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Fluoride enrichment on the surface of ash from Cumbre Vieja volcano, Canary Islands

DR. ELENA MATERS[1], ARNAUD DENIS[2], MATTHEW J PANKHURST[3,4], PIERRE ELOY[2] AND PIERRE DELMELLE[2]

[1]University of Cambridge
[2]Université catholique de Louvain
[3]Instituto Tecnológico y de Energías Renovables (ITER), Tenerife, Canary Islands
[4]Instituto Volcanológico de Canarias (INVOLCAN), Tenerife, Canary Islands

Presenting Author: ecm63@cam.ac.uk

After 50 years of repose, Cumbre Vieja volcano in the Canary Islands began erupting in September 2021, producing recurrent ash fall on La Palma for almost three months. Eight plastic boxes set up by the Instituto Volcanológico de Canarias at various distances (2–10 km) around the volcano enabled a (multi-day) time series of ash fall samples to be collected throughout the eruption. The samples were split for various physico-chemical analyses among collaborating scientists. To investigate the ash as a possible source of fluoride to the environment, we analysed the surface composition of seven ash samples and the water leachate composition of 36 ash samples erupted from 19 September to 16 November 2021. The Si, Al, Fe, Mg, Ca, Na, K, Ti, S, Cl and F concentration within the topmost 2–10 nm of ash surfaces was measured by X-ray photoelectron spectroscopy (XPS). Following leaching of the ash in water for 1 h at a 1:100 mass ratio, the filtered leachate was analysed for Si, Mg, Ca, Na and K by inductively coupled plasma atomic emission spectroscopy and SO_4^{2-}, Cl^- and F^- by ion chromatography. Surface F concentrations ranged from 8.3–52.4 (mean 23.4 ± 11.6) at.% (excluding C and O and normalised to 100%) — reaching higher than any surface F concentration reported on volcanic ash to date by XPS analysis. Leachate F^- concentrations ranged from 13–683 (mean 281 ± 177) mg kg^{-1} with pH values from 5.3–6.0 (mean 5.6 ± 0.1). The F measured in the ash leachates represents only some of that measured on the ash surfaces, implying that soluble F originating for example from salts (e.g., Na_2SiF_6, NaF) formed by ash-$HF_{(g/aq)}$ interaction [1] is unlikely to explain fully the surface F enrichment on the Cumbre Vieja ash. Insights on these findings from complementary analyses and potential implications for element release from the ash to the environment will be discussed.

[1] Delmelle, Maters, Calkins, Gaspard, Opfergelt & Jenkins (2021), *Chemical Geology* 579, 120327.