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Crustal evolution and final assembly of the Napier Complex – record of late Archean magmatism and metamorphism inscribed in zircon

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The Napier Complex is a unique component of the East Antarctic Shield because it records a timeline of crustal growth from the Eo- to Neoarchean, with protoliths dating back to 3.75 Ga (Kusiak et al., 2013; Król et al., 2020). It is principally composed of gneisses and granulites of variable composition that underwent high- to ultra-high-temperature (UHT) metamorphism at ~2.5 Ga and locally at ~2.8 Ga (Harley et al., 2019). Although UHT rocks are spatially related to convergent plate margins and assembly of supercontinents (Jiao et al., 2023), there is still no consensus when the final assembly of the Napier Complex occurred.

To gain more insights into the crustal evolution of the terrain, samples from the Ragatt, Scott and Napier Mountains were selected for whole-rock geochemistry and zircon U-Pb dating. Rocks from the Napier Mountains record zircon metamorphic growth and recrystallization at 2800-2770, 2540-2520 and 2490-2460 Ma. Furthermore, protolith crystallization ages of ~3210 and ~2825 Ma were recorded from tonalitic and granitic gneisses, respectively. These are similar to ages obtained from Mount Riiser-Larsen and Mount King on the respectively eastern and western side of the Tula Mountains. The generation of granitic gneiss was coeval with ~2800 Ma metamorphism. In contrast, tonalitic and trondhjemitic rocks from the Raggatt and Scott Mountains only yield Neoarchean magmatic ages of ca. 2720 Ma and syn-metamorphic ages of ca. 2530 Ma. All the samples show significant zircon recrystallization due to the ca. 2500 Ma metamorphic event that continued until at least 2460 Ma. Based on available data, the ~2500 Ma event likely represents the cumulation of tectonothermal processes that juxtaposed diverse crustal domains. This mimics the geological history known from other Archean cratons, for example the Dharwar Craton in India (Jayananda et al., 2018).

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