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Origin and reworking of Paleoarchean mafic lower crust at the Karelian Craton margin, Finland

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The lower crust of Archean cratons remains a poorly characterised realm. Although exposed Archean granulites are relatively common, it is not always evident whether they represent lower continental crust or granulites formed at transient high pressure-temperature conditions during continent–continent collisions. Therefore, xenolith suites, which show clear evidence for derivation from the present lower crust of Archean cratons bear fundamental information on the growth mechanism of the Archean crust, allow more accurate estimates of its total volume to be made, and may constrain the origin of the underlying mantle root. Lower crustal xenoliths recovered from the c. 600 Ma old Kaavi-Kuopio kimberlites, eastern Finland, provide us direct access to the chemical composition, physical state and age of the craton margin lower crust. Mineral thermometry, together with isotopic and general petrological constraints, imply that this sample suite is derived from the geophysically determined, dense, high-velocity layer at the base of the crust (45–60 km deep). Single grain zircon U-Pb dates and Nd model ages (T_{DM}) both imply that this is a hybrid layer consisting of both Archean and Proterozoic mafic granulites. Crystallisation ages of up to $\sim$ 3.5 Ga for lower crustal granulites are equal to the age of the oldest upper crustal orthogneisses in the region. Recrystallisation or dissolution-precipitation reactions of Archean zircons led to Proterozoic zircon dates that coincide with major events of basic magmatism within the craton. Most important post-Archean lower crustal growth and reworking took place due to $\sim$ 1.9 Ga accretion of the Svecofennian arc complex to the craton margin when underplating basaltic magmas became mingled with Archean mafic lower crust. Overall, Karelian Craton lower crust records geological evolution of the craton through an epoch of over 3 billion years, implying that upper

and lower crust have remained coupled since their origin in the Paleoarchean. Finally, our results are a new piece in the emerging data from several continents that emphasises the global importance of the 3.5 Ga episode. We suggest, that it represents a super plume event – more widespread than previously recognised – when a significant fraction of Paleoarchean continental crust was formed.