

PAN AFRICAN METAMORPHISM OF THE WESTERN ETHIOPIAN SHIELD

by

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The Precambrian basement of Ethiopia occupies a position of particular geological importance where juvenile metavolcano-sedimentary rocks of the Arabian-Nubian Shield (ANS) are in contact with higher-grade, gneissic rocks of probable Mozambique Belt (MB) affinity. In the Western Ethiopian Shield, the ANS Birbir domain largely comprises chlorite-rich meta-tuffs with subordinate pelites and psammites and contains a broadly N-S oriented linear belt of highly altered mafic and ultramafic intrusions – the Yubdo-Daleti-Tulu Dimtu belt. The margins of the Birbir domain are marked by mylonitic shear-belts where the Birbir is in tectonic contact, to the east and west respectively, with the gneissic (MB) Geba and Baro domains. The Geba and Baro domains are dominated by banded quartzofeldspathic biotite- and/or hornblende-bearing orthogneisses and contain rare slivers of quartzite, calc-silicate and pelitic paragneiss. The pronounced (subsequently folded) gneissose layering and the preservation of both subsolidus and anatectic migmatites suggest an early, high-temperature (Archean?) event not recorded in the Birbir rocks, implying that the Baro and Geba domains form an older crystalline basement to the Birbir. All domains were strongly deformed by the subsequent Pan African (c. 900 - 550 Ma) tectonothermal event, resulting in N-S trending Dp1-folds and ductile Dp2-shear-zones, polyphase intrusion and metamorphism.

The Pan African metamorphic event (Mp1) affected the entire area. Porphyroblast-matrix relationships suggest Mp1 occurred at an early stage within the Pan African structural framework, either pre- or syn-Dp1. Thermobarometric calculations on gneisses from the Geba and Baro domains yield mid- to upper-amphibolite facies conditions for this event, with peak temperatures of around 650 - 700°C and pressures in the range 7 - 10 kbar. The abundant metabasite parageneses within the Birbir domain generally indicate greenschist to lower-amphibolite facies conditions, both within and away from Dp2 shear-zones. Calculations on a low-variance garnet-chloritoid-staurolite-bearing pelitic schist from a metamorphosed clastic shelf sequence within the Birbir domain gives results of 560 - 580°C at c. 7 - 10 kbar. Such high pressures have not previously been recorded in the ANS of Western Ethiopia and, when combined with lithological considerations, may imply the existence here of a discrete lithostratigraphical group, possibly equivalent to the “Middle Complex” of Kazmin [1].

The Pan African metamorphic peak within the region was evidently attained prior to, or during the earliest stages of, continent-continent collision (i.e. of east and west Gondwana [2]) and maintained throughout much of the period of deformation. An overall anti-clockwise P-T-t evolution is implied. A significant contribution to the heat required for this widespread metamorphic event was probably provided by intraplated mafic and/or ultramafic intrusions emplaced within an extensional back-arc setting [3], examples of which are preserved as the Yubdo-Daleti-Tulu Dimtu belt.

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### References

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