# Evolution of iron redox state in serpentine from mid-ocean ridge to subduction zone

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Serpentinization is a hydration and redox reaction that transforms ultramafic minerals (olivine, pyroxenes) into hydrous phyllosilicates (serpentine +/- brucite), iron oxides and hydrogen. The abiotic production of $H_2$ is attributed to the reduction of $H_2O$ during oxidation of the ferrous component of primary minerals. Serpentinization occurs in many geological settings where aqueous fluids react with ultramafic rocks. On Earth serpentinites have been identified within Archean magmatic terrains, at mid-ocean ridges, and in subduction zone. They have also been observed in meteorites, on Mars surface, and it is suspected on other extraterrestrial bodies, i.e. in the core of icy satellites. Hence, serpentinization and associated redox processes can considerably influence the redox state of many geological systems and the fate of key chemical elements such as iron, sulfur or carbon, involved in biogeological processes, both in present days and at life origins.

To investigate the evolution of serpentinites redox conditions during their formation at mid-ocean ridges and along their way down to dehydration in subduction zones, we followed the evolution of iron redox state. Measurements of magnetite content have been coupled to punctual $\mu$-XANES analyses at the iron K-edge (ESRF and SOLEIL synchrotrons France) of serpentine minerals from oceanic and subduction settings. The results show that $Fe^{3+}$ in serpentinites increases during oceanic serpentinization due to the increasing content of magnetite and $Fe^{3+}/Fe^{Tot}$ in serpentine. The latter is highly variable (~0.2 to 1) even at the mm-scale, testifying of strong heterogeneities in fluid circulation and redox conditions. $Fe^{3+}$ in serpentine represents ~20% of the total Fe of fully serpentinized rock. Hence, serpentine minerals are important $Fe^{3+}$-carrier in subduction zones and may affect mantle redox state. In the first 70 km of subduction, the serpentine phase transition lizardite-to-antigorite is accompanied by a global reduction of Fe that allow the oxidation of reduced oceanic phases such as sulfurs, and the formation of oxidized fluid.