Cratonic signature and CO_2-rich metasomatism: new insights from Veneto Volcanic Province mantle xenoliths

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The Tertiary Veneto Volcanic Province (VVP), NE Italy, is constituted by five volcanic districts: Val d'Adige, Marosticano, Mts. Lessini, Mts. Berici and Euganean Hills. VVP alkaline lavas commonly host ultramafic xenoliths. The anhydrous spinel-bearing mantle harzburgites and lherzolites from Marosticano district (MA) have major element composition and metasomatic signature different to those of xenoliths from Val d'Adige and Lessini, which were interpreted as off-craton lithospheric mantle affected by Na-alkaline silicate metasomatism. MA, together with a few Val d'Adige xenoliths show high contents of residual components in the peridotitic mineral phases (i.e. Ni in ol and Cr in cpx), as observed for on-craton peridotites worldwide. These findings are consistent with ancient Re-Os ages (3.4 Ga) for Val d'Adige xenoliths and suggest that cratonic mantle underlies the VVP. Trace element model that MA cpx were formed by the interaction between carbonatite or CO_2-rich silicate metasomatic melts and original cpx-barren cratonic peridotite. This melt could be responsible also for the observed T-fO_2 conditions of MA (T= 923-1117°C; $\Delta\log fO_2$ (FMQ)=-0.6 +1.1), which are anomalously high for a proper cratonic environment but similar to the off-craton VVP xenoliths. The calculated dissolved CO_2 mole fractions for the metasomatic agent are close to 1, indicating that CO_2 was the largest component of the metasomatic melt. Therefore, T-fO_2 conditions of MA primarily reflect matrix/carbonatitic melt interaction rather than the original cratonic fO_2 conditions. Studies, such as these, may provide insights about how plate boundary processing of cratonic mantle could factor importantly into global carbon budgets.