Mantle CO_2 fluxes to the Pannonian lithosphere inferred from mantle xenolith investigation

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The Pannonian Basin in East-Central Europe has been affected by lithospheric fluxing by mantle CO_2-rich fluids as evidenced by alkaline/calc-alkaline volcanism and basin gas geochemical data [1]. The source, timing and amplitude of this CO_2 flux remain enigmatic and are of prime importance for petroleum exploration.

Mantle xenoliths from the Bakony-Balaton Highland alkaline volcanic field (Hungary) are lithospheric spinel-bearing lherzolites. They contain trapped melt as veins, reaction zones and grain boundary fillings that show calc-alkaline compositions from basaltic andesite to trachyandesite. The melts clearly differ in composition from the alkaline host volcanics. The trapped melts reflect a metasomatic event related to the percolation of 1) subduction-derived melts and fluids from the Carpathian-Pannonian system or 2) melts produced by decompression melting of the previously metasomatised mantle wedge during rifting that followed collision. 3D mapping using X-ray microtomography of trapped melts and fluids suggest that 1) large vesicles in trapped melts and secondary trails of fluid inclusions (FI) are cogenetic; 2) the volume of melt and fluid in the xenolith suite are correlated. This correlation is consistent with the exsolution of magmatic CO_2 in the closed system of the lithospheric mantle. The pure CO_2 FI densities cover a range from 0.3 to 1.1 $g.cm^{-3}$, implying CO_2 contents at saturation in melts between 0.11 ± 0.02 wt% to 0.47 ± 0.02 wt%. The rhyolite-MELTS software [2,3] has been used for the first time to study the volume of CO_2 liberated from the primary calc-alkaline melt before quenching of the glass. This approach will allow better quantification of the amount of mantle CO_2 released to the Pannonian Basin lithosphere.

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