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Early Carboniferous Paleo-Asian oceanic plate subduction: Implications from geochronology and geochemistry of early Carboniferous magmatism in southern West Junggar, NW China

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The subduction and closure of the Paleo-Asia Ocean generated the Central Asian Orogenic Belt (CAOB), which extends from the Urals in the west through Kazakhstan, northwestern China, Mongolia, and northeastern China to the Russian Far East. It is generally accepted that the CAOB comprises a complicated and varied collage of terranes, including island arcs, ophiolites, accretionary prisms, seamounts, and microcontinents. The CAOB is the world's largest accretionary orogen and is also considered a type area for studying Phanerozoic continental growth. The accretionary processes of the orogen might have resulted from either the progressive duplication of a single and long-lived island-arc system or the collision of several island arcs and micro-continents, similar to the complex archipelago systems in the modern southwestern Pacific. West Junggar is located in a key area of the CAOB, has been a focus of studies of the tectonic evolution and crustal growth of the orogenic belt. West Junggar has been considered by some geologists as a paleo-Asian intra-oceanic subduction system, whereas others have variously argued that West Junggar was formed by single subduction, arc–arc collision, or ridge subduction, or by post-collisional processes after the early Carboniferous. An understanding of the Carboniferous tec-tonic setting is critical for determining the evolution of West Junggar. A series of early Carboniferous volcanic and intrusive rocks occur in the southern West Junggar. Our new zircon U–Pb geochronological data reveal that diorite intruded at 334.1 ± 1.1 Ma, and that basaltic andesite was erupted at 334.3 ± 3.7 Ma. These intrusive and volcanic rocks are calc-alkaline, display moderate MgO (1.62–4.18 wt.%) contents and Mg# values (40–59), low Cr (14.5–47.2 ppm) and Ni (7.5–34.6 ppm) contents, and are characterized by enrichment in light rare-earth elements and large-ion lithophile elements and depletion in heavy rare-earth elements and high-field-strength elements, meaning that they belong to typical subduction-zone island-arc magma. The rocks show low initial $^{87}Sr/^{86}Sr$ ratios (0.703649 to 0.705008), positive $\varepsilon_{Nd(t)}$ values (+4.8 to +6.2, mean +5.4), and young T_{DM} Nd model ages ranging from 1016 to 616 Ma, indicating a magmatic origin from depleted mantle involving partial melting of 10%–25% garnet and spinel lherzolite. Combining our results with those of previous studies, we suggest that these rocks formed as a result of northwestward subduction of the Paleo-Asian Junggar oceanic plate, which caused partial melting of sub-arc mantle. We conclude that intra-oceanic arc magmatism was extensive in

southern Paleo-Asian Ocean during the early Carboniferous.

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