Mineralogical and geochronological records of paleo- and neoproterozoic orogenies in the Kabul Block (Afghanistan)

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Two supperposed basement units (the lower Sherdarwaza and the upper Welayati) from Kabul Block were investigated. The lower is represented mostly by migmatites and gneisses that are derived from pelitic and psammitic lithologies with lenses and layers of mafic and carbonate rocks. Several bodies of orthogneisses are also exposed in the Sherdarwaza Formation. The upper unit is characterized by micaschist, quartzite and amphibolite. SHRIMP U–Pb data on zircon from the orthogneiss in the Sherdarwaza Formation indicates a Neoarchean age of ca 2.5-2.8 Ga for their magmatic crystallization. The rocks exhibit granulite facies conditions of 5-7 kbar and 800°C and show a Paleoproterozoic age of ca. 1.85-1.80 Ga for this metamorphism that was obtained using U-Pb dating on zircon and U-Th dating on monazite. Mineral textural relations also show a younger amphibolite facies metamorphism that is documented in both the Sherdarwaza and Welayati formations. This metamorphism occurred at relatively higher pressure conditions of up to 9 kbar at ca. 650 °C, compared to the granulite facies event. A Neoproterozoic age of ca 0.85-0.9 Ga, for this metamorphism is confirmed by Ar-Ar data on biotite and white mica as well as by U-Th data on monazite. By combining the presented results on the metamorphic petrology, geochronology and geochemistry, we conclude that: (1) The Kabul basement is a fragment of an Archean block (craton); (2) the ca. 1.85-1.8 and 0.9-0.85 Ga metamorphism marks an important orogenic events for the basement rocks of the Kabul Block which was stabilized during the early Precambrian; (3) the two metamorphic ages correlate well with global-scale orogenies related to the assembly of the Paleoproterozoic Columbia and Neoproterozoic Rodinia supercontinents; (4) based on metamorphic characteristics and ages, the Kabul basement rocks show an affinity to the Neoarchean rocks of the Tarim and/or South China cratons.