Diamondiferous Proterozoic mantle roots beneath Arctic Canada

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The mantle roots directly beneath Archean cratons have been relatively well studied because of their economic importance, yet much less is known about the genesis, age, composition and thickness of the mantle lithosphere beneath the regions surrounding these cratons. However, it is critically important to establish the nature of the relationship between this circum-cratonic mantle and that beneath the cratons, including the diamond potential of circum-cratonic regions. Here we present mineral and bulk elemental and isotopic compositions for kimberlite-borne mantle xenoliths from the Parry Peninsula (PP) and Central Victoria Island (CVI), Arctic Canada. These xenoliths provide key windows into the lithospheric mantle underpinning regions to the North and Northwest of the Slave craton, where the presence of cratonic mantle has been proposed. The mineral and whole rock chemistry of peridotites from both localities is indistinguishable from that of typical cratonic mantle lithosphere. The cool mantle geotherms defined by mineral thermobarometry reveal that the lithospheric mantle beneath the PP and CVI terranes extended well into the diamond stability field at the time of kimberlite eruption, consistent with the recovery of diamonds from both kimberlite fields. Bulk Se, Te, and highly siderophile element abundance systematics, plus Re-Os isotope age data suggest that the mantle beneath these parts of Arctic Canada formed at ~2 Ga, rather than in the Archean. The presence of a diamondiferous Paleoproterozoic mantle root is part of the growing body of evidence for peridotitic diamond generation in mantle roots that stabilized well after the Archean. In the context of regional tectonics, the highly depleted mantle compositions beneath both regions developed during mantle melting associated with hydrous metasomatism in the major Paleoproterozoic Wopmay- Great Bear-Hottah arc systems. These terranes were subsequently accreted along the margin of the Slave craton to form a craton-like thick lithosphere with significant diamond potential.