Duration of the Petermann Orogeny from coupled diffusion and phase equilibria modelling

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25th October, 2010

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Abstract

The Ediacaran to Cambrian (600-500 Ma) intraplate Petermann Orogeny significantly affected the crustal architecture of Central Australia, resulting in the exhumation of the Musgrave Province from beneath the Centralian Superbasin. In the western Musgrave Province response to intensive deformation is variable, with pervasive mylonitic reworking and localised migmitisation in the western Mann Ranges, and discrete mylonitisation in the eastern Mann Ranges. The duration of this period of intraplate orogenesis is a currently debated topic. Ti-in-zircon thermometry coupled with SHRIMP U-Pb zircon geochronology indicate that peak temperatures of 733±23°C in the western Mann Ranges occurred at *circa* 540 Ma. Combined diffusion-cooling modelling, U-Pb rutile and titanite isotopic data and calculated phase equilibria of recrystallised metagranites from the Cockburn Shear Zone and kyanite-bearing mylonites from the Mt. Charles Thrust indicate exhumation driven cooling from peak *P-T* conditions of 12-14 kbars and 700-750°C to 6-7 kbars and 550-600°C at *c.* 500 Ma occurred at a rate of 3.75-5.6°C/ My. These results indicate a slow-cooling and long-lived thermal regime and additionally suggests that final exhumation of the Musgrave

Province had not occurred by *c.* 500 Ma, much younger than previously estimated. These findings suggest that granulite-facies metamorphism in the Musgrave Province was regional and that other factors such as fluid, control the variations in style of structural reworking. This study lends support to the notion that the intraplate Petermann Orogeny was long-lived and does not advocate short-lived orogenesis or the theory that shear heating is the driving force for metamorphism.