Oxygen isotopic evidence from Karoo flood basalt olivines for metasomatism of the sub-Gondwanan upper mantle

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We report oxygen isotopic compositions for hand-picked olivine phenocrysts of Jurassic (~190-180 Ma) continental flood basalts (CFBs) and related intrusive rocks from Vestfjella, western Dronning Maud Land, Antarctica.

Previous studies have shown that the CFBs exhibit highly heterogeneous trace element and radiogenic isotope compositions (e.g., ε_{Nd} from -16 to +2 at 180 Ma) indicative of contamination with lithospheric mantle and continental crust. Importantly, our dataset also includes dike rock samples that do not show evidence of lithospheric contamination (ε_{Nd} of +8 at 180 Ma) and derive from mantle sources similar to those of MORBs of the Southwest Indian Ridge, the modern successor of the Africa-Antarctica rift system.

Oxygen isotopic compositions were determined in-situ with Cameca 1280 ion microprobe at the Laboratory for Isotope Geology, Swedish Museum of Natural History. The majority of the oxygen isotopic compositions of the dike rock olivines ($\delta^{18}O$ = 4.2–6.1‰; Fo = 75–92 mol. %) are compatible with MORB sources. The CFB olivines, however, are characterized by notably heavier compositions ($\delta^{18}O$ = 6.2–7.5‰; Fo = 70–88 mol. %).

The oxygen isotopic compositions of the rocks do not correlate with radiogenic isotope compositions or trace element ratios diagnostic of crustal contamination. Instead, positive correlations of $\delta^{18}O$ are observed with trace element ratios such as K/Nb, Ba/Nb or Pb/Ce that indicate metasomatic enrichment. The correlation is especially strong in the case of K/Nb, which is most effectively buffered by the primary magma compositions. We suggest that the oxygen isotopic compositions of the CFB olivines record large-scale (subduction-related?) metasomatism of the sub-Gondwanan upper mantle prior to the break-up of the supercontinent.