

Image Analysis and Morphometry of Hydromagmatic and Magmatic Tephra Grains, Reykjanes Volcanic System, Iceland.

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Abstract – The paper describes two-dimensional shape of tephra grains from the Reykjanes volcanic system in SW-Iceland. The Reykjanes volcanic system offers numerous well mapped tephra units that have been formed in submarine and subaerial eruptions during the Holocene. Samples from Surtsey, Heimaey, and Laki were studied for comparison. All the tephra samples were obtained from dispersed, unlithified units of basaltic composition with minimal signs of alteration. Morphometric parameters were obtained by computerized image analysis. SEM images were used for visual evaluation of the grain shape and as an aid for interpreting the parameters. Initially, tephra grain shape is controlled by eruptive mechanisms and by the chemical and physical properties of the magma. The primary shape may subsequently become modified during transport away from the eruptive vent before deposition, e. g. in surges. Image analysis enables rapid quantification of tephra grain shape by calculating shape parameters from digitized silhouette outlines. The project was motivated by the need to obtain quantitative tephra grain shape characteristics in various eruption types. This is necessary for the interpretation of ancient tephra layers and for maturation studies of volcanoclastic sediments in general. In the present study, the main emphasis is on the shape of phreatomagmatic tephra grains from the Reykjanes volcanic system, with additional phreatomagmatic samples from the Surtsey and Lakagíggar volcanoes. Magmatic tephra samples from Heimaey and Laki were studied for comparison. Hydromagmatic tephra is generally more fine grained and shows much greater areal distribution. Slightly vesicular, blocky glass shards with distinct, partly straight-edged outlines characterize the hydromagmatic tephra, while the magmatic tephra is more vesicular with outlines that are partly jagged, partly smoothly undulated. Fifteen samples of sand-sized tephra grains were analyzed and the shape parameters ruggedness, elongation, and circularity were calculated for a random subset of 160 grains from each sample. The parameter values enabled a statistically significant differentiation between strombolian and hydromagmatic tephra. The strombolian tephra is more rugged and elongate than the hydromagmatic one.