Behavior of Mo, U, and Tl isotopes during differentiation in the Kilauea Iki system

RICHARD GASCHNIG[1], CHRIS REINHARD[2], JEREMY D. OWENS[3], NOAH PLANAVSKY[4], XIANGLI WANG[4], DAN ASAEL[4], ALLISON GREANEY[5], ROSALIND HELZ[6]

[1]Dept. of Environmental, Earth and Atmospheric Sciences, University of Massaschuetts Lowell, Lowell, MA, USA; richard_gaschnig@uml.edu

[2]School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, GA 30332, USA

[3]Dept. of Earth, Ocean and Atmospheric Science, Florida State University, Tallahassee, FL 32306, USA

[4] Dept of Geology and Geophysics, Yale University, New Haven, CT 06520, USA

[5]Department of Earth Science, University of California Santa Barbara, Santa Barbara, CA 93106, USA

[6] U.S. Geological Survey, Reston, VA 20191, USA

Kilauea Iki lava lake formed during a 1959 eruption and represents a unique natural laboratory for studying magma crystallization and differentiation. Samples with MgO contents ranging from ~27 to 2% have been obtained from drill cores produced by the U.S. Geological Survey, and this sample suite has been used extensively to determine whether non-traditional stable isotope systems experience high-T isotope fractionation. Here, we use these samples to investigate the behavior of the Mo, U ($^{238}U/^{235}U$), and Tl isotope systems during differentiation.

Mo and U show similar chemical behavior in the lava lake system. Both experience mild increases in concentration as MgO decreases from 27% to 8%, followed by a steeper increase over the remainder of the MgO range. No systematic resolvable isotopic change is observed for either element. Mean $\delta^{98}Mo$ (relative to NIST-3134, set to 0‰) and $\delta^{238}U$ compositions are -0.220 +/-0.079‰ and -0.293 +/- 0.095‰ (2σ stdev).

Tl shows nearly identical chemical behavior to Mo and U, but unlike those other elements, Tl shows significant isotopic heterogeneity. Samples with MgO less than 8% show an increase in $\varepsilon^{205}Tl$ values with decreasing MgO, and three high MgO samples have anomalously high $\varepsilon^{205}Tl$ values (>> 0.0‰). We suggest that these high MgO/high $\varepsilon^{205}T$ samples reflect the influence of traces of Fe-Mn sediments previously identified in the Hawaiian mantle source [1], whereas differentiation may have driven the increase in $\varepsilon^{205}Tl$ in the low MgO samples.

[1] Nielsen, Rehkamper, Norman, Halliday, and Harrison (2006), *Nature* 439, 314-317.