Mantle-like oxygen isotopes in kimberlites determined by *in situ* SIMS analyses of zoned olivine

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Kimberlites are the deepest melts produced on Earth that are erupted at the surface and can therefore provide unique insights into the composition and evolution of the mantle. Radiogenic isotopes provide ambiguous evidence for the occurrence of recycled crustal material in kimberlite sources. Oxygen isotopes can fractionate significantly only in the shallow crust, thus providing a powerful tracer of subducted material in the kimberlite sources. To constrain the oxygen isotope composition of kimberlite melts, we have examined olivine grains in eleven Cretaceous to Eocene archetypal kimberlites from southern Africa, Lac de Gras (Canada) and Alto Paranaiba (Brazil), which exhibit radiogenic isotope evidence of recycled crustal material in their sources including highly radiogenic Pb isotopes and Nd-Hf isotope compositions deviating below the mantle array. Olivine grains are commonly zoned between a mantle-derived xenocrystic core and a magmatic rim. The oxygen isotope composition of olivine was determined *in situ* by secondary ion mass spectrometry (SIMS) after point selection using back-scattered electron images combined with major and minor element analyses. With the exception of a few cores, the $\delta^{18}O$ values of different olivine zones do not deviate from typical mantle olivine values. There are no correlations between oxygen isotopes and major/minor element compositions for rims from individual localities or in the entire dataset. This indicates that the oxygen isotope composition of kimberlite melts is not affected by melt differentiation to the point of olivine rim crystallisation. The mantle-like $\delta^{18}O$ composition of olivine rims suggests that assimilation of mantle material and liberation of a CO_2-rich phase during ascent in the mantle do not significantly modify the original $\delta^{18}O$ signature of kimberlite melts. Our results combined with mass balance calculations indicate that only a limited amount (<5-10 wt%) of recycled crustal material could occur in the source of the examined kimberlites or that the recycled material had an oxygen isotope composition similar to the mantle.