Abstract

The Variscan orogenic belt along the exhumed root domain, known as the Moldanubian Zone as well as the Arabian-Nubian Shield (ANS) in the East African Orogeny (EAO) of Ethiopia, are considered as typical areas for studying late-orogenic (post-collisional) processes and magmatism. Based on a wider range of field and analytical methods: field structural mapping, anisotropy of magnetic susceptibility (AMS) analysis, thermobarometric calculation and P-T evolution, conventional U/Pb dating, a reconstruction of geodynamic evolution and magmatism in the southwestern part of Moldanubian Zone (Bohemian Massif) and Tokar-Barka Terrain (southern part of Arabian-Nubian Shield is undertaken. The Variscan case portrays the peculiar overprint by the Late Orogenic tectonothermal event which is absent in the case of the Arabian-Nubian Shield (ANS) hence offering a compelling contrast to investigate the possible underlying mechanism involved for the different processes in the post-orogenic phase. In the southern ANS a post-collisional intrusive Chewo pluton composed of monzodiorite and quartz monzonite marks the late tectonic overprint which intruded into a low-grade Neoproterozoic juvenile crustal Tokar-Barka terrane. Thermobarometric estimations indicate its emplacement to be c. 10-13 Km depth, idealized from AMS fabric overprinting and magmatic textures relation, to have been driven diapirically through the local extension in the hinge of the large-scale asymmetric syncline that evolved during the last increments of regional deformation as orogen-perpendicular, WNW(NW)-ESE(SE) compression. The inferred convergence is constrained from the concordant, zircon U/Pb crystallization age of the pluton as 618.1 ± 1.5 Ma which must have been the prominent orientation, at least in the realm of the Tokar-Barka teranne (part of the southern ANS). The geochemical affinity of the pluton which shows a high-K calc-alkaline and metaluminous composition with significant enrichment in both LREE and LILE on the other hand points to the role of hybridization and magma mixing between crustal and mantle-derived melts at this stage of the orogeny. In the second study area from the southern ANS new U–Pb zircon geochronological data, field structural analysis and detailed petrological study of the plutonic and high-grade metamorphic rock complex (Hammar Domain of Southern Ethiopian Shield) was carried out which brings broad implications for the southern ANS evolution. The geochronological data points to a prolonged orogenic convergence in forming the East-African orogeny which can be divided into two main geodynamic phases: (a) Late Tonian to late Cryogenian (ca. 770 to 650 Ma) large volcanic arc construction (with protolith of ca. 770 Ma) followed by crustal accretion and flat-lying fabrics origin (D_2 stage), intense migmatization and HT-MP metamorphism (T: 700–850 ◦C and P: 0.7–0.9 GPa) at depths of ~25–35 km (dated at ca. 720 and 715 Ma). (b) Late Cryogenian to early Ediacaran (ca. 650 to 620 Ma) phase of continental collision corresponding to the Greater Gondwana assembly. An early ~E–W oriented compression (D3 stage) resulted in ~N–S trending fabrics that have been continuously changed to the left-lateral transpression (D4 stage) forming ~NW–SE oriented foliations. The time-scale of D3 and D4 events is inferred by syn-tectonic granitoid intrusions yielded at ca. 648 Ma and ca. 630 Ma respectively. The southwestern segment of the Moldanubian Zone (Bavarian Unit and

peripheral adjacent WMU) underwent a successive tectonometamorphic evolution during mid- to late-Variscan episode (c. 340 to 310 Ma). Relics of HT-LP metamorphism at T: 720-754 °C and P: ca 790 MPa (M1) and T: 674 ± 27 °C and P: 680 ± 110 MPa (M_2) associated with WNW-ESE compression (D_1 stage) followed by crustal exhumation and rapid cooling influenced by oblique NE(NNE)-SW(SSW) under thrusting of Brunia microcontinent (D_2 stage) which is also common to rest of Moldanubian „orogenic root domain" is noted to have lasted from c. 356 to 339 Ma. The subsequent Late-Variscan overprint (c. 332 to 327 Ma) is marked by N-S oriented compression due to convergence between the Salzburgia Block (western Gondwana) and consolidated Bohemian Massif resulting in regional E(ENE)-W(WSW) trending fabrics and syn-tectonic emplacement of numerous Weinsberg granitoids. These processes were also responsible for regional extension in perpendicular direction including emplacement of NNE-SSW trending Pelhřimov Core Complex. In the later stage late-Variscan processes (ca. 325 to 320 Ma) ensued under T: 662 to 701 °C and 362 to 437 Mpa (M_4) during the fading of compression forces and synchronous switch from the frontal ~N–S compression to ~NW–SE right-lateral transpression or strike-slip shearing. In light of the above, the late-orogenic episode had an external heat source corresponding to the increase in temperature of about 200 °C. Metamorphic record (M_3 and M_4 events) indicates rather slow cooling of the rock complex without significant contribution of decompression path.

Key Words

East African Orogeny, Arabian-Nubian Shield, European Variscides, Bohemian Massif, Moldanubian Zone, U-Pb dating, Anisotropy of Magnetic susceptibility, P-T modelling