Deep carbon cycle and mantle metasomatism: contribution from the subduction of the continental crust

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Primary melt inclusions (MI) of crustal affinity were found in garnets in the UHP eclogites of the Erzgebirge (Bohemian Massif, Germany). This case study presents an excellent opportunity to investigate the metasomatic agents derived from the partial melting of the continental crust and estimate the contribution of the continental subduction to deep carbon fluxes. The micrometric MI are clustered in the inner part of the garnet and they are both polycrystalline – *i.e.*, nanogranitoids – and glassy. Nanogranitoids contain kumdykolite, quartz, kokchetavite, biotite, white mica, calcite and rare graphite whereas the glassy inclusions often contain a shrinkage bubble. The MI occur in the same microstructural position of polycrystalline quartz interpreted as quartz pseudomorph after coesite, indicating entrapment at UHP conditions, ~4.5 GPa and 1000 °C. The melt is granitic, hydrous, slightly peraluminous and shows enrichments in Cs, Pb, Th, U, Li and B, which is consistent with a continental crust origin. Similar signatures were observed in other metasomatic melts and mantle-derived rocks from the Bohemian Massif suggesting a widespread crust-mantle interaction. The melt volatile (H_2O, CO_2) contents were measured with the NanoSIMS in glassy and rehomogenized inclusions. The CO_2 content is on average 19552 ± 772 ppm after correction with reintegration of the vapor contained in the bubble. These values are the highest measured so far in crustal melt inclusions. Using these data, we modelled the endogenic carbon flux associated with the subduction of the continental crust during the Variscan orogeny at 12 ± 5 Mt C yr^{-1}. This flux is, within error, similar to the endogenic carbon fluxes in the serpentinized mantle (~ 14 Mt C yr^{-1}) and to the exogenic fluxes in mid-oceanic ridges (~ 16 Mt C yr^{-1}). Hence, deeply subducted continental crust, in collisional settings, carried a large amount of volatiles to the mantle and the lower crust competing with some of the better known fluxes. Due to the absence of post collisional arc volcanism, most of these volatiles, carbon in particular, remained trapped in the roots of mountain belts preventing ultimately the closure of the carbon cycle.