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Diamonds and growth of cratonic roots

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The important role of buoyant cratonic mantle keels in preserving the overlying oldest continental crust is undeniable. The origin and growth of mantle roots, and their link to continental crust formation, remain however topics of debate. Here we provide a diamond perspective on these ongoing fields of study, using the diamond age database [1], alluvial Archean diamonds, and newly obtained diamond ages, with a focus on the Slave craton.

The oldest known diamonds to date have been recovered from the Central Slave craton and were dated by Re-Os analyses of sulphide inclusions. These diamonds inform us about early craton formation processes and show that cold cratonic roots existed by 3.5 Ga [2]. Survival of these sulphide inclusions, as opposed to a lack of old peridotitic sulphide inclusions from the Kaapvaal craton, indicates that these two mantle areas experienced different amounts of melting during keel building [2]. Mesoarchean alluvial diamonds, as indicated by maximum U-Pb depositional ages of zircons in the metasediment host from Tree River from the Northern Slave craton, have $\delta^{13}C$-$\delta^{15}N$ values indicative of a crustal component, possibly brought to greater depths by a local slab-stacking process [3]. Thus, not all cratonic roots were created equal and Archean diamonds reveal a range of formation models.

Globally, continued addition of material to the cratonic roots has taken place via e.g., subduction after plate subduction was established at 2.9 Ga, based on the first appearance of eclogitic diamonds [1]. In the Central Slave craton, such accretionary processes have been recorded at 1.9 Ga [2], linked to collision events at 2.1-1.8 Ga recorded in the crust. Newly obtained eclogitic and peridotitic U-Pb and Re-Os ages indicate renewed diamond growth beneath the Southern Slave craton during the Mesoproterozoic. We will review the temporal relationship of diamond growth in the mantle to magmatic-tectonic events recorded in the crust, which reveals that in many instances, though not all, the growth of mantle roots and continental crust are linked.

[1] Smit et al. (2021) *Borealis* V1, https://doi.org/10.7939/DVN/DRAJGT. [2] Aulbach et al. (2009) *Lithos* 112, 747-757. [3] Timmerman et al. (2022) *EPSL* 592, 117633.