

# An updated stratigraphic framework for the Georgina Basin, Northern Territory and Queensland

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## Introduction

The Georgina Basin is a Neoproterozoic to Lower Devonian sedimentary basin in Queensland and the Northern Territory (Figure 1), with prospective conventional and unconventional hydrocarbon targets within Cambrian and Ordovician rocks. Stratigraphic interpretations of the prospective southern, central and eastern regions of the basin have been revised to reflect the 2012 Geological Time Scale (Gradstein et al. 2012), resulting in an updated chronostratigraphic framework for the basin. Biostratigraphic studies summarised by Laurie (2012) have been integrated with existing stratigraphic information (such as presented by Dunster et al, 2007) and detailed well log analyses to produce a revised biostratigraphic chart with implications for important hydrocarbon source rocks.

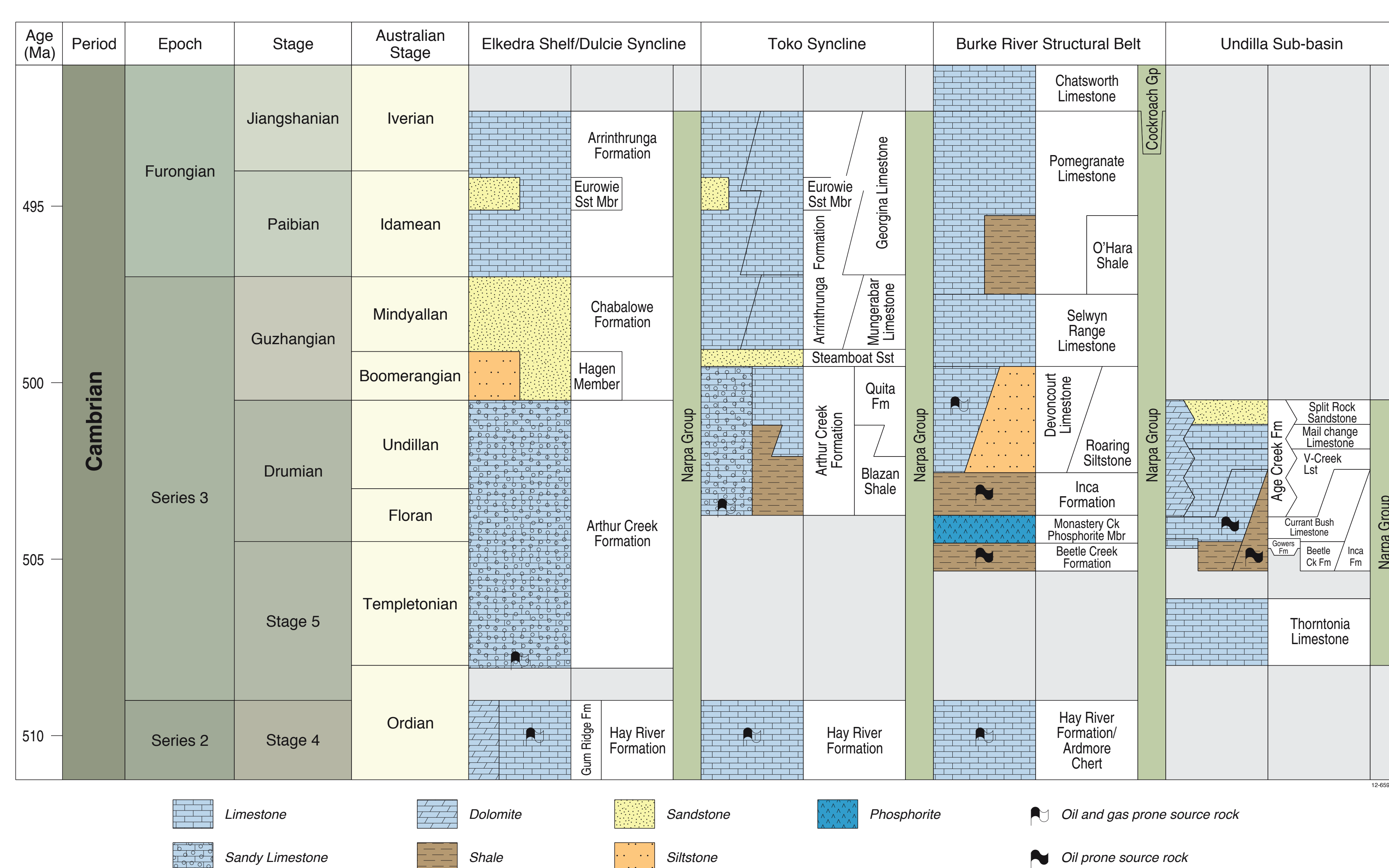


Figure 2: Excerpt from the Georgina Basin Biozonation Chart, showing the revised Cambrian chronostratigraphy of the Dulcie and Toko synclines, Burke River Structural Belt and Undilla Sub-basin.

