Grenvillian-aged reworking in the Warumpi Province, central Australia: constraints from geochronology and modelled phase equilibria

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November 2010

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Abstract

In situ LA-ICPMS U-Pb monazite geochronology and garnet Sm-Nd geochronology, combined with calculated metamorphic phase diagrams, indicate that the eastern Warumpi Province along the southern margin of the North Australia Craton has undergone extensive Grenvillian-aged reworking. Rocks in the eastern Warumpi Province are characterised by a pervasive flat lying fabric, with a NE-trending lineation that is associated with top to the north shear sense. This flat lying fabric has been overprinted by E-W trending upright folds that dominate the topography of the Chewings Range. In the Chewings Range region, quartzites containing kyanite are structurally interleaved with aluminous metapelites containing garnet + staurolite overgrown by andalusite. Calculated metamorphic phase diagrams indicate a clockwise pressure-temperature (*P-T*) evolution involving decompression and heating from maximum pressures of 4-4.5 kbar at 530 °C to maximum temperatures of ~570 °C at 3.5 kbar. Sm-Nd isotopic analyses of garnet give ages of 1141 ± 10 Ma and 1100 ± 10 Ma. These garnets are wrapped by a S_{1-2} fabric which gives LA-ICPMS U-Pb monazite ages in the range 1190-1100 Ma. The age data suggests that the flat lying fabric in the eastern Warumpi is associated with Grenvillian-aged reworking. Dolerite dykes of the 1080 Ma Stuart Dyke Swarm cross cut the upright folding, constraining the deformation in the eastern Warumpi to 1190-1080 Ma. This interpretation contrasts with previous work, which attributes the tectonic architecture in the eastern Warumpi Province to the c. 1590 Ma Chewings Orogeny. The metamorphic conditions indicate a high geothermal gradient regime, associated with the formation of a regional, low-angle fabric and decompression, suggestive of an extensional setting. The timing of the deformation in the eastern Warumpi Province is synchronous with high-*T* magmatism in the Musgrave Province, several hundred kilometres to the south. This implies that the affects of the Grenvillian-aged tectonism in central Australia are more extensive than previously understood. It also suggests that much of the basement to the intracratonic Amadeus Basin records this event.