erosion. In the southern part of the mapped area, more dramatic paleotopography exists, including a series of intra-canyon flows and a lava lake-like feature > 100 m thick (Hjallin Lens of Annells, 1968; cf. McClanahan, this volume). The northern area of Vatnsdalsfjall contains at least two separate rhyolitic flows, one with a visible feeder conduit. At the southern end of the mapped area, northeast of Hvammur farm, a deformed series of flows dips underneath the Hjallin Lens in a monoclinal structure (cf. Ackerly, this volume). Mafic dikes are ubiquitous in the lava pile, with an extremely dense population visible northwest of Hrafnaklettur.

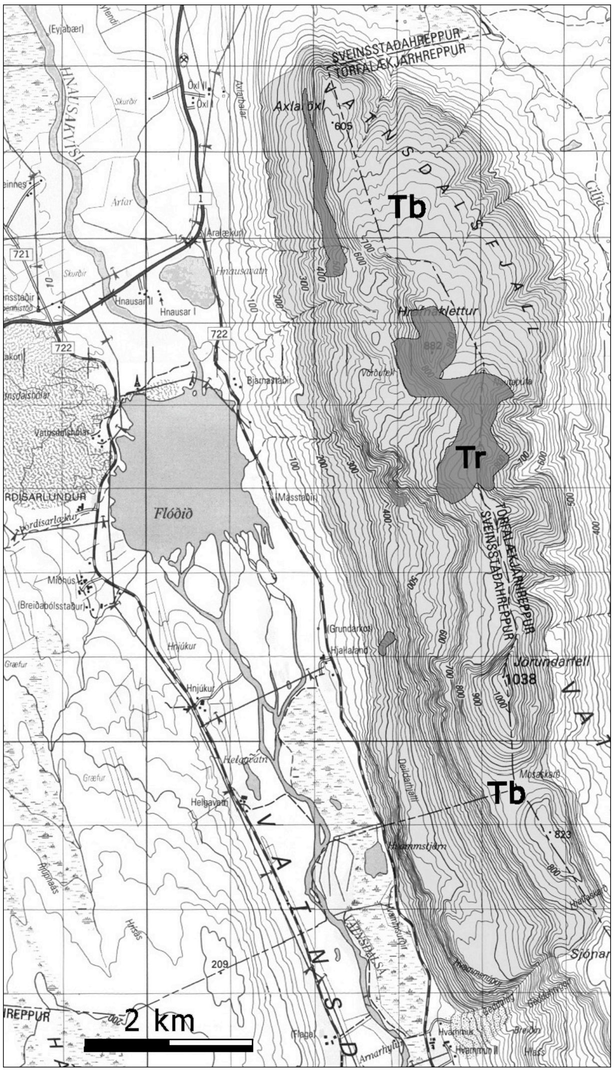

Figure 2. Mapped bedrock geology of Vatnsdalsfjall. Tb = Tertiary basalt, Tr = Tertiary rhyolite.

RESULTS

Petrography. Although crystal size varies from sample to sample, basalts from Vatnsdalsfjall are chemically similar, with phenocrysts of calcic plagioclase (An_{65-80}) in a groundmass dominantly composed of laths of calcic plagioclase, augite, pigeonite, and Fe-Ti-oxides. Silicic extrusives (dacites and rhyolites) are finely microcrystalline (< 0.01 mm) and are composed dominantly of volcanic glass, quartz, and sodic plagioclase (An_{10-25}).

Major elements. The major element data, plotted for total alkalis vs. silica, indicate that most samples are basalts and that all samples describe a linear trend (Fig. 3). On an AFM plot (Fig. 4) the data follow a tight trend of Fe-rich tholeiites.