## Biostratigraphic Revisions

### Revision One

The unit previously interpreted as Thornton Limestone across the southern portion of the basin is older than the Thornton Limestone in its type area in the Undilla Sub-basin (Figure 2). The Hay River Formation is suggested as a name for this Ordian Limestone unit.

- Ordian limestone at the base of the Narpa Group is commonly referred to as Thornton Limestone.
- The type area for the Thornton Limestone in the Undilla Sub-basin (Öpik and Pritchard, 1960) was originally thought to be Ordian, but fauna recorded from sections near Thornton Station is actually Templetonian (unpublished data).
- The name of Thornton Limestone has been attributed to Ordian limestone in the Elkedra Shelf, Dulcie and Toko synclines, and Burke River Structural Belt (Ambrose et al, 2001; Dunster et al, 2007). As it is a different age to the 'original' Thornton Limestone, this unit requires a different name.
- Before being reassessed as equivalent to the Thornton Limestone, the limestone unit underlying the Arthur Creek Formation in the Toko Syncline was named the Hay River Formation (Walter et al, 1979). The name Hay River Formation is here reinvoked for this unit.

The complete Georgina Basin Biozonation and Stratigraphy Chart is available digitally from the Geoscience Australia Booth (booths 161–166) or online at [www.ga.gov.au](http://www.ga.gov.au) (GeoCat 75819).

### Revision Two

The base of the Arthur Creek Formation is diachronous, including the basal 'hot shale' which is younger towards the east (Figures 2 & 3).

- In the Dulcie Syncline, the Arthur Creek Formation ranges from the latest Ordian to Undillan or younger.
- In the Toko Syncline, the base of the formation is Floran, with thick Undillan and Boomerangian successions.
- The 'hot shale' interpreted at the base of the Arthur Creek Formation in both synclines, similarly varies in age from Late Ordian to Floran across the major depocentres.

### Revision Three

The age of the contact between interpreted 'upper' and 'lower' Arthur Creek Formation (Ambrose et al, 2001) is inconsistent (Figure 3).

- The contact between the 'upper' and 'lower' Arthur Creek Formation, picked by Ambrose et al (2001) on the basis of wire-line logs and lithology in a number of wells across the Dulcie and Toko synclines, is diachronous.
- It varies in age from late Templetonian–early Floran to early Boomerangian, in the four wells for which biostratigraphic control exists (Laurie, 2012):
  - Baldwin 1: late Templetonian to early Floran.
  - Ross 1: mid Floran to Undillan.
  - Hacking 1: Boomerangian.
  - Owen 2: Undillan.

