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Crustal growth and reworking of the southeastern Central Asian Orogenic Belt during late Paleozoic: Evidence from the magmatism in central Inner Mongolia, China

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The Central Asian Orogenic Belt (CAOB) is one of the largest accretionary orogens in the world. Most Phanerozoic granitoids in the orogenic belt display positive $\varepsilon_{Nd}(t)$ values and young model ages, and the CAOB is considered to be the most important site of juvenile crust growth since the Neoproterozoic [1]. However, Kröner et al. [2] reassessed the continental growth of the CAOB and put forward that both juvenile material and abundant reworking of older crust with varying proportions were involved during the evolution of the CAOB. Central Inner Mongolia is situated at the southeast part of the CAOB, where the closure of the Paleo-Asian Ocean and the collision between the Siberian and the Sino-Korean paleoplates occurred during late Paleozoic. The crust of this area underwent significant growth and reworking with the closure of the Paleo-Asian Ocean. To elucidate the evolutionary characteristics of the crust, we carried out detailed geochronological, petrological and geochemical studies on the late Paleozoic magmatism in this area.

Geochronological analyses suggest that the late Paleozoic magmatism is continuous and can be divided into three stages: late early Carboniferous–late Carboniferous (326-300 Ma), late early Permian (287-271 Ma) and late Permian–early Triassic (259-246 Ma). During the first stage, the magmatism is mainly composed of calc-alkaline diorite, quartz diorite, granodiorite and granite. The $\varepsilon_{Nd}(t)$ values of some granitoids are positive (+5.6 to +6.2), which indicate that they were derived from juvenile crust; and some granitoids have negative $\varepsilon_{Nd}(t)$ values (-4.83 to -2.97), which are similar to those of the Xilin Gol Complex nearby and suggest that they were originated from partial melting of the metamorphic complex. Additionally, the $\varepsilon_{Nd}(t)$ values of most granitoids are between those above, indicating a mixed magmatic source.

The late early Permian volcanism is a suite of bimodal assemblage. The mafic rocks are composed of sub-alkaline basalt, basaltic andesite, basaltic trachyandesite and trachyandesite. They are rich in Th, U and LILEs, depleted in HFSEs of Nb, Ta and Ti and have positive $\varepsilon_{Nd}(t)$ values (+3.44 to +7.90). Geochemical analyses indicate that they were originated from a metasomatized lithospheric mantle beneath a subduction zone. While the $\varepsilon_{Nd}(t)$ values of the felsic end-members are slightly lower (+1.85 to +3.60), which are similar to the average values of the late Carbonifeours arc rocks. So it is suggested that they were originated from partial melting of the juvenile arc-related rocks.

The volcanic rocks of late Permian–early Triassic are mainly basalt, trachybasalt, basaltic andesite and shshonite, together with minor andesite, dacite and rhyolite. Geochemical analyses indicate that the mafic rocks originated from a depleted lithospheric mantle, with $\varepsilon_{Nd}(t)$ values being from +4.38 to +9.23. The felsic rocks have slight lower $\varepsilon_{Nd}(t)$ values (+2.18 to +5.08) and might be formed through fractional crystallization by the mafic magma with some assimilation of crust. The intrusive rocks are mainly granodiorite, granite and minor gabbro. The zircon $\varepsilon_{Hf}(t)$ values of gabbros are from +8.3 to +14.0, which indicates that they share the same sources with the mafic volcanic rocks. The granitoids have similar zircon $\varepsilon_{Hf}(t)$ values (+8.6 to +14.4) and variable $(La/Yb)_N$ values, which suggest that they were formed by partial melting of the new-born lower crust at different depth.

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References:

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