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Enigmatic ultrahigh-temperature metamorphism in the Warumpi Province: Continental collision or extension?

SAMANTHA NICOLE MARCH[1], MARTIN HAND[1], LAURA JANE MORRISSEY[2] AND DAVID KELSEY[3]

[1]The University of Adelaide

[2]The University of South Australia

[3]Geological Survey of Western Australia

Presenting Author: samantha.march@adelaide.edu.au

The southern margin of the North Australian Craton (NAC) acts as an archive for the long-lived Palaeoproterozoic to Mesoproterozoic growth and assembly of the Australian continent. This margin is defined by two geological provinces: the Aileron Province to the north, and the Warumpi Province to the south. Existing tectonic models interpret the Paleoproterozoic-aged Aileron Province as native to the NAC, whereas the Mesoproterozoic-aged Warumpi Province is assumed to be exotic to both the Aileron Province and the NAC. The amalgamation of these provinces is linked to the *c.* 1640 Ma Liebig Orogeny, a tectonic event suggested as collisional. This study focuses on ultrahigh-temperature Mg–Al-rich metapelites and associated metabasites. Multimineral U–Pb geochronology and mineral trace element geochemistry combined with *P–T* modelling indicates rapid burial of sedimentary protoliths to depths of around 30 kilometres was associated with mafic magmatism that locally boosted metamorphic temperatures to around 950 °C. The presence of mafic magmas during metamorphism may instead reflect a tectonic regime governed by extension rather than collision. This would help explain the presence of layered mafic and ultramafic complexes with mid-ocean ridge basalt (MORB)-like geochemistry on the margin of the NAC equivalent in age to the high temperature metamorphism, as well as some similarities between detrital zircon age populations in the Warumpi Province and the Aileron Province in the NAC. We suggest that instead of collision and accretion with the NAC and the resultant building of a larger Paleoproterozoic Australia, the Warumpi Province represents a partially rifted and re-joined part of the NAC. In this scenario, rifting lead to the accumulation and rapid burial of sediments within a high heat regime boosted by mafic magmatism.