Metamorphic Evolution and Metasomatism in the Tso Morari UHP Terrane, NW India: Constraints from Geochemistry, Fe Isotopes, and Thermodynamic Modeling

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The Himalayan orogenic belt is associated with one of the largest subduction zones on Earth in terms of elemental cycling, crust-slab-mantle interactions, and areas of ultrahigh pressure (UHP) terranes. This project aims to examine the hypothesis that some microcontinents (MC) can be subducted to mantle depths surrounded by oceanic crust prior to the major Indo-Asian continental collision, which would allow for metasomatism to alter the subducted MC at high pressure through water-rock interactions at depth (Kylander-Clark et al. 2012; Menold et al. 2016).

Mineral recrystallization in the presence of geofluids and changes of mineral phases in solid solution may occur at the UHP depths and during exhumation, and those processes can be identified by studying its geochemical and isotopic signatures and also through thermodynamic modeling. The Tso Morari UHP terrane, NW India, provides an ideal geologic site to examine the above suggested hypothesis. Petrographic investigation shows that the modal abundances of minerals formed through metasomatic reactions (e.g. amphiboles and epidotes) increase markedly at the eclogite-gneiss contact. The whole-rock geochemistry shows that LILE (e.g. K, Rb, Cs, Sr, Ba) are enriched along the traverse and the Ba/Rb ratios are relatively lower at the contact. In addition, the whole-rock $\delta^{56}Fe$ slightly decrease and the $\Delta^{56}Fe_{omphacite\text{-}garnet}$ fractionation dramatically decreases approaching the contact. The changes regarding mineral phases, LILE, trace elements, and Fe isotopes at the lithologic contact are thought to be caused by metasomatism deep in the subduction zone (Macris et al. 2016).

Metamorphic pseudosections and the corresponding garnet compositional isopleths in the eclogite based on whole-rock XRF and EMPA data are constructed as to further constrain the metamorphic evolution. We found that the pressure and temperature increase from ~515 ℃ and ~25 kbars to ~730 ℃ and ~31 kbars during the prograde metamorphism. Future work will focus on investigating retrograde metamorphism, metasomatism, and thermodynamic modelling in a high *P-T* aqueous environment.

References:

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