The O-isotope composition of Karoo and Etendeka picrites: High $\delta^{18}O$ mantle or crustal contamination?

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Olivine and orthopyroxene phenocrysts from picrite and picrite basalt lavas and dykes (Mg# 64-80) from the Tuli and Mwanezi (Nuanetsi) regions of the ~180 Ma Karoo LIP have $\delta^{18}O$ values that range from 6.0 to 6.7 ‰. They appear to have crystallized from magmas having $\delta^{18}O$ values about 1 to 1.5 ‰ higher than expected in an entirely mantle-derived magma. Olivines from picrite and picrite basalt dykes from the 135 Ma Etendeka LIP of Namibia and Karoo-age picrite dykes from Dronning Maud Land, Antarctica do not have such elevated $\delta^{18}O$ values. The Etendeka picrites show good correlations between $\delta^{18}O$ value and Sr-, Nd- and Pb-isotope ratios that are consistent with previously proposed models of crustal contamination (e.g. Thompson et al., 2007). High $\delta^{18}O$ values in selected Tuli/Mwenezi picrites obtained by laser fluorination were confirmed by SIMS. Previously a variety of models that range from crustal contamination to derivation from the 'enriched' mantle lithosphere have been suggested to explain average εNd and εSr values of -8 and +16, and high concentrations of incompatible elements such as K are typical of picrites from the Mwanezi (Nuanetsi) region. However, the primitive character of the magmas, combined with the lack of correlation between $\delta^{18}O$ values and radiogenic isotopic compositions and MgO contents or Mg# are inconsistent with crustal contamination. An ^{18}O-enriched mantle source having high incompatible trace element concentration and enriched radiogenic isotope composition appears to be required. Incorporation of crustal material into the mantle by subduction or delamination of the lower crust are the most likely mechanisms for enriching the mantle in ^{18}O. Elevated initial Sr isotope ratios, εNd values of -8, and $\delta^{18}O$ values about 1 ‰ higher than expected for mantle-derived magma are also a feature of the Bushveld mafic and ultramafic magmas, and the possibility exists that a long-lived ^{18}O-enriched mantle source has existed beneath southern Africa.