Subduction relics in the cratonic root - evidence from $\delta^{18}O$ variations in eclogite xenoliths

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The origin of mantle eclogites is commonly accepted as derived from altered subducted oceanic crust, yet this mechanism is still poorly understood. The present study focuses on the petro-geochemical characteristics of an extensive collection of eclogite xenoliths from Roberts Victor and Jagersfontein kimberlites, South Africa. Non-metasomatised samples are preserved in the lowermost part of the cratonic root, corresponding to depths of 145-200km. These samples, variable in textures, are bi-mineral (garnet (grt)-omphacite (cpx)), kyanite- or corundum-bearing. The high-Al eclogites show low REE abundances and pronounced positive Eu and Sr anomalies. The $\delta^{18}O$ values of cpx and grt show chemical equilibrium and a wide variability $\delta^{18}O_{grt}$ (1.11 to 7.62‰) with a bi-modal distribution with respect to mantle garnet values (5.15±0.35‰). Most bi-mineral samples equilibrated around 5GPa at 950°–1000°C, whereas the corundum-bearing eclogites equilibrated at higher pressures (6.5GPa) and temperatures (1400°–1450°C) according to thermo-barometric calculations with the $39 mWm^{-2}$ local geotherm. Reconstructed whole rocks have the REE distribution of a depleted gabbro (for high-Al eclogites) and of an associated websterite (for bi-mineral eclogites), which together with the $\delta^{18}O$ values indicate an oceanic crustal origin for mantle eclogite xenoliths. This is consistent with the subduction of a hydrothermally altered, gabbro to websteritic sequence of a depleted oceanic crust. Nevertheless, the $\delta^{18}O$ values of some samples are lower than those found in present day oceanic crust and in Cretaceous ophiolites and they may reflect higher temperatures of seawater – oceanic crust interaction.