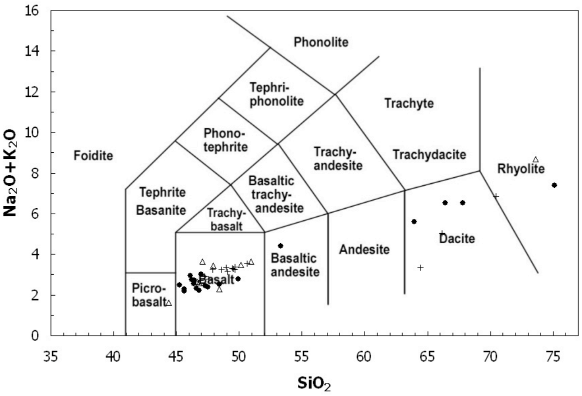

Figure 3. Classification of representative samples from Vatnsdalsfjall. Different symbols denote different workers: open triangles from this study, filled circles from Ackerly (this volume), crosses from McClanahan (this volume).

Trace elements. Fitton et al. (1997) used Zr/Y and Nb/Y ratios to discriminate between basalts derived primarily from Iceland plume material and the evolved upper mantle (N-MORB) reservoir. Zr, Nb, and Y are high field strength elements with similar mafic partition coefficients, and the relationship of Zr to Nb is generally immune to both low-pressure fractional crystallization (Hardarson et al., 1997) and post-magmatic alteration (Hardarson and Fitton, 1997). Samples from this study plot in the same field as modern plume-derived Icelandic basalts (Fig. 5).

Samples are enriched relative to primitive mantle (Fig. 6). Basalts and more siliceous samples have similar trace element patterns, though the latter show additional enrichment.

The silicic samples also display a pronounced negative Sr anomaly.

^{40}Ar-^{39}Ar dating. DA03-49, a basalt from the top of the modern lava pile (~1060 m elevation) gave an interpreted ^{40}Ar/^{39}Ar plateau date of 7.35 ± 0.19 Ma (2□).

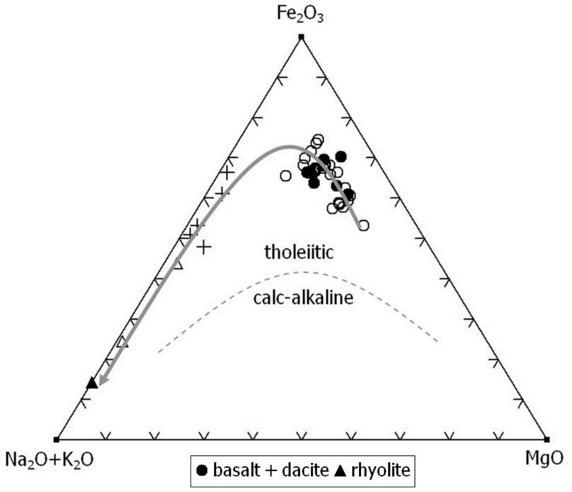

Figure 4. AFM diagram with samples divided by rock type. Possible crystallization path in grey. Filled samples from this study, unfilled samples from Ackerly (this volume), McClanahan (this volume).

DISCUSSION

Geochemical analyses indicate that all of the lavas are genetically related. Composition was chiefly controlled by fractional crystallization, which is in agreement with other work in the Skagi region (e.g. Schilling et al., 1978). Trace element enrichment of the silicic rocks compared to the basalts can also be explained by fractional crystallization. Such a scenario is also supported by the negative Sr anomaly (Fig. 6) in the silicic samples, which most likely resulted from the consumption of Sr as a substitute for Ca in calcic plagioclase during fractionation. However, fractional crystallization does not provide a good explanation for certain features such as the Pb enrichment of some samples (Fig. 6) or the deviation of certain silicic samples from a linear trend in Figure 3.

Lavas in Vatnsdalsfjall follow a fractional crystallization path close to the one indicated in Figure 4. Crustal contamination appears to be minimal or uniform across magma reservoirs. However, the absence of samples across the Daly gap (here, 54-63% SiO_2) is difficult to explain. Mixing of mafic magma with crustal melts is unlikely, as samples do not plot on mixing trends between basaltic and rhyolitic compositions (Jordan, pers. comm.).

