Geophysical Research Abstracts
Vol. 12, EGU2010-11780, 2010
EGU General Assembly 2010

Impregnating unconsolidated pyroclastic sequences: A tool for detailed facies analysis

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The interpretation of volcanic eruptions is usually derived from direct observation and the thorough analysis of the deposits. Processes in vent-proximal areas are usually not directly accessible or likely to be obscured. Hence, our understanding of proximal deposits is often limited as they were produced by the simultaneous events stemming from primary eruptive, transportative, and meteorological conditions.

Here we present a method that permits for a direct and detailed quasi in-situ investigation of loose pyroclastic units that are usually analysed in the laboratory for their 1) grain-size distribution, 2) componentry, and 3) grain morphology. As the clast assembly is altered during sampling, the genesis of a stratigraphic unit and the relative importance of the above mentioned deposit characteristics is hard to achieve. In an attempt to overcome the possible loss of information during conventional sampling techniques, we impregnated the cleaned surfaces of proximal, unconsolidated units of the 1957-58 Capelinhos eruption on Faial, Azores. During this basaltic, emergent eruption, fluxes in magma rise rate led to a repeated build-up and collapse of tuff cones and consequently to a shift between phreatomagmatic and magmatic eruptive style. The deposits are a succession of generally parallel bedded, cm- to dm-thick layers with a predominantly ashy matrix. The lapilli content is varying gradually; the content of bombs is enriched in discrete layers without clear bomb sags.

The sample areas have been cleaned and impregnated with two-component glue (EPOTEK 301). For approx. 10 * 10 cm, a volume of mixed glue of 20 ml was required. Using a syringe, this low-viscosity, transparent glue could be easily applied on the target area. We found that the glue permeated the deposit as deep as 5 mm. After > 24 h, the glue was sufficiently dry to enable the sample to be laid open. This impregnation method renders it possible to cut and polish the sample and investigate grain-size distribution, componentry, and grain morphology in situ in a 2D-plane. In a first step, the sample surface has been scanned and analysed by means of image analysis software (Image J). After that, selected areas were investigated through thin section analysis. We were able to define depositional units in the (sub)-mm scale and the show the varying relative importance of 1) eruptive style, 2) transportation mode, and 3) the influence of wind and (air) humidity. The presented method is an easy and efficient tool for a detailed stratigraphic investigation of unconsolidated pyroclastic units.