

Abstract

The Kabul Block is a lenticular crustal fragment that, along with the Farah, Helmand, and Nuristan terranes, is situated within a tectonic zone known as the Afghan Central Blocks. The Afghan Central Blocks form within the collision zone between the Indian, Eurasian, and Arabian plates. The Kabul Block consists of a highly-deformed crystalline basement overlain by weakly-deformed Late Paleozoic-Mesozoic sediments. U/Pb SHRIMP analysis of zircon cores from the lowermost basement formations (the Sherdarwaza and/or Khair Khana) indicates the presence of a Neoproterozoic component (~ 2700 Ma), while the majority of zircon cores yield a range of Early Paleoproterozoic ages (2200 - 2500 Ma). The Sherdarwaza and Khair Khana Formations are comprised of migmatite and orthogneiss with minor marble, quartzite, and amphibolite that reached granulite-facies conditions. Conventional geothermobarometry and phase equilibria modelling on well preserved granulite-facies assemblages indicates that the rocks reached conditions of approximately 850 °C at up to 7 kbar of pressure. Textural relations indicate that this was a strongly temperature dominated event. U/Pb SHRIMP dating of zircon rims and U-Th-Pb dating of monazite inclusions in granulite-facies garnet suggest that this event occurred in the late Paleoproterozoic (~ 1750 - 1900 Ma).

The granulite-facies assemblages are overprinted by a younger, amphibolite-facies metamorphism, and are unconformably overlain by amphibolite-facies rocks belonging to younger formations (the Kharog and Welayati) that lack paragenetic evidence for a preceding high-grade metamorphism. The Welayati Formation crops-out extensively in the south of Kabul City and consists of a variety of mica-schists and garnet-amphibolites, which contain textural relations suitable for the construction of a pressure-temperature (P-T) path. Inclusion assemblages in porphyroblastic garnet yield P-T conditions of around 525 °C and 6 kbar. Chemical zonation in garnet and phase equilibria modelling indicates that from this point garnet grew during a pressure increase of ~ 3.5 kbar over a temperature increase of ~ 125 °C. A subsequent period of near isothermal decompression of up to 2 kbar is recorded by plagioclase and biotite porphyroblasts which overgrow and cross-cut the main foliation. Ar/Ar dating of mica and U-Th-Pb dating of monazite has been used to constrain both the amphibolite-facies overprint in the Sherdarwaza and Khair Khana Formations, and the metamorphism in the Welayati Formation to the Early-Mid Neoproterozoic (~800 - 850 Ma).

Subsequent deformation and metamorphism is evidenced by the transformation of the amphibolite- and granulite-facies assemblages to lower-grade phases and by the partial resetting of geochronological systems. The lack of equilibrium assemblages precludes the constraining of P-T conditions for these transformations and the age relations are not clearly resolved. However, north from the Kabul Block, in the Western Hindu Kush, Paleozoic and Cenozoic metamorphic events are observed. Eocene pressure dominated amphibolite-facies metamorphism is recorded in Cretaceous meta-granitoids. This metamorphism occurred as a result of indentation tectonics resulting in the wedging of the Kabul Block between the Helmand and Nuristan Terranes.