

Mantle composition, age, and geotherm beneath the Darby Kimberlite field, West Central Rae Craton

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The Rae craton in Canada's North contains several kimberlite fields and has been the subject of episodic diamond exploration, with proven diamond-bearing deposits. However, relatively little is known about the deep mantle lithosphere that underpins the architecturally complex crust of this craton. The Darby Kimberlite field, located ~120 km southwest of the community of Kugaaruk, Nunavut, provides an opportunity to study the mantle beneath the western portion of the central Rae craton via mantle xenoliths. The Darby kimberlite field contains eight kimberlite bodies erupted at circa 540 Ma. Five of the kimberlites have proven to be diamond-bearing including the 12 hectare 'Iceberg' kimberlite.

Mantle xenoliths were collected from kimberlite float above proven kimberlite targets across the property. Most of the surface kimberlite is highly altered and hence the peridotite xenoliths they contain are generally serpentized or deeply-weathered. Eclogites/pyroxenites were recovered from each locality visited. A total of 33 mantle xenoliths exceeding one cm in maximum dimension (14 peridotites and 19 "eclogites") were selected for mineral chemistry and bulk analysis. Four peridotite xenoliths contain fresh garnet.

Clinopyroxenes from kimberlite heavy mineral concentrate provide a preliminary geotherm for the West Central Rae lithosphere and indicate a lithospheric depth of ~200 km. Using Ni-in-garnet temperatures, four garnet peridotites and 49 peridotitic garnets from concentrate yield two distinct mantle sampling depths. Whole rock Re-depletion ages for Darby peridotites range from Mesoarchean to Paleoproterozoic. Archean whole rock T_{MA} ages for the eclogites/pyroxenites are consistent with a Mesoarchean age for the western Central Rae lithosphere, older than the lithosphere beneath the Repulse Bay block to the East.

The anomalously high abundance of eclogite/pyroxenite xenoliths and garnet concentrate found in the Darby field (58 % of xenoliths and 82 % of concentrate) is at odds with the abundance of eclogite thought to be present in cratonic lithospheric mantle from xenocryst studies (~one to five %). The high abundance may be related to the proximity of the field to the proposed suture between the Committee Block and the Queen Maud Block to the far West of the Rae craton.

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