Eclogitized serpentinites from the Rhodope Massif: Exploring the fate of serpentinites in the deep mantle

DAVID COLLINGS[1]*J IVAN SAVOV[1], NIKOLAY BONEV[2] AND KATHRYN ECCLES[3]

[1]School of Earth & Environment, Univ. Leeds, LS2 9JT (*ee09dac@leeds.ac.uk)
[2] Univ. of Sofia, Dept. of Geology & Paleontology, Sofia
[3]Department of Earth and Environment, Boston Univeristy

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 Al_2O_3 (ave.~ 7 wt%). Texturally, enstatite-diopside–Cr-spinel symplectites are common and in agreement with proposed exposures to deep mantle wedge conditions (T ~650ºC 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→Ant→Ol+OPX+Sp+Grt→Hbl; 2)Srp→ Ant→Tc+Chl→Tr/Act→Hbl. Importantly, in association with the garnets we have discovered vesuvianite, which has been shown to be an important H_2O carrier in dewatering serpentinites in subduction zones [2]. Bulk rock trace element variations are in the range of typical mantle wedge serpentinites with Li = 0.5 ppm; Cr = 1115 ppm; Ni= 1355 ppm and $[Nd/Yb]_N$ ~ 1. LA-ICP-MS results indicate garnets with $[Nd/Yb]_N$ ~ 0.05 and $[La/Sm]_N$ ~ 0.07. The EPMA data indicates that the garnets are $Py_{59}Gross_{12}Alm_{23}$ and the CPX are diopsides with $Wo_{46}En_{46}Fs_3$. The recrystalized olivines have high Mg# (~ 89). Based on Sm-Nd dating of garnets from the eclogite bands we report that the serpentinites were exposed to HP/UHP conditions during a Late Jurassic- Early Cretaceous subduction event. This timing is in agreement with metamorphic ages (U-Pb zircon rims) from adjacent parts of the RM [3,4]. Finding remnants of deeply subducted serpentinites on the surface may be rare [2, 4], but understanding their composition may shed light on the elemental fluxes associated with dewatering slabs under arc volcanic fronts. Such rocks may hold the answer for the anomalous (Vp/Vs) layers characteristic for many Western Pacific arcs (IBM, Japan, Aleutions, Kuriles)[6].

[1]Kozhoukharova, 1996; [2] Halama *et al*., 2013, *EJM*. [3] Liati, 2005, *CMP;* [4] Burg, 2011, *JVE*; [5] Debret *et al*., 2013, *JMG*; [6] Abers, 2000, EPSL.

Record of Subduction Zone Carbon Cycling in HP/UHP Rocks, W. Alps

COLLINS, N.[1]* BEBOUT, G.[1] COOK-KOLLARS J.[1] AND KUMP, L.[2]

[1]Department of Earth and Environmental Sciences, Lehigh University, Bethlehem, PA, USA. *(nac211@lehigh.edu)
[2] Department of Geosciences, Pennsylvania State University, University Park, PA, USA.

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 CO_2 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 meta-ophiolitic and metasedimentary rocks in the Italian Alps. Study of metapelite 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 $\delta^{13}C$ overlapping with that for carbonate in AOC, with some HP/UHP metamorphic 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 CO_2 levels and thus global climate.

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