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Quantitative assessment of subduction input of F, Cl, and S via serpentinites: Preliminary report

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Studies of arc magmas have shown systematic enrichment of F, Cl and S relative to other mantle derived magmas suggesting that these elements are released during slab dehydration or melting and can potentially act as tracers of volatile elements in arc magmas source. Because serpentinites may be present in more than 40% of the oceanic lithosphere that formed at slow to ultra-slow spreading centers, they are potential carrier of these elements into the sub-arc mantle. Therefore, we have studied the evolution F, Cl and S contents in a series of alpine serpentinites representing from the serpentinite formation at the ocean floor to their dehydration.

At mid-oceanic ridge, ultramafic rocks are serpentinized by interaction with seawater derived fluids. In slightly serpentinized peridotites, the first steps of serpentinization correspond to the formation of lizardite veins, the low pressure and temperature polymorph of serpentine, crossing the olivine and the orthopyroxene. This step is mark by an increase of F, Cl, and S contents of serpentine (F=5-100ppm, Cl=20-8500ppm, S=12-230ppm) relative to primary mantle olivine and orthopyroxene (F<5ppm, Cl<30ppm, S<5ppm). At higher degrees of serpentinization, olivine and orthopyroxene are totally replaced into mesh and bastite texture in which highest F (50-280ppm), S (280-1000ppm) and similar Cl (170-870ppm) contents are found.

During subduction, lizardite is progressively transformed into antigorite, as conditions of metamorphism change from the greenschist to blueschist facies. This stage is marked by a decrease of F, Cl, S content in serpentine composition (F=17-55ppm, Cl=45-970ppm , S=15-200ppm). At eclogite facies, in fully recrystallized serpentinites, antigorite F, Cl and S contents reach 9-20ppm, 30-300ppm and 10-60ppm, respectively. Finally, antigorite breaks downs to secondary olivine similar to primary mantle olivine (F<1ppm, Cl<30ppm, S<18ppm).

Our results demonstrate that, first, F, Cl, and S contents of serpentine increase with advances in serpentinization. Serpentinites likely scavenge F, Cl, and S at the ridge. Second, during initial subduction stages up to eclogite facies, lizardite breaks down to antigorite is accompanied with a significant reduction of these elements suggesting that F, Cl, and S are mostly removed from the slab to mantle wedge in the first ~80km of subduction. While at greater depth, after antigorite breakdown into secondary olivine, halogens are no more present in the subducting peridotite.