Magma Reservoir Assembly at Kīlauea Volcano: Insights from chemical zoning in olivine

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Kīlauea Volcano (HI) has a violent eruptive history despite the dominance of effusive activity for the last two centuries. The most recent explosive eruptive cycle (Keanakāko‘i Tephra; 1500-1823 CE) began after caldera collapse when crustal reservoirs were likely disrupted or destroyed [1]. Cycles of effusive-explosive activity correlate with changes in magma supply rates, which strongly impact Kīlauea’s magmatic plumbing and reservoir system [1]. Major, minor, and trace element concentrations in olivine and glass from Keanakāko‘i Tephra and modern effusive eruptions (1823-present) are used to investigate magma storage histories and the nature of Kīlauea’s crustal reservoir(s) during these contrasting eruptive periods.

We find that the explosive period of low magma supply has high MgO melts [1] and highly heterogeneous olivine populations dominated by primitive compositions (>Fo_{86}). In contrast, the effusive period of high supply has lower MgO melts and more homogeneous olivine populations that are generally more evolved ($Fo_{80\text{-}84}$). The evolved olivine is consistent with a shallow reservoir (2-5 km below the summit) that is continually crystallizing, outgassing, and being recharged with mantle-derived magma [2]. Modeling of Fe-Mg zoning in Keanakāko‘i olivine suggests magma storage timescales of weeks to years (mostly 4-8 months). In additon, olivine rims are out of Fe-Mg equilibrium with the carrier melt, indicating that they must have been stored in shallow regions and picked up by recharge magmas shortly before eruption. These timescales of magma storage and recharge are interpreted to record the early stages of reservoir recovery and re-assembly following caldera collapse. Since ~1500 C.E., progressive reservoir re-establishment has led to increased melt evolution and homogenization of olivine in the crust. Trace elements in olivine and glass will be used to further explore this hypothesis.

[1] Swanson *et al*. (2014), *Geology* **42**, 631-634. [2] Poland *et al*. (2014), *U.S.G.S. Prof. Paper* **1801**, 179-234.