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A Neoarchean Subduction Polarity Reversal Event in the North China Craton: Evidence from 2.5 Ga Mafic Dikes and Coeval Granites

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Fabrics of an Archean mélange belt in the Zanhuang Complex of the North China Craton (NCC) were intruded by mafic dikes and a granite pluton (Deng et al., 2013; Wang et al., 2013). Igneous zircons from an undefomed mafic dike yield a $^{207}Pb/^{206}Pb$ age of 2535 Ma, interpreted as the crystallization age. In addition, pegmatites cutting across the mafic dikes in the field also yield an igneous zircon $^{207}Pb/^{206}Pb$ age of 2504 Ma, proving that the mafic dikes in the NCC intruded during the Neoarchean (Deng et al., 2014). Trace element systematics of the mafic dikes indicates an arc-related lithospheric mantle source region, rather than an ocean island basalt (OIB)-like source region. The whole rock Nd isotopic composition ($\varepsilon_{Nd}(t)$= +0.71 to +3.70) is relatively more evolved compared to that of the depleted mantle at 2.5 Ga, indicating an enriched lithospheric mantle source. Accordingly, the 2.5 Ga mafic dikes in the Zanhuang Complex are proposed to have formed in a subduction-related environment and their enriched mantle source was metasomatized by the melts and fluids derived from the subducted slab (Deng et al., 2014). In addition, the granite pluton also yields a 2.5 Ga intrusion age, indicating its intrusion is coeval with the dike intrusion. The 2.5 Ga granite pluton is characterized by A-type potassic granite affinities and positive $\varepsilon_{Nd}(t)$ values (Wang et al., 2015). Based on our overview of 2.5 Ga mafic dikes across the NCC, we suggest that 2.5 Ga mafic dikes are widely distributed in the Central Orogenic Belt (COB) and the Eastern Block of the North China Craton (NCC) and are considered to constitute 2.5 Ga deformed mafic dike swarms (Deng et al., 2014). 2.5 Ga potassic granites of the NCC also occur both in the COB and the Eastern Block and are synchronous with intrusion of the 2.5 Ga mafic dikes of the NCC (Wang et al., 2015). We propose that these 2.5 Ga potassic granites of the NCC are the contemporary counterparts of the 2.5 Ga mafic dikes. Accordingly, the 2.5 Ga mafic dikes and granites are interpreted to have formed after an arc–continent collision between the Eastern Block which is defined as a continental block and an oceanic arc terrane belt developed in what is now the COB of the NCC. A subduction polarity reversal event placed a new slab beneath the collisionally modified margin of the Eastern Block and converted it to an Andean-type margin after the arc-continent collision. The subduction polarity reversal event at ca. 2.5 Ga resulted in melting of the enriched mantle, giving rise to the intrusion of 2.5 Ga mafic dikes. Meanwhile, the rising magma induced partial melting of the older and thickened TTG crust leading to the intrusion of ca. 2.5 Ga potassic granites. The Neoarchean subduction polarity reversal event and prior arc–continent collision provide strong evidence that plate tectonics was operated by the end of the Neoarchean.

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