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FOREARC MANTLE METASOMATISM BY ^{11}B-DEPLETED FLUIDS FROM A HIGHLY DEHYDRATED SLAB: A SNAPSHOT OF SLAB ROLL-BACK?

Yunying Zhang[1], Chao Yuan[1], Min Sun[2], Xiaoping Long[3], Yingde Jiang[1], Pengfei Li[3]

[1] *State Key Laboratory of Isotope Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China*
[2] *Department of Earth Sciences, The University of Hong Kong, Pokfulam Road, Hong Kong, China*
[3] *State Key Laboratory of Continental Dynamics, Department of Geology, Northwest University, Northern Taibai Str. 229, Xi'an 710069, China*

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Accretionary orogens form along convergent plate margins due to the ongoing subduction of oceanic lithosphere, and comprise accretionary prisms, magmatic arcs, back-arc domains, ophiolitic mélanges and possibly oceanic plateaus and continental fragments [*Condie, 2007; Cawood et al., 2009*]. Based on the dips and velocities of subducting slabs, accretionary orogens can be divided into retreating and advancing type, as exemplified by modern SW Pacific and Andes, respectively [*Royden, 1993; Cawood et al., 2009*]. As the largest accretionary orogen in the world, the Central Asian Orogenic Belt (CAOB) has been considered to form in a way resembling modern SW Pacific [*Şengör et al., 1993; Windley et al., 2007*]. Hence, the retreat of downgoing slab (i.e., slab roll-back) could have played an important role in the development of the CAOB [*Xiao et al., 2004*]. However, recognition of the retreat of a subducted slab is not straightforward in an ancient orogenic belt. One way to recognize this process is to identify deep-derived fluids in the forearc. We present new whole-rock B isotopic data for the late Carboniferous (318–312 Ma) granodioritic and dioritic dykes in the Langwashan area from the Beishan orogenic collage, southern CAOB, aiming to investigate what kinds

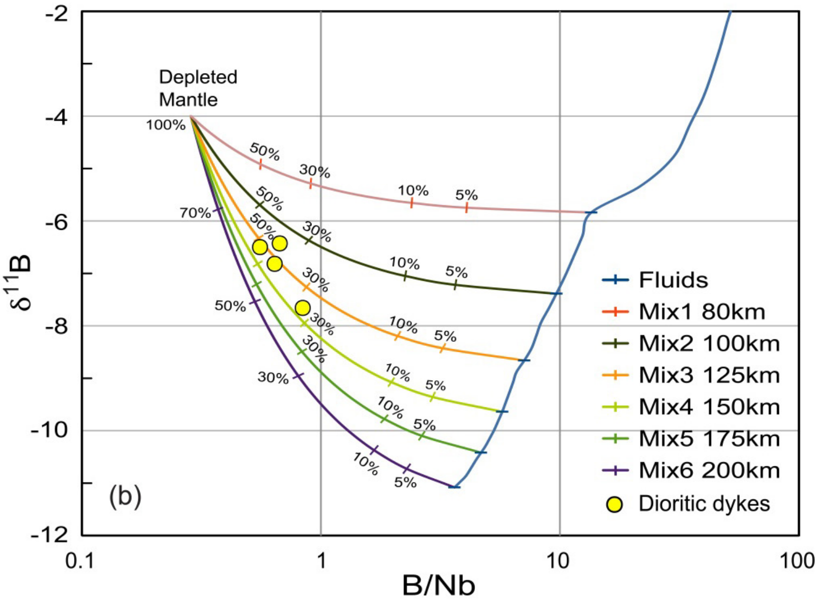

Fig. 1. Plot of $\delta^{11}B$ versus B/Nb showing the mixing relations between the depleted mantle wedge and fluids derived from dehydrating slab.

