From carbonates to possible organic compounds at high pressure: the carbon journey at the Monviso meta-ophiolite

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The Monviso meta-ophiolite (Western Alps, Italy) is an oceanic lithosphere relict that experienced high pressure and temperature metamorphism (eclogitic facies, P-T conditions of 550-620°C and 1.9-2.6 GPa) during the alpine subduction. Despite its complex metamorphic history, the massif preserves a complete section of the Tethysian oceanic lithosphere. Here we investigate the mechanisms of carbonate solubilisation at high-pressure/high-temperature by studying a suite of meta-serpentinites and meta-ophicarbonates outcropping near a paleo-oceanic detachment fault in the massif. We show that serpentinites preserve typical features related to high pressure metamorphism, such as secondary olivine and titanoclinohumite formed at the expense of antigorite (high pressure serpentine variety), brucite and magnetite. The meta-ophicarbonates contain three types of primary abyssal carbonates – namely calcite, magnesite and dolomite – showing different degrees of decarbonation. In contact with antigorite and secondary olivine assemblages, magnesite displays coronitic textures made of magnetite-calcite and tremolite-talc-chlorite assemblages, while dolomite is partly replaced by calcite, magnetite and chlorite assemblages. The calcite can present complex coronas made of andradite, magnetite and talc. These coronas are associated with poorly organized carbonaceous matter, characterized by microspectroscopy (FTIR and Raman) and microscopy (SEM). This observation suggests changes in carbon redox state (i.e. reduction of carbonates) as well as a partial retention of carbon in the form of graphitic material during meta-ophicarbonates devolatilization at high pressure. The reactions leading to carbonate reduction and the amount of carbon devolatilized during these processes will be further investigated via an innovative combination of isotope tracers (C, Fe, Cu, Zn) sensitive to the mobility and redox state of carbon in metamorphic fluids.

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