

# Post-Palaeoproterozoic thermotectonic evolution of the northern Western Australian Shield

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We report the results of an  $^{40}\text{Ar}/^{39}\text{Ar}$  (16 K-feldspars, 2 secondary muscovites) and apatite fission track (AFT) thermochronological study of the northern Western Precambrian Shield of Western Australia. Broadly distributed  $^{40}\text{Ar}/^{39}\text{Ar}$  data suggest slow cooling from either  $\sim 1800\text{--}1600$  Ma or  $\sim 1200\text{--}1000$  Ma, depending on the sample. Most of the samples give minimum ages  $\sim 500$  Ma, which suggests either a small amount of reheating and minor argon loss at that time, or slightly more rapid cooling. AFT data reveal cooling between  $290\text{--}180$  Ma and confined horizontal mean track lengths range between  $11.5\text{--}14.3$   $\mu\text{m}$  with standard deviations falling between  $1.1\text{--}2.2$   $\mu\text{m}$ . Forward modelling of time-temperature history paths from AFT data reveal a late Carboniferous to early Permian regional cooling episode and minor late Mesozoic cooling. Assuming that the average present day geothermal gradient of  $\sim 18\pm 2^\circ\text{C.km}^{-1}$  was prevalent since the late Palaeozoic, then a minimum of  $\sim 75^\circ\text{C}$  of cooling predicted by the AFT modelling suggests overall denudation of  $\sim 3.7\text{--}4.6$  km of section since that time. Together with the  $^{40}\text{Ar}/^{39}\text{Ar}$  K-feldspar data the results suggest an overall regional cooling since the Palaeoproterozoic from  $\sim 350\text{--}400^\circ\text{C}$ . Proterozoic and Phanerozoic basins, that partly continue offshore, contain up to  $\sim 15$  km of predominantly clastic sediments and are likely to have been depocentres for much or at least some of the detritus derived from the denudation inferred by the thermochronological data. Forward modelling of  $^{40}\text{Ar}/^{39}\text{Ar}$  K-feldspar data will reveal whether thermal relaxation following a heating episode may also have been part of this cooling history. The post-Palaeoproterozoic thermotectonic history presented here complements previous geochronological data (U-Pb zircon SHRIMP,  $^{40}\text{Ar}/^{39}\text{Ar}$  dating of hornblende, muscovite, biotite) revealing the early history of the Western Shield.

**Key words:**  $^{40}\text{Ar}/^{39}\text{Ar}$  dating, apatite fission track dating, thermochronology, Western Australia, time-temperature history, Proterozoic, Phanerozoic