Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16356

The silica-saturated pyroxenite of the Phalaborwa Complex (South Africa), and its relation to the coexisting carbonatites.

MEGAN SAUER AND **MARLINA A. ELBURG**

University of Johannesburg

Presenting Author: marlinae@uj.ac.za

The 2.06 Ga Phalaborwa Complex, South Africa consists of three coalescing bodies of pyroxenite, with a carbonatite-phoscorite core. Recent work on the latter two rock types revealed evidence for a recycled component, likely from the subcontinental lithospheric mantle (e.g. [1]), but it is unclear how the associated silicate rocks fit into this framework.

The pyroxenite consists of diopside ± phlogopite (both typically Mg# >80, with only pyroxene from pegmatoids reaching Mg# 60 and Aeg_{10}), apatite and microcline. Micron-sized patches of quartz, calcite or titanite are scarce. Feldspathoids are absent, which is highly unusual for carbonatite-associated (ultra)mafic silicate rocks. TiO_2 is mostly partitioned in phlogopite, increasing with decreasing Mg#, but concentrations are low (0.3-2.4 wt.%). Chromium contents are generally< 500 ppm in phlogopite or diopside. Average total REE are 9000 and 60 ppm for apatite and diopside, respectively, with high LREE/HREE and Eu/Eu* 0.7-0.8. Sr concentrations are 4000 (apatite) and 400 ppm (diopside).

The pyroxenites show higher $^{87}Sr/^{86}Sr_i$ (>0.7095) than most carbonatite-phoscorite samples (<0.707), apart from the latest 'transgressive carbonatite'; epsilon Nd (ca. -6) and Hf (ca.-9) overlap for all rock types. Pyroxenite Sr and Nd concentrations are much higher than in the granitoid host rocks, so crustal contamination is unlikely to explain the isotopic characteristics.

The diopside of the Phalaborwa pyroxenites is unusually Si-rich and Al- and Ti-poor compared to worldwide pyroxenes, including those from carbonatites or clinopyroxene-phlogopite lamprophyres, which the pyroxenite resembles mineralogically. To explain the pyroxenite as an 'anti-skarn' [2] of the transgressive carbonatite is difficult, considering the composition of the Archaean gneissic host. It is more likely that melting of an unusual Si-rich lithospheric source containing a recycled component gave rise to the magma of which the cumulates formed the Phalaborwa pyroxenite. A broad genetic link to the penecontemporaneous Bushveld Complex could thereby be invoked.

References:

[1] Bolhar et al. (2020). Atmospheric S and lithospheric Pb in sulphides from the 2.06 Ga Phalaborwa phoscorite-carbonatite Complex, South Africa. *Earth Planet. Sci. Lett.* 530, 115939.

[2] Vasyukova and Williams-Jones (2022). Carbonatite metasomatism, the key to unlocking the carbonatite-phoscorite-ultramafic rock paradox. *Chem. Geol.* 602, 120888.