IMPLICATIONS OF POST-PALAEOPROTEROZOIC THERMOCHRONOLOGICAL DATA FROM THE PRECAMBRIAN NORTHERN WESTERN AUSTRALIAN SHIELD

[1]U.D.Weber, [1]B.P.Kohn, [2]D.A.Foster, [3]D.R.Nelson and [1]A.J.W.Gleadow
[1]School of Earth Sciences, The University of Melbourne, Victoria 3010, Australia
[2]Department of Geological Sciences, University of Florida, Gainesville, FL 32611, USA
[3]Geological Survey of Western Australia, 100 Plain Street, East Perth, WA 6004, Australia

In this reconnaissance study we present new thermochronological data from the northern part of the Western Australian Shield, including the Pilbara Craton, the northern part of the Yilgarn Craton and the intervening Proterozoic terranes. Techniques employed include $^{40}Ar/^{39}Ar$ dating of K-feldspars and muscovites, apatite fission track and (U–Th)/He thermochronometry. Combining numerical models of the K–feldspar $^{40}Ar/^{39}Ar$ and fission track data provides constraints on possible time-temperature cooling paths for the Shield from temperatures below ~450˚ C.

Previous geochronological data from the Pilbara Craton and the northern Yilgarn Craton using $^{40}Ar/^{39}Ar$ analysis of hornblende, muscovite and biotite and U/Pb zircon SHRIMP data yield middle to late Archaean ages, while Mesoproterozoic sphene fission track ages have also been reported. These data and the fact that exposed rocks of the Western Shield are mostly Archaean and Palaeo- to Mesoproterozoic in age with a fairly subdued geomorphology led to the notion that the West Australian Shield has been tectonically stable over a long period of geological time.

K–feldspar data indicate slow cooling from 2300–2200 Ma, 1800–1600 Ma or 1200–1000 Ma depending on sample location. Some samples yield minimum ages of ~500 Ma, which suggests either a small amount of reheating and minor argon loss at that time, or a minor pulse of increased cooling. Apparent apatite fission track ages range between 290–180 Ma with confined horizontal mean track lengths between 11.5–14.3 µm. Preliminary apatite (U–Th)/He results yield ages ~241 Ma or older, although most samples do not duplicate well due to heterogeneous U distribution and the presence of micro-inclusions.

Numerical modelling of the K-feldspar $^{40}Ar/^{39}Ar$ data reveal accelerated cooling ~1800–1600 Ma, 1100–900 Ma and ~500 Ma and modelled apatite fission track data indicate a cooling episode between 320–280 Ma from temperatures > ~120˚ C. Cooling inferred by the $^{40}Ar/^{39}Ar$ K-feldspar data, probably reflect tectonic events related to the waning stages of the Capricorn, Paterson and Pan-African Orogenies respectively. Permo/Carboniferous cooling, inferred by the apatite fission track data, is probably related to the development of the passive continental margin to the west and north of the shield, which subsequently led to the break-up of Greater India from the Australian continent. This last event is also partly reflected in the development of the Phanerozoic basins surrounding the Shield, which acted as depocentres for at least some of the erosional clastic sediments denuded off the Western Shield. Assuming that an average present day geothermal gradient of $\sim 18\pm 2°C.km^{-1}$ was prevalent during the late Palaeozoic and Mesozoic, then the minimum of ~50°C of cooling inferred by the fission track modelling suggests an overall denudation of at least ~2.5–3.1 km of section from the Western Shield. In an independent study the volume of clastic sediments deposited in the marginal Phanerozoic basins was calculated, suggesting that ~4 km of basement section were removed from the Shield since the Palaeozoic.

Acknowledgments
This work was supported by the Australian Research Council and the Australian Institute of Nuclear Sciences and Engineering