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Late Paleozoic slab rollback events in the southeastern part of the Central Asian Orogenic Belt: implications for Paleo-Asian Ocean subduction and continental crust growth

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The Central Asian Orogenic Belt (CAOB) is considered to be the largest Phanerozoic accretive orogenic belt on Earth. The Late Paleozoic magmatic rocks in central Inner Mongolia are crucial for understanding continental crust (CC) growth and the tectonic evolution of the southeastern part of the CAOB. We present comprehensive geochemical, isotopic, and geochronological data of three Late Paleozoic magmatic units in the Mandula area, west of the Solonker Suture Zone. Zircon U-Pb dating indicates that these rocks formed during the Late Carboniferous (315-304 Ma). The Mandula high-Mg diorites exhibit high MgO (3.9-6.5 wt.%), high Mg# (61-69), and depleted Nd-Hf isotopic compositions, which were generated through the interaction between a metasomatised mantle and a melt derived from the slab including the overlying sediments. The Mandula granodiorites exhibit adakite geochemical characteristics with high Sr/Y mass ratios (29-52), high MgO (1.7-2.2 wt.%), and Mg# (52-54), which indicate subduction of oceanic crust and partial melting of the overlying sediment. Mafic microgranular enclaves (MMEs) exhibit consistent ages, Sr-Nd-Hf isotope compositions, and hornblende crystallization temperatures-pressure conditions with their host granodiorite. They are formed from a cognate magma associated with the host granodiorites through rapid crystallization during ascent. We propose that slab rollback took place in two phases during the Late Paleozoic southward subduction-accretion of the PAO. The first phase is related to the transformation of a low- to a medium-angle slab subduction and the second phase is associated with subduction-related extension. Considering the tectonic-magmatic evolution, crustal maturity, and thickness variations in the Late Paleozoic southeastern part of the CAOB, we propose that long-term slab rollback accretion and subduction resulted in CC growth. At least 56% of the southeastern part of the CAOB consists of juvenile crust, highlighting significant Late Paleozoic CC growth. The CAOB coincides temporally and spatially with the Phanerozoic Pangaea cycle, suggesting that continuous subduction and amalgamation of supercontinents led to significant CC growth.