Abstract

The Neoproterozoic tectonic development of the Arabian-Nubian Shield (ANS) can be divided in three parts: 1) the oceanic stage, which includes mainly remnants of intra-oceanic subduction; 2) the arc-accretion stage; 3) the extensional stage. Three key-areas in the Arabian-Nubian Shield, namely the Bi'r Umq Complex, The Tabalah and Tarj Complex and the Wadi Kid Complex, were studied in the framework of this research with the aim to investigate each of these three stages in detail and to integrate these stages into one geodynamic model for the Neoproterozoic of the ANS.

The Bi'r Umq Complex is part of the Bi'r Umq-Nakasib Suture that trends SW-NE in the central part of the ANS. It represents the border between the Jiddah and the Hijaz Terranes in the Arabian part of the ANS. The ophiolite of the Bi'r Umq complex was formed at ca. 830 Ma. The ophiolite was formed at a fore-arc or at a back-arc of an island-arc in the Mozambique Ocean. It was folded and extensively sheared during three phases of deformation. D1 resulted in regional folding and axial planar foliation, and regional deformation localized into shear zones with good shear sense indicators, and localized in shear zones, the development of foliations, and of steeply plunging stretching lineations, and the development of good shear indicators. These structures resulted from SE-vergent thrusting on the Bi'r Umq Shear Zone (BUSZ), the main shear structure, and on minor shear zones within the Bi'r Umq Complex. The D1-deformation phase was a result of NW-SE compression and was responsible for the emplacement of the ophiolites in the overriding plate. The second phase, D2, was marked by dextral strike-slip in the central zone of the WSW-ENE-trending BUSZ and resulted in the formation of sub-horizontally WSW-plunging elongated clast-lineations. This phase resulted from WNW-ESE compression. The third phase, D3, involved sinistral strike-slip shear reversal on the BUSZ and resulted from NNE-SSW compression. Deformation in the Bi'r Umq Complex (BUC) occurred during obduction of the Bi'r Umq ophiolite and ended at ca. 760 Ma. The changes of the sense of movement on the shear zones of the Bi'r Umq Complex were related to a change in the direction of plate motion of the subducting plate. The structures and structural history in the region are associated with the closure of an oceanic basin by subduction and are relicts of the "off-shore amalgamation" of a number of island-arcs in the Arabian shield. The "off-shore amalgamation" led to the formation of the Amennakhte Superterrane.

The Tabalah and Wadi Tarj Complex in the central part of the Neoproterozoic Asir Terrane in Saudi Arabia, display typical intra-terrane features. The Tabalah and Wadi Tarj areas contain gabbros and quartz-diorites, which were intruded in an island arc, together with tonalites and granodiorites, which display characteristics of intrusion during subduction at an active continental margin. These rocks were deformed during two deformation-phases: D1 and D2. The D1-phase was characterized by thrusting as illustrated by steep lineations and hanging wall over footwall shear sense indicators. This phase was dated at ca. 779 Ma and resulted from E-W to WNW-ESE compression. The D2-phase was characterized by dextral strike slip that resulted from NNE-SSW compression. This event was dated at ca. 765 Ma. The observed deformation phases and late intrusions in the Tabalah and Wadi Tarj area are also related to the

“off-shore amalgamation” along NE-SW trending sutures which formed the Amennakhte Superterrane.

In the Wadi Kid Complex in the Sinai, Egypt, a sequence of thick sub-horizontal amphibolite HT/LP grade schists, was interpreted as low-angle normal shear zones which displayed top-to-the-NW movement and was associated with upper-crustal extension. Undeformed granites, similar to the A-type granites found in other parts of the ANS and interpreted to be related to extension, intruded the area. The intrusion of NE-SW trending dykes, perpendicular and synchronous to the movement on the shear zone, indicated that the shear zones were formed in a NW-SE extensional regime. The activity on the low-angle shear zone was dated at ~595 Ma. These geological features indicate that the Wadi Kid Complex represent a core complex that was formed during NW-SE extension. Other “gneissic domes” in the ANS can also be interpreted as core complexes.

Published data show that the extension as observed in the Wadi Kid Complex, was pre-dated by a phase of arc-accretion at the N-S trending active continental margins of East- and West Gondwanaland at 700-650 Ma. During this phase, independent island-arcs and superterranes that were formed off-shore, accreted upon these continental margins. In summary, the arc-accretion at the continental margins led to lithospheric thickening. When convergence slowed down, thermal re-equilibration led a decrease of strength in the lithosphere. This led, in turn, to the gravitational collapse of the thickened lithosphere and the extension that caused the formation of the core complexes. The Neoproterozoic development of the ANS is thus similar to the Mesozoic development of the Cordillera in western North America.