A new chronostratigraphic framework for the Mount Isa Inlier

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SUMMARY

The integration of detrital and magmatic SHRIMP U-Pb zircon geochronology with facies analysis has allowed the development of a chronostratigraphic framework for the Leichhardt and Calvert Superbasins of the Western Fold Belt, Mount Isa Inlier. This new event chart recognises three supersequences in the Leichhardt Superbasin: the ~1800-1785 Ma Guide, ~1780-1765 Ma Myally and ~1755-1740 Ma Quilalar Supersequences. The younger Bigie Supersequence encompasses the Bigie Formation and is temporally associated with the ~1710 Ma Fiery magmatic event. This supersequence, together with the ~1690 Ma Prize Supersequence, comprise the Calvert Superbasin. Combining the new geochronological constraints with previous work now provides a detailed stratigraphic event framework between 1800 and 1575 Ma for the Western Fold Belt of the Mount Isa Inlier. Using this framework, it is now possible to develop detailed comparisons and correlations with the Eastern Fold Belt. This framework can then be used to generate facies models for the development of the Mount Isa region through time.

Key words: Proterozoic, Mount Isa, SHRIMP geochronology, basin analysis.

INTRODUCTION

Basins of the Proterozoic Mount Isa contain a number of world-class Pb-Zn-Ag deposits. Understanding the timing and nature of basin development is a critical component in understanding these mineral systems. SHRIMP U-Pb zircon geochronology has been integrated with sequence stratigraphy and facies analysis to develop a regional chronostratigraphic framework for sedimentary packages of the Leichhardt and Calvert Superbasins in the Western Fold Belt of the Mount Isa Inlier. The depositional age and regional extent of these packages are important because they may be possible source regions for younger mineralising systems, and because the geometries of these basins have an important control on the development of the overlying Isa Superbasin and on the migration of fluids. This stratigraphy is combined with the previous framework for the Isa Superbasin in order to construct a new event framework for the Western Fold Belt of the Mount Isa Inlier, and used as a template to integrate with sequences in the Eastern Fold Belt.

METHOD AND RESULTS

Lithostratigraphic units included in the Leichhardt and Calvert Superbasins are the Bottletree Formation, Haslingden Group (Mount Guide Quartzite, Eastern Creek Volcanics and Myally Subgroup), Quilalar Formation, Bigie Formation and lower McNamara and Isa Groups. As there are only a limited number of felsic volcanics present within these superbasins, geochronology relied on the analysis of detrital zircons in sedimentary units to define maximum depositional ages and provenance distributions.

New detrital and magmatic SHRIMP U-Pb zircon geochronology integrated with basin analysis recognises three supersequences in the Leichhardt Superbasin:

- The Guide Supersequence spans the interval ~1800-1785 Ma and includes the Bottletree Formation and the Mount Guide Quartzite. Sequence relationships suggest that this package represents an asymmetric second order cycle, recording a thickened transgressive suite and a condensed interval.
- The overlying Myally Supersequence spans the interval ~1780-1765 Ma and includes the Eastern Creek Volcanics and syn-depositional Lena Quartzite, and the Myally Subgroup. This package represents a second order supersequence cycle in which mafic volcanism was initiated during a phase of east-west extension. Following the cessation of volcanism, transgression led to the deposition of the Alsace Quartzite and deeper water Bortala Formation. An increase in the rate of sediment supply over accommodation resulted in progradation and deposition of the Whitworth Quartzite and red bed playa facies of the Lochness Formation as accommodation closed.
- The Quilalar Supersequence spans the interval ~1755-1740 Ma and includes the Quilalar Formation in the Western Succession, and the Ballara Quartzite and Corella Formation in the Mary Kathleen Zone. Sequence analysis indicates that this package represents a series of storm-, tide- and wave-dominated shelfal marine depositional systems.

New maximum depositional ages of ~1760 Ma for the Bigie Formation are older than the depositional age suggested by field relationships, which imply that this unit is coeval with the ~1710 Ma Fiery Creek Volcanics. Therefore, we have defined a separate supersequence for the Bigie Formation, the Big Supersequence, even though it may be more genetically related to the Fiery magmatic Event. The Big Supersequence,
together with the ~1690 Ma Prize Supersequence (Southgate et al. 2000), comprise the Calvert Superbasin.

The evolution of the Leichhardt, Calvert and Isa Superbasins are temporally and spatially related with magmatism. The new SHRIMP age for the Weberra Granite is within error of the age for the Fiery Creek Volcanics, indicating that they are both part of the ~1710 Ma Fiery Event. Refined ages for the Sybella Granite confirm that this unit is coeval with the Carters Bore Rhyolite, suggesting that magmatism associated with this event is constrained to 1675–1670 Ma, associated with and followed by deposition of the Gun Supersequence.

CONCLUSIONS

The integration of detrital and magmatic zircon SHRIMP geochronology with sequence stratigraphic understandings of basin history has led to the development of a chronostratigraphic framework for the sandstone-rich packages of the 1800-1670 Ma Leichhardt and Calvert Superbasins in the Western Fold Belt of the Mount Isa Inlier. When this event chart is integrated with the chronostratigraphic basin framework for the Isa Superbasin (Southgate et al. 2000) it is possible to consider the evolution of the entire Western Succession of the Mount Isa region from a chronostratigraphic perspective for the interval 1800-1575 Ma. Such an analysis represents the essential first step in determining more accurate time-based correlations and geodynamic models for the evolution of the resource rich Palaeoproterozoic successions of Australia.

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REFERENCES

