The slab-mantle interaction for the origin of andesitic rocks: Geochemical evidence from postcollisional intermediate volcanics in the Dabie orogen

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There is a consensus that Earth's continental crust is andesitic and andesites are common at continental margins, so that the petrogenesis of andesitic rocks is fundamental to understanding of the formation of continental crust and the crust-mantle differentiation in the history of Earth. This study presents a combined study of whole-rock major-trace elements and Sr-Nd-Pb-Hf isotopes as well as zircon U-Pb ages and Hf-O isotopes in the postcollisional volcanics of intermediate composition from the Dabie orogen, China. The results provide constraints on the origin of andesitic volcanics and thus insights into the slab-mantle interaction in continental subduction channels. The Dabie volcanics exhibit variable contents of SiO_2 (50.28-63.86 wt.%), MgO (1.18-4.65 wt.%), Na_2O (2.08-6.30 wt.%) and K_2O (0.73-5.25 wt.%). They are characterized by arc-like trace element distribution patterns, exhibit enriched whole-rock Sr-Nd-Pb-Hf isotope compositions, with high initial $^{87}Sr/^{86}Sr$ ratios, highly negative $\varepsilon_{Nd}(t)$ values and $\varepsilon_{Hf}(t)$ values as well as elevated $^{207}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$ ratios at given $^{206}Pb/^{204}Pb$ ratios. Zircon Hf-O isotope analyses yield negative $\varepsilon_{Hf}(t)$ values of -31.0 to -17.8 and $\delta^{18}O$ values of 4.4 to 6.8‰ for syn-magmatic domains. Zircon U-Pb dating yields consistent Early Cretaceous ages of 124 ± 3 to 130 ± 2 Ma for magma emplacement. Residual zircon cores show Triassic, Neoproterozoic and Paleoproterozoic U-Pb ages, respectively, in agreement with the ages of tectonothermal events for ultrahigh-pressure metamorphism and protolith formation in the Dabie orogen. An integrated interpretation of these geochemical characteristics is that the andesitic volcanics were derived from partial melting of less ultramafic metasomatites in the orogenic lithospheric mantle. The metasomatites were generated by reaction of the subcontinental lithospheric mantle wedge peridotite with felsic melts originated from the deeply subducted continental crust during the continental collision in the Triassic. Therefore, the melt-peridotite reaction in the subduction channel is a key to the origin of mantle sources for the andesitic rocks in collisional orogens.