Paleoproterozoic rejuvenation of an Archaean lithosphere: evidence from U-Pb zircon dating in crustal xenoliths at Udachnaya, Siberian craton

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Cratons represent the oldest preserved lithospheric domains. Their lithosphere (lithospheric mantle welded to overlying Precambrian crystalline basement) is considered to be particularly robust and long living due to the protecting presence of buoyant and rigid “keels” made up of residual harzburgites.

In this study, we report new U—Pb zircon ages on crustal xenoliths from the Udachnaya kimberlite in the Siberian craton; this dataset includes samples from both the upper and lower portions of the crust. The zircon ages agree well with model melt-extraction Re-Os ages on refractory peridotite xenoliths from the same pipe; taken together they allow an integrated view of lithosphere formation.

Our data reveal that the present day upper crust is Archaean, whereas both the lower crust and the lithospheric mantle yield Palaeoproterozoic ages. Consequently, the deep lithosphere beneath the Siberian craton was not formed in a single time, but grew in two distinct events, one in the late Archean and the other in the Palaeoproterozoic.

We propose a two-stage scenario for the formation of the Siberian craton involving delamination and rejuvenation of the Archean lower lithosphere (lower crust and lithospheric mantle) in the Palaeoproterozoic. This demonstrates that craton formation can be a protracted, multi-stage process, and that the present day crust and mantle do not represent complementary reservoirs formed through the same episode.