of slab-derived fluids modify the mantle wedge. The granodioritic dykes show high Mg#, and high Sr/Y, La/Yb and Na_2O/K_2O ratios, low Y and Yb contents, and MORB-like Sr–Nd isotopes and high zircon $\varepsilon_{Hf}(t)$, similar to slab-derived adakite, indicating that they were likely formed by partial melting of subducted oceanic crust. The dioritic dykes exhibit typical subduction-like geochemical signatures, together with relatively high Mg#, high $\varepsilon_{Nd}(t)$ and $\varepsilon_{Hf}(t)$ and low initial Sr isotopes, suggesting a subduction-modified mantle. The coeval adakitic and normal dioritic dykes reflect a thermal anomaly that was probably caused by roll-back of subducted oceanic slab. The dioritic dykes have $\delta^{11}B$ values from −7.7 to −6.4 ‰, whereas the adakitic dykes have relatively high $\delta^{11}B$ values from −6.9 to −4.4 ‰. The $\delta^{11}B$ values of adakitic dykes are lower than those of typical altered oceanic crust, in agreement with the expected loss of ^{11}B from subducted oceanic slab during

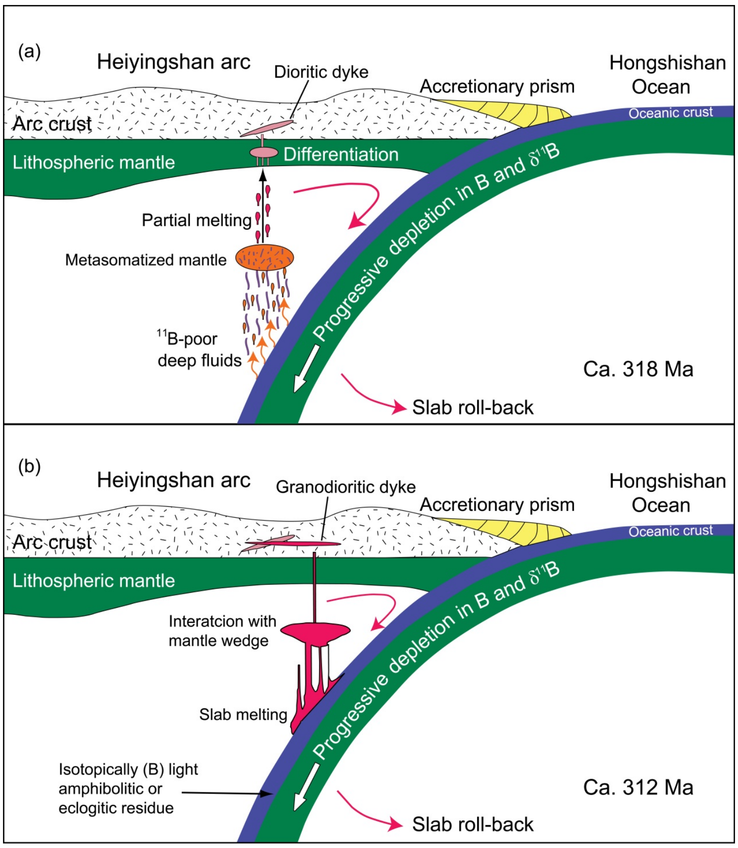

Fig. 2. Cartoon illustrating the production of the Late Carboniferous (318–312 Ma) dioritic and granodioritic dykes in the northern Beishan.

The Hongshishan oceanic lithosphere, characterized by a high-angle dip as a result of slab roll-back, subducted southward beneath the Heiyingshan arc. *a* – fractional crystallization of a mantle-derived magma, which was metasomatized by deep-derived fluids with light $\delta^{11}B$ values released from the deep portion of the subducted oceanic slab, led to the formation of the dioritic dykes; *b* – partial melting of the subducted slab, triggered by thermal disturbance of the upwelling asthenospheric mantle flow, resulted in the generation of the granodioritic (adakitic) dykes.

early subduction. The $\delta^{11}B$ values (–7.7 to –6.4 ‰) of the dioritic dykes are lower than that of MORB ($\delta^{11}B \approx -4$ ‰) [*Chaussidon, Marty, 1995*], reflecting that their mantle source has been hybridized by ^{11}B-poor fluids released from a highly dehydrated slab at deep depths. Results of a mixing model indicate that the B/Nb ratios and B isotopic compositions of the dioritic dykes can be explained by mixing of 30–50 % B contribution from the depleted mantle with 50–70 % B from highly dehydrated fluids liberated at a deep depth of 125–150 km, as shown in Figure 1. Considering the dykes from the forearc, it is proposed that metasomatism of subarc mantle by ^{11}B-depleted fluids expelled from a highly dehydrated slab at deep depth could be a snapshot of slab roll-back (Fig. 2).

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