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The application of stable K-isotope systematics to subduction metamorphism

SARA HANEL, DONNA L. WHITNEY, SOISIRI CHARIN AND XINYUAN ZHENG

University of Minnesota

Presenting Author: hanel021@umn.edu

Analysis of the oxidation state of Fe in the hydrous silicates lawsonite and epidote in high-pressure – low-temperature rocks (blueschist, eclogite) exhumed from subduction zones reveals variation in Fe3+/Fe(total). This variation may result from pre-subduction factors such as the extent of hydrothermal alteration of oceanic crust and/or from syn-subduction factors such as fluid-rock interactions involving fluids from varying sources at different stages of subduction or exhumation. To better understand P-T-X controls on redox evolution, this study investigates the use of stable K-isotope systematics to track the extent to which the parent basalts experienced seafloor hydrothermal alteration prior to subduction and to evaluate how alteration influences fluid-rock reactions during subduction.

We present results from a sequence of unmetamorphosed basalt to metamorphosed basalt representing a range of P-T conditions from lawsonite blueschist to epidote eclogite from New Caledonia. Samples were selected based on petrologic observations of Fe-bearing mineral assemblages and reaction textures (e.g., lack of retrogression), in addition to the evaluation of K2O contents and other major and trace element whole rock and mineral composition data.

Analyses were conducted on an MC-ICP-MS. The preliminary results display a large spread of δ41K values, ranging from -1.12 to 0.00‰, with the largest variation in eclogites (Figure). Despite the variation, K isotope ratios correlate with whole-rock K2O wt%; the sample with the lowest (-1.08‰) has the lowest whole rock K concentration (0.07%) and the sample with the highest δ41K value (0.00‰) has the highest whole rock K concentration (0.48%). Results show that the sample suite records changes in K isotope composition as a function of prograde metamorphism. Ongoing work involves K-stable isotope and radiogenic Sr isotope ($^{87}Sr/^{86}Sr$) analysis of an expanded whole-rock sample suite and analysis of mineral separates (phengite, amphibole, pyroxene) from representative samples.

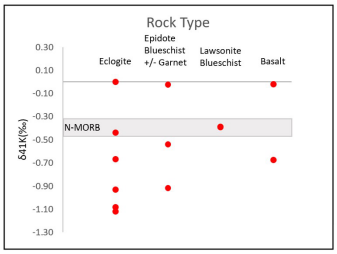

Figure 1. Stable K isotope compositions (‰) of the investigated New Caledonia rocks