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LA-ICP-MS U–Pb dating of detrital rutile and zircon from the Reynolds Range: A window into the Palaeoproterozoic tectonosedimentary evolution of the North Australian Craton

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ABSTRACT

The Palaeoproterozoic Reynolds Range of the Arunta Region, central Australia, comprises a series of shallow marine clastic sediments (Reynolds Range Group) which overlies deeper water sequences of turbidites (Lander Rock Formation) and minor sandstones ("unnamed sandstone"). U–Pb age data collected from detrital rutile and zircon in these rocks indicates these sequences contain very similar age spectra, although with a notable and important shift to younger ages within the stratigraphically younger Reynolds Range Group. Detrital zircons from the "unnamed sandstone" directly underlying the unconformity with the Reynolds Range Group contain a major age component at ca. 1860 Ma, together with a wide spread of ages between ca. 3.2 and 2.0 Ga and a minor age component of 1830–1805 Ma. Detrital rutile from the same rock yield a unimodal age spectrum with a mean age of ca. 1840 Ma. The detrital zircon age spectrum from the Reynolds Range Group is similar, although the youngest cluster of ages is younger and dates to between 1800 Ma and 1780 Ma. Detrital rutile from these rocks yield a unimodal age spectrum with a mean age of ca. 1790 Ma. Although the observed differences in ages are subtle, we suggest these nevertheless mark a significant change in provenance.

We attribute the predominance of 1860–1820 Ma detrital zircon and 1840 Ma detrital rutile within the "unnamed sandstone" and the characteristic ca. 1860 Ma detrital zircon age cluster in previously published provenance studies from the Lander Rock Formation to uplift and erosion of the Halls Creek–Pine Creek Orogen. This orogenic belt marks collision between the North Australian and Kimberley cratons, an event dated to between 1835 Ma and 1810 Ma and which incorporates marginally older rocks dating to 1860 Ma from the foreland of the Kimberley Craton. By contrast we attribute the influx of younger rutile and zircon, together with a distinct facies change observed with the onset of the deposition of the Reynolds Range Group, to a shift in provenance region to the Yapungku Orogen, which marks the collision between the West Australian and North Australian cratons and is dated to ca. 1800–1765 Ma. A change in provenance is additionally consistent with significant differences in rutile trace element composition.

The Lander Rock Formation and the Reynolds Range Group are stratigraphically correlated with sedimentary rocks that overly large parts of the North Australian Craton. We suggest this indicates spatially continuous basinal conditions within the North Australian Craton between ca. 1840 Ma and 1780 Ma, although the erosion and drainage systems feeding this basin were strongly influenced by the collision and orogenesis along the northwest and southwest margins of the North Australian Craton.

1. Introduction

The poly-metamorphic Arunta Region of central Australia (Fig. 1a and b) plays a central role in the Palaeoproterozoic tectonothermal and sedimentary evolution of the North Australian Craton (Etheridge et al., 1987; Zhao and Bennett, 1995; Zhao and McCulloch, 1995). The oldest rocks exposed in this region are variably metamorphosed siliciclastic sedimentary rocks that were deposited in the late Palaeoproterozoic and intruded episodically by voluminous granitoids and reworked by both local and regional phases of deformation and metamorphism between ca. 1800 Ma and 300 Ma (e.g. Collins and Williams, 1995; Rubatto et al., 2001;

