Origin of enriched Hawaiian mantle signatures: insight from the thallium isotopic compositions of shield lavas

NICOLE M.B. WILIAMSON[1*], DOMINIQUE WEIS[1], JULIE PRYTULAK[2]

[1]PCIGR, Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia, Vancouver, BC, V6T1Z4, Canada (*correspondance: nwilliam@eoas.ubc.ca, dweis@eoas.ubc.ca)

[2]Department of Earth Sciences, Durham University, Durham, DH13LE, UK (julie.prytulak@durham.ac.uk)

Ocean island basalts (OIB) of the >5800 km Hawaiian-Emperor chain record ~82 million years of Hawaiian mantle plume magmatism and support a heterogeneous mantle composed of multiple isotopic domains [1]. The distinct Hawaiian 'Loa' isotopic component is elevated in large ion lithophile elements, $^{208}Pb^*/^{206}Pb^*$, and $^{87}Sr/^{86}Sr$ [2] that trend towards the enriched mantle I (EMI) mantle end-member, which might represent old, subducted and recycled components [3]. Stable thallium (Tl) isotopes are highly fractionated, by over 35 epsilon units, in a number of Earth reservoirs [4] and during subduction, the Tl isotopic composition of downgoing materials is shown to be variably preserved [5]. Heavy $\varepsilon^{205}Tl$ compositions in Hawaiian lavas have been linked to the presence of recycled ferromanganese sediments in the Hawaiian mantle plume (HMP) based on the analysis of 11 unleached picrites from six volcanoes [5,6]. We undertake a higher resolution examination of this hypothesis by measuring Tl trace element and isotopic compositions of 29 shield-stage basalt samples from 13 Hawaiian volcanoes that represent the entire range of isotopic compositions observed along the Hawaiian archipelago. A leaching protocol was used prior to column chemistry to remove secondary, post-eruptive alteration and to ensure that primary, magmatic Tl isotopic compositions were measured. The protocol was tested on five reference materials and two Hawaiian samples to asses Tl isotopic compositions in unleached, leached, and leachate fractions. This study provides insight on optimal analytical procedures for determining primary Tl isotopic compositions in OIB, explores the applicability of Tl as a source tracer in the HMP, and offers constraints on the processes and materials that create geochemical heterogeneities in the Earth's mantle.

[1] Harrison and Weis (2018) *Geochem. Geophys. Geosys.* 19, 2823-2842. [2] Weis *et al.* (2011) *Nat. Geosci.* 4, 831-838. [3] White (2015) *Geochem. Perspect.* 4, 95-251. [4] Nielsen *et al.* (2017) *Rev. Mineral. Geochem.* 82, 759-798. [5] Shu *et al.* (2019) *Geochim. Cosmochim. Acta* 250, 130-148. [6] Nielsen *et al.* (2006) *Nature.* 439, 314-317