

The ash that closed Europe's airspace: Part I, grains size distribution of the Eyjafjallajökull ash and soluble salt coatings

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On 14 April 2010, when magma from the Eyjafjallajökull volcano intruded glacier-meltwater, an explosive phreato-magmatic eruption sent unusually fine-grained ash into the jet stream. It quickly dispersed over Europe. Reported airplane encounters with ash have caused sand blasted windows and melting of particles inside jet engines, causing them to fail. Therefore, air traffic was grounded for several days. Concerns also arose about health risks from fallout, because ash can transport acids as well as toxic compounds. Most studies on ash are made on post-eruptive material that have mixed with other atmospheric particles and suffered exposure to water as rain or fog, which would alter surface composition. In this study, a unique set of dry ash samples was collected during the explosive eruption and compared with fresh ash with the same bulk composition from a later more typical magmatic event, when meltwater did not have access to the magma.[1]

Up to 70 mass % of the phreato-magmatic ash particles, collected 50 km from the source, was <60 µm in diameter, 22% was <10 µm and 11% was ≤ 4.4 µm. The finest grain size was found in the centre of the plume. The magmatic ash was coarser and its surface area was an order of magnitude smaller than for the explosive ash. The relative concentration of surface salts was significantly lower on the explosive ash than the magmatic ash, because less volatile compounds were available to condense on the surfaces when water and steam were present. Instead, they dissolved in the meltwater and were transported as solutes in the ensuing floodwaters. The surface salts dissolved rapidly when exposed to experimental and natural waters, releasing pollutants and nutrients. Some of the salts further enhanced bulk dissolution of the ash.

This paper is the first of a two part presentation, where the second part, by Susan Stipp, focuses on the characteristics of the nanoparticles.

[1] Gislason S.R. *et al.* (2011), *PNAS*, **108**, 7307-7312.

The effect of time and climate on volcanic soil formation

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Andosols, soils derived from volcanic material, cover about 1.9% of the terrestrial surface and store about 4.9% of the Earth's carbon [1]. Andosols cover most of the volcanic islands on Earth. These soils are fertile, most of the islands are heavily populated and much of the river suspended matter delivered to the ocean stems from these islands. To a great extent, the soil is formed from air borne volcanic ash, preventing nutrient depletions with time, but making it prone to mechanical erosion.

In the days, weeks and months after deposition of air borne volcanic ash, nutrients and pollution will migrate into the soil at elevated rates. This is caused by soluble metal and proton salts coating the volcanic ash that dissolve orders of magnitude faster than the bulk volcanic ash that is mostly glass. Between these periodic fluxes of dissolved elements, weathering and erosion rates are primarily governed by climate, lithology, average rock age, topography and vegetation cover. A detailed study of catchments in NE Iceland shows that for each degree of temperature increase the runoff, mechanical weathering flux, and chemical weathering fluxes in these catchments have been found to increase from 6 to 16%, 8 to 30%, and 4 to 14% respectively, depending on the catchment [2]. These results demonstrate a significant feedback between climate and Earth surface weathering on the timescale of years to millions of years [3], and suggest that weathering rates are currently increasing with time due to global warming.

[1] Eswaran *et al.* (1993) *Soil Science Society of America Journal* **57**, 192–194. [2] Gislason *et al.* (2009) *Earth Planet. Sci. Lett.* **277**, 213–222. [3] Gislason *et al.* (2006) *Geology*, **34**, 49-52.