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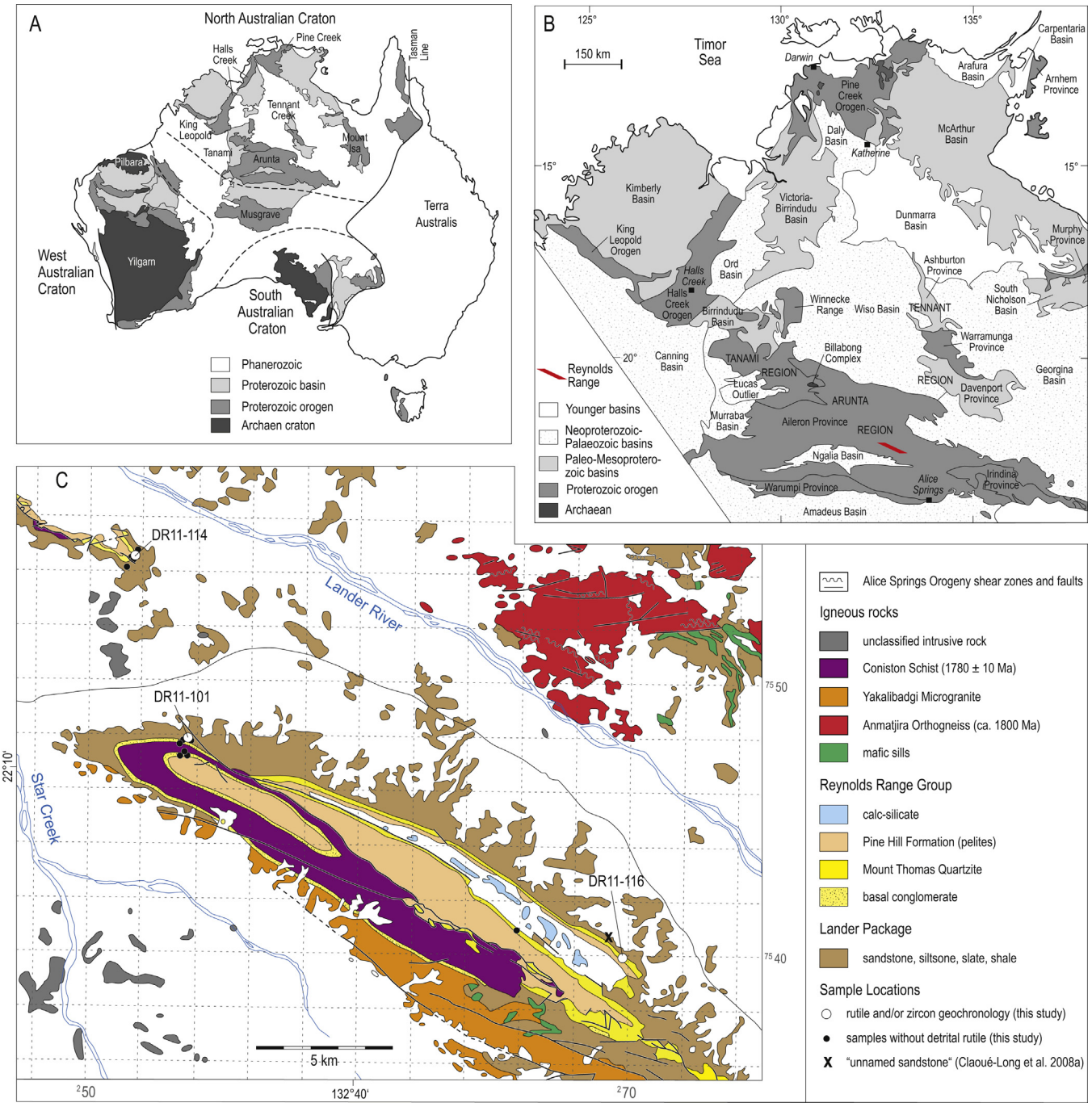

Fig. 1. Location and geological maps. (A) Simplified tectonic map of Australia (after Myers et al. (1996) and Cawood and Korsch (2008)). (B) Simplified regional geological map of North Australia including province divisions (after Neumann and Fraser (2007)). The position of the Reynolds Range is indicated. (C) Geological map of the northwest Reynolds Range showing the distribution of major rocks types (modified from Stewart (1981)). 2 km intervals of the Australian Map Grid (Zone 53) are drawn. Sample locations of this study together with the sample location for the "unnamed sandstone" from Claoué-Long et al. (2008a) are marked. Age constraints for the Coniston Schist are based on Smith (2001) and for the Anmatjira Orthogneiss on Rubatto et al. (2006) and Worden et al. (2008a).

Maidment et al., 2005; Scrimgeour et al., 2005; Claoué-Long and Edgoose, 2008; Raimondo et al., 2011; Anderson et al., 2013).

To better constrain the Palaeoproterozoic sedimentary evolution of the Arunta Region, we have undertaken a combined LA-ICP-MS U–Pb age study of detrital rutile and zircon from the northwest Reynolds Range. A multi-mineral approach has the advantage that zircon and rutile record different provenance information. Whereas zircon mostly dates the age of magmatic and high-temperature metamorphic events, rutile is commonly formed in medium to high-pressure metamorphic rocks and yields ages that date cooling from metamorphism (e.g. Mezger et al., 1989). In addition, rutile trace element compositions reflect the lithology in which it formed and can be potentially used to recover metamorphic temperatures in the source region (e.g. Zack et al., 2004a, 2004b; Tomkins et al., 2007; Triebold et al., 2012). Thus, it records properties of the source region, which complement traditional U–Pb dating of detrital zircon (e.g. Rösel et al., 2011; von Eynatten and Dunkl, 2012).

The northwest Reynolds Range is a key region to study the basinal development of the Arunta Region as it records the stratigraphic transition from a low energy depositional environment defined by the turbidites of the Lander Rock Formation to the higher-energy