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Mineral inclusions in zircons of S-type granite: implications for high pressure metamorphism history of meta-sedimentary rocks in the Huai'an terrain, North China Craton

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The Paleoproterozoic evolution of North China Craton (NCC) arises many argument as geologists have different viewpoints on the distribution and metamorphic history of mafic granulites and granulite facies meta-sedimentary rocks. To provide more evidence of constraining the metamorphic history of granulite facies meta-sedimentary rocks, we select granulite facies meta-sedimentary rocks and co-existing S-type granite in the Huai'an terrain to make a deep research. Magmatic zircons derived from the S-type granite reveal the magmatic age of ∼1.95 Ga and metamorphic age of ∼1.85 Ga with εHf(t) value of -4.5 – -0.5. The εHf(t) value of S-type granite and relict of garnet-sillimanite gneiss suggest that the S-type granite is generated by melting of meta-sedimentary rocks. Zircons with ages of ∼1.95 Ga and ∼1.85 Ga have the mineral inclusions of Ky + Qz + Ru + Pl and these mineral inclusions are determined by method of Laser-Raman. The ∼1.95 Ga magmatic zircons with inclusions of Ky + Qz + Ru + Pl suggest that meta-sedimentary rocks have mineral assemblages Ky + Qz + Ru + Pl. However, previous studies in the Huai'an terrain showed that almost granulite facies metamorphic condition of meta-sedimentary rocks were regarded as medium pressure by considering the Sill + Grt + Bt + Pl + Qz + Ru + Kf. Presence of kyanite instructs that meta-sedimentary rocks may experience high pressure granulite facies metamorphism. According to pseudosection calculation by using effective bulk composition of garnet-sillimanite gneiss, mineral assemblage of Grt + Ky + Pl + Bt + Qz + Ru + Kf is regarded as the peak stage of high pressure metamorphism. This mineral assemblage is occurred at field of 1033 – 1123 K and 9 – 15 Kbar and the peak pressure is around 11 – 13 Kbar, determined by the X_{Mg} and X_{Ca} isopleths of garnet. This P-T result is consistent with peak condition of high pressure mafic granulite. Considering the ∼1.95 Ga magmatic age of S-type granite generated by decompression partial melting of meta-sedimentary rocks, we propose that the high pressure granulite facies metamorphism on meta-sedimentary rocks before or around 1.95 Ga. Integrating 1.95 Ga metamorphic age recorded in the high pressure mafic granulite occurred in Huai'an terrain, we deduce that mafic granulite and meta-sedimentary experience the similar granulite facies metamorphism since ∼1.95 Ga. Additionally, inclusions of kyanite occurred in ∼1.95 Ga and ∼1.85 Ga zircons may be a robust evidence that ∼1.85 Ga zircons are recrystallized from ∼1.95 Ga magmatic zircons. Based on these results and deduction and related previous data, we suggest that Huai 'an terrain experienced the continental collision since ∼1.95 Ga.

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