Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.9380

Thallium behavior within subduction zone metamorphism and related metasomatic processes

SHELBY T. RADER[1], RICHARD M. GASCHNIG[2], SARAH C PENNISTON-DORLAND[3] AND GRAY E. BEBOUT[4]

[1]Indiana University
[2]University of Massachusetts - Lowell
[3]University of Maryland
[4]Lehigh University

Presenting Author: shtrader@iu.edu

The role of fluids in subduction zone processes is increasingly important in understanding elemental mobility across various earth reservoirs, particularly for more novel trace elements, such as thallium (Tl). Thallium is remobilized and isotopically fractionated by two primary mechanisms: low-temperature alteration of oceanic crust and oxidation and absorption of Tl by pelagic clays and Fe/Mn oxides. The strong influence of these two processes leads to unique behavior of Tl within subduction zone settings, ultimately allowing for tracking of various sediment fluxes accompanying subduction. More recent work has shown that the release and transport of fluids during subduction-related metamorphism may also play a crucial role in the geochemical behavior of Tl within these settings. However, quantification of the extent that metamorphic fluids may impact Tl geochemical signatures is still limited. To this end, we present new Tl concentration ([Tl]) and isotope composition data (ε^{205}Tl) of metasedimentary, mélange matrix, and block-rind samples from the Catalina Schist (California, USA). These samples are part of a well-characterized suite of high *P/T* metamorphic rocks which demonstrate complex interactions with aqueous fluids, providing a robust preexisting dataset with which to compare.

A suite of 21 metasedimentary samples and nine mélange samples were analyzed for bulk-rock Tl concentration and isotope compositions. Metasedimentary rocks show no evidence of Tl loss or enrichment ($[Tl]_{range}$: ~90 to 400 ppb) and no significant variation in Tl isotope compositions across a range of metamorphic grades ($\varepsilon^{205}Tl_{range}$: -3.4 to -1.9); each grade is within error of typical crustal and mantle-derived values, further signifying minimal alteration of Tl. The mélange matrix material, however, demonstrates an overall decrease in [Tl] ($[Tl]_{range}$: ~7 to 200 ppb) and a shift of isotopic compositions to higher values ($\varepsilon^{205}Tl_{range}$: -3.4 to +1.2) with increasing metamorphic grade. The mélange material is interpreted to have undergone extensive fluid-rock interaction, which likely removed Tl from the system and shifted isotopic compositions to slightly higher values. These data suggest that extensive fluid-rock interactions may significantly alter the Tl geochemical composition during subduction, reiterating the importance of understanding the systematic controls on Tl behavior during such processes.