Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.30374

Trans-Supercontinental Mafic Magmatic Belts Associated with the Breakup of Multiple Supercontinents

STEVEN DENYSZYN, VANESSA JONES AND ALYSON PARK

Memorial University of Newfoundland

The use of mafic magmatism in establishing geological correlations across now-distant continents throughout Earth history is well-established, including magmatic records of continental break-up. Reconstructions of supercontinents Gondwana in the Paleozoic, and Nuna in the Mesoproterozoic, suggest the existence of linear belts of mafic rocks through the hearts of these landmasses, with available geochronology indicating emplacement occurring shortly before breakup.

Gondwana is reasonably well-constrained paleogeographically, and the Karoo-Ferrar Large Igneous Province is extensively studied. Mafic magmatism occurred at ~183 Ma from Botswana through South Africa and Antarctica, into Australia, before opening of the southern Atlantic Ocean. The San Pedro/Soubré dyke swarm in Côte d'Ivoire, western Africa, have a SE trend – i.e., towards the main Karoo magmatic centre. An ID-TIMS U-Pb baddeleyite age of 183 Ma was obtained for these dykes, indicating an affiliation with the Karoo-Ferrar LIP. This apparent genetic connection is also supported by the geochemical signatures of the dykes, with trace element patterns consistent with intraplate magmatism and similar to the Karoo-Ferrar LIP. Isotope geochemistry provides further insights on the mechanisms and sources of the magmatism, supporting the hypothesis of a linear belt that spanned the entire width of Gondwana – over 10,000 km.

Less well-defined is the configuration of Nuna, postulated to have existed from ~1.8–1.3 Ga. Another linear, trans-supercontinental belt of mafic magmatism may have shortly preceded Nuna's breakup, with 1330 Ma to 1350 Ma intrusive rocks found from one extent to the other of the supercontinent. The magmatic belt extends from Voisey's Bay in eastern Laurentia, through Siberia, to the Yanliao/Derim Derim LIP in China and Australia. Dykes of the Dundas Harbour swarm in the Canadian Arctic and Greenland are dated using baddeleyite to 1337 Ma, consistent with an association with the proposed magmatic belt, and supported by lithogeochemistry and isotope geochemistry. These dykes fill a geographic gap in the belt, completing a total linear extent of over 8,000 km.

Geophysical modelling provides a mechanism for the geometry and volume of mantle melting through development of linear thermochemical piles at the base of the mantle resulting from the extensive subduction girdle developed after supercontinental assembly.