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PETROGENESIS AND TECTONIC IMPLICATION OF THE NEOPROTEROZOIC BONINITIC-THOLEIITIC LAVAS AND MAGNESIAN ANDESITES IN THE GORNY ALTAI TERRANE, NORTHWESTERN CENTRAL ASIAN OROGENIC BELT

Ming Chen[1, 2], Min Sun[2], Jianping Zheng[1]

[1] *School of Earth Sciences, China University of Geosciences (Wuhan), Wuhan 430074, China*
[2] *Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong, China*

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The late Neoproterozoic tholeiitic-boninitic lavas and minor magnesian andesites cropping out in the Kurai Ridge, southeast of the Gorny Altai terrane, represent magmatic products of the nascent Kuznetsk-Altai intra-oceanic island arc southwest off the Siberian continent. Samples of these rocks can provide key information about sub-arc mantle and slab-mantle interaction during the early phase of ocean-ocean subduction.

The high-Ti tholeiitic lavas yield rare earth elements (REEs) patterns as well as Sm/Yb, Zr/Yb and Ti/V ratios comparable to, but Nb/La ratios lower than, those of the E-MORB. Combining with the depleted Nd isotopic compositions and minor enrichment of Th, we suggest that the high-Ti tholeiitic lavas were possibly formed by decompression melting of the upwelling asthenospheric mantle in a back-arc basin with subtle involvement of slab-derived components. In contrast, the boninitic rocks possess extremely low REEs and high field strength elements (HFSEs) with the most primitive ones characterizing high CaO/Al_2O_3 ratios, indicating a clinopyroxene-poor harzburgitic source that had been depleted by previous melt extraction. The enrichment of large ion lithosphere elements (LILEs; e.g., Ba) and Th, coupled with enriched Nd-Hf isotopic compositions, require minor involvement of both aqueous fluid from the downgoing basaltic oceanic crust and hydrous siliceous melt (<5 %) from the subducted sediments in their mantle source. The distinctly high Ti/Zr and low Zr/Sm ratios of these rocks further suggest that garnet possibly formed in the residue after partial fusion of

the subducted sediments, controlling the trace-element budget of the slab-derived components. Taken together, our data point out that the boninitic rocks from the Kurai Ridge were possibly formed in a back-arc basin-related setting. The low-Ti tholeiitic lavas show trace-element and Nd isotopic compositions intermediate between those of the boninitic rocks and high-Ti tholeiitic ones. We infer that these low-Ti rocks either represent island arc tholeiitic basaltic rocks that had been generated during the proto-arc stage or formed by mixing of partial melts from the refractory lithospheric mantle (i.e., the source of the boninitic rocks) and upwelling asthenospheric mantle (i.e., the source of the high-Ti tholeiitic lavas). The magnesian andesites yield higher REEs concentrations, stronger enrichment of Th, and more enriched Nd isotopic compositions relative to the boninitic rocks. Geochemical modeling suggests that about 10 % sediment-derived siliceous melts were added into their mantle source. The high Zr/Sm ratios further imply that the partial melting of these sediments occurred in a relatively shallow depth where amphibole existed in the residue. Accordingly, these magnesian andesites probably formed more adjacent to the trench.

Our data suggest that back-arc basin initiation or propagation was possibly responsible for producing the volcanic suite from the Kurai Ridge, where variable components from the subducted slab and overlying mantle in a potentially paired arc–back-arc system made a significant contribution. The available data imply that similar tectonic scenarios might prevail during the early phase of many intra-oceanic island arcs and possibly contributed to the formation of numerous supra-subduction zone ophiolites.

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