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Multiple stages of serpentinization in mantle derived peridotites of the South Armorican Variscan suture zone

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South Armorican mantle peridotites represent a great diversity of protoliths from supra-subduction zone to arc-fore arc ophiolites. In this study, we investigate the serpentinization of these protoliths. Numerous samples were collected in five different units, which represent ophiolitic dismembered pieces (Ty-Lan Peridotites (TLP) from the Audierne Complex, and Pont de Barel Peridotites (PBP), Folies Siffait Peridotites (FSP), l'Orgerais Peridotites (LOP) and Drain Peridotites (DP) from the Champtoceaux Complex). Field and microscopic observations together with Raman spectroscopy and electronic microprobe analysis (EMPA) allowed to identify several stages of serpentinization. All samples display a high rate of serpentinization, up to 80-90 %. Primary assemblage is represented by spinel (TLP, PBP, DP and LOP), olivine (TLP and FSP) and Ti-poor or Cr-rich pargasite (TLP and PBP). In all the samples, lizardite from olivine and bastites from pyroxene and amphibole characterize the first stage of serpentinization. It is associated with magnetite crystallization. No Al-rich lizardite meshe is identified by EMPA suggesting a low temperature (< 340°C) event. This serpentinization is followed by two generations of veins (V1 and V2). The V1 are Al-poor lizardite shear veins and crack-seal chrysotile veins characterize the V2. In PBP, microprobe mapping shows that V2 displays heterogeneous chemical chrysotile composition with significant variations of Al, Fe and Mg contents, suggesting metasomatism and/or variation of fluid composition during serpentinization. All these observations are closely similar to those of oceanic serpentinized peridotites. In the TLP, we identified a second stage of serpentinization characterized by antigorite after lizardite suggesting a high temperature event. In the OP, antigorite after lizardite was also identified. However, compared to the TLP ones, LOP antigorite is related to ductile (i.e., ultramylonite) deformations. This clearly indicates a high temperature stage of serpentinization (up to 500 °C). Furthermore, LOP ultramylonitized samples display one more chrysotile veins generation (V3) characterized by three distinct vein networks. The first one (V3a) is a crack-seal type vein network opened parallel to the main foliation. The second one (V3b) is perpendicular to the first one, whereas the third one (V3c) corresponds to tension gashes connected to C' plans. This latter is perpendicular to V3a and V3b networks. The mylonitic foliation of LOP is similar to the surrounding micaschists schistosity, suggesting an orogenic high temperature stage of serpentinization. In the FSP, σ-type polycrystalline structures were identified. Lizardite meshes are progressively transposed and recrystallized into the foliation plan. This stage is associated with the crystallization of chlorite after tremolite, suggesting a retrograde stage of serpentinization during serpentinites exhumation. Finally, despite a great diversity of mantle-derived protoliths, our study shows that South-Armorican peridotites recorded a similar first low temperature oceanic stage of serpentinization. According to the Variscan history, it could have started during the Cambro-Ordovician for TLP, and during the Late Devonian for PBP, DP, LOP, FSP. Furthermore, some of these peridotites also recorded an orogenic serpentinization (LOP and FLP). Such observations provide new constraints that could be useful to a better understanding of the tectonometamorphic evolution of the South Armorican suture zones during the Variscan orogeny.