Age and evolution of the lithospheric mantle beneath the Khanka Massif: Geochemical and Re–Os isotopic evidence from Sviyagino mantle xenoliths

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New geochemical and Re–Os isotopic data of Sviyagino mantle xenoliths from the Russian Far East provide insights into the age and evolution of the sub-continental lithospheric mantle (SCLM) beneath the Khanka Massif, within the Central Asian Orogenic Belt. These mantle xenoliths are predominantly spinel lherzolites with minor spinel harzburgite. The lherzolites contain high whole-rock concentrations of Al_2O_3 and CaO, with low forsterite content in olivine (Fo = 89.5-90.3%) and low Cr# in spinel (0.09-0.11). By contrast, the harzburgite is more refractory, containing lower whole rock Al_2O_3 and CaO contents, with higher Fo (91.3%) and spinel Cr# (0.28). Two-pyroxene rare earth element (REE)-based thermometry (T_{REE}) yields predominant equilibrium temperatures of 884–1043 °C, similar to those obtained from two-pyroxene major elements-based thermometry (T_{BKN} = 942–1054°C). Two lherzolite samples yield high T_{REE} relative to T_{BKN} ($T_{REE} - T_{BKN} \geq 71$°C), suggesting that they cooled rapidly as a result of the upwelling of hot asthenospheric mantle material that underplated a cold ancient lithosphere. The harzburgite with a low Re/Os value has an $^{187}Os/^{188}Os$ ratio of 0.11458, yielding an Os model age (T_{MA}) relative to the primitive upper mantle (PUM) of 2.09 Ga, and a Re depletion ages (T_{RD}) of 1.91 Ga; both of which record ancient melt depletion during the Paleoproterozoic (~2.0 Ga). The $^{187}Os/^{188}Os$ values of lherzolites (0.12411-0.12924) correlate well with bulk Al_2O_3 concentrations and record the physical mixing of ancient mantle domains and PUM-like ambient mantle material within the asthenosphere. This indicates that the SCLM beneath the Khanka Massif had been formed since at least the Paleoproterozoic (~2.0 Ga), and was replaced by juvenile (Phanerozoic) mantle material accreted from the asthenosphere.

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