Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18856

Petrogenesis of the ~2.5 Ga mafic rocks in the eastern North China Craton: Implications for the Neoarchean ocean subduction and micro block amalgamation

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Whether plate subduction or mantle plume activity dominated the formation of the Archean crust is hotly debated. The Neoarchean crust-mantle interaction and crustal evolution are instructive of continental crustal growth and cratonic evolution processes. We present a systematic study of the petrology, geochemistry, and geochronology of amphibolite enclaves in Neoarchean granitoids and amphibolite lenticles in Neoarchean supracrustal rocks from the eastern Hebei area in the North China Craton. The amphibolites are characterized by low to moderate SiO_2 content (45.18-56.59 wt%), high MgO ($Mg^{\#}$ = 0.44-0.75), Cr and Ni contents, depletion in high field strength elements (Nb, Ta, Zr, Hf) and enrichment in light rare earth elements (Rb, Ba). The protoliths were calc-alkaline gabbros and gabbroic diorites with LA-ICPMS zircon U-Pb ages of 2554-2472 Ma, positive zircon $\varepsilon Hf_{(t)}$ values of +0.91 to +5.54, and T_{DM1} model age peaks at ~2.7 Ga. They were derived from the partial melting of a lithospheric mantle source that was subsequently enriched by slab-derived fluids and melts under different crustal levels in an extensional back-arc setting. Subsequent amphibolite-facies metamorphism affected these intrusive rocks, suggested by mineral assemblages of magnesio-hornblende, plagioclase (An = 0.38-29.7), and magnesian biotite with minor edenite and phlogopite. Combining our results with existing data, we identify a transition of arc-related magmatism from tholeiitic series to calc-alkaline series from northwest to southeast in the eastern Hebei area. It is inferred that a southeast-dipping subduction of oceanic crust beneath the eastern Hebei occurred at 2.61-2.45 Ga. There were four main stages of crustal growth in the Eastern Block of the North China Craton from ~3.0 Ga to 2.5 Ga. Multipolar subduction and accretion around several ancient continental nuclei resulted in the final amalgamation and stabilization of the craton.