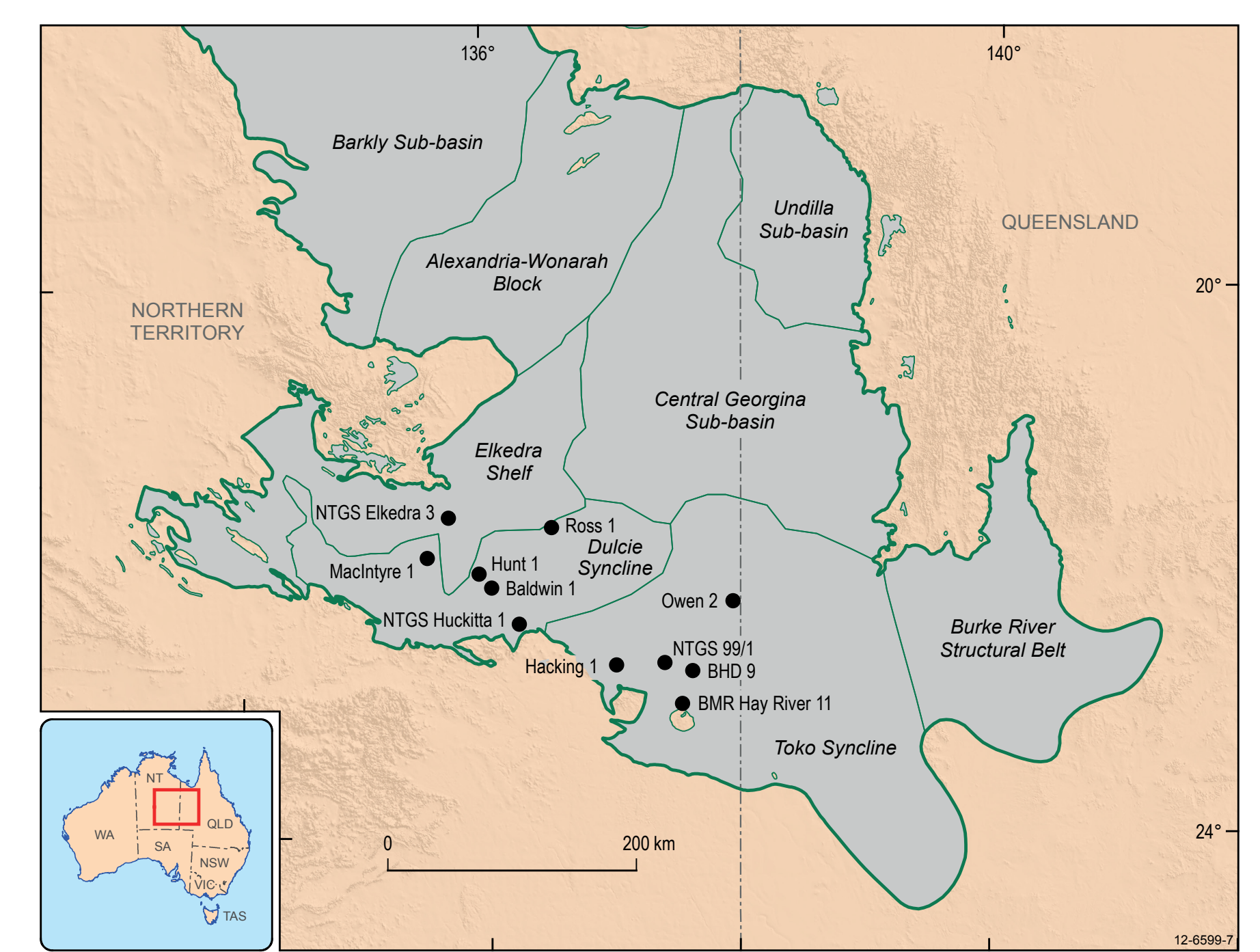


Figure 1: Sub-basins of southern, central and eastern Georgina Basin and locations of wells referred to in text and in Figure 3. Inset: Location of the Georgina Basin.

