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Distribution and characteristics of gabbros, gabbronorites and amphibolites across the western Namaqua Province and their role in constraining terrane boundaries.

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Throughout the Mesoproterozoic rocks of southern Namibia, numerous gabbroic outcrops are enigmatic in their origin in part because the tectonic environment of their emplacement has never been clearly identified. Overall the geology of Precambrian rocks of southern Namibia consists of a sequence of terranes characterised by differences in petrography and geochemistry, structural evolution, U-Pb ages and detrital zircon are spectra. The overriding commonality amongst these terranes is the classic arc signature of a pronounced negative Ta-Nb anomaly but the source of this anomaly is ambiguous. One explanation for the arc signature is that the terranes amalgamated through closure of oceanic or back arc basins and that the gabbroic rocks possibly represent relicts of this basin floor. However, intrusive relationships as well as mineralogy and isotope geochemistry of the gabbroic rocks would seem to preclude such an interpretation. More recently, the relationship between these gabbroic rocks has been reevaluated during a regional mapping project between the Council for Geoscience in South Africa and the Geological Survey of Namibia [1]. The gabbroic rocks have been grouped together into the Kum Kum Suite which encompasses broadly gabbronorite compositions that crop out within the Keimasmund Klippe, the Tantalite Valley Complex (which is surrounded by the Marshall-Rocks-Pofadder Shear Zone (MRPSZ)) and the Sandfontein and Kum Kum klippen. All these outcrops probably represent small remnants of a much larger granulite-facies Mesoproterozoic thrust block called the Kakamas Domain. Small isolated outcrops of Kum Kum Suite rocks also occur as pods within gneisses of the Palaeoproterozoic Pella Domain in the footwall to the Kakamas Domain and within the thrust zone that separates the Kakamas and Pella domains. In outcrop, gabbros, gabbronorites and their metamorphic equivalents are almost impossible to distinguish from one another. This is in part due to the ubiquitous presence of a dark grey to black desert varnish that covers these rocks. Petrographically, the Kum Kum Suite rocks are variably metamorphosed and altered such that green amphibole and chlorite now makes up a significant proportion of the mineralogy but this does not manifest in fabric development. In thin-section the meta-varieties are differentiated from the non-meta varieties by the distinct absence of olivine in the meta-types. The Kum Kum Suite in both the Tantalite Valley Complex and the Sandfontein klippe also contains ultramafic rocks, principally troctolite and pyroxenite, with the same weak metamorphic / alteration overprint. Locally doleritic dykes are also associated with the Kum Kum Suite. The Kum Kum Suite has been dated by U-Pb zircon ICPMS at ~1212 Ma in both the Tantalite Valley Complex (through zircon in the contact metamorphic aureole to the complex) and the Kum Kum Klippe. The sample from the Kum Kum Klippe also contained no detrital zircon. Depleted mantle (T_{DM}) model ages (~2.2 – 3.1 Ga) indicate that the Kum Kum Suite was derived from melting of crustal material significantly older than that of the contemporaneous granitic Eendoorn Suite (T_{DM} ~ 1.8–2.2 Ga).

Moreover, gabbros associated with the Keimasmund Klippe yielded a significantly older U-Pb zircon age of 1878 Ma despite having very similar petrography and bulk rock geochemistry. To the far west, the Ai-Ais Complex also contains similar gabbronoritic rocks with bulk rock geochemistry dominated by the Ta-Nb anomaly. In this case however, the gabbroic rocks have U-Pb zircon ages of ~1280 Ma. Overall, gabbroic rocks of the Kakamas Domain appear to have a diachronous emplacement history from west (older) to east (younger) and this may link to diachronous emplacement of the Kakamas Domain over the Pella Domain. The older Keimasmund gabbroic rocks remain enigmatic and their position relative to the Kakamas Domain is difficult to determine.