**Deciphering Magmatic Processes during the Ongoing Eruption of Kīlauea Volcano, Hawaii**

Michael O. Garcia1*, Aaron J. Pietruszka2, J. M. Rhodes3, Kendra J. Lynn1,4, Brett H. Walker1

1Dept. of Geology & Geophysics, Univ. of Hawaii, Honolulu, HI 96822, USA [*correspondence:mogarcia@hawaii.edu]
2USGS, Denver, CO 80225, USA
3Dept. of Geosciences, University of Mass., Amherst, MA 01003, USA
4Dept. of Geol. Sciences, Univ. of Delaware, Newark, DE 19716, USA

Kīlauea’s 35-year-old, voluminous (>4 km³) Pu‘u ‘Ō‘ō eruption provides a superb opportunity to evaluate models for the generation and evolution of basaltic magmas. Our suite of 1350+ fresh lava samples shows wide variations in major and trace element concentrations, and Pb, Sr, O and U-series isotope ratios providing unique insights into the dynamic processes during a single eruption. These compositional variations result from the interplay between crustal and mantle processes. Compositional zoning generated by diffusive re-equilibration in olivine provides insights into magma mixing, storage and transport within the crust. Timescale modeling of Fe-Mg and Ni diffusion indicates that Pu‘u ‘Ō‘ō olivine crystals can be stored at magmatic temperatures after magma mixing for months to years before eruption. Whole-rock compositional variation 1983-1985 involved mixing of two, rift-zone-stored magmas and a new, continually changing mantle-derived magma. The 1985-2004 lava shows a temporal evolution with progressively lower MgO-normalized CaO, K₂O, Ni concentrations, and Nb/Y and 206Pb/204Pb ratios that were accompanied by an increase in SiO₂ and ⁸⁷Sr/⁸⁶Sr. These systematic variations document relatively rapid changes in the parental magma composition that require at least three source components and are unrelated to crustal processes. Three short (<1 day) eruptions occurred uprift from the Pu‘u ‘Ō‘ō vent. The 1997 and 2011 eruptions produced fractionated lavas that were mixtures of rift-stored and Pu‘u ‘Ō‘ō magmas whereas the 2006 lava sampled unmixed summit-derived magma that avoided contamination in Pu‘u ‘Ō‘ō’s shallow reservoir. Surprisingly, in 2015 the lava composition trend reversed becoming more enriched (higher MgO-normalized K₂O, CaO and Nb/Y) indicating the incorporation of a new source component (or mixture of sources). Some of these lavas have anomalously high CaO/TiO₂ from incorporation of gabbroic clots. These changes are superimposed on a 30-year-long, overall trend of decreasing MgO (10-6.5 wt%) despite variations in eruption rate of a factor of two or more. Kīlauea’s longest historical eruption continues vigorously with no signs of ending soon.