



## **Proterozoic metamorphism in the Neoproterozoic Kabul Block, Afghanistan**

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The Kabul Block is an elongate crustal fragment that is situated within a tectonic zone known as the Afghan Central Blocks, which form at the triple junction between the Indian, Eurasian, and Arabian plates. Unique amongst the Afghan Central Blocks, the Kabul Block contains quantifiably Precambrian basement rocks. Recent U/Pb SHRIMP analysis of zircons from the lowermost basement formations (the Sherdarwaza and Khair Khana) indicated the presence of a small Neoproterozoic component ( $\sim 2700$  Ma), while the majority of zircon cores yielded ages of 2200-2500 Ma. The Sherdarwaza and Khair Khana Formations consist predominantly of migmatites and orthogneisses that reached granulite-facies conditions. Conventional geothermobarometry and phase equilibria modelling on well preserved granulite-facies assemblages indicate that the rocks reached peak conditions in excess of  $850^{\circ}\text{C}$  and up to 7 kbar. U/Pb SHRIMP dating of zircon rims in addition to Th/U dating of monazite inclusions in garnet suggest that this event occurred in the late Paleoproterozoic (1800-1900 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  $525^{\circ}\text{C}$  and 6 kbar. Chemical zonation in the garnet and phase equilibria modelling indicates that from this point garnet grew during a pressure increase of  $\sim 3.5$  kbar over a temperature increase of  $\sim 125^{\circ}\text{C}$ . A subsequent period of near isothermal decompression over  $\sim 2$  kbar is confirmed by the growth of plagioclase, kyanite, and biotite porphyroblasts. Ar/Ar dating of mica and Th/U monazite dating from both the Sherdarwaza and Welayati Formations indicate that the amphibolite-facies metamorphism likely occurred in the early Neoproterozoic (800-900 Ma).

Based on the litho-stratigraphic and petrological relations of the basement of the Kabul Block, two metamorphic processes are identified, the ages of which correlate well with global-scale orogenies related to the assembly of the Paleoproterozoic Columbia and Neoproterozoic Rodinia supercontinents.