A golden spike for the Paleo-Asian Oceanic slab subduction under the North China Craton

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Lithospheric refertilization of the North China Craton (NCC) by the Paleo-Asian Ocean plate subduction is poorly constrained, largely because the convincing evidence for subduction of the Paleo-Asian Ocean plate under the NCC is scarce. Carbonatite was recently found as a laccolith intruded into the Neogene alkali basalts in the northern margin of the NCC. It shows trace element patterns similar to sedimentary carbonate rocks, with positive Sr and U anomalies, and negative HFSE (Nb, Ta, Zr, Hf and Ti) anomalies. Carbonates in the carbonatite are featured by enriched radiogenic Sr isotopic compositions ($(^{87}Sr/^{86}Sr)_i$ = 0.70522 – 0.70796), but high $(^{143}Nd/^{144}Nd)_i$ ratios (0.51280 – 0.51296). Trace element patterns and Sr isotopic compositions suggest that the carbonatite intrusion has a precursor of sedimentary carbonate rocks. In other words, it could have been generated by melting of a sedimentary carbonate rock rather than partial melting of a carbonated peridotite and carbonated eclogite.

Xenocrysts (coarse-grained Cpx, Opx and Sp) in the carbonatite are characterized by high Mg# (90.5–92.3) in both Opxs and Cpxs. Especially for some Cpxs, they show trace element patterns similar with the Cpxs in the peridotite xenoliths from the northern margin of the NCC, which indicates that they have a mantle origin. Futhermore, high $(^{143}Nd/^{144}Nd)_i$ ratios of the carbonates suggest that the carbonate melts were derived from the mantle. Considering the regional tectonic setting, these features indicate that the carbonatite intrusion might be formed by melting of subducted carbonate rocks carried by the Paleo-Asian Ocean plate, and thus provides direct evidence for subduction of the Paleo-Asian Ocean plate under the NCC.

The Sr–Nd isotopic compositions of the carbonates in the carbonatite intrusion vary along a simple mixing trend between marine limestone and mantle peridotite. CaO contents of the carbonates negatively correlate with Ni, suggesting consumption of olivine by carbonate melt-peridotite rection. These lines of evidence imply intensive interaction between carbonate melt and mantle peridotite beneath the NCC. Hence, we here emphasize that the subduction-related carbonate fluid/melt derived from the Paleo-Asian Oceanic slab might have played an important role in the lithospheric refertilization of the NCC.