MULTISTAGE TECTONISM DURING GONDWANA COLLISION: BALADIYAH COMPLEX, SAUDI ARABIA

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The formation of orogens is a complex process often involving multiple stages of compression and extension. Field evidence from the Baladiyah complex in the northern part of the Arabian-Nubian Shield of Saudi Arabia shows that several erosional unconformities separate different high grade metasedimentary rocks within the complex. This indicates that the collision between East- and West-Gondwana involved several cycles of exhumation and burial. Mineral equilibria approach and thermodynamic modeling are used to place constraints on the formation conditions of each of these stages. It is shown that the complex is characterised by three regional metamorphic events followed by a fourth event of contact metamorphism due to the intrusion of post-tectonic granites. The first metamorphic event experienced peak metamorphism around 705 – 715 °C and 5.2 – 5.6 kbar and subsequent isothermal decompression to the Earth's surface. The second metamorphic events attained peak conditions of 635 – 670 °C and 4.2 – 5 kbar followed by exhumation, erosion and deposition of molasse sediments. The rocks were buried for a third time and metamorphosed to greenschist facies metamorphic conditions (330 ± 30 °C and 3.6 – 4.6 kbar) under the load of the molasse sediments. Post-tectonic granites intruded at a depth of 12 km during the final Pan-African exhumation causing the fourth metamorphic event (700 ± 25 °C). Correlation of this metamorphic evolution with the deformation history shows that the first and the second metamorphic events occurred in a compression regime (D_1 and D_2), interpreted to be related to the collision between East- and West-Gondwana. While the third deformation phase began as compression regime causing the third metamorphic event, and then turned into an oblique transpressive regime which led to form escape tectonics and development of a large scale strike-slip shear zone "the Najd Fault System" This tectonic evolution accompanied several cycles of exhumation and burial indicates multistage crustal flexure during Gondwana Collision.