

A Survey of thallium concentrations in igneous and hydrothermal minerals

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Thallium (Tl) is a highly incompatible element that has long been associated with ore deposits, particularly precious metal systems such as Carlin-type deposits. While the association between Au and Tl (\pm the suite of Sb, Hg, As) has been commonly observed, the geochemical controls between mineralization and Tl enrichment are poorly understood. Tl has the potential to be both an exploration vector and an environmental challenge; thus the need for a better understanding of Tl geochemical behavior in these systems. This study looks at the distribution of Tl between coexisting minerals from a variety of igneous and hydrothermal systems to better understand the partitioning between mineral phases.

Solution Tl concentration data were collected on a Micromass Isoprobe MC-ICP-MS in K-rich minerals sampled from over fifty localities with geologic settings including pegmatites, IOCG deposits, porphyry systems, and carbonatites, among others. A typical crustal whole rock Tl concentration averages 0.7 ppm; preliminary work has shown anomalous Tl values from K-bearing minerals across a variety of occurrences and mineral types, with enrichment predominantly occurring in micas. For example, hyalophane from Långban, Sweden contains an average of 3.1 ppm Tl; amazonite from Amelia Courthouse, Virginia contains an average of 22.6 ppm. One notable sample, a hendricksite from Sterling Hill, New Jersey contains an average of 22.7 ppm Tl.

In addition to the global database, in an attempt to better understand the distribution of Tl among coexisting minerals, feldspars and micas from the Battle Mountain, Nevada region have also been analyzed. Measured minerals display Tl concentrations ranging from below detection (<0.2 ppm) up to 2.0 ppm. Initial evidence suggests that elevated Tl coincides with weak to strong potassic alteration, and biotite samples appear more enriched in Tl than coexisting K-feldspar by a factor of $\sim 5x$.

This study is aimed at understanding Tl distribution in terrestrial hydrothermal systems. Ongoing compilation of a database containing Tl concentrations in minerals, as well as distribution among coexisting mineral species, demonstrates the complex geochemical behavior of Tl within a variety of geologic settings.