A high carbon content of the Hawaiian mantle from olivine-hosted melt inclusions

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The deep mantle carbon content and flux represents a significant uncertainty in global volatile cycles and distributions. Here, we present CO_2 concentrations measured in >400 primitive olivine-hosted melt inclusions from Hualalai, Kilauea, Koolau, Loihi, and Mauna Loa to constrain the Hawaiian mantle CO_2 content and flux.

Quantification of CO_2 in melt inclusions is complicated by the ubiquitous presence of vapor or "shrinkage" bubbles. We measure exsolved vapor bubble CO_2 by a volumetric method, and add that to dissolved CO_2 measured by SIMS, in order to reconstruct total melt inclusion CO_2 concentrations. Unlike a similar method using Raman spectroscopy, our method accounts for the presence of cryptic carbonates, which may sequester much of the vapor bubble CO_2.

We demonstrate that addition of vapor bubble CO_2 to dissolved CO_2 results in ~50% uncertainty in total melt inclusion CO_2, primarily due to melt inclusion geometry. This same uncertainty is also applicable to Raman studies. Due to this uncertainty, large numbers of samples must be measured in order to accurately capture population statistics.

Based on our data set, we estimate that parental melts from five Hawaiian volcanoes have between 0.24 and 1.1% CO_2, similar to a recent independent estimate [1], with mantle sources between 130 and 490 ppm CO_2. The average mantle source of the five volcanoes has 315 ppm CO_2, suggesting that the Hawaiian plume is significantly more C-rich than the MORB mantle. The high CO_2 concentration of the Hawaiian plume could either be due to deeply subducted surficial C, retention of juvenile C, or both.

[1] Anderson, K.R., Poland, M.P., *Nature Geosci.* **10**, 704-708.