

## Insights into biogenic secondary organic aerosols produced from five structurally different precursors

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A series of novel experiments were carried out at the Manchester Aerosol Chamber in order to investigate the chemistry and microphysics of the formation and transformation of biogenic secondary aerosols. A selection of compounds covering a wide range of reactivity including monoterpenes, sesquiterpenes and oxygenated VOCs has been studied in detail. The chemical composition of the formed SOA was measured on-line using an Aerodyne Time-of-Flight Aerosol Mass Spectrometer (cToF-AMS). A hygroscopicity tandem differential mobility analyser (HTDMA) and a cloud condensation nuclei (CCN) counter were used to probe the hygroscopic properties and of the aerosols in the sub- and super-saturated regimes, respectively. A proton transfer mass spectrometer was used to study the evolution of the gas phase oxidation products.

We presents an overview and synthesis of results covering the chemical composition, hygroscopicity and cloud condensation nuclei (CCN) properties of secondary organic aerosols formed from five structurally different biogenic VOCs ( $\beta$ -caryophyllene, limonene, myrcene, linalool,  $\alpha$ -pinene). The effect of the use of organic [1] and inorganic seed on the limonene SOA will be presented. Results showed that the formed SOA have a wide range of chemical properties, and that the effect of photochemical ageing on their properties was not uniform across all five precursors. A link of these results to the corresponding findings of the hygroscopic properties of the SOA particles and their CCN behaviour will be presented and discussed.

[1] Hamilton, J.F., Alfarrá, M.R., Wyche, K.P., Ward, M.W., Lewis, A.C., McFiggans, G.B., Good, N., Monks, P.S., Carr, T., White, I.R. and Purvis, R.P. (2010) *Atmos. Chem. Phys. Discuss.*, **10**(10), 25117-25151.

## Release rate of pollutants, nutrients and protons from pristine Eyjafjallajökull ash

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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 and flood waters all the way to the ocean. Later, when meltwater did not have access to the magma, the eruption produced a larger grained magmatic ash. We were able to sample dry ash, from both these eruption phases. Both ashes were coated with salts during the eruption, and the surface area of the phreato-magmatic ash was an order of magnitude larger than the one of the magmatic ash [1]. Single pass plug flow experiments were carried out at 22 °C using DI-water and North Atlantic seawater. The outlet was connected directly to an ion chromatograph to determine release rate of anions with time without exposure to the atmosphere. The rest of the dissolved elements were measured by various ICP methods.

Magmatic ash released protons, resulting in initial pH drop in the DI-water to 3.2, and initial proton release of  $10^{-6.5}$  moles/m<sup>2</sup>/s. The surface of phreato-magmatic ash, however consumed protons, a minimum of  $-10^{-7.8}$  moles/m<sup>2</sup>/s, resulting in an initial pH of 10.3. Initial release rates, normalized to the BET-surface area, were 2-4 orders of magnitude faster than bulk dissolution rate of volcanic glasses and olivine. The rates dropped by orders of magnitude over a few hours. Surface area normalized rates from the magmatic ash was in general faster than the phreato-magmatic rates, and it is only the magmatic ash that releases Fe and Al at elevated rates,  $10^{-6.6}$  and  $10^{-6.4}$  moles/m<sup>2</sup>/s, respectively. These experiments show fundamental difference in the potential environmental impact of volcanic ash of the same bulk composition, but produced by different eruption mechanism. Acid producing gases and salts dissolve in meltwaters and are transported to the ocean via flood waters. Furthermore, phreato-magmatic ash will not fertilize surface waters with water soluble iron, like the magmatic ash.

[1] Gislason S.R. *et al.* (2011), *PNAS*, *in press*.