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A new early Cambrian bradoriid (Arthropoda) assemblage from the northern Flinders Ranges, South Australia

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ABSTRACT

A new assemblage of early Cambrian bivalved arthropods (Bradoriida) is described from the Arrowie Syncline in the northern Flinders Ranges, South Australia. The well preserved, largely endemic fauna comprises a total of six taxa (including five new species): *Jiucunella phaseloa* sp. nov., *Jixinlingella daimonikoa* sp. nov., *Mongolitubulus anthelios* sp. nov., *Neokunmingella moroensis* sp. nov., *Phasoia* cf. *spicata* (Öpik, 1968), and *Sinskolutella cuspidata* sp. nov. This assemblage is derived from a carbonate sedimentary package representing a high energy, shallow water archaeocyath-*Renalcis* biohermal facies of Terreneuvian, Stage 2 age which transitions up-section to a more restricted, low energy, intra-shelf lagoonal environment that correlates with a Cambrian Series 2, Stage 3 age. The new taxon *J. phaseloa* sp. nov., has a first appearance datum (FAD) in shallow water biohermal facies of the Hideaway Well Member of the Wilkawillina Limestone at a level 47 m below the FAD of *Pelagiella subangulata* which is taken to approximate the base of Series 2, Stage 3 in South Australia. Along with *Liangshanella circumbolina*, this makes *J. phaseloa* sp. nov. amongst the oldest bivalved arthropods in South Australia and potentially greater Gondwana. The presence of 25 bradoriid taxa from the early Cambrian of South Australia suggests East Gondwana represents a major centre of origin for the Bradoriida.

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1. Introduction

Bradoriid arthropods achieved global distribution during the early Cambrian (Williams et al., 2007, 2011) and were significant benthic faunal elements in terms of abundance and diversity during the Cambrian radiation (Siveter and Williams, 1997; Hou et al., 2002; Vannier et al., 2005; Zhang, 2007; Dies Álvarez et al., 2008). Much of the known species diversity is based on specimens derived from both "crack out" material and acid processed carbonates (Shu, 1990; Siveter and Williams, 1997; Williams and Siveter, 1998; Hou et al., 2002; Williams et al., 2007; Zhang, 2007; Topper et al., 2011) and appears to be closely tied to fluctuating oxygen levels on marine shelves throughout the Cambrian (Williams et al., 2011). Recent investigations documenting early Cambrian (Series 2, Stages 3–4) phosphatic skeletal faunas from carbonate shelf facies in the Flinders Ranges, South Australia have revealed an unexpectedly high diversity of bradoriid species (Skovsted et al., 2006; Topper et al., 2007, 2011). Topper et al. (2011) recently described a bradoriid assemblage from the Ajax Limestone in the Mt Scott Range that included *Liangshanella circumbolina*, a taxon that has a first appearance before the incoming of trilobites and the FAD of the widely distributed micromollusc *Pelagiella subangulata* which has been suggested as a potential tool to define the base of Cambrian Series 2, Stage 3. *L. circumbolina* was recognised as the earliest known bradoriid taxon from East Gondwana. Topper et al. (2011) also revealed a strong provincial signal for bradoriids from East Gondwana, though a clear biogeographic link with South China was also documented.

This study documents a new assemblage of six bradoriid taxa, including five new species from the Arrowie Syncline in the northern Flinders Ranges of South Australia. Many of the genera have Chinese affinities that have not previously been reported from East Gondwana. The new fauna brings the total number of bradoriid genera known from the early Cambrian of Australia to 25, suggesting East Gondwana was a major centre for the origin and early diversification of the group. Of particular significance is the new taxon, *Jiucunella phaseloa* sp. nov., which has a first appearance datum in the upper part of the Hideaway Well Member of the Wilkawillina Limestone. Regionally, this stratigraphic level is at least equivalent (possibly older) than the FAD level of *L. circumbolina* (Topper et al., 2011) in the Mt Scott Range, and thus indicates *J. phaseloa* is one of the oldest known bivalved arthropods from East Gondwana. The new assemblage re-enforces generic-level biogeographic links to South China (Topper et al., 2011) and high species endemicity of bradoriid faunas in East Gondwana during the early Cambrian.

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2. Locality and lithostratigraphy

Bradoriids described in this study are derived from samples collected along a stratigraphic section (Moro) measured through the lower Cambrian Hawker Group succession in the Arrowie Syncline, northern Flinders Ranges, Arrowie Basin, South Australia (Fig. 1). The Moro section (Fig. 2) is located approximately 5 km south of Moro Gorge on the north-eastern limb of the Arrowie Syncline, a ~25 km long south-west plunging syncline located immediately north of the Stirrup Iron Range. The lower part of the section includes lowstand to transgressive Parachilna Formation and highstand Woodendinna Dolomite of sequence system tract 1.1A of Zang et al. (2004). The base of the Moro section is located at the top of the Parachilna Formation (co-ordinates: 30° 43.616′ S; 139° 12.528′ E), a well sorted, iron-rich quartz sandstone. The lower 72.5 m of section is obscured by alluvium that covers the contact between the Parachilna Formation and the overlying Woodendinna Dolostone. The Woodendinna Dolostone consists of laminated microbialites, often with muddy interlaminations and centimetre scale digitate stromatolites, though pervasive dolomitisation has destroyed much of the original carbonate fabrics.

