Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12093

A major swarm of Mesozoic orangeite dykes intersecting the Western Limb of the Bushveld Complex: tracers of lithospheric mantle evolution

CHARLIE COMPTON-JONES[1], HANNAH S.R. HUGHES[1], GRANT M. BYBEE[2], IAIN MCDONALD[3] AND JENS C.Ø. ANDERSEN[1]

[1]Camborne School of Mines, University of Exeter
[2]University of the Witwatersrand
[3]Cardiff University

Presenting Author: cc715@exeter.ac.uk

Potassic-ultramafic dykes, such as orangeites, can record a protracted history of lithospheric mantle evolution during continent-scale geodynamic processes [1,2]. The Western Limb of the Bushveld Complex, South Africa hosts a vast swarm of orangeite dykes spanning >45 km along strike, far exceeding the size of other orangeite dyke swarms in South Africa recorded so far (generally <10km along strike). The majority of the Bushveld-intersecting dykes fall within an age range of 147-136 Ma [3] which coincides with widespread Mesozoic orangeite magmatism across the Kaapvaal Craton, corresponding to the rifting of Gondwana. The considerable size of this swarm suggests that potassic-ultramafic magmatism occurring within the northern Kaapvaal Craton during this period was far more voluminous than previously thought and offers a unique opportunity to investigate the Kaapvaal sub-continental lithospheric mantle (SCLM) on an unprecedented spatial scale.

The bulk rock major and trace element compositions of the Bushveld-intersecting orangeites are highly variable, but overlap with other Mesozoic Kaapvaal orangeites, significantly the coeval (c. 145 Ma) Swartruggens orangeite dyke swarm [1]. Radiogenic isotope compositions are typically confined to Kaapvaal orangeite variability, with radiogenic Sr compositions ($^{87}Sr/^{86}Sr_i$ of 0.70642 to 0.70787), and unradiogenic Hf (eHf_i of -18.3 to -8.3) and Nd (eNd_i of -11.6 to -8.9). Such Sr-Hf-Nd isotope systematics and trace element abundances are consistent with melts that have been derived from a metasomatically enriched source residing towards the base of the Kaapvaal SCLM. Nd-model ages (T_{DM}) of ~1.3 Ga suggest an ancient episode of enrichment in the orangeite source, which subsequently endured a prolonged period of isolation until the point of eruption at c. 141 Ma.

Using the variations in dyke mineral assemblages, bulk rock geochemistry, and radiogenic isotope compositions we investigate the nature of the mantle source region that was preferentially melted during the break-up of Gondwana, and later extensively tapped to form the swarm of orangeite dykes focused on the Western Limb of the Bushveld Complex.

References:

[1] Coe, N. et al. (2008) Cont. Min. Pet. 156(5). 627-652.

[2] Choi, E. et al. (2021) Gondwana Research. 193. 197-217.

[3] Compton-Jones, C. et al. (in prep.).