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Pelitic high-pressure granulites from the Huai'an Complex, North China Craton: Metamorphic evolution and geological significance

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Previous studies suggest that the khondalite series from the north-central part of the North China Craton (NCC) was metamorphosed at low- to medium-P granulite facies conditions, contrasting with adjacent mafic high-P granulite terranes [1,2]. We report pelitic high-pressure granulites recognized in the Manjinggou area of the Huai'an Complex, which is the first locality for discovery of mafic high-pressure granulites in the NCC [4], providing robust evidence that the khondalite series also underwent a comparable high-pressure granulite facies stage before intensive medium-P granulite facies retrogression. Relict Grt–Ky–Kfs-bearing associations characterize the peak mineral assemblages of the pelitic granulites, and the subsequent medium-P granulite facies retrogression is characterized by Grt–Sil–Kfs-bearing assemblages. The estimated metamorphic peak and retrograde granulite facies conditions are around 11.5–15 kbar, 810–860 ^{o}C and ~9.5 kbar, ~850 ^{o}C, respectively, comparable with published P–T conditions of the associated garnet-bearing mafic granulites [2]. Combined with field geological work and available geochronological data, we propose that both pelitic and mafic granulites shared a similar metamorphic and deformation history from 1.96–1.90 Ga to 1.88–1.82 Ga, corresponding to high-P and medium-P granulite facies stages, respectively [1,3]. This finding contrasts with previous views, which consider pelitic rocks and associated mafic granulites as different slabs with individual metamorphic histories [1].

Similar cases are also reported from other localities of the NCC, where the protolith of mafic high-pressure granulites occurred as dykes intruding the khondalite series, and were then deformed and metamorphosed together. Hence we consider that the metamorphic histories of the pelitic and associated mafic granulites in almost all localities are coherent [5]. Furthermore, relict kyanites are also reported in some pelitic granulites imprinted with UHT granulite facies metamorphism from the northern margin of the NCC, indicating that those granulites had probably experienced high-pressure granulite facies metamorphism. It is suggested that such phenomena might be a common metamorphic feature in the whole NCC, and these Paleoproterozoic granulite facies rocks likely formed in similar tectono-metamorphic settings. Moreover, these high-pressure–high-temperature granulite facies rocks record higher apparent geothermal gradients and slower exhumation rates, within the thermal regime of medium-P/T metamorphic facies series, different from those HP–UHP rocks under Phanerozoic plate tectonic regimes [5]. It seems to indicate that the thermal regimes and tectonic mechanisms of the Paleoproterozoic probably have differenced from those of the Phanerozoic Eon.

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