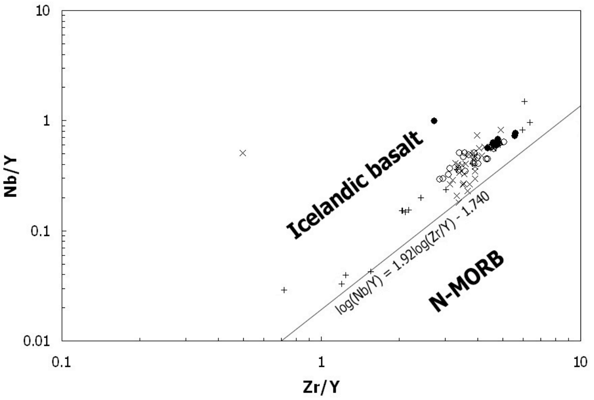

Figure 5. Source identification by comparison of conserved trace element ratios. Line divides plume-derived Icelandic basalts from N-MORB-sourced basalts (Fitton et al., 1997). Samples from Vatnsdalsfjall (filled circles, this study; open circles, from Ackerly (this volume) and McClanahan (this volume) plot in the field of modern basalts (crosses from Kempton et al., 2000; Xs from Hardarson and Fitton, 1997).

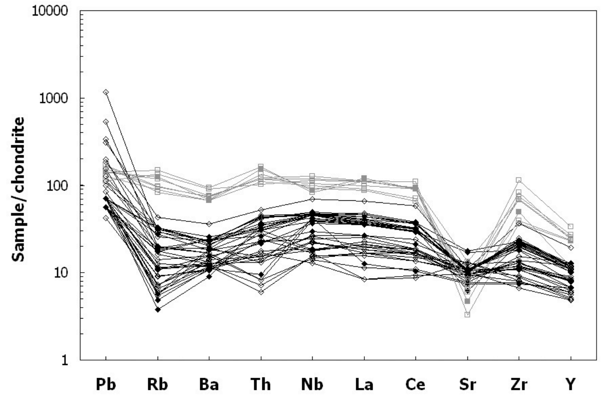

Figure 6. Normalized spider diagram showing trace element patterns. Silicic samples (grey squares) are enriched relative to basaltic samples (black diamonds) and show pronounced Sr depletion. Filled symbols are data from this study, open symbols are other Vatnsdalsfjall analyses from Ackerly (this volume) and McClanahan (this volume). Values are normalized to chondrite and undepleted mantle data of Sun (1980, in Rollinson, 1993).

The lavas share a common source, mostly plume-derived, which probably gave rise to a number of shallow magma reservoirs. Some reservoirs became more fractionated than others due to more frequent eruptions; thus compositions do not show a consistent trend through the stratigraphic section. Supply of new melt must have been infrequent, as some reservoirs became fractionated enough to produce dacites and rhyolites. The extent of the plume's influence on late Skagi-

Snaefellsnes rift magmatism appears to have been similar to its influence on modern rift zone magmatism (Fig. 5).

Volcanic Chronology

Dating indicates that the entirety of the exposed lava pile was extruded near the end of the active period of the Skagi-Snaefellsness rift zone. Lavas accumulated rapidly during this period, with >700 m of flows extruded between 7.62 Ma (Ackerly, this volume) and 7.35 Ma. This accumulation resulted in subsidence that structurally warped the lava pile, promoting development of considerable topographic relief (>100 m in places) (Annells, 1968; Ackerly, this volume). However, not all subsidence caused deformation, as the top several hundred meters of the pile are not appreciably deformed.

If appreciable magmatism occurred in the Vatnsdalsfjall area during Plio-Pleistocene reactivation, those lavas have been removed by erosion. The only possible products of this period remaining are the mafic dikes. It is unclear if the melt supplying this magmatism was a remnant from previous rift activity or fresh deflected plume material (Trønnes, 2002), but recent seismic anisotropy data support the latter hypothesis (Allen, 2004).

CONCLUSIONS

Volcanic productivity in Vatnsdalsfjall was high shortly before the extinction of the Skagi-Snaefellsnes rift zone. The magmatic source was dominated by undepleted, plume-derived material. The chemical composition of lavas was mostly controlled by fractional crystallization, although other processes were operative as well.

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