

## The influence of oceanic oxidation on serpentinite dehydration during subduction

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Breakdown of antigorite represents the most prominent aqueous fluid release in subducting lithosphere, boosting fluid-mediated element cycling from the slab to the mantle wedge. An antigorite dehydration reaction front is preserved in subducted serpentinites at Cerro del Almirez, Spain.

Bulk rock and mineral major element chemistry linked to detailed petrography reveals that silicate mineral Mg# ( $100 \cdot [\text{Mg}/(\text{Mg}+\text{Fe})]_{\text{molar}}$ ) are higher than bulk rocks due to the presence of magnetite, and olivine Mg# are lower in Chl-harzburgite than in Atg-serpentinite. The amount of magnetite is lower in Chl-harzburgite (1.4 vol%) than in Atg-serpentinite (2.8 vol%), resulting in reactive bulk rock compositions with Mg# of 92.7 and 96.0, respectively. Pseudosection modelling employing these reactive bulk compositions demonstrates that antigorite with lower Mg# decomposes at lower temperature than does antigorite with higher Mg#, as for all Mg-Fe solid solution silicates. Model results for Almirez yield a small temperature field at 670 °C, 1.6 GPa where Atg-serpentinite and Chl-harzburgite coexist at the same metamorphic conditions. Thus, the antigorite dehydration front represents a compositional boundary rather than a thermal front (isograd).

We interpret this compositional boundary to represent an oxidation front established upon serpentinisation at the ocean floor. Previous studies have shown that with increasing extent of ocean floor serpentinisation increasing amounts of magnetite are formed concomitant with an increase in the Mg# of coexisting silicates while bulk rock  $\text{Fe}_{\text{tot}}$  remains constant. Consequently, the difference in the amount of magnetite between Atg-serpentinite and Chl-harzburgite is not related to a change in redox budget of subducting serpentinites at Almirez imposed by the antigorite dehydration reaction. Rather, mass balance considerations suggest that ferric iron from antigorite may contribute to new formation rather than consumption of magnetite during the antigorite dehydration reaction. Our findings also imply that direct comparison between Atg-serpentinites and Chl-harzburgites to infer geochemical changes associated with prograde dehydration reactions may lead to erroneous conclusions, including estimates on element loss mediated by aqueous fluid escape and associated changes in redox budget based on  $\text{Fe}^{3+}/\text{Fe}_{\text{tot}}$ .