Age and origin of peridotites from the Obnazhennaya kimberlite, NE Siberian craton: A most unusual cratonic xenolith suite

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We report Re-Os isotope, PGE and major oxide content data for 19 spinel and garnet peridotite xenoliths from the Obnazhennaya kimberlite in the NE Siberian craton. Most samples in this study, and Obnazhennaya peridotites in general, show a combination of relatively low Al_2O_3 (0.1-2%) with very high CaO (2-4%). Only four harzburgites in our sample suite have low contents of both Al_2O_3 and CaO (0.1-0.8%), but their relatively low Mg# (0.89-0.92) and highly variable Os contents (0.6-35 ppb) suggest they may have formed in melt migration channels rather than as residues of melt extraction. A group of six Ca-rich (2.0-3.2% CaO) peridotites yields the highest Re-Os T_{RD} ages, from 2.6 to 2.9 Ga. Eight peridotites with low to moderate Al_2O_3 (<2%) and Mg# ≥0.91 yield T_{RD} ages from 1.65 to 2.3 Ga (2.0±0.1 Ga). The remainder may not yield valid T_{RD} ages because they are not refractory (Al_2O_3 >2.6% and/or Mg# ≤0.90). Re-Os T_{MA} ages for all rock types range from 1.6 to 3.4 Ga. We interpret the T_{RD} data as evidence for a two-stage formation of the lithospheric mantle: at ~2.8 Ga and at ~2 Ga. The peridotites formed at the two stages show similar chemical compositions. Widespread enrichments in Ca, which we attribute to metasomatism by carbonate-rich melts, may have taken place either at the end of the Archean melting event, when at least one Ca-Al-rich peridotite was formed, or later. Combined Re-Os age data on xenoliths from Obnazhennaya and Udachnaya suggest that the lithospheric mantle beneath the Siberian craton took a long time to form, from late Archean to the Paleoproterozoic. The formation of cratonic mantle was not completed in the Archean as previously thought but continued well into the Paleoproterozoic when the Siberian craton was definitively stabilized at ~2 Ga.