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Trace element emissions during the 2018 Kilauea Lower East Rift Zone eruption

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The 2018 eruption on the Lower East Rift Zone of Kilauea volcano, Hawai'i released unprecedented fluxes of gases (>200 kt/d SO_2) and aerosol into the troposphere [1,2]. The eruption affected air quality across the island and lava flows reached the ocean, forming a halogen-rich plume as lava rapidly boiled and evaporated seawater.

We present the at-source composition – gas and size-segregated aerosol – of both the magmatic plume (emitted from 'Fissure 8', F8) and the lava-seawater interaction plume (ocean entry, OE), including major gas species, and major and trace elements in non-silicate aerosol. Trace metal and metalloid (TMM) emissions during the 2018 eruption were the highest recorded for Kilauea, and the magmatic 'fingerprint' of TMMs (X/SO_2 ratios) in the 2018 plume is consistent with measurements made at the summit lava lake in 2008 [3], and with other rift and hotspot volcanoes [4,5].

We show that the OE plume composition predominantly reflects seawater composition with a small contribution from plagioclase +/- ash. However, elevated concentrations of some TMMs (Bi, Cd, Cu, Zn, Ag) with affinity for Cl-speciation in the gas phase cannot be accounted for by the silicate correction and therefore may derive from degassing of lava in the presence of elevated Cl^-. In the case of silver and copper, concentrations in the OE plume are elevated above both the F8 plume and seawater.

At-vent speciation of TMMs in the F8 plume during oxidation (following a correction for ash contributions) was assessed using a Gibbs Energy Minimization algorithm (HSC chemistry, Outotec Research). We also demonstrate the sensitivity of speciation in the plume to the concentration of

common ligand-forming elements, chlorine and sulfur. These results could be used as initial conditions in atmospheric reaction models to investigate how plume composition evolves as low-temperature chemistry takes over.

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