

Isotopic evidence for iron mobility during subduction

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During subduction, prograde metamorphism leads to the disappearance of Fe³⁺-rich phases in serpentinites (mostly magnetite and lizardite). This redox reaction is accompanied with a decrease in serpentinite Fe³⁺/ΣFe and the release of fluid mobile elements (e.g. B, S) [1] but little is known about the mobility of iron in fluids during subduction-related dehydration processes. Here we explore this problem through a Fe stable isotope study of serpentinites from Western Alps ophiolites that record metamorphic conditions representative of a subduction gradient.

Iron stable isotopes are a powerful tracer of Fe mobility during subduction since significant isotopic variations can only be achieved by either the addition or loss of Fe-bearing components. During subduction, the δ⁵⁶Fe values of serpentinites increases during the lizardite (Liz) to antigorite (Atg) phase transition. The mean value of Atg-serpentinites (δ⁵⁶Fe = +0.12 ‰ ± 0.06) is greater than that of Atg/Liz-serpentinites (δ⁵⁶Fe = +0.07 ‰ ± 0.07), which is in turn greater than that of Liz-serpentinites (δ⁵⁶Fe = -0.02 ‰ ± 0.14) and published data for abyssal peridotites (δ⁵⁶Fe = +0.01 ‰ ± 0.08).

A striking negative correlation exists between the Fe isotope compositions of the subducted serpentinites and their Fe³⁺/ΣFe. This suggests that during the Liz to Atg phase transition, the decrease of Fe³⁺/ΣFe ratio is accompanied with an increase in bulk serpentinite δ⁵⁶Fe and the loss of a Fe³⁺ and isotopically light Fe-bearing fluid. These observations provide the first evidence for the mobility and solubility of iron in the slab derived fluids.

[1] Debret *et al.* (2014) *EPSL*, **400**, 206-218.