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Post-depositional thermal history of the 4364–3060Ma zircon-bearing metasandstones of the Illaara and Maynard Hills granite greenstone belts, Western Australia

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The post-depositional thermal history (spanning 3060Ma to 26Ma) of the ca. 3060Ma Illaara and Maynard Hills granite greenstone belt metasandstones (peak metamorphism of upper greenschist facies) is characterized by a combination of SHRIMP U-Th–Pb, Ar/Ar and (U-Th)/He geochronology.

Ar/Ar multi-grain tourmaline results defining two plateau ages of ~2940Ma on a cross-cutting quartz-tourmaline vein provide a minimum depositional age for the metasandstones. Post depositional stratiform qtz-tourmaline veins are a common occurrence in Archean quartzites, and can be useful in assigning minimum depositional ages and timing of hydrothermal fluids.

SHRIMP U-Th–Pb data of >275 rutile analyses from 8 metasandstone samples reveal a complex history of events between deposition of metasandstones (ca. 3060 Ma) and the subsequent folding, thrusting and granitic intrusions (ca. 2730–2630 Ma, regional D1 to D3 events). Some individual rutile grains yield multiple dates which span from before the maximum depositional age of the quartzite at ca. 3060Ma to the last major metamorphic and granitic event at ca. 2630Ma. These rutiles exhibit weakly defined core-rim younging profiles which represent multiple stages of metamorphic growth or Pb-loss reset events. These results suggest that under protracted greenschist metamorphic conditions rutile can retain signatures of multiple thermal events and even retain some of their original detrital characteristics.

Ar/Ar plateau ages on muscovites from both greenstone belts show that late to post deformation planar-foliation recrystallization at ca. 2605Ma (possibly coeval with the end of D3) marks the end of high-grade tectono-thermal events.

(U-Th)/He on zircon at ca. 230Ma defines exhumation and temperatures <180C for these metasandstones, similar to fission track results throughout the Yilgarn. Goethite (U-Th)/He ages of 26Ma are likely coeval with Fe-rich meteoric fluid influx and associated zero-age Pb-loss and Fe enrichment in metamict zones of both rutile and zircon within the metasandstones.