The recycling of subducted Paleotethyan oceanic crust: Geochemical evidence from Paleozoic mafic igneous rocks in the Tongbai orogen, central China

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It has been a paradigm that the recycling of subducting oceanic crust and crust-mantle interaction produce syn-subduction arc volcanics at convergent plate margins. While this process is easily traced in modern oceanic subduction zones, it is difficult for fossil oceanic subduction zones due to modification by subsequent arc-continent or continent-continent collision. A combined study of zircon U-Pb ages and Hf-O isotopes, whole-rock major-trace elements and Sr-Nd-Hf isotopes was carried out for the Paleozoic gabbroic diorites from the Tongbai orogen, central China, the results provide geochemical evidence for the recycling of subducted Paleotethyan oceanic crust. SIMS zircon U-Pb dating yields ages of 435 ± 5 to 449 ± 4 Ma for their magma emplacement. They have arc-like trace element distribution patterns, with enrichment in LILE and LREE but depletion in HFSE. They show depleted whole-rock Sr-Nd-Hf isotope compositions, with initial $^{87}Sr/^{86}Sr$ ratios of 0.7037 to 0.7047, $\varepsilon_{Nd}(t)$ values of 2.6 to 4.9, and $\varepsilon_{Hf}(t)$ value of 7.8 to 13.9. Zircons from the gabbroic diorites exhibit various $\varepsilon_{Hf}(t)$ values of 8.5 to 14.7 and $\delta^{18}O$ values of 4.4 to 5.9‰, some of them are either lower or higher than those of normal mantle zircons (5.3 ± 0.3‰). While most samples have high Ba/Th and low Th/Nb ratios, a few samples have low Ba/Th and high Th/Nb ratios. The above geochemical results indicate that these gabbroic diorites would be derived from partial melting of a depleted mantle source, which was previously metasomatized by both aqueous fluid from oceanic basaltic rocks and melt from sediment during the subduction of Paleotethyan oceanic crust. In addition, the gabbroic diorites have Fe/Mn ratios higher than and Fe/Zn ratios similar to those of MORB, this suggests their origination from an orthopyroxene-rich mantle source, which might be generated by melt-peridotite reaction during the subduction of Paleotethyan oceanic crust. Therefore, the Ordovician to Silurian gabbroic diorites provide the petrological and geochemical records of the recycling of subducted Paleotethyan oceanic crust.