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Temporal variations of trace element ratios in basaltic tephra from Katla volcano, Iceland: a reconnaissance study.

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Katla volcano is located in the off-rift volcanic zone of South Iceland. It is known for the subglacial eruptions of FeTi-rich basaltic tephra and large fissure eruptions such as the 10th century Eldgja Fires. Following a detailed field study, volcanic glass fragments of 125 tephra layers from three soil sections were analysed for the major element composition by EMP-technique. These layers represent the last 8400 years of the volcanic activity at Katla, and the compositional variations were used to distinguish 8 periods of different secular magma evolution pattern. Periods 1 (historic time), 5 and 8 show no variations in K_2O concentrations with time, whereas periods 4 and 7 display irregular patterns and, finally, the K_2O increases regularly with decreasing age of the tephra layers during the periods 2, 3 and 6. The three compositional patterns may represent different behaviour of the magma plumbing system beneath Katla volcano: absence of a shallow magma chamber, dyke- and sill-complex and a closed system magma chamber, respectively. At present it is not clear what causes the changes from one physical state of the magma plumbing system to a subsequent one. However, the very large Eldgja fissure eruption took place at the transition of period 1 to period 2. In order to better assess the magmatic processes beneath Katla volcano, a study of trace element variability has been undertaken.

Selected samples from periods 2 and 3 have been analysed for their trace element concentrations by LA-ICP-MS. Only fresh and homogeneous sideromelane glasses were chosen for spot analysis and the average of 5 analyses yields the trace element composition for each sample. Both reproducibility and accuracy, estimated from 16

analysis of BCR-1 glass standard during the course of these analysis and comparison with results from Eggins et al., (1997), range from 0.2 to 13% (2RSDp.

The concentrations of highly incompatible elements vary by more than 50%. Linear correlation of these elements and Th concentrations in all samples except one (AT-18) extrapolates through the origin. This is consistent with fractional crystallisation as the principal mechanism of magma differentiation in these basalts. Ratios of elements with similar behaviour, rare earths (La/Yb) and high-field strength elements (Ta/Zr), are constant in all samples from period 2 and 3. Such constancy is also observed for ratios of incompatible elements having different characteristics (Ba/La, Ba/Th, Th/Ta), except in one sample (AT-18). Sample AT-18 is located just above the transition from period 3 to period 2 in the tephra section. The significantly higher values for some incompatible element ratios in this sample are readily explained by smaller degree of mantle melting at the origin of its parental magma. Uniform Sr and Th isotope ratios in lavas and tephra of different ages from Katla volcano suggest a mantle source of homogeneous composition during its Holocene activity (Sigmarsson et al., 1992). Changes in mantle melting, therefore, appears to coincide with the transition from period 2 to period 3. Finally, these trace element results permit the speculation that mantle processes can induce different behaviour of the magma plumbing system under the Katla volcano.