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Segregation veins in Surtsey lavas, Iceland: implications for volatile-melt induced magma differentiation

O. Sigmarsson (1,2), T. Thordarson (2,3) S. P. Jakobsson[4]

(1) Laboratoire Magmas et Volcans, CNRS - Université Blaise Pascal, Clermont-Ferrand, France, (2) Earth Science Institute, University of Iceland, Reykjavik, Iceland, (3) University of Hawaii at Manoa Honolulu, Hawaii, USA, (4) Institute of Natural History, Reykjavik, Iceland

Segregation structures are common in the 1963-67 Surtsey lavas representing 2-3 per cent of the total volume of individual lava lobes. In stark contrast to the alkali olivine basalt host, the segregated material has evolved FeTi basalt composition. Field relations indicate that these structures are formed by filter-pressing of volatile-rich melt. The segregated melt evolved from the host lava by 50-60% fractional crystallization of olivine, plagioclase and clinopyroxene. The eruption temperature of the Surtsey magma was approximately 1160˚C, whereas the segregation melts were extracted at 1130 $\pm$5˚C and crystallized down to approximately 750˚C. The oxygen fugacity during crystallization changed from approximately FMQ-buffer to 100 times lower values at the time of final solidification. Such reducing conditions favoured crystallization of olivine, which has continuous compositional trend from Fo85 to Fo13. Feldspar compositions range from An79 to Or57 and clinopyroxene compositions from diopside rich augites to aegerine-augites. Other mineral phases are magnetite, ilmenite and apatite, along with trace amounts of amphibole and nepheline. Segregations in vesicle cylinders also contain residual phonolite glass of variable peralkalinity.

The composition of the segregations is identical to high dry-melt density FeTi basalts of the Katla volcano, South Iceland. The volatile-induced liquid transfer responsible for the formation of the segregation melts in the Surtsey lava is likely to play an important role in magma differentiation in reservoirs beneath Katla and other FeTi-basalt volcanoes. This process may explain the common occurrence of erupted FeTi basalt magmas in Iceland and elsewhere.