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Dating the onset of transpressional deformation in the Kaoko Belt (Northwestern Namibia)

J. Konopásek (1,2), S. Ulrich (2,3), J. Košler (1,4), L. Tajčmanová (1,5), P. Jeřábek (1,2)

(1) Czech Geological Survey, Klárov 3, 118 21, Praha 1, Czech Republic (jiri.konopasek@geology.cz), (2) Institute of Petrology and Structural Geology, Charles University, Albertov 6, 128 43, Praha 2, Czech Republic, (3) Geophysical Institute, Academy of Sciences, Boční II-1401, 141 31, Praha 4, Czech Republic, (4) Centre for Geobiology and Department of Earth Science, University of Bergen, Allegaten 41, N-5007 Bergen, Norway, (5) Institute of Geological Sciences, Freie Universität, Malteserstr. 74-100, 12249 Berlin, Germany

Western part of the Kaoko Belt in NW Namibia is subdivided in three tectonic domains. Coastal Terrane in the west is interpreted as an exotic crustal domain due to presence of ∼650-630 Ma old migmatites not known from other parts of the belt. The Orogen Core domain to the east represents former passive margin of the Congo Craton highly reworked due to its collision with the Coastal Terrane during Pan-African orogeny. The suture between these two units is intruded by a layered sequence of granitoid intrusions of the Boundary Igneous Complex. Two superimposed deformation fabrics in the western part of the belt are commonly interpreted as a result of protracted period of transpressional deformation. In such model, development of large-scale transcurrent shear zones is interpreted as synchronous with thrust-related deformation in surrounding domains. However, combination of isotopic dating and detailed structural mapping in various domains of the belt shows that these fabrics are the result of two distinct periods of deformation.

The flat lying S1 foliation in the Coastal Terrane is the result of reactivation of an older migmatitic fabric under the solid state conditions. This foliation is folded and reworked by localized shear zones with steep S2 fabric. There is no direct geochronological information regarding the onset or activity of these two deformation events.

Several intrusions in the Boundary Igneous Complex show well developed flat magmatic layering suggesting injection of magma during D1 thrusting of the Coastal Terrane over the underlying Orogen Core domain. Dating of various granitic intrusions along the suture has shown igneous activity between ∼580-550 Ma. The intensity of the D2 overprint increases from south to north and results in development of subvertical solid-state fabric with subhorizontal lineation. As the S2 fabric affects also the youngest granitoids of the magmatic complex, the D2 deformation cannot be older than 550 Ma.

The Orogen Core domain also shows two metamorphic fabrics. Relics of flat lying S1 foliation are preserved in low-strain domains surrounded by homogeneous steep S2 migmatitic fabric with ubiquitous steep close to isoclinal F2 folds. Migmatitic melt is often injected in hinge zones along axial planes of F2 folds suggesting its formation during the D2 deformation. The oldest metamorphic age of ∼575 Ma in this domain is known from dating of metamorphic garnets. Dating of foliation-parallel migmatitic melts from domains with homogeneous S2 fabric gave an age of 549-550 Ma.

Combination of structural and geochronological data suggests that the early evolution of the Kaoko Belt was governed by oblique underthrusting of the attenuated Congo Craton margin below the Coastal Terrane. Geochronological data from both the Boundary Igneous Complex and the Orogen Core domain show that this period persisted at least 30 My. Major change in deformation regime occurred at ∼550 Ma when the oblique thrusting changed to sinistral transpression. The reason for this abrupt change can be seen in rheological collapse of the partially molten rocks of the Orogen Core domain. Ongoing transpressional deformation accompanied by cooling of the entire belt resulted in progressive localization of transcurrent shear zones under continuously decreasing metamorphic conditions.

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