Airborne measurements of volcanic particles and gases with small aircrafts — Examples of measurements in the Eyjafjallajökull ash plume over Germany and Iceland

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During the 2010 eruption period of the Eyjafjallajökull the University of Applied Sciences of Duesseldorf and the University of Reykjavik performed several measurement flights with small aircraft in the volcanic plume. Whereas the University of Applied Sciences mapped the distal plume over Germany, the University of Iceland explored the airspace over western Iceland and near the Eyjafjallajökull, partly entering the volcanic plume boundary directly.

The use of the small piston-motor driven research aircraft in the special situation of volcanic plumes has several advantages over jet engine driven research aircrafts:

The piston-motor driven aircraft are robust enough to operate even at elevated ash concentration levels.

The small aircrafts allow a low cruising speed during the measurements and have thus the advantage of delivering results with a high spatial resolution.

The low possible aircraft cruising speed during the measurements simplifies the intake of even bigger ash particles into the measurement systems.

Small aircraft allow a very cost effective operation.

The aircraft were equipped with optical particle counters (OPCs) for on-line in-situ results. Moreover, the German aircraft was equipped with a DOAS system for SO_2 and a NDIR analyzer for CO_2 measurements.

The measurement flights revealed that the ash plume over Germany had a very inhomogeneous structure. Sub-plumes and different vertical plume layers could be identified. Regional elevated SO_2 concentrations could be detected. Peak ash particle concentrations of more than 330 μg/m3 could be found during the measurement flights over northern Germany, whereas the flights over Iceland showed low concentrations outside the plume, but values of about 2000 μg/m3 within the boundary of the plume.

A "cradle to grave" analysis of geothermal arsenic in a lowland river system

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In the central North Island of New Zealand, arsenic is released from geothermal hotsprings into the large lowland Waikato River, and thereafter into the Tasman Sea. Aspects of arsenic geochemistry in the geothermal fluids, and in the river and its lake waters, have been previously studied but a catchment-scale analysis of factors affecting geothermal arsenic on its journey to the sea has highlighted the importance of biological as well as geochemical processes.

Evidence for biological interactions with arsenic occurs on a different timescale to that typically used to identify geochemical interactions. For example, when arsenic is released into the surface environment via the Champagne Pool hot spring at Waiotapu, it occurs predominantly as arsenite ion. In the outflow arsenic is immediately exposed to a regime of decreasing temperature, attended by increasing oxygen and periodic influxes of H_2S from small fumeroles, favouring oxidation to arsenate ion or removal as orpiment (As_2S_3) respectively. However, diurnal variations in arsenic concentrations in the outflow confirm the influence of photosensitive microorganisms, evidently through their intervention in dissolved sulphide-sulphate equilibria. Similarly, after discharging into the Waikato River, geothermal arsenic appears to be most immediately controlled by adsorption to the iron oxide component of SPM. However, long term adsorption experiments under light/dark conditions, and a more detailed assessment of the competitive adsorption of important diatom nutrients; silica and phosphate, indicate that arsenic concentration is not regulated simply by the availability of iron oxide adsorption sites. In a river such as the Waikato, enriched in both geothermal silica and agricultural phosphate, diatom growth and decay also influences arsenic speciation and mobility.