Precise age determination of the Paleozoic kimberlites in North China Craton and Hf isotopic constraint on the evolution of its subcontinental lithospheric mantle

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Kimberlite, a kind of deep-sourced igneous rock, carries not only diamond, but also invaluable mantle xenolith and/or xenocryst, which are vital to track the evolution of subcontinental lithospheric mantle (SCLM). However, crustal and/or mantle contamination and post-emplacement alteration bring difficulties to determining the emplacement age of kimberlite and its compositions of primary magma. This paper finely constrains the emplacement age of diamondiferous kimberlites in Mengyin and Fuxian of the North China Craton (NCC) via three different dating methods. For Mengyin kimberlite, single grain phlogopite Rb–Sr dating yields an isochron age of 485 ± 4 Ma, U–Th–Pb analyses on perovskite give a U–Pb age of 480.6 ± 2.9 Ma and a Th–Pb age of 478.9 ±3.9 Ma, and baddeleyite yields a Pb–Pb age of 480.4 ± 3.9 Ma. For Fuxian kimberlite, baddeleyite gives a Pb–Pb age of 479.6 ± 3.9 Ma, indicating that the Paleozoic kimberlites in the NCC were emplaced at ~480 Ma. Numerous lines of evidence indicate that the studied baddeleyites are xenocrysts from the SCLM, and can be used to constrain Hf isotope compositions (~ –6) of the SCLM when kimberlite erupted. Combined with data from Mesozoic–Cenozoic mantle-derived rocks and xenoliths, the Hf isotope evolution trend of the SCLM beneath NCC before destruction was tentatively constructed, which suggested that the Archean SLCM was enriched by metasomatism at ~1.3 Ga. Further Hf isotope investigations on additional SCLM-derived materials could be compared with the constructed Hf isotope evolution trend before destruction to determine when the lithospheric thinning happened.

Late Mesozoic tectonic evolution of the Songliao basin, NE China: Evidence from detrital zircon ages and Sr-Nd isotopes

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The Songliao basin, located in NE China, is one of the important oil and gas fields in China. The basin is tectonically bounded by the Jiamusi-Khanka, Erguna, Xing'an blocks between the North China and Siberian cratons. It is filled with thick Mesozoic sedimentary and volcanic rocks. This study presents detrital zircon ages and Sr-Nd isotopic compositions of two late Mesozoic sedimentary sequences, and discusses the tectonic evolution of the basin from the sedimentary record.

Dominant zircon populations of the underlying Denglouku Formation are Paleozoic (270-230 Ma) and Mesozoic (190-160 Ma) in age and are of magmatic origin. The overlying Quantou Formation contains older zircon populations of ~1800 Ma and ~2500-2900 Ma. The youngest detrital zircons place the deposition ages of both rock formations at about 110 Ma. The two sequences have distinguishable Sr-Nd isotopic features. The Denglouku Formation is characterized by higher initial ε_{Nd} values (-6.4 to -2.8) and lower initial $^{87}Sr/^{86}Sr$ ratios (0.707 to 0.709), compared to the Quantou Formation (-12.8 and 0.713).

Both rock formations appear to have been derived from different sedimentary sources. Most likely, Paleozoic and Mesozoic magmatic rocks were widespread in the northern periphery of the basin, and served as potential sources of the Denglouku Formation. In the south and in the east, old basement rocks of the North China craton provided major sedimentary material to the Quantou Formation. The south-eastward migration of erosion center(s) and the north-westward movement of the deposition center of the Songliao basin in late Mesozoic were probably related to the subduction of the western Pacific plate.