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Ordovician high-grade metamorphism of a newly recognised late Neoproterozoic terrane in the northern Harts Range, central Australia

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ABSTRACT Granulite facies rocks from the northernmost Harts Range Complex (Arunta Inlier, central Australia) have previously been interpreted as recording a single clockwise cycle of presumed Palaeoproterozoic metamorphism (800–875 °C and >9–10 kbar) and subsequent decompression in a kilometre-scale, E-W striking zone of noncoaxial, high-grade (*c.* 700–735 °C and 5.8–6.4 kbar) deformation. However, new SHRIMP U-Pb age determinations of zircon, monazite and titanite from partially melted metabasites and metapelites indicate that granulite facies metamorphism occurred not in the Proterozoic, but in the Ordovician (*c.* 470 Ma).

The youngest metamorphic zircon overgrowths from two metabasites (probably meta-volcaniclastics) yield $^{206}Pb/^{238}U$ ages of 478 ± 4 Ma and 471 ± 7 Ma, whereas those from two metapelites yield ages of 463 ± 5 Ma and 461 ± 4 Ma. Monazite from the two metapelites gave ages equal within error to those from metamorphic zircon rims in the same rock (457 ± 5 Ma and 462 ± 5 Ma, respectively). Zircon, and possibly monazite ages are interpreted as dating precipitation of these minerals from crystallizing melt within leucosomes. In contrast, titanite from the two metabasites yield $^{206}Pb/^{238}U$ ages that are much younger (411 ± 5 Ma & 417 ± 7 Ma, respectively) than those of coexisting zircon, which might indicate that the terrane cooled slowly following final melt crystallization. One metabasite has a second titanite population with an age of 384 ± 7 Ma, which reflects titanite growth and/or recrystallization during the 400–300 Ma Alice Springs Orogeny. The *c.* 380 Ma titanite age is indistinguishable from the age of magmatic zircon from a small, late and weakly deformed plug of biotite granite that intruded the granulites at 387 ± 4 Ma. These data suggest that the northern Harts Range has been subject to at least two periods of reworking (475–460 Ma & 400–300 Ma) during the Palaeozoic.

Detrital zircon from the metapelites and metabasites, and inherited zircon from the granite, yield similar ranges of Proterozoic ages, with distinct age clusters at *c.* 1300–1000 and *c.* 650 Ma. These data imply that the deposition ages of the protoliths to the Harts Range Complex are late Neoproterozoic or early Palaeozoic, not Palaeoproterozoic as previously assumed.

Key words: Arunta Inlier; granulites; Palaeozoic; SHRIMP; U-Pb geochronology.

INTRODUCTION

The Arunta Inlier (Fig. 1) has a polyphase Proterozoic and Palaeozoic metamorphic history (cf. Collins & Shaw, 1995). It is overlain unconformably by several Neoproterozoic to mid Palaeozoic intracratonic sedimentary basins (the Amadeus, Ngalia, Georgina and Officer Basins; Fig. 1) that are the remnants of the formerly more extensive Centralian Superbasin (Shaw *et al.*, 1991). Sedimentation in these basins was terminated during the intraplate *c.* 400–300 Ma Alice Springs Orogeny, when the Arunta Inlier basement was exhumed and interleaved with overlying basinal cover sequences in southerly directed nappe stacks (Teyssier, 1985; Shaw *et al.*, 1991).

The timing of Alice Springs-age deformation in the northern Amadeus Basin is relatively well constrained through the depositional age of Devonian foreland-style molasse-type sediments produced by the uplift (Shaw *et al.*, 1991). In contrast, the timing, distribution and grade of the Palaeozoic overprint in the Arunta Inlier has been the subject of considerable debate. In particular, high-grade fabrics in the eastern Arunta Inlier have been interpreted as either Palaeoproterozoic (James & Ding, 1988) or largely Palaeozoic (Dunlap & Teyssier, 1995). Moreover, recent Sm-Nd and U-Pb studies in the Harts Range (Fig. 1) have shown that Palaeozoic metamorphism in the eastern Arunta Inlier is polyphase, with an upper amphibolite to

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