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Towards a new geodynamic model for the western Namaqua Province

Macey, P.H.[1], Lambert, C.W.[1], Kisters, A.F.M.[2], Gresse, P.G.[1], Thomas, R.[1], Miller, J.A.[2], Groenewald, C.[1], Angombe, M[2,3], Indongo, J.[2,3], Shifotoka, G.[3], Minnaar, H.[1], Smith H.[1,2], Dhansay, T.[1], Diener, J.[4], Frei, D.[2], Muvangua, E.[3], Spencer, C.[5], le Roux, P.[4] and Doggart, S.[1,2]

[1]Council for Geoscience, South Africa, pmacey@geoscience.org.za
[2]Dept. Earth Sciences, Stellenbosch University, South Africa; [3]Geological Survey of Namibia, Windhoek, Namibia
[4]Dept. Geological Sciences, University of Cape Town, South Africa; [5]Dept. Applied Geology, Curtin University

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Recent 1:50 000 scale geological mapping of 25 000km^2 of Precambrian basement in southern Namibia, including P-T studies and >120 new U-Pb ages, indicates that the western Namaqua Metamorphic Province (NMP) consists of a ~NW-trending stack of very thin but laterally extensive, SW vergent thrust sheets, each slice characterised by differences in stratigraphy and tectono-metamorphic histories. The Palaeoproterozoic (1905-1865 Ma) **Richtersveld Magmatic Arc** (RMA) forms a ~200km wide crustal block in the west. The RMA consists of rafts of Orange River Group (ORG) volcanics intruded by the voluminous coeval Vioolsdrif Suite granitoids (1905-1865 Ma) during the Orange River Orogeny (D_1). The RMA is subdivided into the low grade **Vioolsdrif Domain** in the west and the amphibolite-facies (~660°C, 4kbar) **Pella Domain**, which was strongly reworked by the D_2 Namaqua Orogeny at ~1215 Ma. The **Sperrgebiet Domain** occurs as a window in the Pan African Gariep Belt west of the RMA and consists of ~2050-2000 Ma arc-type granitoids intruded by ~1885Ma Vioolsdrif Suite granitoids synchronous with the D_1 Orange River Orogeny. The RMA contains rare inclusions of metaquartzite that provide detrital ages indicating deposition coeval with ORG volcanic activity but with detritus derived from Sperrgebiet aged rocks and minor Archean sources. Xenoliths and inherited zircon xenocrysts in the Vioolsdrif Suite have 2050-1990 Ma ages which along with the T_{DM}=2.4-2.2 Ga ages indicate the RMA magma was derived with contributions from the Sperrgebiet arc and minor Archean crust. The RMA is structurally overlain in the NE by a vast thrust sheet known as the **Kakamas Domain** along the Lower-Fish River-Onseepkans Thrust Zone (LFROTZ). The granulite grade (~780°C, 5.5kbar) Kakamas Domain consists of pelitic granulites deposited at ~1215 Ma, intruded by leucogranites, granites and mafic melts between 1220 and 1195 Ma. The high grade metamorphism, dated at ~1140 Ma, was associated with intrusion of voluminous gt-leucogranite dehydration melts and followed by late-tectonic, I-type granodiorites and charnockites at ~1115 Ma. The **LFROTZ** separating the Pella and Kakamas domains is a shallow NE-dipping to sub-horizontal, wide complex imbricate zone comprising interleaved sheets of highly sheared gneisses from both the Pella and Kakamas domains but, importantly, also slices of exotic rocks not found in either domain. In the Onseepkans area, the LFROTZ is ~10km wide and ~1km thick and includes, in addition to the Pella and Kakamas rocks, interlayered sheets of sheared ~1215 Ma leucogranite and metabasites, and supracrustal schists deposited after 1164 Ma. In the Lower Fish River area, the thrust zone forms a complex tectonic mélange 25 km wide containing slices of ~1830 Ma migmatites, ~1320-1270 Ma orthogneisses and 1125 Ma granites. The mapping and U-Pb intrusive and metamorphic ages indicate that thrusting occurred during at least two major episodes at ~1200 (D_{2b}) and ~1100 Ma (D_{2c},~640°C, ~6kbar) associated with magmatism focussed along LFROTZ. After thrusting, the NMP was deformed by F_3 mega-folds and reworked along several major, NW-trending late-Namaqua (D_4) transcurrent shear zones, synchronous with the intrusion of granites and pegmatites at ~980 Ma. Inherited and detrital zircon ages from the Kakamas Domain indicate sourcing from the Sperrgebiet and

RMA (peaks at ~2020 and ~1885 Ma) and a 1350-1250 Ma source region, possibly the Areachap Domain which lies NE of the Kakamas Domain. Most of the T_{DM} ages obtained from the whole of the NMP are >1.9 Ga. Together, these data suggest that the NMP is not comprised of discrete exotic accreted terranes but rather represents tectonically imbricated and melted older crust, of which the Sperrgebiet and RMA are remnants and the Kakamas Domain is completely transposed. Field and age data suggest the long duration, high geothermal gradient was maintained through several cycles of mafic underplating and associated magma intraplating associated with Namaqua thrust tectonics. The low P (<6kbar) indicates the NMP was never over-thickened by plate collision and another geodynamic setting is required to explain the tectonism.