Petrogenesis and evolution of the continental lithospheric mantle below the Cameroon Volcanic Line

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Outgassing of mantle-derived CO_2 has been related to two major catastrophies along the Cameroon Volcanic Line (CVL), however, the origin of this CO_2 remains enigmatic. The mantle might have been enriched in carbonates during relatively recent plume-related carbonatite metasomatism or by ancient subduction-related metasomatism during the Pan-African orogeny. Trace elements, including hydrogen, have been analysed in 7 spinel lherzolites recovered from Cenozoic alkaline basalt flows along an 800 km section of the CVL to provide new contraints on the relationship between mantle processes and CO_2 outgassing.

Olivine forsterite content varies significantly (0.89-0.92), indicating a heterogeneous subcontinental mantle. Two-pyroxene major element thermometry yields a broad temperature range (840-1150 °C at 15 kbar). Values calculated from Ca, Al and Cr in olivine are similarly high (890-1140 °C) despite the lower closure temperatures of these thermometers, indicating a reheating event prior to eruption.

To determine the nature and tectonic association of metasomatic events, trace elements and hydrogen contents were measured *in situ* in pyroxenes and olivines. Olivine contains <1 ppm H_2O, indicating loss of H during ascent of the xenoliths. Opx and cpx have a limited range of water contents, with 17-35 ppm and 85-170 ppm at their cores respectively. Some grains show a decrease in H_2O from core to rim, interpreted as diffusive loss during ascent in the host magma.

There is great inter- and, occasionally, intra-sample variability in REE patterns of cpx, from strong LREE enrichment to LREE depletion. Variable Th-U fractionation indicates the presence of different types of mantle-derived fluids. Low Ti/Eu ratios point to carbonatite metasomatism, whereas overall enrichment in incompatible elements indicate silicate metasomatism. In one sample, a moderate enrichment in Pb is detected, however, the typically low Pb and H_2O contents of cpx do not support an extensive subduction-related metasomatism.

Whilst the precise tectonic association(s) of the distinct metasomatic fluids is yet to be fully constrained, the identification of pervasive carbonatite metasomatism in cpx from CVL mantle xenoliths provides a potential source for CO_2 released during episodic degassing events at the surface.