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Petrogenesis of the Doros Gabbroic Complex, Namibia: Multiple mingling magma mushes?

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The 132 Ma Paraná-Etendeka Large Igneous Province has been attributed to the impingement of the Tristan mantle plume and the associated opening of the South Atlantic Ocean, during the Early Cretaceous breakup of West Gondwana (Miller, 2008). On the Namibian side of the rift, this is preserved as the extensive Etendeka flood volcanics, and the Damaraland Intrusive Suite, a series of subvolcanic intrusions within the Damara Orogenic Belt (Miller, 2008).

The Doros Complex is a relatively small mafic layered intrusion that forms part of the Damaraland Suite. Doros consists of a gently inward-dipping series of stacked layers of massive or foliated olivine gabbro with varying compositions and mineral proportions, cut by gabbro pegmatite, monzodiorite and dolerite dykes. This study investigates the petrogenesis of the Doros magmas, using major element, trace element and Sr-, Nd- and Pb-isotopic data.

Trace element and isotope geochemistry confirm that all the Doros rock types, except the dolerite, are derived from the same magma source. The dolerite is interpreted to belong to the Horingbaai dyke suite of the Etendeka. The mineralogy and rock compositions indicate negligible crustal contamination, apart from a glassy chill margin that shows evidence of assimilation of local Damaran metasediments. Depleted 143Nd/144Nd, moderate 87Sr/86Sr and particular trends in incompatible trace element ratios indicate that the Doros magma was derived primarily from enriched Tristan plume melts with a significant component of entrained depleted upper mantle and minor lower crustal or lithospheric mantle contamination.

It is argued that the Doros intrusion cannot be explained by the emplacement and subsequent differentiation of a single body of magma. We present evidence, including intrusive interlayer contacts, grain-size layering, flow foliation patterns, cumulus crystal enclaves, and a lack of simple progressive fractionation trends in whole-rock and mineral chemistry, that favours emplacement as a series of diverse, intermingling magma mushes into a shallow-level magma chamber. We infer a multi-stage process of fractionation and accumulation, largely of olivine, plagioclase and magnetite, which is reflected in the whole-rock geochemistry.