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Late Palaeoproterozoic evolution of the buried northern Gawler Craton

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ABSTRACT

This study utilises U-Pb geochronology, Lu-Hf, Sm-Nd isotopes and geochemistry to constrain the timing of deposition, metamorphism and provenance characteristics of buried Palaeoproterozoic meta-sedimentary and meta-igneous rocks in the northern Gawler Craton, Australia. The data suggest that sedimentary sequences were deposited between ca. 1780 and 1740 Ma across a wide region accompanied by *syn*-depositional magmatism. Restricted zircon age spectra, relatively radiogenic whole-rock Hf-Nd and in-situ zircon Hf isotopic compositions and enriched REE signatures support the notion of a connected series of basins or a single large basin, which developed on a common Neoarchaean substrate across the northern Gawler Craton during the Late Palaeoproterozoic. Temporal and isotopic correlation of these indurated rocks with Palaeoproterozoic basins throughout the North Australian Craton suggests they may form part of an extensive basin system that developed across the Australian continent during the Late Palaeoproterozoic. The meta-sedimentary and meta-igneous rocks of the northern Gawler Craton record high-grade crustal anatexis during the ca. 1730–1690 Ma Kimban Orogeny and subsequent Early Mesoproterozoic re-working.

1. Introduction

A major hindrance to unravelling the evolution of the Australian continent is the dearth of exposed geology in critical regions. Consequently tectonic interpretations have been biased from regions where there is outcrop. The northern Gawler Craton (Fig. 1a) occupies a region comparable in size to the United Kingdom, but due to the lack of basement outcrop there are fewer constraints than for other Proterozoic terranes of the Australian continent.

The geography-based nomenclature of Myers et al. (1996) provides a framework for the interpretation of Proterozoic Australia into the North, South, and West Australian cratons (Fig. 1b). The South Australian Craton comprises the Curnamona Province and the Gawler Craton, including the predominantly buried northern Gawler Craton. In palaeogeographical reconstruction models, the position of the South Australian Craton with respect to the North and West Australian cratons, the temporal correlation of major accretion, and deformational and thermal events across these blocks (e.g. Betts and Giles, 2006; Wade et al., 2006; Gibson et al., 2008; Swain et al., 2008; Payne et al., 2009; Korsch et al., 2011; Aitken et al., 2016; Betts et al., 2015). A consistent theme in these reconstruction models however, is the predominance of plate margin processes and continental growth at the margins of the Archaean nucleus of the Gawler Craton. In order to test these models a better understanding of the Proterozoic evolution of the northern Gawler Craton is required because it lies at the interface between the South and North Australian cratons.

Geochronology coupled with isotopic and geochemical fingerprinting of ancient rock packages is a powerful tool for constraining reconstructions of Proterozoic terranes (e.g. Cawood et al., 1999; Nelson, 2001; Halilovic et al., 2004). These methods allow us to identify potential links between cratonic elements with greater confidence, which informs our understanding of the regional tectonic evolution. This study aims to provide constraints on the timing and provenance for a series of meta-sedimentary and magmatic rocks intersected during the 2010 Gawler-Officer-Musgrave-Amadeus (GOMA) drilling program across the northern Gawler Craton (Korsch et al., 2010a). To achieve this, the isotopic and temporal signatures of distinct detrital, metamorphic, and

