The Record of Subduction and Collision along the Southern Margin Zone of the Damara Orogen

Hartnady, M.I.H., Fagereng, A.1,2, and Diener, J.F.A.1

1Department of Geological Sciences, University of Cape Town, South Africa, michael.hartnady@gmail.com
2Present Address: School of Ocean and Earth Sciences Cardiff University, Wales, UK.
3Umvoto Africa (Pty) Ltd, Muizenberg, Cape Town.

The Southern Marginal Zone (SMZ) of the Damara Belt, exposed in the Gaub Canyon in central Namibia, consists of seven litho-tectonic units of high strain amphibolite facies rock with pelagic, hemi-pelagic and clastic sedimentary protoliths. These rocks are intercalated with lenses of metabasite. Regional high-pressure - low-temperature metamorphic conditions dominated the Southern and Southern Marginal Zones of the Damara Belt, leading to the interpretation that these tectonostratigraphic terrains formed as an accretionary prism along an ancient subduction margin [1].

The structures in the SMZ are the result of progressive deformation, inferred to have initiated under low-grade metamorphic conditions (D1) and evolved through prograde to peak metamorphism (D2), ending in relatively low-temperature retrograde conditions (D3). Each of the deformation phases is characterised by a structural foliation. D1 is associated with approximately symmetrical layer-parallel extension characterised by disrupted lithological layering and bedding-parallel foliation S0+1. D2 is defined as deformation related to the formation of an axial-planar S2 foliation caused by folding of the S0+1 fabric. Widespread isoclinal recumbent folds resulted in transposition of these fabrics and the general foliation is thus termed S0+1+2. This composite foliation contains a down-dip L2 stretching lineation. Folding was contemporaneous with top-to-the-SE directed thrusting in D2 faults and shear zones that are seen to displace D1 fabric. D3 is defined by a crenulation cleavage S3, at near right angles to S0+1+2 foliation. This phase of deformation may also be associated with retrograde, reverse faulting that occurred along some of the D2 shear zones. The presence, in places, of a sub-horizontal stretching lineation (L3) is attributed to a component of strike-slip during D3 deformation.

We relate the deformation phases to processes observed in modern accretionary prisms. In this model, D1 deformation is associated with underthrusting of marine and trench-fill sediments beneath the accretionary prism. D2 deformation is attributed to underplating of underthrust sediment by duplex accretion, and occurred under high-pressure, prograde greenschist- to amphibolite-facies conditions. Subsequent isoclinal recumbent folding during bulk shear of the accreted thrust packages generated axial planar S2 which was transposed with S0+1 through progressive deformation. D3 structures are interpreted to record the change from the accretionary to the collisional phase in the Damara Orogeny. If this is true, then exhumation-related deformation and retrogression of the Khomas accretionary prism was concentrated on discrete D2 structures, as continental crust entered the subduction zone. As a result, the individual litho-tectonic units that make up the SMZ show very little evidence for the
(probably short-lived) collision between the Kalahari and Congo Cratons and deformation features related to the accretionary phases are remarkably well preserved.

References: