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A ~3 Ga record of mafic dyke and sill swarms across the Kaapvaal Craton: Further structural and geochemical clues for six Large Igneous Provinces

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An exceptionally well preserved stratigraphy across much of South Africa exposes the existence of at least six major mafic igneous provinces that can potentially be classified as LIPs. In chronological order, these are the (1) ~2.95 Ga Dominion-Pongola (which are here inferred to be roughly coeval), (2) ~2.7 Ga Ventersdorp, (3) ~2.06 Ga Bushveld Igneous Complex, (4) ~1.9 Ga Hartley-Soutpansberg (again, inferred parts of an extended magmatic event), (5) ~1.1 Ga Umkondo, and (6) ~0.18 Ga Karoo LIP. Mafic LIPs are obviously fed from mantle reservoirs and typically through extensive feeder dyke swarms, but it is only after the advent of precise U-Pb dating of extracted baddeleyites (e.g., [1]) that we have recently been able to properly unravel the complex dyke arrays that cross-cut the Kaapvaal Craton and relatively older cover rocks. Following upon a previous attempt [2], this is my second personal review to link feeder dyke swarms to individual LIPs, summarised as:

(1) ~2.95 Ga Pongola-feeders are mainly identified as a NW-SE trending swarm across the SE-corner of the Kaapvaal Craton and geochemically match lavas that erupted along a continental Pongola Rift. There is growing evidence for at least three pulses during this LIP-event, including the emplacements of Dominion (no known feeder dykes) and the Hlagothi Complex [3]. Its most outstanding dykes have assimilated large quantities of Archaean TTG crust.
(2) ~2.7-2.65 Ga feeders to the upper part of the Ventersdorp, as well as Transvaal's proto-basinal volcanics, are mainly identified as a predominantly E-W trending swarm that coincides with the proto-basin's elongation. It will be argued that these dykes also fed large sills below these proto-basinal fills. Again, its outstanding dykes have assimilated large quantities of Archaean TTG crust. Again, there is growing evidence for several pulses that upset a proposed radiating swarm during this LIP-event [4], including an obliquely cross-cutting, SW-NE trending regional swarm of anorthite-megacrystic dykes that also gives associations to a hidden anorthosite complex.
(3) ~2.06 Ga feeder dykes to the Bushveld Igneous Complex have yet to be discovered. However, a large number of 'boninitic' B1 marginal sills occur throughout the Transvaal Supergroup (cf., [6]).
(4) Between 1.93-1.83 Ga [7,8], it appears that the Kalahari Craton experienced another extended 'LIP' episode, arguably behind an active NW-margin of the Kalahari Craton where roughly margin-parallel feeder dyke swarms, associated sills and volcanics are preserved.
(5) A shorter lived ~1.1 Ga Umkondo LIP [9] across the northern half of the Kalahari Craton was also emplaced behind an active (Namaqua-Natal) orogeny, but can on the other hand also be related to coeval break-up along the opposite side of the craton [10].
(6) Finally, at ~0.18 Ga, an extensive array of better preserved flood basalt remnants, sill complexes and feeder dykes were emplaced across the Karoo LIP during Gondwana break-up.

A comparison between these six successive LIPs across the same Archaean Craton block, based on field relationships, published ages and a compilation of 550 geochemical analyses, will be presented.

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