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PETROLOGY AND GEOCHEMISTRY OF MANTLE XENOLITHS FROM THE ADIGE VALLEY, NORTHERN ITALY

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The alkali basalts from the Adige Valley represent the westernmost volcanic products of the Tertiary Veneto Volcanic Province (VVP). The magmatic activity of the VVP is interpreted as the result of the partial melting of a metasomatised mantle involved, during Tertiary times, in the Europe-Adria collision after the subduction of the Jurassic Liguria-Piedmont Ocean.
The considered sector of the Adige valley is located within the Southalpine domain. Here the main lithology consists of fossil-bearing carbonates (e.g. "rosso ammonitico veronese") and a dominant dolomite unit. The alkali basalt occurs as veins of 10 cm to 1 m in diameter within the dolomite and shows porphyritic texture with megacrysts of olivine, plagioclase and/or pyroxene. The ultramafic xenoliths (2-10 cm in diameter) characterised as four phase spinel-bearing lherzolithes and harzburgites with protogranular texture are randomly distributed in the alkalibasalt. Deformation of the xenoliths is shown by mineral grains such as olivine and pyroxene with kink-bands. Triple points are well developed and pyroxenes show exsolution-lamellae. Spinel often displays the typical "holly-leaf"-shape or intergrowth with orthopyroxene.
Olivine is Fo-rich (about 90 mol% Fo), pyroxenes are enstatite and/or diopside (Cr_2O_3 = 0.5-1.24 wt%). Spinels have 60-70 mol% $MgAl_2O_4$, 15-17 mol% $FeAl_2O_4$ and 7-15 mol% $MgCr_2O_4$. Based on the pyroxene thermometer of LINDSLEY (1983), the equilibration temperature is around 900°C. The olivine-spinel thermometer of ROEDER et al., (1979) yields equilibration temperature between 860°C and 1064°C.
The MgO concentrations of the xenoltihs range between 30 and 43 wt.% and all major elements except FeO show negative correlation. Trace elements with positive correlation with MgO are Cr, Co and Ni. Whole-rock major element compositions are consistent with variable degrees of melt depletion while cryptic metasomatism produced LREE enrichment (La_N/Yb_N = 2.7 – 17.3).
Osmium isotope data from spinel-peridotite xenoliths provide constraints on the age of mantle partial melting. The $^{187}Os/^{188}Os$ isotopic compositions vary from 0.1185 to 0.1308 and are positively correlated with the Al_2O_3 concentrations. The y-axis intercept on a $^{187}Os/^{188}Os$ vs. Al_2O_3 plot suggests that a partial melting event occurred during the Proterozoic (~ 1.2 Ga) which is consistent with observations from xenoliths and orogenic peridotites from Central Europe.

References

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