

Early and Late Paleozoic mafic dykes in South Qinling, central China: Evidence for evolution of the Paleo- Tethys Ocean

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Mafic dykes commonly existing in extensional settings can record vital facts for understanding nature of the mantle and tectonic evolution in orogenic belts. Here we report zircon U-Pb ages and whole-rock Sr-Nd-Hf isotopic compositions of mafic dykes densely exposed in the Daba Mountains of South Qinling. They are dominated with gabbro and diabase. Zircon ages suggest two magmatic episodes of ~450-440 Ma and ~290-280 Ma. Dykes from two episodes share similar geochemical features in major elements and Sr-Nd-Hf isotopic compositions, but distinctive characteristics in trace elements. Dykes of both episodes have variable initial $^{87}\text{Sr}/^{86}\text{Sr}$ values from 0.7034 to 0.7070, and high initial ϵ_{Nd} and ϵ_{Hf} values (1.9-4.7; 4.1-7.1). Early Paleozoic dykes are characterized by enrichment in LILEs and HFSEs, with an OIB-like mantle source. Late Paleozoic dykes display enrichment in LILEs but depletion in HFSEs, akin to arc rocks. Similar isotopic characteristics were also reported for Early Paleozoic mafic rocks exposed in adjacent terranes, such as the East Kunlun and South Qilian orogenic belts and the northern Yangtze block in previous studies.

Geochemically, sources of these dykes are similar to the lithospheric mantle metasomatized by subducted slab derived fluids probably in Neoproterozoic, with negligible crustal contamination. We propose that Early Paleozoic mafic dykes intruding in the Early Silurian strata record crustal extension in the South Qinling belt. They represent magmatic products of initial splitting of South Qinling from the northern Yangtze Block and subsequent opening the Paleo-Tethys Ocean. In Early Permian, northward subduction of the oceanic plate led to partial melting of the lithospheric mantle, producing arc-akin mafic dykes.