Mineral chemistry of peridotites from Paleozoic, Mesozoic and Cenozoic lithosphere: constraints on lithospheric mantle evolution, eastern China

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Major- and trace element data on the minerals of peridotite xenoliths from early Paleozoic (457-500 Ma) and Neogene (16-18 Ma) volcancs within the North China craton are compared with those from the tectonically exhumed Triassic Sulu ultrahigh-pressure (UHP) terrane along its southern margin. *P-T* estimates for the Paleozoic and Neogene peridotite xenoliths reflect different model geotherms corresponding to surface heat flow of ~40 mW/m^2 (Paleozoic) and ~80 mW/m^2 (Neogene). Peridotite xenoliths from Paleozoic kimberlites are strongly depleted, like peridotites from other areas of cratonic mantle; they have low Al_2O_3 and TiO_2 contents, magnesian olivine (mean $Fo_{92.7}$), Cr-rich garnet (6.8-29 $Cr^{\#}$), and high Ni and La/Yb in diopside. Peridotite xenoliths from Neogene basalts are derived from fertile mantle; they have high Al_2O_3 and TiO_2 contents, low-Mg olivine (mean $Fo_{89.5}$), low-Cr garnet (2.6-5.7 $Cr^{\#}$) with high REE contents, and diopside with flat REE patterns. The differences between the Paleozoic and Neogene xenoliths suggest that the buoyant refractory lithospheric keel presented beneath the eastern North China craton in Paleozoic time was largely replaced by younger, hotter and more fertile lithospheric mantle during Mesozoic-Cenozoic time. Peridotites from the pre-pilot hole of the Chinese Continental Scientific Drilling project (CCSD-PP1) in the Sulu UHP terrane have slightly lower $Mg^{\#}$ in olivine (91.5±1.0), lower $Mg^{\#}$ (74-82) and $Cr^{\#}$ (4.0-9.0) in garnet, and lower Al_2O_3 in enstatite (mean 0.20 wt%) than the Paleozoic xenoliths. The diopsides have low HREE contents and display sinusoidal to LREE-enriched patterns and negative Nb, Zr and Ti anomalies. The garnets have low REE contents and strongly negative Ce anomalies (δCe = 0.27-0.61). Much higher $Cr^{\#}$ and $Mg^{\#}$ in Cpx, $Cr^{\#}$ in Sp, and high Mg/Si, and low CaO and Al_2O_3 in the whole-rock peridotites indicate that the CCSD-PP1 peridotite represents a primitive refractory mantle protolith that experienced complex metasomatism by asthenospheric mantle-derived (Mesoproterozoic) and crustally-derived (Early Mesozoic) fluids and subsolidus re-equilibration during UHP metamorphism. Exhumation of the Sulu UHP rocks was accompanied by an extensional regime that induced the upwelling of asthenosphere. Peridotites sampled by Neogene basalts represent the newly accreted lithosphere derived from cooling of the upwelling asthenospheric mantle in Jurassic-Cretaceous and Paleogene time.