Mafic igneous rocks record two styles of the crust-mantle interaction during decratonization in North China

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This study presents a compilation and synthesis of geochemical data available for Mesozoic-Cenozoic mafic igneous rocks in east-central China. The results reveal a series of geochemical changes at ~121 Ma, marking the transition of mantle property at that time during the decratonization in North China. We distinguish two types of mafic igneous rocks with contrasting geochemical compositions from North China. The first type of mafic igneous rock shows arc-like trace element distribution patterns and enriched radiogenic Sr-Nd isotope compositions, with emplacement ages spanning from the Triassic to Early Cretaceous. In contrast, the second type of mafic igneous rocks exhibits OIB-like trace element distribution patterns and relatively depleted radiogenic Sr-Nd isotope compositions, with emplacement ages spanning from the Early Cretaceous to Cenozoic. The contrasting geochemical features for the two type mafic rocks indicate a series of the differences in the compositions of crustal and mantle materials in their mantle sources.

Zircon U-Pb dating yields an age of ~121 Ma for the geochemical transformation between the two types of mafic igneous rocks. This age marks a dramatic demarcation in FeO_t and TiO_2 contents, TiO_2/Al_2O_3, K_2O/Na_2O, Nb/U, Ce/Pb, Rb/Nb and Ba/Th ratios, as well as radiogenic Sr-Nd isotope compositions of these mafic rocks. The ancient arc-like mantle source was generated by reaction of the cratonic mantle wedge with feslic melts from subducted Yangtze continental crust, whereas the juvenile OIB-like mantle source was generated by reaction of the depleted MORB mantle with felsic melts from subducted Pacific oceanic crust. As such, the nature of mantle lithosphere in North China was changed from the ancient arc type to the juvenile OIB type at ~121 Ma. Thus, this age not only signifies the tectonic transition from the enriched mantle to the depleted mantle in the Early Cretaceous, but also dates the termination of peak decratonization in North China. Therefore, the craton destruction in the Early Cretaceous is temporally and spatially associated with the slab-mantle interaction in the subduction channel.