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Geochemistry of serpentinites in subduction zones: A review

Fabien Deschamps (1), Marguerite Godard (1), Stéphane Guillot (2), and Kéiko Hattori (3)

(1) Géosciences Montpellier, Université Montpellier 2, CNRS, cc 060, Place E. Bataillon, 34095 Montpellier, France, (2) ISTerre, Université Grenoble I, CNRS, 1381 rue de la Piscine, 38400 Grenoble Cedex 09, France, (3) Department of Earth Sciences, University of Ottawa, Ottawa, Ontario, K1N 6N5, Canada

Over the last decades, numerous studies have emphasized the role of serpentinites in the subduction zones geodynamics. Their presence and effective role in this environment is acknowledged notably by geophysical, geochemical and field observations of (paleo-) subduction zones. In this context, with the increasing amount of studies concerning serpentinites in subduction environments, a huge geochemical database was created. Here, we present a review of the geochemistry of serpentinites, based on the compilation of $\sim$ 900 geochemical analyses of abyssal, mantle wedge and subducted serpentinites. The aim was to better understand the geochemical evolution of these rocks during their subduction history as well as their impact in the global geochemical cycle.

When studying serpentinites, it is often a challenge to determine the nature of the protolith and their geological history before serpentinisation. The present-day (increasing) geochemical database for serpentinites indicates little to no mobility of incompatible elements at the scale of the hand-sample in most serpentinized peridotites. Thus, Rare Earth Elements (REE) distribution can be used to identify the initial protolith for abyssal and mantle wedge serpentinites, as well as magmatic processes such as melt/rock interactions taking place before serpentinisation. In the case of subducted serpentinites, the interpretation of trace element data is more difficult due to secondary enrichments independent of the nature of the protolith, notably in (L)REE. We propose that these enrichments reflect complex interactions probably not related to serpentinisation itself, but mostly to fluid/rock or sediment/rock interactions within the subduction channel, as well as intrinsic feature of the mantle protolith which could derive from the continental lithosphere exhumed at the ocean-continent transition.

Additionally, during the last ten years, numerous studies have been carried out, notably using in situ approaches, to better constrain the geochemical budget of fluid-mobile elements (FME; e.g. B, Li, Cl, As, Sb, U, Th, Sr) stored in serpentinites and serpentine phases. These elements are good markers of the fluid/rock interactions taking place during serpentinisation. Today, the control of serpentinites on the behaviour of these elements, from their incorporation to their gradually release during subduction, is better understood. Serpentinites must be considered as a component of the FME budget in subduction zones and their role, notably on arc magmas composition, is undoubtedly underestimated presently in the global geochemical cycle.