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Regional high-grade metamorphism during rift basin development: implications for burial mechanisms to lower crustal depths

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REGIONAL HIGH-GRADE METAMORPHISM DURING RIFT BASIN DEVELOPMENT: IMPLICATIONS FOR BURIAL MECHANISMS TO LOWER CRUSTAL DEPTHS

RUNNING TITLE: HIGH-GRADE METAMORPHISM DURING BASIN DEVELOPMENT

ABSTRACT

Crustal-scale exhumation during the intraplate Alice Springs Orogeny (c. 450–300 Ma) in central Australia has exposed the medium-pressure, high-grade metasedimentary and metabasaltic rocks of the Harts Range Group (HRG). Similarities in the detrital zircon age spectra and Lu–Hf-isotopic composition between the HRG and surrounding unmetamorphosed late Neoproterozoic–Cambrian Amadeus and Georgina basin sequences indicate the HRG is a highly metamorphosed equivalent to these basin successions. Calculated phase equilibria modelling and thermobarometry constrain peak metamorphic conditions to ~880ºC and 10.5 kbar and ~670ºC and 7 kbar in the structurally lowest and highest parts of the HRG, respectively. Peak metamorphic assemblages are associated with extensive mafic magmatism, a coarse layer-parallel fabric and NE-side-down kinematics, the combination of which points to an extensional setting. Metamorphic conditions indicate a high geothermal gradient regime also existed during burial, manifested by the prograde development of andausite-bearing metapelite mineral assemblages. Monazite within prograde-zoned garnet and the enclosing fabric yield a U–Pb age of c. 442 Ma which is interpreted to record the timing of high-grade metamorphism of the upper HRG during continuation of the late Ordovician Larapinta Event (c. 480–460 Ma). Burial and metamorphism was synchronous with Centralian Superbasin sedimentation in central Australia and accordingly the deep burial, metamorphism and deformation of the HRG to mid-lower crustal depths must be justified in the context of the broader intraplate basin evolution. The HRG seems consistent with burial by sediment loading and associated high-grade metamorphism driven by elevated heat flows in a super-deep rift. This suggests that regional medium-pressure, high-grade metamorphic terranes may be generated in deep intraplate rift basins during extension and therefore are not necessarily reflective of compressional thickening of the crust.

KEYWORDS

Deep-rift basin; intraplate deformation; regional high-grade metamorphism; zircon provenance; geochronology; Lu–Hf; pseudosection; Harts Range; Ordovician

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