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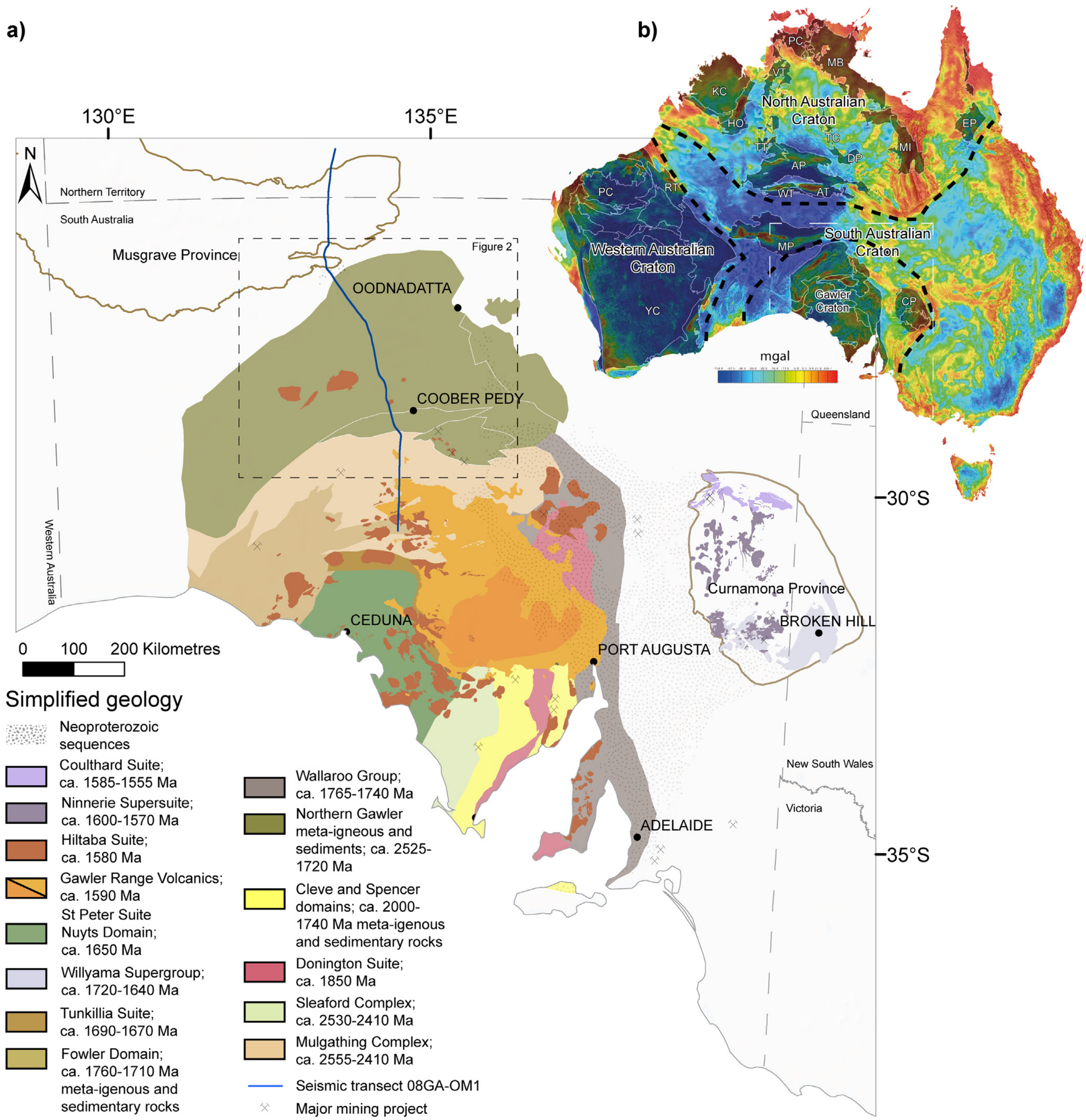

Fig. 1. a) Interpreted simplified bedrock geology of the Gawler Craton. The position of the deep seismic reflection line 08GA-OM1 is shown. Major intrusive bodies and Palaeoproterozoic meta-sedimentary rocks of the Curnamona Province are also shown. Insert shows the extent of Fig. 2; b) Location of the Gawler Craton in relation to other major Precambrian elements of Australia draped on the continental scale gravity grid (filtered to show large wavelength features by upward continuing the data to 6 km) blended with the 1st vertical derivative of the continental scale magnetic grid which has also been upward continued 6 km (original grids from Geoscience Australia). Abbreviations: AP – Aileron Province, AT – Arunta Terrane, CP – Curnamona Province, DP – Davenport Province, EP – Etheridge Province, HO – Halls Creek Orogen, KC – Kimberley Craton, MB – McArthur Basin, MI – Mount Isa terrane, MP – Musgrave Province, PC – Pine Creek Orogen, RT – Rudall Terrane, TC – Tennant Creek region, TT – Tanami Terrane, VT – Victoria River Basin, WT – Warumpi Terrane, YC – Yilgarn Craton.

igneous crystallisation zircon and monazite populations are compared with those of neighbouring tectonic elements. Direct comparison of our new zircon and monazite age data with existing U-Pb age spectra for the Precambrian terranes of eastern Australia can then be used to identify the most likely crustal element(s) from which refractory grains could be derived. The use of in-situ Lu–Hf isotope system fingerprinting allows comparison of the source (i.e. relative contemporary crust/mantle contribution) from which different zircon populations have crystallised (Belousova et al., 2002). These data have the potential to discriminate between terranes that have similar chronology, but different magmatic source chemistry and antiquity, allowing a further level of discrimination between potential sources of detritus. The integration of in-situ zircon and monazite data with whole-rock geochemical, Sm-Nd and Lu-Hf isotopic analysis is assessed to constrain the evolution of this poorly part of the Australian continent.