Trace element characteristics of deformed and undeformed olivine from Kilauea Iki

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As the first silicic phase to crystallize in most mafic magmas, olivine may provide information about early magmatic processes. However, fast diffusion rates of divalent cations also means that olivines compositions may rapidly re-equilibrate, and as a result major and minor elements may not retain information about possible different olivine origins (phenocryst, antecryst, xenocryst). We present trace element and textural data from olivine-rich magmas from the 1959 Kilauea Iki eruption as an alternative approach to distinguish different olivine populations. Kilauea Iki picrites, like many other olivine-rich magmas from oceanic magmatic systems contain both deformed (with kinkbands, undulose extinction or subgrains) and undeformed olivine grains [1]. A common interpretation is that deformed olivine is plastically deformed during storage in dunite cumulate piles. However, this interpretation has recently been challenged [2,3] suggesting instead formation from collisions or via differences in growth rates.

EMP (spot analyses and compositional mapping) and LA-ICP-MS data on deformed and non-deformed olivine populations show subtle but consistent differences in trace element chemistry between these two textural groups. In particular Kilauea Iki olivine grains document higher Al, Ti, V, Cr, and Ni and lower Ca and P contents on average (Student's T-test $P<0.001$ for each element) in deformed grains versus undeformed grains. This is the first time to our knowledge that deformed olivine have been shown to have consistently different chemical compositions, and suggests that the different textural types of olivine derive from distinct chemical reservoirs. In turn this is consistent with picritic magmas being assembled by mixing of diverse liquid and olivine populations.

[1] Claque & Denlinger (1994) *Bull. Volcanol.* **56**, 425–434 [2] Welsch *et al* (2013) *J. Petrology* **54**, 539–574 [3] Natland (2003) *J. Petrology* **44**, 421–456