Luenha picrites reveal a primitive mantle-like plume source for the Karoo LIP?

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A mantle plume source has frequently been proposed for the Mid-Jurassic Karoo LIP, but the geochemical data for primitive rocks have suggested derivation of magmas from depleted mantle [1] and refertilised lithospheric mantle (or recycled oceanic crust) [2]. Judging from flood basalt geochemistry, these upper mantle reservoirs were significant magma sources for the Karoo LIP, but up to 50% of the flood basalts require a different, primitive mantle-like mantle source [3].

We suggest that a series of high-Mg Karoo lavas from the Luenha River, Mozambique, represents this previously missing, third mantle source component. The Luenha picrites are well-preserved and contain primitive olivine phenocrysts ($Fo_{89–87}$). The recalculated primary melts are komatiitic and indicate a peridotite source with mantle potential temperatures of >1400 °C. The incompatible element ratios (e.g. Nb-Zr-Y) point to a primitive mantle-like source and the least-crustally contaminated lava has mildly depleted initial εNd of +1.6, and $^{87}Sr/^{86}Sr$ of 0.7041 at 180 Ma. Overall, the Luenha picrites show geochemical affinity to the so-called non-chondritic primitive mantle component that has been associated with several mantle plumes [4]. They are also a plausible parental magma type for the voluminous flood basalts that require a primitive mantle-like mantle source. The isotopically mildly depleted primitive mantle-like source of the Luenha picrites complements the 'mantle zoo' of the Karoo LIP. This source component may well have been a mantle plume based on its non-chondritic primitive mantle-like geochemistry and the inferred high mantle potential temperature.

[1] Heinonen *et al*. (2010). *Chem. Geol*. **277**, 227-244. [2] Harris *et al*. (2015). *Contrib. Mineral. Petrol.* **170**, 8 doi 10.1007/s00410-015-1164-1. [3] Luttinen (2018). *Sci. Rep*. **8**, 5223 doi:10.1038/s41598-018-23661-3. [4] Jackson, Jellinek (2013). *Geochem. Geophys. Geosyst*. **14**, 2954–2976.