The structural and metamorphic evolution of the central Arunta Block: evidence from the Strangways Metamorphic Complex and the Harts Range Group, central Australia.

by

Anthony Richard Norman

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School of Earth Sciences, Macquarie University,
N.S.W. 2109, Australia.

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Abstract

An analysis of the compositions of minerals and the geometries of their fabrics in rocks from the Strangways Metamorphic Complex and the Harts Range Group indicates that the central Arunta Block was affected by two major granulite facies tectonometamorphic cycles prior to greenschist facies retrogression and uplift to the surface. The Strangways Metamorphic Complex consists of interlayered felsic, mafic and pelitic gneisses that contain granulite facies assemblages. A continental rift setting or a rifted continental margin setting is inferred, on the basis of the composition of mafic granofelses, metapelites and felsic gneisses. Uncommon K-poor felsic granofelses probably indicate diagenetic alteration of rhyolitic tephra, rather than widespread metasomatism during metamorphism. The whole-rock compositions of mafic granofelses in the Strangways Metamorphic Complex are similar to those of mafic gneisses in the Harts Range Group. Mineral chemistry and zoning indicate that limited decompression accompanied cooling after peak metamorphism in both the Strangways Metamorphic Complex and the Harts Range Group. Isostatic compensation of the lithosphere, inferred as having been due to a magmatic thickening of the crust, resulted in the limited decompression and intense non-coaxial ductile extensional deformation. Mineral assemblages and compositions indicate that peak metamorphism occurred at conditions of high-temperature and low- to intermediate pressure in the Strangways Metamorphic Complex ($P = 5.3\pm1.5$ kbar, $T\sim850°C$) and high-temperature and intermediate pressure in the Harts Range Group ($P \geq 6.5$ kbar, $T\sim800°C$). Dissimilar P-T-t paths for the Strangways Metamorphic Complex and the Harts Range Group may reflect spatially separate but contemporaneous metamorphism/deformation, cooling and decompression of one protolith, rather than recording unrelated early-Proterozoic histories. The metamorphic geotherm is inferred to have been greater to the south during peak metamorphism, reflecting the geometry of an extensional detachment during the first tectonometamorphic cycle (the *Strangways Event*).

The central Arunta Block was subsequently reworked along a northeast to southwest-trending axis during a second major tectonometamorphic cycle (the *Arunta Orogeny*) that affected large portions of the Arunta Block and was unlike the events responsible for peak metamorphism. This event progressively deformed the Harts Range Group and Strangways Metamorphic Complex, and buried the Strangways Metamorphic Complex to greater depths. The pervasive layer-parallel granoblastic foliation in the Strangways Metamorphic Complex was folded into northeast-plunging, isoclinal to open folds that are colinear with an almost ubiquitous northeast-plunging stretching lineation. These folds resemble mylonitic folds in shear zones and were probably produced during progressive non-coaxial deformation. Retrograde minerals in the axial planes of these folds indicate the movement of Cl-bearing and F-bearing fluids during deformation,

which may have resulted in strain weakening and the formation of local macroscopic sheath folds. The Strangways Metamorphic Complex is also dissected by ultramylonite zones that contain recrystallized, high-temperature mineral assemblages and stretching lineations that are oriented parallel to stretching lineations in the unmylonitized gneisses. Most ultramylonites preserve evidence for normal movement and may represent limited gravitational collapse after tectonic thickening.

The granoblastic mineral assemblages in the Strangways Metamorphic Complex are enveloped by fine-grained symplectic aggregates that represent the effects of a second metamorphism. An increase in temperature and pressure ($P = 7.3 \pm 0.8$ kbar, $T \sim 800°C$) during this second metamorphic event may have been concomitant with the dominant folding of the Strangways Metamorphic Complex.

The pervasive high-grade foliation in the Harts Range group is folded into tight, upright eastsoutheast-trending folds and north-plunging reclined folds. Unlike the Strangways Metamorphic Complex, the effects of a distinct second metamorphic event are not recognized in the Harts Range Group and hydrous minerals are poor in Cl and F. The Harts Range Group may represent a lower crustal section that was progressively deformed during the Arunta Orogeny and juxtaposed with the Strangways Metamorphic Complex. The inferred P-T-t paths for the Strangways Metamorphic Complex and the Harts Range Group converged during this major tectonometamorphic cycle.

The Strangways Metamorphic Complex and Harts Range Group are separated by wide shear zones and anastomosing north-dipping ultramylonite zones that resemble a tectonic mélange. These zones contain a northnortheast-plunging, high-grade mineral elongation lineation and preserve evidence for a reverse sense of movement. Deformation along these shear zones was probably responsible for juxtaposing the Harts Range Group against the Strangways Metamorphic Complex during the second tectonometamorphic cycle.

After the second tectonometamorphic cycle, the central Arunta Block remained at depth until uplift during the late-Proterozoic and mid-Carboniferous. North of late-Proterozoic sediments belonging to the Amadeus Basin, a mylonitic foliation in the Strangways Metamorphic Complex is overprinted by a northwest-trending, fine-grained muscovite lineation. This lineation is parallel to mineral elongation lineations in the deformed Amadeus Basin metasediments and represents deformation during the mid-Carboniferous *Alice Springs Orogeny*.

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