Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12547

Halogens (F, Cl, Br, I) in submarine glasses from around Hawai'i

DR. MARK A KENDRICK[1], MICHAEL O. GARCIA[2], OLIVER NEBEL[3], TAKESHI HANYU[4] AND IAN WILLIAMS[5]

[1]University of Queensland
[2]University of Hawai‘i at Mānoa
[3]Monash University
[4]JAMSTEC
[5]Australian National University

Presenting Author: m.kendrick@uq.edu.au

The Hawaiian Islands sit atop the largest mantle plume underlying the Pacific Ocean and are one of the few ocean islands globally where some lavas have $^{3}He/^{4}He$ ratios that exceed ~30 Ra (Ra = atmospheric $^{3}He/^{4}He$) unequivocally demonstrating a primitive component in the mantle source. We analyzed F, Cl, Br and I in submarine alkali basalt glasses selected from locations around Hawai'i including: the North Arch (n = 11); the Kaua'i Channel (n = 3); north of Moloka'i (n = 3); and NW of NÄ«hau (n = 3); which all have $^{3}He/^{4}He$ of 4-11 Ra; the South Arch (n = 6) with $^{3}He/^{4}He$ of 18-21 Ra and LÅ 'ihi (n = 12) with $^{3}He/^{4}He$ of 18-26 Ra. The aim was to test if halogen abundance ratios (F/Cl, Br/Cl and I/Cl) vary as a function of $^{3}He/^{4}He$ in Hawaiian glasses.

The Hawaiian glasses investigated have 350-880 ppm F, 215-1100 ppm Cl, 500-2,200 ppb Br and 8-102 ppb I. The F/Cl ratios vary from 1.8 to 0.8 in the most Cl-rich glasses. Most of the glasses have Br/Cl and I/Cl ratios that are tightly clustered at each location and within the global range of ocean island basalts and MORB (Br/Cl = 2.8±0.6 $\times 10^{-3}$ and I/Cl = 30-90$\times 10^{-6}$) . The glasses from LÅ 'ihi have low I/Cl ratios of 20-40$\times 10^{-6}$ with the lowest values in the samples with the highest $^{3}He/^{4}He$ ratios. In contrast, the glasses from the South Arch have high I/Cl ratios of ~120 $\times 10^{-6}$ and the glasses from the North Arch have variable I/Cl ratios of 40-190$\times 10^{-6}$.

The constancy of the glasses Br/Cl ratios suggests that none of the melts investigated assimilated hydrothermal brines, which can strongly influence Cl concentrations of submarine glasses. However, further isotope data are required to determine if the variation in I/Cl results from mixing between different mantle components or is the result of the melts variably assimilating altered crustal material. The Hawaiian primitive mantle component with high $^{3}He/^{4}He$ might yet be characterized by a different I/Cl ratio than all other mantle reservoirs.