

Isotopic mobility tracks late-stage reactivation of the East Pilbara Craton

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In the core of the East Pilbara Terrane, the ancient heart of the Pilbara craton in Western Australia, a structural dome known as the North Pole Dome (NPD) is preserved. The area is mostly composed of komatiitic to basaltic volcanic rocks from the Warrawoona and the Kelly groups and is intruded by the North Pole Monzogranite (NPM), described as an elliptical (in map view) and a steeply plunging plug 1.5–3.0 km thick (3D view) body in the very centre of the NPD. Zircon U–Pb data from the NPM yields an upper intercept age of 3449 ± 12 Ma interpreted to represent the crystallization age, and a lower intercept at 932 ± 51 Ma suggesting radiogenic-Pb loss at this time. Zircon trace element data shows an enrichment pattern in LREE relative to HREE, with a negative Eu anomaly. The LREE-Index ranges from 1.4 to 8.2, suggesting hydrothermal alteration in zircon. Apatite from the North Pole Monzogranite exhibits two chemical groups distinguished by Gd/Yb signatures. Group A yields a U–Pb lower intercept age of c. 3334 ± 140 Ma suggesting closure to Pb diffusion after granite crystallization. Component B shows a lower intercept age of 779 ± 63 Ma, indicating Neoproterozoic re-equilibration. Biotite Rb–Sr isotopes yield an isochron age of 2958 ± 27 Ma, which may reflect fluid interaction related to the formation of the dome (ca. 3240–2775 Ma). Importantly, biotite does not record Neoproterozoic ages, suggesting that the hydrothermal fluids responsible for trace element mobility in zircon and apatite had no significant effect on biotite. Although typically regarded as a stable cratonic block, recent work has shown that fluid mediated element mobility in the Pilbara Craton continued into the Mesoproterozoic. We extend this history to the Neoproterozoic, when major craton-bounding basins were developing.