

## Iron mobilisation from volcanic ash/glass by atmospheric processing

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Deposition of volcanic ash can provide a source of bioavailable Fe to remote regions of the ocean where Fe deficiency limits primary production. Understanding controls of ash Fe solubility is essential for assessing volcanogenic Fe input to the marine environment. It is well known that interaction with acids (e.g., H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>) and exposure to cloud condensation/evaporation cycles during transport increase Fe solubility in mineral dust. Airborne volcanic ash particles, which act as cloud condensation nuclei and are co-emitted with volcanic acids (e.g., H<sub>2</sub>SO<sub>4</sub>, HCl, HF), are similarly expected to undergo atmospheric processing. We investigated the influence of such processing on ash Fe solubility by i) exposing six ash samples (57-74 wt.% SiO<sub>2</sub>) to pH 1 H<sub>2</sub>SO<sub>4</sub> for 336 h to mimic contact with acid during transport, and ii) subjecting a glass sample (58 wt.% SiO<sub>2</sub>) to three 12-h cycles of alternating pH 2 and 6 H<sub>2</sub>SO<sub>4</sub> to simulate pH changes during cloud evaporation and condensation, respectively. Solution sub-samples were analysed for Si, Al, Fe, Mg, Ca, Na and K concentrations by ICP-AES. Changes in sample surface compositions were assessed by X-ray photoelectron spectroscopy, and untreated ash surfaces were examined by scanning electron microscopy. Results suggest that surficial Fe salts do not constitute a significant fraction of the soluble Fe mobilised from ash in acid. The Fe release trend is consistent with leaching/dissolution of silicate components in the ash. We propose that ash surface properties imparted by eruption plume processing, including oxidation in a water- or HCl-rich environment or interaction with HF, are key in governing ash Fe release. The preliminary findings of the pH cycling experiment suggest that Fe release over 36 h is driven by dissolution and precipitation of Fe(III) at pH 2 and 6, respectively. Acid mobilisation of Fe does not appear to increase significantly over multiple cycles.

## Volcanic ash and aerosol

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Volcanoes are an important source of silicate particles (e.g., ash) and aqueous aerosol (e.g., sulphate) to the Earth's atmosphere and environment. Persistent emanations represent a key background flux to the atmosphere maintaining its characteristics and composition, while sporadic large-scale eruptions have the potential to perturb the atmosphere's chemical and radiative balance as well as having other direct effects on the Earth's environment. The recent travel chaos in Europe during the Icelandic eruptions of Eyjafjallajökull and Grimsvötn in 2010 and 2011 has also brought into sharp focus the vulnerability of highly developed societies, remote from volcanoes, to their far-flung effects.

In this talk I will explore some of the nature and impacts of volcanic ash and other volcanic particles and how volcanologists study them. I will cover topics such as the generation of particles during volcanic activity, their effects in the plume (e.g., lightning generation and the scavenging of gases), their fall out and their environmental effects (e.g., the potential of volcanic ash to fertilize the oceans). Recent work has also shown the importance of understanding the relationship between volcanic emissions and cloud properties in order to understand the perturbation that anthropogenic emissions represent in terms of the Earth's radiative budget via the indirect aerosol effect.