

Paper Number: 4984

A petrographic, geochemical and geochronological study of mafic sills within the Transvaal Supergroup, east of the Bushveld Igneous Complex.

Thendo Netshidzivhe and Klausen, M.B.

Department of Earth Sciences, University of Stellenbosch, Matieland 7602, South Africa, ndokie32@gmail.com

The ~9 km thick Rustenburg Layered Series (RLS) of the enormous Bushveld Igneous Complex (BIC) is the World's largest known ultramafic-mafic layered intrusion, where it has shown that its Marginal Zone (MZ, ~2056 Ma), Lower Zone (LZ) and Critical Zone (CZ; ~2055 Ma) crystallized within ~1 Ma [1]. For this 'Large Igneous Province', it has been inferred that so-called B1, B2 and B3 type marginal sills, represent feeders/parents to the RLS' (1) LZ to Lower CZ, (2) upper CZ, and (3) Main Zone (MZ), respectively [2-3]. While most previous studies have focused on BIC's more proximally located marginal sills, this paper reports new geochemical, petrographical as well as U-Pb geochronological data on more distal sills that are also hosted stratigraphically deeper into – and even below – the Transvaal Supergroup.

We find that typical 'boninitic' B1-sills (with higher Mg-Si and lower Fe-Ti; cf., Figure) were emplaced throughout this sedimentary sequence, together with associated more differentiated varieties (with interstitial-graphic quartz) as well as orthopyroxenites (only in the Magaliesberg Fm). Arguably, slightly older (2058 ± 6 Ma; [4]) B1 sills are consistent with initial parents being injected as a more extensive and pervasive sill complex prior to the initial growth of the BIC magma chamber. This model interpretation will be tested by additional baddeleyite U-Pb ages of sampled B1 sills.

In contrast, no B2 and B3 sills – as defined by [3] – are found along our sample traverse, but rather more tholeiitic sills (with lower Mg-Si and higher Fe-Ti; cf., Figure) that cluster within Silverton's Bowen Member as well as below the basal Protobasins (including Uitkomst). Thus, we are inclined to believe that all of our more tholeiitic dolerites represent younger intrusions. This is supported by the presence of geochemically similar ~1.85 Ga Black Hills dykes [5] – which cut across our study area and are hosted as associated sills within the nearby Waterberg Group [6] – but could, of course, also include sills that were emplaced during an even younger Umkondo [7] or Karoo event. U-Pb ages on baddeleyite extracts from two Strubenkop-hosted tholeiitic sills and a gabbro from the Uitkomst Complex will be able to test whether tholeiitic sills were syn-BIC feeders or belong to any of the above-mentioned younger magmatic events.

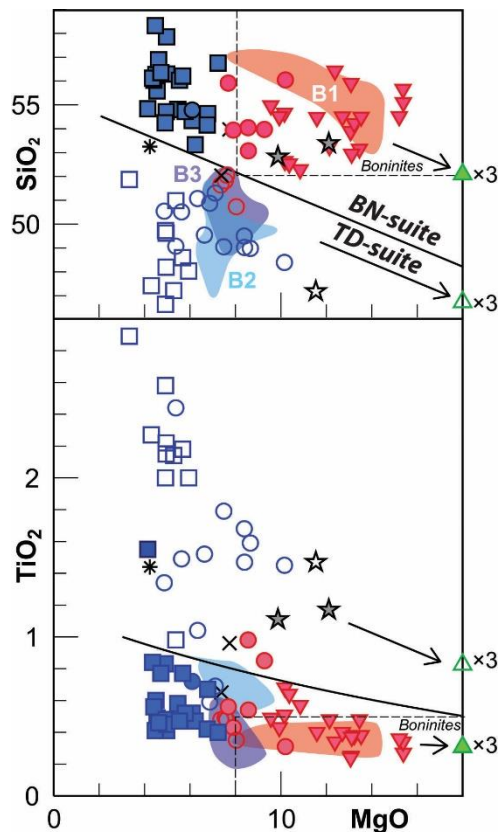


Figure: Bulk rock compositions of sampled sills compared to

B1-3 magmas [3]. Solid lines separate a 'boninitic norite' (BN) suite from 'tholeiitic dolerites' (TD). Dashed lines delineate typical boninitic compositions. Arrows point towards three cumulate samples belonging to each suite.

References:

- [1] Zeh A, Ovtcharova, M, Wilson, AH & Schaltegger, U (2015) Earth Planetary Science Letters 418: 103-114
- [2] Sharpe, MR (1981) Journal of the Geological Society, London 138: 307-326
- [3] Barnes S, Maier, WD & Curl, EA (2010) Economic Geology 105: 1491-1511
- [4] Wabo, H, de Kock, MO, Klausen, MB, Söderlund, U, Beukes, NJ (2015): GFF, 138: 133-151
- [5] Olsson, JR, Klausen, MB, Hamilton, MA, März, N, Söderlund, U, & Roberts, RJ (2015) GFF 138: 183-202
- [6] Hanson, RE, et al. (2004) South African Journal of Geology 107: 233-254
- [7] de Kock, MO et al. (2014) Precambrian Research 249: 129-143

