

Timing of subduction along the northern margin of the Siberian craton: Lu-Hf and Sm-Nd isochrons for kimberlite-borne mantle eclogite xenoliths

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Eclogitic mantle xenoliths brought up by the ca. 152 Ma old Obnazhennaya kimberlite on the Siberian craton are examples of metamorphosed oceanic crust, and their formation is commonly attributed to ancient subduction regimes along the northeastern craton margin. In this study, Lu-Hf and Sm-Nd isotope data for clinopyroxene and garnet were obtained for high-MgO and low-MgO eclogite xenoliths from the Obnazhennaya kimberlite. Although the majority of eclogite samples are characterized by equilibrium temperatures higher than the closure temperatures of the Lu-Hf and Sm-Nd isotope systems, they might have experienced rapid cooling and uplift to shallower lithospheric mantle depths, or fast heating immediately prior to kimberlite eruption, without resetting of the isotopic systems. If so, the mineral pair two-point isochron ages represent a cooling episode during the Proterozoic between 2.2 and 0.8 Ga. The age peak at 1.9 Ga for the Obnazhennaya eclogites falls within the 2.1-1.8 Ga age range for eclogite xenolith suites from cratons worldwide, which supports the evidence for widespread oceanic lithosphere subduction during the Paleoproterozoic. The timing of this global subduction event coincides with the formation of orogenic belts at ca. 1.8 Ga during the final assembly of the Paleoproterozoic Columbia supercontinent, which was completed by 1.6 Ga. Age complexity is revealed by the majority of eclogite samples, which equilibrated close to or above the closure temperatures for the Lu-Hf and Sm-Nd isotope systems. Isochron ages as young as 185 Ma for a single low-MgO eclogite xenolith suggest that these mantle-derived materials resided deep within the Siberian cratonic root, and that radiogenic Hf and Nd only accumulated in the constituent garnet and clinopyroxene after xenolith entrainment into the host kimberlite magma. The presence of garnet exsolution lamellae in clinopyroxene also records protracted cooling, but presents a challenge for producing clean mineral separates in an attempt to obtain robust Lu-Hf and Sm-Nd isochron ages.