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Serpentinites act as sponges for fluid-mobile elements from abyssal to subduction zone environments

Stephane Guillot (1), Fabien Deschamps (2), Marguerite Godard (2), Muriel Andréani (3), Kéiko Hattori (4), Stéphane Schwartz (1), and Romain Lafay (1)

(1) ISTerre, UJF, CNRS, Grenoble, France(sguillot@ujf-grenoble.fr), (2) Geoscience Montpellier, CNRS, Montpellier, France, (3) LST, UCBL, CNRS, Lyon, France, (4) Dept of Earth Sciences, Ottawa, Canada

Serpentinites play an important role in chemical exchange between mantle and seawater and then contribute to the geochemical cycle in subduction zones. In order to constrain geochemical behavior of fluid-mobile elements hosted by serpentine phases during subduction processes, we examined subducted serpentinites coming from the accretionary wedges of Greater Caribbean (Cuba and Dominican Republic), Western Alps (France and Italy) and Himalaya (India).
In situ analysis of serpentine minerals shows that serpentine is enriched in fluid-mobile elements (B, Li, As, Sb, Pb). Low temperature serpentine phases (chrysotile and lizardite) in abyssal and subducted serpentinites display similar compositions, whereas antigorite in subducted serpentinites contains higher As-Sb content. The enrichment suggests a second stage of serpentinization in trench zones and/or in mantle wedge, facilitated by newly formed or reactivated normal faults, during which subducted sediments imprint their geochemical characteristics to fluids for serpentinization in forearc. In environments spanning from spreading ridges to forearc environments, serpentine phases act as sponges, incorporating large amount of fluid-mobile elements during at least two serpentinization events. Progressive enrichment of these elements is observed during the prograde metamorphism of serpentinites (i.e. transition from lizardite to antigorite). Therefore, serpentinite can efficiently transport significant quantity of fluid-mobile elements to greater depths in the mantle until ultimate breakdown of antigorite.