The Woodendinna Dolostone is disconformably overlain (Jago et al., 2012) by 171 m of the Mt. Mantell Member of the Wilkawillina

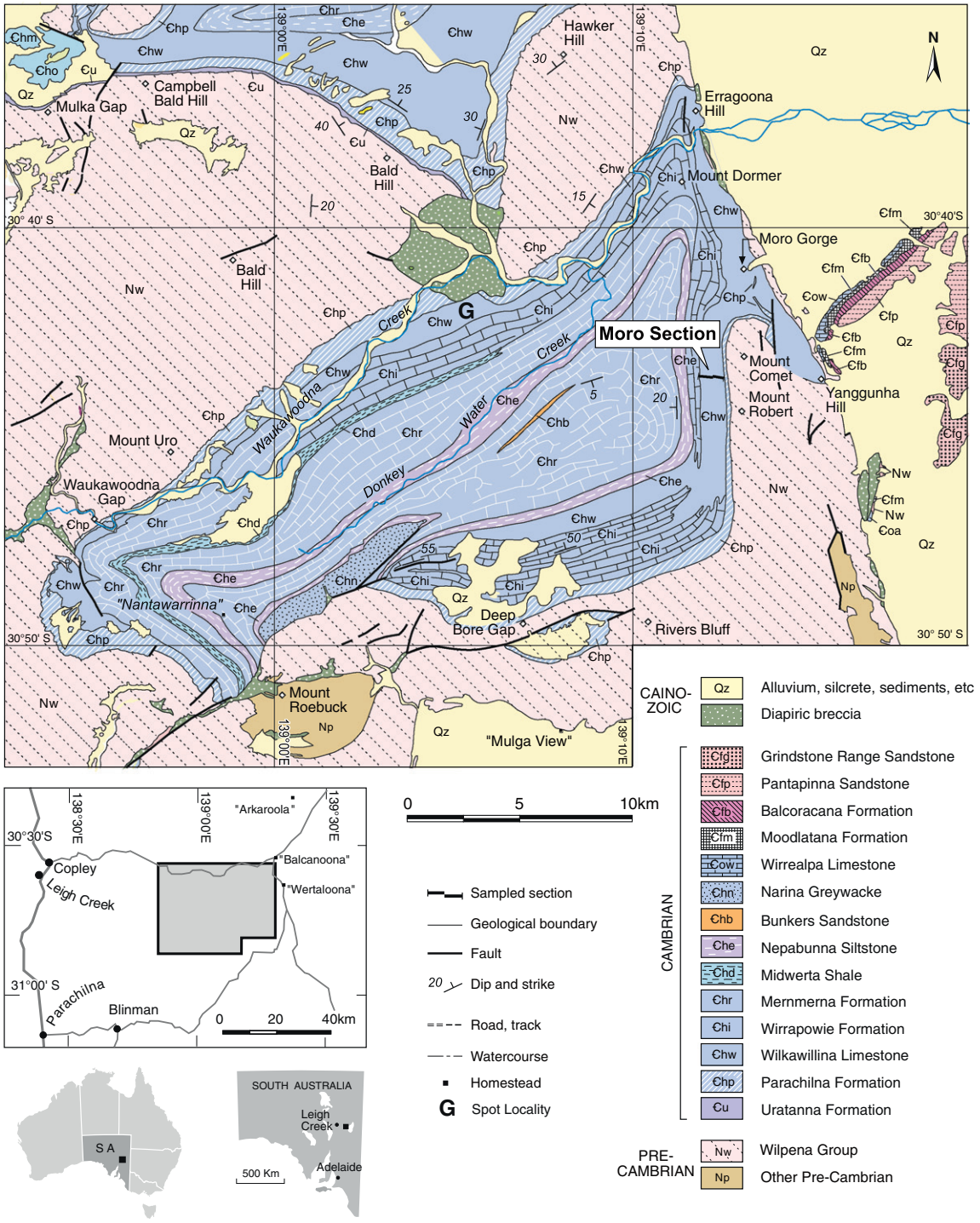

Fig. 1. Regional locality and detailed geological map showing the study area in the Arrowie Syncline, Flinders Ranges, South Australia. The Moro section was measured through the Wilkawillina Limestone and Wirrapowie Limestone on the eastern limb of the syncline.

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