

University of New England

**SYSTEMATICS, BIOGEOGRAPHY AND
PALAEOECOLOGY OF CAMBRIAN SERIES
3 TRILOBITES AND AGNOSTIDS FROM
EAST GONDWANA**

by

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Declaration

All work submitted is solely for a PhD at University of New England, Armidale. NSW.

All assistance for this PhD and all sources used in its preparation are duly acknowledged.

Signature



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Abstract

Trilobites and agnostids are the best tools for intercontinental correlation during the Cambrian. This thesis documents these arthropods from the East Gondwanan margin (comprising mainland Australia, Tasmania, East Antarctica and New Zealand) during Cambrian Series 3. Trilobite and agnostid taxonomy underpins the biostratigraphy and biogeography undertaken in this thesis. Quantitative statistical analyses are used to interpret the biogeography and diversity of the East Gondwana margin within the world at this time.

A summary of each chapter of this thesis is outlined below.

Chapter 1 – The Cambrian is a period of great innovation in geological and evolutionary history, with the establishment of most modern phyla, mineralized skeletons, a large rise in biotic diversity, and the initial separation of Gondwana from Laurentia, Baltica, Siberia and Avalonia. Cambrian Series 3, up until recently known as the Middle Cambrian, comprises a part of the Cambrian where trilobites and agnostids dominated animal life and as such they make excellent global biostratigraphic indicators for this part of the Cambrian. The agnostids are especially critical for Cambrian Series 3 as many species were cosmopolitan with relatively short biostratigraphic ranges. Chapter 1 details the current state of knowledge for Cambrian Series 3 in East Gondwana, and Australia more specifically, and the importance of this thesis in its contribution to global knowledge of biostratigraphy and biogeography, based heavily on trilobite and agnostid taxonomy.

Chapter 2 - Prior to this work, *Rhyssometopus* typified many Australian trilobite and agnostid genera, in that it required a taxonomic revision in order to clarify the concept of the genus and its relationships. The revision conducted in this study found that the genus had been oversplit due to the use of inappropriate characters in generic division. These

characters were found to vary and the use of several other non-linear characters were found to be more useful for the basis of division into different species. This chapter provides a basis for the proceeding taxonomic work in chapter 3 where a further 12 species undergo a similar modern taxonomic treatment.

Chapter 3 – The faunas of the Gowers Formation from the Georgina Basin of western Queensland are well recognized for their exceptional preservation. Additionally, many trilobites and agnostid species are found in such abundance that they provide an opportunity to study and revise trilobite and agnostid taxonomy and biostratigraphy and to hence add substantially to our understanding of the relationships between Australia, Gondwana, Laurentia, China, Siberia and Avalonia during Cambrian Series 3. The Gowers Formation is found to be of *T. gibbus* to *A. atavus* age rather than the *E. opimus* age given previously, based primarily on its contained agnostids. This Drumian fauna is found to have closest connections with Laurentia, Scandinavia, Siberia and China.

Chapter 4 – An analysis of 224 genera of trilobites and agnostids from 78 fossil sites across the three Cambrian Stage 3 time intervals (Stage 5, Drumian, Guzhangian) is presented here. Results of the analyses reveal major grouping of faunas from the various basins of Australia and parts of East Gondwana. The groups are represented by various sites along the entire East Gondwanan margin, from northern Australia to the Transantarctic Mountains that characterise a range of shallow to deep marine palaeoenvironments. The complex groupings most likely reflect long-range faunal exchange along the margin permitted by the eustatic transgressions taking place at various times during Cambrian Series 3. An increase in the number of cosmopolitan agnostid species during the Guzhangian Stage of Cambrian Series 3, in association with distinct deep-water trilobite-agnostid assemblages, strongly reflects the eustatic transgressive event that reached its pinnacle during

this time, which allowed for greater faunal exchange between areas on the margin and other palaeocontinents and terranes. The East Gondwana margin was determined to represent a biodiversity ‘hot spot’ during Cambrian Series 3, containing almost one-quarter (~23%) of the trilobite and agnostid genera known worldwide. The data support previous interpretations that Cambrian Series 3 trilobites and agnostid faunas from the East Gondwana margin have strong biogeographic links with those from Chinese terranes (especially North and South China), the Himalaya, and to a lesser extent, Iran, Kazakhstan, Laurentia and Siberia.

The data reveals an overall increase in generic diversity throughout Cambrian Series 3, reaching a peak in the Guzhangian, with major diversifications most likely corresponding to eustatic transgressive phases.

Note regarding Thesis format

The thesis consists of four sections, each representing a separate, stand-alone manuscript that has been submitted for publication to various journals. As such, differences in text format, spelling and plate/figure size between each section reflect specific requirements of the targeted journals.

Chapter 2 has been published (Hally, 2011). All aspects of the paper were solely my responsibility. Section 2 has been formatted for *Alcheringa*, to be published as soon as possible. It too, was solely my responsibility. Chapter 4 has also been published (Hally and Paterson, 2014). Dr J. R. Paterson contributed 10% to the biofacies analyses sections of the paper; all other aspects were solely my responsibility.

Hally, L . A . 2011. The Cambrian trilobite *Rhyssometopus*, with taxonomic revision of Guzhangian species from Queensland, Australia. *Memoirs of the Association of Australasian Palaeontologists* 42, 175-191.

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