Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18809

Sr isotope behavior in apatite during metamorphism

LILITH HAVEN WALLENBROCK AND JOHANNES HAMMERLI

Washington State University

Presenting Author: lilith.wallenbrock@wsu.edu

The Rb-Sr radiogenic system is a diverse tool for geochemists looking to decipher anything from the timing of mantle-crust differentiation to the historic spawning grounds of salmon. In hard-rock geochemistry, the Rb-Sr isotope system can be used to study early continental crust formation in a similar way that the Sm-Nd and Lu-Hf systems are used. However, the difference in the Sr isotope signature, compared to, for example Nd and Hf isotope ratios, between the crust and mantle reservoir is more prominent and arguably easier to distinguish due to the high incompatibility of Rb. A drawback is the mobility of Sr and Rb and hence the original Rb-Sr isotope system and its radiogenic signature (87/86 Sr) is easily disturbed by fluids. However, this limitation can potentially be mediated by looking at Sr isotopes in individual mineral grains, namely apatite, which is relatively robust and excludes Rb during its crystallization. Analysis via LA-MC-ICP-MS, can allow for rapid and inexpensive measurements when compared to TIMS and allow for high spatial resolution. However, one key question remains: under which metamorphic conditions are the Sr isotopes in apatite reset and/or disturbed? This is an important question to answer since, for example, most ancient rocks have undergone some degree of metamorphism and hence the reliability of Sr isotope signatures in apatite may be impacted.

In order to shed light on this fundamental question, we study a prograde sequence of metasedimentary rocks from Northern Idaho in the Belt Supergroup for their whole rock Sr and apatite Sr isotope signatures to see when Sr isotope ratios are homogenized (i.e. represent the whole rock Sr isotope values). Finding this isotope homogenization temperature is key to assess the reliability of Sr isotope signatures in apatite, especially in rocks that underwent a thermal event. We will discuss our findings as well as analytical pitfalls when analyzing Sr isotope in natural apatite with low Sr compositions, which is typical in metasedimentary and granitic rocks.