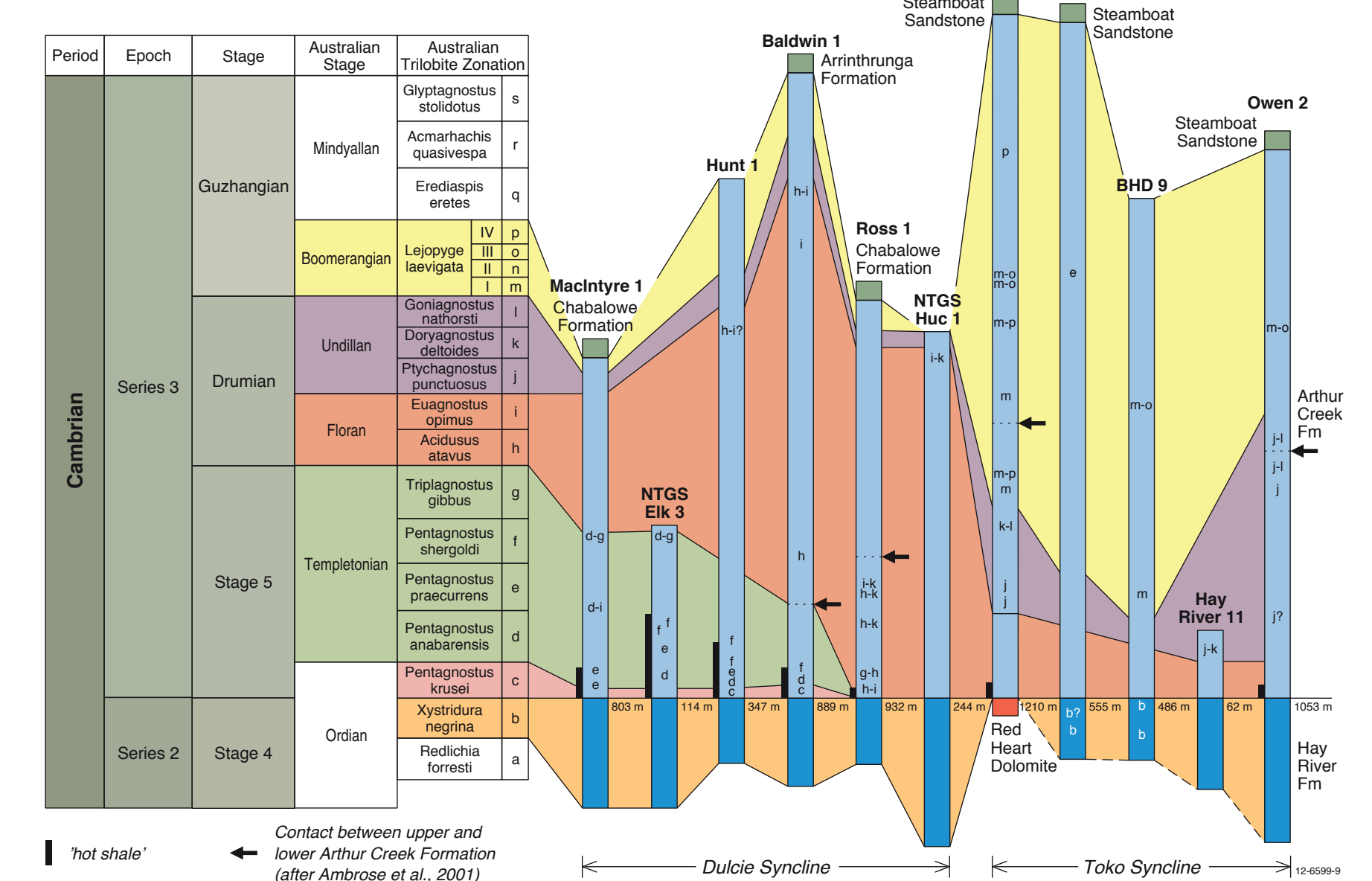


Figure 3: Columns based on thicknesses penetrated of the Hay River Formation and Arthur Creek Formation in the Georgina Basin wells, plotted against the latest early and middle Cambrian biostratigraphic scheme for the basin (from Öpik 1979; Laurie 2006 and unpublished data). The columns for each well are proportional to the thickness of the units encountered except for the unit overlying the Arthur Creek Formation, which are purely schematic and are used to show that the entire thickness of the Arthur Creek was penetrated. The 'hot shale' interpreted by Ambrose et al (2001) is indicated by the thick line to the left of the column. Age determinations using trilobite faunas are indicated by the pertinent letters in the columns which are keyed to the zones in the biostratigraphic column at left. The arrows to the right of some columns refer to the boundary between the 'upper' and 'lower' subdivisions of the Arthur Creek Formation given by Ambrose et al (2001). The coloured regions joining the columns are suggested approximate correlations (after Laurie 2012).

## Conclusion

Revised biostratigraphic interpretations for the Georgina Basin have implications for the understanding of the stratigraphy of the basin and the distribution of potential hydrocarbon source rocks. The limestone unit in the southern part of the basin, previously interpreted as the Thornton Limestone, is of a different age to that in its type area in the Undilla Sub-basin, and is here renamed the Hay River Formation. The basal 'hot shale' of the Arthur Creek Formation is diachronous across the Dulcie and Toko synclines and the age of the contact between the interpreted 'upper' and 'lower' Arthur Creek Formation is inconsistently picked across the southern part of the basin. More detailed analyses of the biostratigraphy of other wells are likely to lead to a better understanding of the distribution of source rocks in the Georgina Basin.

## References

- AMBROSE, G. J., KRUSE, P. D. AND PUTNAM, P. E. 2001—Geology and hydrocarbon potential of the southern Georgina Basin, Australia. *The APPEA Journal*, 41, 139-163
- DUNSTER, J.N., KRUSE, P. D., DUFFETT, M. L. AND AMBROSE, G. J. 2007—Geology and resource potential of the southern Georgina Basin. Northern Territory Geological Survey, Digital Information Package DIP007.
- GRADSTEIN, F.M., OGG, J.G., SCHMITZ, M.D. AND OGG, G.M. (EDITORS), 2012—The Geological Time Scale 2012, Volumes 1 & 2, Elsevier BV, Oxford 1144 pp.
- LAURIE, J. R. 2012—Biostratigraphy of the Arthur Creek Formation and Thornton Limestone, Georgina Basin. In Ambrose, G. J. and Scott, J. (editors), 'Proceedings of the Central Australian Basins Symposium, Alice Springs, Northern Territory, 16-17 July 2012, Northern Territory Geological Survey, CD ROM.
- ÖPIK, A. A. AND PRITCHARD, P. W. 1960—Cambrian and Ordovician. In Hill, D. and Denmead, A. K. (editors), 'The Geology of Queensland'. *Journal of the Geological Society of Australia*, 7, 89-109.
- WALTER, M. R., SHERGOLD, J. H., MUIR, M. D. AND KRUSE, P. D. 1979—Early Cambrian and latest Proterozoic stratigraphy, Desert Syncline, southern Georgina Basin. *Journal of the Geological Society of Australia*, 26, 305-312.

