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Geochemical and Isotopic studies on the Xiyanghe Volcanics at the Southern Margin of the North China Craton

Y.H. He, G.C. Zhao and M. Sun

Department of Earth Sciences, the University of Hong Kong, Hong Kong, Hong Kong (h0492037@hkusua.hku.hk)

A major advance has been made in understanding the history of the North China Craton, with the recognition of the Trans-North China Orogen, which separates the craton into the Western and Eastern Blocks. There is now a coherent outline of the timing and tectonic processes involved in the Palaeoproterozoic amalgamation and much intensive knowledge concerning the pre-collisional history of the Eastern and Western Blocks that were subsequently incorporated into the North China Craton. However, much of the post-collisional history of the craton remains unknown. The Xiyanghe volcanics, together with the Xiong'er volcanics, constitute a large Paleo-Mesoproterozoic volcanic belt along the southern margin of the North China Craton, but their petrogenesis and tectonic setting still remain controversial, with one school of thought proposing that they were the products of within-plate magmatism, whereas others argue that they formed under a continental margin arc environment. In this study, we provide geochemical and Sr-Nd isotopic data for the Xiyanghe volcanics, which provide important constraints on their petrogenesis and tectonic environment.

The Xiyanghe volcanics could be subdivided into three units: BA1 (basaltic andesites-1), BA2 (basaltic andesites-2) and andesites, all of which show consistent ε_{Nd}(t), La/Nb and Th/Nb values irrespectively of SiO_2, precluding significant crustal contamination during ascent. Based on the covariation between La and La/Sm_N, the BA2 unit shows the trend of partial melting processes with the BA1 unit representing the major products of a magma chamber, whereas the andesites may fractionally crystallize from the BA1. The BA2 unit is characterized with variable Ti/Eu, Zr/Sm and Nb/La ratios, suggesting that amphiboles have been involved in a partial melting process, which im-

plies that the Xiyanghe volcanics were derived from hydrous magma. A large range in initial Sr (0.7039 to 0.7111) and a relatively narrow range in $^{143}Nd/^{144}Nd$ (εNd = -6.8$\sim$-10) suggest inheritance of the enriched Nd-isotopic composition from the mantle wedge metasomatized by slab derived fluid. On the primitive mantle normalized trace-element diagrams, the Xiyanghe volcanic rocks show enrichments in the LILE and LREE and negative anomalies on the Nb-Ta-Ti, similar to arc-related volcanics produced by the hydrous melting of the metasomatized mantle wedge. The BA1 rocks and andesites show HSFE enrichments (especially Nb $>$ 6 ppm) and high Fe-Ti contents, comparable with Nb-enriched basalts, suggesting that the Xiyanghe volcanics were derived from a metasomatized mantle source, similar to that of Nb-enriched basalts. The Xiyanghe volcanics were produced by the slab dehydration-induced melting of an existing metasomatized mantle source in the Paleo-Mesoproterozoic, and the fluids from the slab dehydration introduced significant LILE and LREE to the source, masking its inherent HEFE-enriched characteristics. The arc-related characteristics of the Xiyanghe volcanic rocks suggest a subduction zone at the southern margin of the North China Craton in the Paleo-Mesoproterozoic, implying that the craton may have recorded the outbuilding history of the Columbia Supercontinent during Paleo-Mesoproterozoic time.

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