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The Lower Fish-River/Onseepkans Thrust Zone: Time constraints and insights into Namaquan thrust tectonics

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Thrusts and thrust tectonics have previously been recognised within the Namaqua Metamorphic Province (NMP) and although recent work by (e.g. [1]) has built upon the existing models such as that of Joubert [2], the timing and details of deformational events related to the major terrane boundaries are often poorly constrained or understood. Data from recent mapping and U-Pb dating in southern Namibia by the Council for Geoscience and the Geological Survey of Namibia has led to new insights and interpretations that shed light on the timing and evolution of some of the major thrusts and terrane boundaries of the NMP [3].

The newly recognised Lower Fish-River/Onseepkans thrust zone (LFROTZ, [3]) forms a wide, shallow NE-dipping to sub-horizontal, complex imbricate zone that separates amphibolite-facies Paleoproterozoic gneisses of the Pella Domain (footwall) from granulitic rocks of the mainly Mesoproterozoic Kakamas Domain (hanging-wall) and was active during the long duration, regional D_2-phase of the Namaqua Orogeny. The LFROTZ consists of interleaved sheets of highly sheared gneisses derived from both the footwall and hanging-wall but, importantly, also slices of exotic rocks not found in either domain. The thrust zone ranges in width from ~10km in the Onseepkans area to ~25km in the Lower Fish region and is bounded by the Onseepkans basal thrust and the Lower Fish-Kerelbad-Tafelkop roof thrust. The D_2 Namaqua Orogeny is multi-phase and spans ~200Ma with three major events recognised in the current study area: D_{2a} (~1215-1200 Ma), D_{2b} (~1200±5 Ma) and D_{2c} (~1100 Ma, [3]). D_{2a} manifests as the formation of pervasive S_{2a} and L_{2a} ductile fabrics and corresponds with peak metamorphism of the Pella Domain. Field and geochronological data indicate thrust tectonics was initially active during D_{2b} but reactivation during D_{2c} was responsible for the formation of a wide LFROTZ (at ~640°C, ~6kbar) and the final juxtaposing of the Kakamas and Pella domains [3]. Fabric analysis indicates deformation during the phases of D_{2b} and D_{2c} to be largely co-axial despite the ~90 Ma hiatus between the two events. D_{2c} thrusting is younger than 1163Ma, the youngest detrital zircon age of the Velloorsdrif Schists, a unit which is restricted to the LFROTZ [3]. The age of thrusting is further constrained by the recent dating of late-tectonic granites at ~1115Ma which are truncated and imbricated by LFROTZ [3]. LFROTZ was locally folded by the regional F_3 mega-folds and reworked along late-Namaqua (D_4) transcurrent dextral shear zones, synchronous with the intrusion of leucogranites and c.980Ma pegmatites.

As the LFROTZ developed at ~1100Ma the Onseepkans thrust (D_{2b}) formed the basal thrust to the thrust zone which developed into the hinterland as an out of sequence thrusting system [4]. The thrust zone is lithologically distinct from both the Pella domain (footwall) and the Kakamas domain (hangingwall) with strong rheological contrasts that contribute to strain localisation within the LFROTZ. New observations within the thrust zone indicate a significant change in the style of deformation at the base of the LFROTZ as it evolves and the lower thrusts lock up. This also has implications for the degree of footwall material

being incorporated into the lower part of the thrust zone. The recognition of the $D_{2b,2c}$ events along with the insights into the structural evolution of these thrusts have led to an improved understanding of the polyphase nature of the tectonic evolution of this part of the NMP.

References:

[1] Colliston, W.P., Cornell, D.H., Schoch, A.E., Praekelt, H.E., (2015). Precambrian Res. 265, 150–165.
[2] Joubert, P. (1986) Mineral Deposits of South Africa, Geological Society of South Africa, pp. 1395 -1420.
[3] Macey, P.H. et al. (2015). CGS/GSN explanation to 1:50 000 geological map sheets 2818 Warmbad, 701pp
[4] Morley, C.K. (1988) Tectonics, vol 7, 539-561.