

Thinning of the North China Craton caused by delamination: Constraints from the Dagushan adakitic porphyries in the Anshan area, Northeastern China

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The North China Craton (NCC) was stabilized since the Paleoproterozoic. Nevertheless, it indicated that the ancient and thick (ca. 200 km) lithospheric mantle was replaced by the juvenile and thin (60-120 km) lithospheric mantle since the Mesozoic, suggesting the loss of more than 100 km of cratonic lithosphere in the eastern NCC. Consequently, the eastern part of the NCC became unstable and it caused strong magmatism in the Jurassic and particularly Early Cretaceous during this process. However, it remains in debate for the lithospheric thinning mechanism, and two predominant processes proposed in previous studies are lithospheric delamination and thermal-chemical erosion.

The Dagushan adakitic rocks which are located in the Anshan area, northeastern China provide a key opportunity to investigate the lithospheric thinning mechanism and geodynamic setting of the NCC. The zircon LA-ICP-MS U-Pb dating indicates that it was formed at 120.5 ± 0.5 Ma. The Dagushan diorite porphyries exhibit adakitic affinities with relatively high contents of Sr, low contents of Y and Yb, and resultant high Sr/Y and La/Yb ratios. Moreover, the diorite porphyries show high contents of MgO (or Mg[#]), Cr, and Ni, suggesting that the pristine adakitic magma interacted with mantle peridotite. However, the zircon Hf isotopic signatures indicate that the magma was formed by melting of ancient crustal material. Therefore, it is proposed that the Dagushan adakitic rocks were likely generated by the interaction between melts from delaminated lower crust and mantle peridotites. Geochemical characteristics indicate that the delaminated lower crust was composed of garnet-bearing amphibolite, and it is inferred that the delamination was probably triggered by the activity of the Tan-Lu Fault Zone. Collectively, it is suggested that delamination was an important mechanism for lithospheric thinning of the NCC, which was also recorded by the rapid uplift of syntectonic granite and metamorphic core complex in the eastern Liaoning Province of the NCC.