Complex mixing of old and new: a petrological overview of the Kīlauea 2018 eruption

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At around 5pm on May 3rd, 2018, an eruptive fissure opened in Leilani Estates, on the lower East Rift Zone (LERZ) of Kīlauea Volcano (Hawaii). This activity marked the beginning of the most highly effusive eruption in at least 200 years, emitting ~800 Mm^3 of magma (dense rock equivalent) in 3 months, with devastating effects on several communities on the Island of Hawai‘i [1]. The first two weeks were dominated by moderate fountaining activity at >20 fissures along a 7 km-long segment of the LERZ. These lavas were plagioclase and pyroxene-rich, different from magma that had erupted at Pu‘u ‘Ō‘ō over the last 35 years. Remarkable compositional differences were also observed between different fissure segments: both basalt and andesite were erupting simultaneously a few hundred meters apart. Hotter, more olivine-rich magma arrived ~12 days into the eruption, soon followed by widespread flows to the south. By the end of the 4th week, activity focused at ‘Fissure 8’, the primary location of magma output until August 6th, when effusion ceased. About 40 km to the west, magma occupying the shallow ~1 km^3 summit reservoir was draining, soon followed by step-wise caldera collapse [1]. Although it is still unclear if any of the summit magma made it to the LERZ, magmas erupted became progressively more homogenous in composition: closer in geochemical character to summit and Pu‘u ‘Ō‘ō magmas, but with notable differences including the presence of Fo_{89} olivine in the crystal cargo, a composition not erupted at Kīlauea since the 1970’s. More than 50 samples spanning the eruption both in location and time have been analyzed for their bulk rock, glass, and mineral chemistry, revealing complex mixing between at least 3 different magmas. Here, we provide a preliminary reconstruction of changes in magma mixing proportions with time and location along the fissure system, and examine potential genetic linkages with older magmas erupted in the LERZ (e.g. 1840, 1955, 1960). Understanding these linkages is crucial for hazards mitigation as pockets of older, residual magma may be pervasive within the rift zones.

[1] Neal *et al.* (2019) Science **363**, 367-374.