Tracking the Reactions of SO_2 and Glass in the 2018 Kilauea Ash

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The 2018 Kilauea eruption was the first major ash producing eruption at Kilauea since 1924. The erupted products reacted with volcanic gases, predominantly SO_2 (sulfur dioxide), that altered minerals and glass in the hydrothermal system, lava lake crust and the eruption plume. Freshly erupted ash samples from the May 13-28 eruptions were mounted in epoxy and polished in anhydrous ethanol. Both individual particles and the bulk sample were observed with QEMSCAN, SEM, electron microprobe, confocal μ-Raman and infrared spectroscopy to identify the altered grains and track the chemical and mineralogical evolution of the eruption.

The ash samples contain a mixture of minerals and mineral aggregates that include primary rock-forming minerals and secondary alteration minerals. Within the erupted products, vesicular and non-vesicular glass fragments have altered to secondary minerals.

Glass fragments that were exposed to high concentrations of SO_2-rich volcanic gas exhibit traits of a shrinking core reaction [1]. Glass is rimmed sequentially by (plagioclase (albite) →) Ca-sulfate and/or Mg-sulfate → Ca-Al- or (Ca-+Al-) sulfates and Ca-Mg- or (Ca-+Mg-) sulfates → silica ± anatase ± Fe-oxides ± Fe-sulfide(s). These minerals are consistent with experiments between glass and SO_2 [2], except for the Al-sulfates. Some glass fragments contain alteration rims of Na-sulfate and Al-sulfate and/or natroalunite. The diffusion of Ca and other cations caused the glass to destabilize [2, 3], resulting in albite crystallization in the glass.

We expect the minerals and glass that were altered in the Halema'uma'u lava lake had a greater opportunity for SO_2 exposure than the juvenile particles. The alteration products (sulfates and silica ± anatase ± Fe-oxides ± Fe-sulfide(s)) may provide clues for SO_2 reactions with the ash particles in either the hydrothermal system, lava lake crust and eruption plume.

References: [1] King PL et al. (2018) Rev. Mineral. Geochem. 84(1), 1-56. [2] Renggli CJ and King PL (2018) Rev. Mineral. Geochem. 84(1), 229-225. [3] Delmelle P et al. (2018) Rev. Mineral. Geochem. 84(1), 285-308.