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Probing ancient continental crust with kimberlite xenoliths: insights from the Siberian Craton

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Most of the continental crust was initially generated in the Archaean. Yet, rocks older than 3 Ga are very rare in the exposed geological record. Kimberlites in cratonic regions sample and carry to the surface otherwise inaccessible rocks from the middle and lower crust. Their composition sheds light into the generation and evolution of cratons.

In the Siberian Craton, numerous Mesozoic to mid-Paleozoic kimberlites occur south and southeast of the late Archaean to Paleoproterozoic Anabar Shield. The Udachnaya kimberlite in the center of the craton, contains particularly abundant mantle and lower crustal xenoliths. We report data on a large new collection of crustal xenoliths that document compositional variation of the ancient crustal basement of the craton. The samples show a large range of igneous rocks, from garnet-bearing mafic to coarse-grained biotite-granites, metamorphic rocks of granulite to low amphibolite facies, as well as felsic igneous rocks with no apparent metamorphic foliation. The granitoids show enrichments in K_2O, Ba, Sr and HFSE in combination with low SiO_2 and high Mg#, indicating metasomatic enrichment of their sources. Some evolved granitoids have high positive Eu anomalies and high La/Yb ratios that we link to magmas derived from sources in the lower crust (>50 km) and fractionated in the middle/upper crust. U-Pb and Lu-Hf data on zircons from the crustal xenoliths, in association with their whole-rock geochemistry, elucidate generation and reworking events in the cratonic lithosphere as well as links of crust and mantle processes in the Siberian Craton.