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# High pressure metamorphism during intracratonic orogenesis: physical conditions and rates from the Amata region, Musgrave Province

Honours Thesis

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# Abstract

The intracratonic orogenesis of the Petermann Orogeny caused the formation of high-pressure, low-geothermal gradient, eclogite facies rocks. These geologically rare rocks are found in the exposed orogenic core, observable near the Traditional community of Amata, in the Musgrave Province. Their formation remains a mystery and as a result two contrasting models have been proposed to explain their formation; namely whether orogenesis occurred in "hot" crust and was long lived, or occurred in "cold" crust and was short-lived. *In situ* LA-ICP-MS analysis of monazite show that metamorphism occurred at *c.* 598 Ma. Using conventional thermobarometric techniques, peak conditions are estimated to have reached ~640 °C and ~11.5 kbar. Integrating this data with petrological observations and calculated *P-T* pseudosections, a clock-wise *P-T* path was defined, which is typical of an orogenic setting. Diffusion modelling using garnet compositional profiles from grains of both relict composition and those interpreted to be reset, estimated the minimum duration for prograde metamorphism to be ~27 Myr. The same garnet grains show little to no evidence of cooling/exhumation, which has been attributed to the low metamorphic peak temperature. Results of this study make a direct contribution to two contrasting models for orogenesis. Combining new evidence from this study with tectonothermal evidence from the western Musgrave Province and sedimentological data from the Officer Basin to the south, it is concluded that shear heating (or short-lived deformation) is not a plausible model for Petermann-aged deformation. Despite the lack of spatially continuous data across the Musgrave Province, long-lived orogenesis is the more supported model in light of new evidence emerging from this study.