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Delayed gratification: Exhumation of Archean granulite terranes by later supercontinent cycles

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Granulite provides a key link between the lower crust and lithospheric mantle, recording the formation and evolution of the continental crust. How early crust was formed and deformed can shed light on uncertain Archean geodynamics. Widespread Archean granulite terranes were generally unexposed in their time of formation, and their exhumation histories are still unclear. Here we report zircon, rutile, and titanite *U–Pb* geochronology and a pressure-temperature (*P–T*) path for deep-seated Archean granulites from the North China Craton to resolve the relationship between their exhumation history and plate tectonics. Our results show that pelitic granulites and opx-cpx granulites were metamorphosed in the Late Archean with weak Paleoproterozoic metamorphic overprinting. In contrast, the co-existing Archean grt-cpx mafic granulites experienced repeated granulite-facies in the Paleoproterozoic, being buried to lower crust depth (>30 km) at ca. 1.9 Ga and then undergoing significant decompression to <15 km. The different degrees of Paleoproterozoic metamorphic overprinting on the Archean lower crust is related to the amalgamation of the Columbia supercontinent. This Paleoproterozoic orogeny induced a second generation of metamorphism of the Archean basement and drove the Archean lower crustal exhumation. The Archean basement of the western Canadian shield, central Finland, Yilgarn craton, South Africa, Siberia Craton, and south India were also uplifted during post-Archean supercontinent cycles. These observations strongly suggest that exhumation of deep-seated Archean granulite terranes was delayed until later orogenic events associated with the assembly of supercontinents. A lack of Archean uplift indicates a significant transition in horizontal compressive stress that only occurred in post-Archean times.