Magmatic volatiles and mantle source lithology in the Hawaiian Plume: a view from olivine-hosted melt inclusions, glasses, and osmium isotopes

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Variations in radiogenic isotopes (e.g. Pb,Nd) and magmatic volatiles (e.g. CO2,H2O) in Hawaiian volcanoes reveal important processes (i.e. source heterogeneity, melting, magma degassing). Shield-stage lavas likely originate from a plume source containing peridotite and ancient recycled oceanic crust (pyroxenite). The source region may also be heterogeneous with respect to volatile concentrations. However, shallow degassing makes it difficult to determine if there is a link between mantle source composition and volatile budget. Here we present Os isotopic ratios and volatile contents on olivines and glasses for 33 samples from Koolau, Mauna Kea, Mauna Loa, Hualalai, Kilauea, and Loihi to determine if volatiles in magmas correlate with geochemical tracers of source lithologies. For a given volcano, most osmium isotopic compositions of olivines are similar to the whole-rock values, yet some Mauna Loa and Loihi olivines display the significantly low 187Os/188Os values (~0.117) that may reflect partial melts of ancient recycled mantle lithosphere. SIMS analyses on Hawaiian glasses reveal a range in abundances of CO2 (10-251 ppm), H2O (0.2-1.2 wt.%), S (38-2960 ppm), and Cl (39-2960 ppm). However, most samples have low CO2 contents (<100 ppm) indicating they experienced degassing. Olivine-hosted melt inclusions may better preserve pre-eruptive concentrations and we will present new volatile contents on Hawaiian melt inclusions from the same olivines analyzed for Os isotopes.

Helium isotopes signature of mafic volcanics at Stromboli (Italy) during its magmatic evolution.

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A study on fluid inclusions of mafic minerals from selected volcanics is conducted to characterize the He and Ar isotopes of Stromboli. We also measured trace element in clinopyroxenes of selected samples and Sr-Nd isotopes. The samples belong to (i) the present-day activity of Stromboli; (ii) the extreme terms among the magmatic series erupted (calcalcaline CA and potassic KS); (iii) the ultramafic xenoliths outcropping in the island. The gas content trapped in mafic crystals is consistent with magma crystallization and fluid entrapment from mantle depths to progressively shallower conditions. All samples have $^{3}He/^{4}He$ in the range 4.0-4.9 Ra, except the KS ($^{3}He/^{4}He$ < 3.5 Ra), associated to higher Sr and lower Nd isotope ratio. Overall, He isotopes are well associated to lithophile element isotopes. The whole set of helium isotope data indicates ratios lower than those measured in the most uncontaminated Aeolian lavas (i.e., Alicudi, ~ 7 Ra) and in common volcanic arcs, due to subduction-related contamination beneath Stromboli. $^{3}He/^{4}He$ from mafic minerals are compared to those of currently geothermal fluids, with the latter ranging between 3.9 and 4.5 Ra. The maximum $^{3}He/^{4}He$ ratio measured in LP fluid inclusions (i.e., 4.6 Ra) would thus correspond to the upper limit that should be expected for surface gases during or before high-intensity eruptive events, when a deep gas component is released from the magma.

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