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Very high CO2 contents (≥3 wt%) in olivine-hosted magmatic inclusions from the Bas-Vivarais volcanic province (Ardèche, France): Implications for magma genesis in a continental intraplate region

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The Bas-Vivarais (Ardèche, France) is one of the two most recent volcanic provinces in the French Massif Central. Very homogeneous basanites containing abundant crustal and mantle xenoliths were produced, but the magma genesis conditions remain unclear. Here, we bring textural, compositional and volatile clues to constrain the origin of the parental magmas of this volcanic province through the study of melt inclusions hosted in olivine phenocrysts of seven volcanoes from Bas-Vivarais. A peculiar feature of these inclusions is that, in addition to the silicate glass, they systematically contain CO_2-rich bubbles whose walls are almost fully covered by microcrystals (mainly carbonates). We characterised the glass phase of the melt inclusions by electron probe microanalysis (major elements, Cl, F and S) and Raman spectrometry (H_2O and CO_2), and obtained basanitic compositions with high volatile contents (ranging from 1.4 to 2.1 wt% H_2O and up to 1.3 wt% CO_2 dissolved in glasses). These CO_2 values do not take into account the carbon dioxide contained in the bubbles (both as a fluid phase and as carbonate microcrystals). Two different techniques were used in order to estimate the total CO_2 content at the time of melt inclusion entrapment. First, two and three-dimensional Raman imaging was used to characterise the phases contained in the bubbles (CO_2 density, carbonates mineral species, etc.), and to estimate their volumes. From the volumes, densities and CO_2 contents of all phases in presence, including glass, we could estimate the total CO_2 content at the time of melt inclusions entrapment [1]. Second, melt inclusions were homogenised at high pressure and temperature in a piston-cylinder apparatus in order to dissolve all the CO_2 into the melt phase. Then, we measured the CO_2 contents of the quenched glasses by Raman spectrometry. Both techniques yield total CO_2 contents in excess of 3 wt%. The implications of such high CO_2 values on magma sources and genesis, on the conditions of inclusion entrapment, and on magma explosiveness will be discussed.

[1] Schiavi et al., 2020. *Geochemical Perspectives Letters*, 16: 17-24.