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Subduction-related prograde metamorphism of the ultramafic members of the Central-Sudetic Ophiolite (SW Poland)

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The Central-Sudetic Ophiolite (CSO) consists of Ślęża (SM), Braszowice-Brzeźnica (BBM), Szklary (SZM) and Nowa Ruda massifs. Ultramafic rocks occurring in ŚM, BBM and SM have MgO/SiO_2 (0.82-1.20) and $Al2O_3/SiO_2$ ($\sim$0.01) ratios typical for serpentinized mantle peridotites. They are enriched in Cs, Pb and Sb and depleted in Rb, Ba, Nb, La, Ce, Sr, Zr, Er and Y relative to primitive mantle. The serpentinites are antigorite ones, pseudomorphic chrysotile varieties occur sparsely. Serpentinites from each massif contain specific non-serpentine phases. Ślęża serpentinites contain primary olivine-chromite aggregates, olivine and clinopyroxene aggregates interpreted as basaltic melt percolation phases, secondary olivine with magnetite inclusions (locally with cleavage) and secondary microcrystalline olivine-clinopyroxene-magnetite aggregates ("brownish aggregates") with bastite and mesh textures. The BBM serpentinites contain primary olivine-chromite aggregates, primary diopside grains, secondary magnetite-bearing olivine and tremolite. The SZM serpentinites contain olivine, tremolite and enstatite grains. Enstatite (Mg# = 92.8-93.0) contains >0.2 wt.% $Cr2O_3$ and >0.7 $Al2O_3$. All secondary non-serpentine phases are intergrown by antigorite.
Very low overall trace element contents, Cs and high Pb-Sb anomalies of the CSO serpentinites are similar to subduction zone related serpentinites not affected by later fluid refertilization. Mineral assemblages shows prograde alteration of the rocks: (1) low-T serpentinization I forming pseudomorphic lizardite-chrysotile serpentinites; (2) antigorite recrystallization; (3) deserpentinization forming secondary olivine with magnetite inclusions, "brownish structures", tremolite and/or enstatite; (4) high-T serpentinization II forming antigorite intergrowths. Alteration degree is different in each massif: rocks from the SM are the most altered, they contain antigorite-olivine-enstatite-tremolite assemblage typical for temperatures $\sim$680-780°C. The BBM serpentinites have mineral assemblage (antigorite-olivine-diopside-tremolite) typical for $\sim$420-490°C and the ŚM rocks containing antigorite-olivine-diopside were altered at $\sim$380-460°C (cf. phase diagram based on Berman et al., 1986). Similar mineral succession indicative for prograde metamorphism of serpentinites is typical for alteration in subduction zone setting and occurs in serpentinites from the Lanzo Massif in Alps (Debret et al., 2013) and in the mantle wedge serpentinites from Guatemala (Kodolanyi et al., 2012).

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