DECIPHERING MAGMATIC PROCESSES DURING THE ONGOING ERUPTION OF KILAUEA VOLCANO, HAWAII

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Kīlauea's 35-year-old, voluminous (>4 km^3) Puʻu ʻŌʻō 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 Puʻu ʻŌʻō 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, K_2O, Ni concentrations, and Nb/Y and $^{206}Pb/^{204}Pb$ ratios that were accompanied by an increase in SiO_2 and $^{87}Sr/^{86}Sr$. These systematic variations document relatively rapid changes in the parental magma composition that require at least three source compoinents and are unrelated to crustal processes. Three short (<1 day) eruptions occurred uprift from the Puʻu ʻŌʻō vent. The 1997 and 2011 eruptions produced fractionated lavas that were mixtures of rift-stored and Puʻu ʻŌʻō magmas whereas the 2006 lava sampled unmixed summit-derived magma that avoided contamination in Puʻu ʻŌʻō 's shallow reservoir. Surprisingly, in 2015 the lava composition trend reversed becoming more enriched (higher MgO-normalized K_2O, CaO and Nb/Y) indicating the incorporation of a new source component (or mixture of sources). Some of these lavas have anomalously high CaO/TiO_2 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.