



The Holocene Eruption History and Magmatic Evolution at the Katla Volcanic System, Iceland

B. Oladottir (1,2), G. Larsen (3), T. Thordarson (3,4) and O. Sigmarsson (1,3)

(1) Laboratoire Magmas et Volcans, Université Blaise Pascal, 5, rue Kessler, 63038 Clermont-Ferrand, France, (2) Agricultural University of Iceland, Keldnaholt 12 IS112 Reykjavik, Iceland, (3) Science Institute, University of Iceland, IS101 Reykjavik, Iceland, (4) Department of Geology and Geophysics, University of Hawaii at Manoa, Honolulu, HI 96822

The Katla volcano of the Eastern Volcanic Zone (EVZ), the third most active volcano in Iceland, is characterized by subglacial explosive eruptions of Fe-Ti-basalt composition. To assess the Holocene eruption history and magma evolution at Katla the tephra stratigraphy in a composite soil section located 18-25 km east of the volcano was measured and sampled. The section contains 174 basaltic and 17 felsic tephra layers recording ~8400 years of explosive activity from Katla and other EVZ volcanoes. About 90% of the layers originated at Katla. We analyzed 125 tephra layers for major elements and 96 of those are pure basaltic Katla tephra and nine include felsic grains as well. Abrupt shifts in major element compositions divide the ~8400-year record into eight intervals of ~700 to ~1800 year duration. Three intervals, ~800-100 AD, ~30 AD-1700 BC, ~4400-6900 BC, are characterized by systematic rise in K_2O , Na_2O , SiO_2 , P_2O_5 and decrease in MgO and CaO . For example, from ~1700 BC to ~30 AD the K_2O content of the magma rose systematically from 0.63 to 0.95 wt.% then dropped abruptly to 0.7 wt.%. In three intervals, 1200-1918 AD, ~4200-2400 BC and 6400-5800 BC, the magma composition was relatively constant. Finally, two intervals show irregular temporal variation of the major elements, ~1900-2500 BC and 5000-5800 BC. Variability of the major elements is readily explained by dominating fractional crystallisation and occasional mixing with silicic crustal melts. The volatiles S and Cl show phreatomagmatic values throughout all the data series which indicates that for the last 8400 years the Katla volcano has been covered with a glacier. Eruption frequency was high (16 eruptions/1000 years) in intervals of gradually changing magma composition, whereas it was low (10 eruptions/1000 years) during intervals of

uniform magma composition (eruption frequency from the two longest time intervals). These results indicate that compositional variations at Katla during the Holocene correlate with shifts in the eruption frequency and suggest changes in magma chamber dynamics on timescales of 1000-2000 years, where periods of closed-system crystal fractionation interrupted steady-state conditions.