The finding of a titanite-rich zone in omphacite epidosite and its geochemical implication for subduction-zone metamorphism

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Recent experimental studies and studies on subduction-zone metamorphosed rocks have challenged our traditional views on mass transfer during subduction-zone metamorphism (SZM). It has been demonstrated that the mobility of an element or a set of elements is not as straightforward as commonly perceived. For example, the apparently mobile elements like Ba-Rb-Cs may in fact be immobile if their host minerals (such as phengite) are stable and present during SZM dehydration. Conversely, other studies argued that highly water insoluble elements (e.g., high field strength elements, HFSEs and heavy rare earth elements, HREEs) could be mobilized at the presence of large amounts of fluids with complex chemistries during SZM.

In our study of blueschist-eclogite from Chinese Western Tianshan, we found a large (~ 8 mm long) titanite crystal together with a titanite-rich zone along the edge of omphacite epidosite, in the vicinity of which marble includes the residual garnet + omphacite + paragonite + phengite + epidote without titanite. This indicates that the prior eclogite is infiltrated by carbonate, whose reaction is also recorded by the epidote overgrown at rims of garnet. LA-ICP MS *in situ* analysis reveals that this epidote shows the highest HREEs than all other epidote analyzed, manifesting the inheritance of HREEs from garnet. Titanite has two trace element patterns with different Th, U and LREEs. The LREE enriched pattern represents rim compositions of titanite crystals, while the depleted pattern represents the core composition. All these observations point to the significance of between-phase elemental re-distribution in response to SZM, and do not in any straightforward way support elemental behaviors perceived in flux melting for subduction-zone magmatism.