Os isotope and PGE data on the age and evolution of lithospheric mantle in the central Siberian craton

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The Siberian craton was assembled 1.8-2.1 Ga ago from terrains containing components as old as 2.4-3.5 Ga [1]. To better constrain the age of the lithospheric mantle in the central craton and its relationship to the events that formed or assembled the overlying crust, we present new whole-rock Re-Os and PGE data on 31 fresh (LOI <1%) spinel and garnet peridotite xenoliths from the Udachnaya kimberlite [2]. 18 out of 24 refractory (0.1-1.2% Al_2O_3) rocks in this study contain 1-10 ppb Os. They mostly yield T_{RD} ages from 1.5 to 2.3 Ga (average 1.8 Ga). The T_{RD} ages do not correlate with P-T estimates (<2.5-6.8 GPa; 760-1330°C), hence depth. These peridotites are depleted in Pd, less commonly in Pt relative to Os-Ir-Ru, with the strongest Pt-Pd depletions in cpx-free spinel peridotites, likely reflecting the lower compatibility of Pt and Pd in residues of melting. Six refractory peridotites have low Os (≤0.5 ppb), high Re/Os and yield low (0.7-1.6 Ga) or meaningless T_{RD} ages. Cpx- and gar-rich peridotites (1.4-4.0% Al_2O_3; likely re-fertilised) with Os >1 ppb have eruption-age-corrected $^{187}Os/^{188}Os$ = 0.120-0.124; some show high Pt/Ir and Pd/Ir indicating Pt-Pd mobility during melt metasomatism.

Overall, Re-Os ages in Udachnaya peridotites are Paleoproterozoic (including 7 out of 8 samples from earlier work [3]), coeval with final rather than early stages of craton formation. Older ages have been reported on megacrystalline dunites (3 out of 5 in [3]), eclogites [4] or inclusions in diamonds [5] that cannot be abundant in the mantle. Thus, long-lived, thick, cold, diamond-bearing lithospheric keels may be generated in the Proterozoic as well as in the Archean.

[1] Rosen (2002) *Russ. J. Earth Sci*. **59**, 103-119. [2] Ionov *et al*. (2010) *J. Petrol* **51**, 2177-2210. [3] Pearson *et al*. (1995) *GCA* **59**, 959-977. [4] Pearson *et al*. (1995) *Nature* **374**, 711-713. [5] Pearson *et al*. (1999) *GCA* **63**, 703-711.

Permafrost active layer dynamics inferred from major element geochemical signatures in six Arctic Alaskan rivers

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Arctic climate warming is expected to degrade permafrost and affect watershed hydrogeology and biogeochemistry. Increasing temperatures could lead to the downward migration of the seasonally thawed (active) layer into previously frozen soil. This could create a unique weathering signal in surface waters during late summer and early fall when the active layer is at its deepest extent. The response of permafrost to climate warming may not lead to a simple, homogeneous increase in active layer depths. Ice lenses, peat layers, and heterogeneous soil ice (water) contents will respond differently to warming. Our study was initiated to determine whether geochemical tracers can provide a proxy for these active layer dynamics in Arctic watersheds.

We collected up to 65 surface water samples from six Arctic Alaskan rivers from melt to freeze-up in 2009 and 2010. Watershed areas range from 1.6 to 610 km^2. Two rivers were underlain by organic rich permafrost, two rivers drained mountainous bedrock, and two rivers were underlain by both bedrock and organic rich permafrost.

We measured the major ion geochemistry of the water samples. For most of the rivers, Na, Ca, Mg, and SO_4 concentrations are lower during melt runoff and steadily increase throughout the summer into the fall. Potassium values are greatest in early melt waters and then decrease through the summer into the fall. Nitrate concentrations increase steadily in the late fall in bedrock dominated streams, suggesting a decrease in N assimilation rates in the bedrock soils during late summer and fall. Our results suggest river chemistry is driven by flow paths that deepen from surface to mineral soils as the melt season progresses.