Oxide-silicate petrology and geochemistry of subducted hydrous ultramafic rocks beyond antigorite dehydration (Central Alps, Switzerland)

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Serpentinite dehydration has been regarded as a potential source of oxidized fluids to the mantle wedge and the main reason for the oxidized nature of arc magmas relative to those formed along mid-ocean ridges. Oxide and sulfide minerals contained in ultramafic rocks are useful tools to assess the redox conditions of the rock and fluids liberated upon progressive dehydration reactions, as these minerals contain two relevant redox sensitive elements, namely iron and sulfur. Magnetite recrystallization and production in equilibrium with prograde silicates is observed to occur up to and including the antigorite-out reaction in serpentinized peridotites from Cerro del Almirez (Vieira Duarte *et al.*, 2021). However, the fate of the oxide phases at even higher P-T conditions has remained ill constrained.

Here we present a comprehensive petrological and geochemical study of oxide-sulfide-silicate mineral assemblages in metaperidotites beyond antigorite- and chlorite-out reactions (between 650-800°C and 1-3 GPa). Several ultramafic lenses, covering different bulk rock compositions and extents of oxidation upon oceanic serpentinization were investigated in several ultramafic lenses from Central Alps, Switzerland.

In most of the investigated samples, magnetite to chromite coexists with olivine and orthopyroxene while hematite is absent indicating moderate redox conditions (log(fO_2) at +1 to +2 above QFM). Only in one sample, coexisting hematite and magnetite have been observed suggesting HM-buffered oxidized redox conditions. High oxide modes (up to 4 vol.%) and olivine Mg# > 95 are characteristic in the hematite-bearing sample, while generally lower oxide modes (0.06-1.41 vol.%) and olivine Mg# (89-91) occur in the moderately oxidized samples. Spinel displays evolving compositions from magnetite to chromite and Al-spinel, roughly correlating with increasing peak metamorphic conditions. Most of the QFM-buffered samples contain coexisting pentlandite ± pyrrhotite, thus identifying stable sulfides beyond antigorite-dehydration for these moderately oxidized samples. No sulfides were recognized in the highly oxidized sample. The transition of magnetite to chromite at around 700 °C goes along with a shift in fO_2 to lower values. Comparison of our data with literature data suggests that sulfur is always present in its reduced form for the moderately oxidized metaperidotites (*e.g.*, Piccoli *et al.*, 2019; Evans & Frost, 2021) and minor H_2S is expected in the fluid phase. However, SO_2 is predicted to be stable in the dehydration fluids released from highly oxidized serpentinites, although, these are thought to represent only a very small fraction of subducted serpentinites worldwide (compare Evans & Frost, 2021).

Evans, K. A. & Frost, B. R., 2021. Deserpentinization in subduction zones as a source of oxidation in arcs: a reality check. *J. Petrol.* 62, 1-32.

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