We report eclogitic mineral assemblages from the Avren serpentinite body on the Bulgarian-Greek border in the E. Rhodope Massif (RM). We have mapped and sampled extensively this 4×1 km body, and discovered thin bands of garnet-CPX bearing assemblages throughout the entire body. The serpentinites have variably melt-depleted protoliths and hydration history as is revealed by their wide ranges in bulk rock MgO (ave. ~31 wt%), CaO (ave. ~ 5 wt%) and Al₂O₃ (ave. ~ 7 wt%). Texturally, enstatite-diopside-Cr-spinel symplectites are common and in agreement with proposed exposures to deep mantle wedge conditions (T ~650°C and P up to 15kbar; [1]). Depending on the T and P, there are several important dehydration reaction paths recorded in the serpentinites: 1) Srp $\rightarrow$ Ant $\rightarrow$ Ol + Opx $+ Sp + Grt $\rightarrow$ Hbl; 2) Srp $\rightarrow$ Ant $\rightarrow$ Tr + Chl $\rightarrow$ Tr $+$ Act $\rightarrow$ Hbl. Importantly, in association with the garnets we have discovered vesuvianite, which has been shown to be an important H₂O carrier in dewatering serpentinites: 1) Srp $\rightarrow$ Ant $\rightarrow$ Ol + Opx $+ Sp + Grt $\rightarrow$ Hbl; 2) Srp $\rightarrow$ Ant $\rightarrow$ Tr + Chl $\rightarrow$ Tr $+$ Act $\rightarrow$ Hbl. Importantly, in association with the garnets we have discovered vesuvianite, which has been shown to be an important H₂O carrier in dewatering serpentinites. Studies of volatiles in HP/UHP metamorphic suites can inform models of cycling among surface and deep-Earth reservoirs, including those focusing on C fluxes contributing to atmospheric CO₂ concentrations. Depending on the magnitude of the poorly constrained C flux in ultramafic rocks, on a global basis, sediments and altered oceanic crust (AOC) together deliver 70-95% of the C currently entering subduction zones (Bebout, 1995; Jarrard, 2003; Dasgupta and Hirschmann, 2010). We are investigating extents of retention and metamorphic release of C in deeply subducted AOC and carbonate-rich sediment represented by HP/UHP mafic-olitic suites and metasedimentary rocks in the Italian Alps. Study of metapelitic devolatilization in this suite (Bebout et al., 2013, Chem. Geol.) provides a geochemical framework for study of C behavior along prograde P-T paths similar to those experienced in most modern subduction zones. Our results for sediments and AOC indicate impressive retention of oxidized and reduced C to depths approaching those beneath arc volcanic fronts. In metasedimentary rocks, extensive isotopic exchange between the oxidized and reduced C reservoirs results in varying shifts toward mantle values. Much of the carbonate in metabasalts has δ¹³C overlapping with that for carbonate in AOC, with some HP/UHP mafic-olitic veins showing greater influence of organic C signatures from metasedimentary rocks.

Carbon retained through forearcs is available for return in volcanic arcs (perhaps via partial melting) or for entrainment into the deeper mantle. On a global basis, imbalance between subducted C input and C return flux by magmatism (excluding ultramafic inputs, ~40±20% of subducted C return via arcs and ~80±20% by all magmatism; Bebout, 2013, Treat. Geochem.) indicates net modern C return to the mantle, perhaps a reversal of Archean net outgassing (despite more rapid subduction). Modern C subduction flux is largely influenced by carbonate-rich sediment sections entering only a few margins, and future C cycling will be affected by the duration of C subduction pulses in these regions and any new subduction in carbonate-rich ocean basins. Global C cycle models predict that a relatively small change in the subduction/volcanic C flux could significantly affect atmospheric CO₂ levels and thus global climate.