

The Morphometry of Selected Tephra Samples from Icelandic Volcanoes

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ABSTRACT

Three dimensional morphometry of tephra samples from a variety of volcanic eruptions in Iceland has been analyzed with methods that are commonly applied to the form of geological bodies regardless of size. These studies were motivated by the need to quantify the descriptive shape classification of tephra and to test the significance of shape variations and the relation to phreatomagmatic, magmatic, or mixed eruption types. 1760 sand sized tephra particles from 22 samples were measured and the results were statistically tested. Cluster analysis was used to investigate differentiation of samples and parameters. Variations in the chemical and physical factors in the eruptive environment are reflected in variations in form parameters such as elongation and sphericity. The tendency to elongate grains increases with increasing SiO_2 content or acidity of the magma. The highest variance values for elongation were obtained for samples from magmatic eruptions, while the lowest values were from phreatomagmatic eruptions.

INTRODUCTION

The main purpose of this paper is to present data on the shape of tephra samples from various Icelandic volcanoes. The objective of the research project was to apply quantitative methods to the classification of sand sized tephra grains according to their three dimensional form. A distinction between tephra units which is simply based on a

visual comparison of shape or other textural properties may yield rapid results. It has been demonstrated, however, that individuals tend to have a biased perception of particle form (Folk, 1955), and a quantitative approach is therefore preferable.

There are at least three reasons why the study of form (morphometry) might be important. Firstly, the particle form characteristics of tephra layers is presumably controlled by environmental and chemical factors during an eruption, and the form parameters could give clues to these factors in past eruptions. Secondly, quantifiable variation in form from one tephra layer to another, or within single layers, may be a useful stratigraphical and tephrochronological tool in the identification of individual layers. Thirdly, form is a routine element in the description and interpretation of sediments, including volcaniclastic sediments, and data on the original form of the grains are therefore necessary as a reference. This is important because any transport of tephra particles during an eruption or through reworking after deposition may lead to collisions between grains or between grains and any obstacles in the transport path. The collisions may cause breakage or abrasion of the grains and the original form will probably be changed.

The literature survey of Ólafsson (1985) revealed a limited number of publications on the textural properties of Icelandic tephra layers. Most of these deal with grain size and mineralogy, but no quantitative studies of tephra morphometry were found.