



Aerosol chemistry of the 2018 Kīlauea Lower East Rift Zone eruption – following major and trace elements from source to exposed communities

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Multiphase volcanic plumes (ash, gas and aerosol) can have severe impacts on human health (e.g., exacerbating respiratory problems) and the environment (e.g., acid rain damaging vegetation).

In 2018, an opportunity arose to characterise a significant ash-poor volcanic plume when a sequence of fissures opened in a populated area on the Lower East Rift Zone (LERZ) of Kīlauea Volcano, Hawai'i. During a 3-week campaign in July-August 2018, we sampled the plumes associated with the active Fissure 8 vent and the lava ocean entry ('laze'). Size-resolved major (including sulfate and chloride) and trace element aerosol chemistry were characterised. We find good agreement between measurements using both ground-based instruments and those mounted on an Unmanned Aerial System (UAS) (cascade impactors and filter packs in both cases). Fluxes of metal and metalloid elements are approximately two orders of magnitude greater than during the 2008-2009 emissions from Halema'uma'u lava lake at the volcano's summit (e.g. 220 ± 61 kg/day of Cu in 2018 compared with up to 8.6 kg/day of Cu in 2008). However, the relative abundances of many elements (measured using element/SO₂ ratios) are similar between the two eruptive periods (within error for the majority of metal and semi-metal elements measured).

A sampling network was established in populated areas around the Big Island of Hawai'i during the field campaign where we sampled the aerosol every 2-3 days (Kona, Ocean View, Pahala, Volcano Village and NOAA Mauna Loa Atmospheric Observatory). Using this network, we captured temporal and spatial changes in the major and trace element chemistry of the volcanic plume as it aged. We clearly demonstrate the conversion rate of sulfur in the plume from $\sim 100\%$ SO₂ at source to up to 25% particulate sulfate at downwind stations. We find evidence of metal fractionation in the volcanic plume downwind, with significant variability in the metal/SO₂ ratios between near- and far-field sites beyond that which can be attributed to dilution and SO₂ conversion to aerosol.

An improved understanding of tropospheric plume aerosol transport, in particular the variable transport of volatile metals is an important addition to our current knowledge of the potential environmental burdens and health effects of volcanic plumes, both at the present day and through geologic history.