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LIP geochronology defines the paleogeography of the Kalahari Craton within the supercontinent of Rodinia in the Neoproterozoic

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N-trending mafic dykes on the Grunehogna Craton in western Dronning Maud Land, East Antarctica, and NNE-trending mafic dykes on the Kalahari Craton in eastern Zimbabwe were dated using U-Pb ID-TIMS on baddeleyite and U-Pb LA-ICPMS on apatite. The new crystallisation ages, combined with petrographic and geochemical studies, reveal temporally and spatially similar magmatism between 720 Ma and 710 Ma, defining the proposed Fingeren Dyke Swarm in Antarctica and the already established Mutare Dyke Swarm in Zimbabwe. This confirms field relationships whereby the dated mafic dyke swarms cross-cut ca. 1.11 Ga Borgmassivet mafic sills and the Richtersflya basalts of the Grunehogna Craton and the Umkondo mafic dykes, mafic sills and basalts of the Kalahari Craton, respectively. This study also confirms the proposed relationship whereby the Grunehogna Craton is a rifted fragment of the Kalahari Craton (e.g., Groenewald et al., 1991), which was severed during the Jurassic breakup of Pangea into Africa and Antarctica. In a paleogeographic reconstruction, the Fingeren dyke swarm aligns with the Mutare dyke swarm in a close-fit, and establishes a shared LIP-scale mafic magmatic barcode at ca. 1.11 Ga between the Umkondo and Borgmassivet, at ca. 0.72 Ga between the Mutare and Finngeren, and finally at ca. 0.18 Ga between the Karoo and Ferrar LIPs on the Kalahari and Grunehogna cratons. The greater Kalahari-Grunehogna crustal block can now also be aligned better within the supercontinent of Rodinia. A mafic magmatic barcode match exists at ca. 1.11 Ga between the Umkondo-Borgmassivet and the Keweenawan Mid-Continental Rift of Laurentia, although paleomagnetic evidence implies approximately 3000 km of separation (Swanson-Hysell et al., 2015). A further match exists at ca. 0.78-.079 Ga between the Gannakouriep mafic dyke swarm on the Kalahari Craton and the Gunbarrel LIP of Laurentia. Finally, a ca. 0.72 Ga connection now exists between the Fingeren and Mutare mafic dyke swarms and the Franklin LIP within Laurentia. Additionally, detrital zircon populations between Laurentia and Kalahari are also similar. The possibility that the Kalahari-Grunehogna block was adjacent to north-western Laurentia (and Siberia, with the 0.72 Ga Irkutsk LIP) during the Neoproterozoic should therefore be considered, despite contrary paleomagnetic evidence at ca. 1.1 Ga. A connection between the LIPs at ca. 0.72 Ga makes the combined Franklin-Mutare-Fingeren-Irkutsk LIPs one of the largest in geological history, and an ideal trigger for the Sturtian Snowball Earth.

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