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The Rooi-Rand and Lebombo dyke swarms: implications for the Karoo mantle plume

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The break-up of Gondwana commenced 180 million years (Ma) ago with the onset of Karoo flood volcanism, evidently due to the arrival of a mantle plume at the base of the lithosphere. This resulted in the formation of three rifts radiating out from the "Karoo triple junction" near Mwenezi, southern Zimbabwe. These rifts are represented by the Okavango dyke swarm (ODS) radiating to the NW, the Save-Limpopo monocline to the NE and the Lebombo monocline to the S. The plume model predicts that magma flow in dykes should be away from the plume head, as has been demonstrated for the ODS. The approximately N-S dykes along the Lebombo comprise a generation that were feeders to the basalts (termed Lebombo dykes here) and a younger generation (ca. 174 Ma) with MORB characteristics, known as the Rooi Rand Dyke Swarm (RRDS), that have no known extrusive equivalents. This study aims to quantify the magma flow direction in these two dyke swarms by measuring the anisotropy of magnetic susceptibility (AMS) of orientated samples and mineral shape preferred orientations (SPO's). Establishing the magma flow directions using these techniques has implications for the Karoo mantle plume hypothesis and the origin of the southern arm of the Karoo triple junction. The Lebombo AMS results are most consistent with lateral flow to the south but results for the younger RRDS are most consistent with vertical flow. The RRDS study of mineral SPO's has revealed some discrepancies with the AMS results, but is generally consistent with sub-vertical flow. This is also the conclusion from the sheeted nature of the RRDS and dyke morphology. This study predicts that the RRDS was fed from a different source to the Lebombo dykes, which is consistent with a similar proposal based on geochemistry.