

FLUID AND ELEMENT CYCLING IN SUBDUCTED SERPENTINITES

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ABSTRACT

Serpentinized peridotites are important components of the oceanic lithosphere and can contain 10-13 wt% bulk water fixed in serpentine and other associated hydrous phases. Since serpentine can survive to considerable depths during cold subduction, serpentinites are considered as the most effective transporters of water into the mantle. Prograde dewatering of subducted serpentinites produces aqueous fluids which contain appreciable amounts of solute. Thus, investigations on the compositional relationships between the oceanic assemblages and the high-pressure minerals + fluids become crucial to assess the fluid and element cycling occurring in serpentinites during subduction. These aspects have been investigated in the Western Alpine serpentinites (Erro-Tobbio peridotite unit), which represent fragments of mantle emplaced at high crustal levels during opening of the Mesozoic Alpine Tethys, and successively recrystallized at eclogite-facies conditions during alpine plate convergence and subduction. Eclogitization was accompanied by dewatering reactions and development of olivine + diopside + Ti-clinohumite + antigorite in the rocks and in vein systems. During this history, shear localization into mylonitic domains, allowed survival of undeformed serpentinized peridotite blocks showing incomplete high-pressure recrystallization and preserving abundant relics of pre-subduction assemblages. Previous studies emphasized that the high-pressure breakdown of chlorine and alkali-bearing hydrothermal serpentines and phyllosilicates was accompanied by fluid production and by partitioning of these elements into the co-existing fluid phase. This has suggested deep cycling of shallow fluids during eclogitization. In this study we analyze

the major and trace element compositions of bulk rocks and of key high-pressure minerals in order to test whether, besides chlorine and alkalies, other elements uptaken during oceanic alteration can be later released during subduction. The bulk-rock analyses were made on in situ profiles from 'preserved' peridotites to intensely serpentinized ultramafites, and from host high-pressure metaperidotite to high-pressure veins. Our results indicate that the shallow serpentinization was accompanied by decrease in bulk-rock Ca, coupled with increase in H₂O and Sr as a function of the intensity of alteration. The Rare Earth Element compositions of peridotite was not affected significantly by the oceanic alteration. The high-pressure veins display much higher bulk Sr concentrations than the precursor serpentinites and than their host rocks, thereby indicating Sr mobilization in the high-pressure fluid. Vein-filling diopside has trace element compositions comparable with those of primary mantle clinopyroxene still preserved in the host rocks, the main difference being related to Sr positive anomaly shown by the vein diopside. Apart their bulk-Sr enrichment, the veins do not display relevant differences in their trace element patterns compared to their host rocks. This indicates that the fluid drained by the vein systems equilibrated with the surrounding rocks. Since dewatering reaction take place in these rocks during ongoing eclogitization, we infer that the fluid was internally produced and buffered. The above results suggests close system behaviour of these serpentinites at eclogitic conditions and the internal cycling of fluid and elements such as chlorine, alkalies and strontium, originally uptaken during alteration at surface environments close to the seafloor.

