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Episodic trench advance and retreat in the North Tianshan Ocean: Insights from Carboniferous magmatism in the Aqishan-Yamansu Belt, Chinese Eastern Tianshan

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Subduction-accretion processes in accretionary orogens are critical for understanding the thermal evolution and geodynamics of the lithosphere, as well as the growth and destruction of continental crust. To trace the Carboniferous tectonic evolution of the Chinese Eastern Tianshan, a systematic study has been conducted on the Carboniferous magmatism in the Aqishan-Yamansu Belt. Two distinct episodes of magmatism are now recognized, the Early Carboniferous arc-related high magnesian andesitic porphyrite and the Pennsylvanian high-alumina basalt. These magmatic rocks experienced variable degrees of interaction between depleted mantle, mantle wedge, and subducting slab-/sediment-derived fluid/melt. Combining with published data, we propose that the Aqishan-Yamansu Belt underwent a transition from a continental arc to an continental intra-arc basin during the Carboniferous, induced by episodic trench advance and retreat of the southward subduction of the North Tianshan Ocean (Fig. 1). Lower values of whole-rock $\varepsilon_{Nd}(t)$ and zircon $\varepsilon_{Hf}(t)$, as well as zircon (age – T_{DM})(event signature curves) troughs and zircon (T_{DM}^{C} – age) (crustal incubation time) peaks in the Early Carboniferous and middle-late Pennsylvanian correspond to two phases of trench advance. Conversely, higher values of whole-rock $\varepsilon_{Nd}(t)$ and zircon $\varepsilon_{Hf}(t)$, as well as zircon (age – T_{DM}) peaks and zircon (T_{DM}^{C} – age) troughs in the early Pennsylvanian record a period of trench retreat, which caused the splitting of the Central Tianshan arc and formation of the Aqishan–Yamansu intra-arc basin. Transition from subduction to collision may have occurred in the Chinese Eastern Tianshan during the latest Carboniferous owing to the continued southward subduction of the North Tianshan Ocean. Episodic trench advance and retreat contributed to the closure of the trench-arc-basin system and the final assembly of the Chinese Eastern Tianshan.

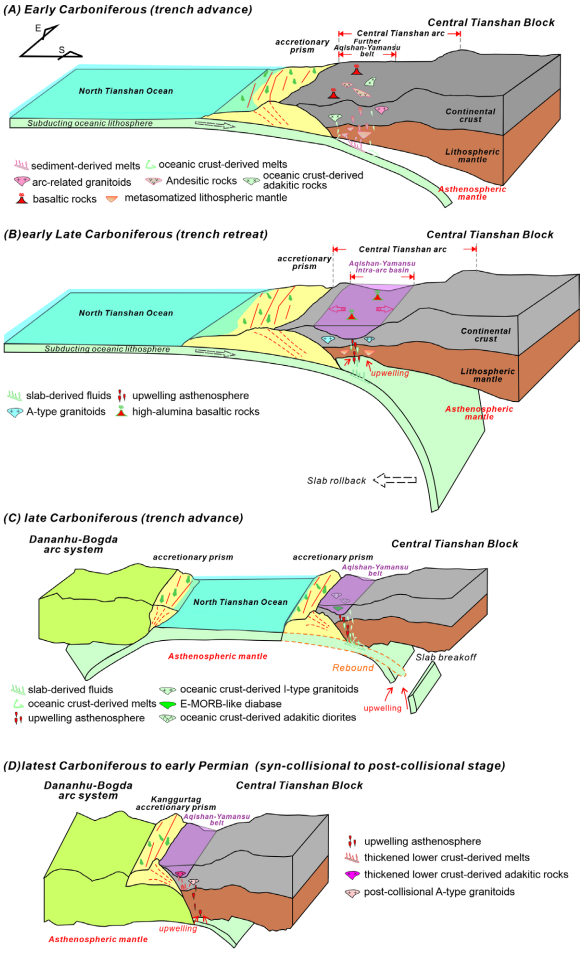

Figure 1