Highly CO_2-supersaturated melts in the Carpathian-Pannonian lithosphere

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Peridotite xenoliths from the lithospheric mantle below the Bakony-Balaton Highland Volcanic Field (BBHVF) in the Carpathian-Pannonian Region (CPR, Central Europe) brought up to the surface by Miocene-Pliocene alkaline volcanism were studied in order to characterize the source of the intense CO_2 fluxing in this region. Petrographic observations together with EPMA and LA-ICPMS analyses show that adakite-like melts percolated and metasomatized the lithospheric mantle before entrapment in the host lavas. These magmas are proposed to originate from slab melting below the CPR at 2-3 GPa. The CO_2 budget of the samples was constrained using the following multi-disciplinary approach : (1) synchrotron X-ray microtomography for measuring phase proportions and densities, (2) NanoSIMS for measuring C and H concentrations, (3) microthermometry and Raman spectroscopy for measuring densities of CO_2 fluid inclusions and (4) thermodynamic modeling using rhyolite-MELTS. Present day dissolved CO_2 concentrations in the trapped melts range between 2700 and 9600 ppm and are consistent with trapping pressures at/or below present Moho depth. Integrated vesicle and melt volumes quantified by 3D X-ray microtomography imply high CO_2 contents in melts between 9.0 and 25.4 wt.%. According to our extensive xenoliths sample collection of this area, the bulk CO_2 concentration in the BBHVF lithospheric mantle can be estimated at ~2000 ppm. This trapped CO_2 was partly released to the atmosphere and crust during alkaline volcanism, and has likely been continuously outgassed during the extensive tectonics that shaped the Pannonian basin during the last 20 My. This transient trapping of carbon in the lithosphere may be more widespread than usually suspected and should be considered for understanding global carbon transfer from the mantle to surface reservoirs.