

Intracratonic basin evolution and links to mineralisation and prospectivity in the Proterozoic Carpentaria Zinc Belt

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The richly endowed Carpentaria Zinc Belt is hosted within an extensive and complex intracratonic basin system that developed from 1790-1570 Ma. The evolution of this basin system was strongly linked to tectonism occurring at distal plate margins, leading to a dynamic basin evolution with periods of extension, basin inversion, and syn-deformational faulting that have strongly influenced mineral systems in the region.

The linked basins that make up the Mount Isa Province, Lawn Hill Platform, and McArthur Basin have been correlated into discrete periods of deposition that have been variously defined as 'Superbasins' or 'packages'. These include the 1790-1710 Ma Leichhardt Superbasin/Redbank package, 1710-1690 Ma Calvert Superbasins/Goyder package and the 1670-1570 Ma Isa Superbasin/Glyde and Favenc packages. The earliest phase of basin development at 1790-1710 Ma, involved both east-west and north-south extension, sedimentation and bimodal volcanism, and hosts a range of uranium, copper, and cobalt mineral systems. The basal unconformity is associated with large unconformity-related uranium systems in the Alligator Rivers field that formed during multiple phases of fault reactivation during long-lived basin development.

The richest mineral endowment in the belt is in the Isa Superbasin that hosts giant stratabound shale-hosted zinc deposits including Mount Isa (1650 Ma), McArthur River and Teena (1640 Ma), and Century (1590 Ma), associated with syn-depositional strike-slip and normal faulting. Kinematics of faulting are consistent with an overall northeast-southwest extensional environment in the Mount Isa region, and north-northwest-south-southeast extension in the McArthur River region. A number of shales within the Isa Superbasin and the overlying 1500-1400 Ma South Nicholson and Roper Groups (Wilton package) are rich in organic carbon, and host large shale gas and oil resources that represent one of the world's oldest potentially viable petroleum plays.

Increasing volumes of seismic data in recent years has demonstrated that this basin system is continuous undercover over a vast area of northern Australia, substantially increasing the search space for large basin-hosted mineral systems. This had also led to the definition of a 'greater McArthur Basin' which is contiguous undercover and extends across an area the size of France, and which is separated by a basement high from the contemporaneous basin systems of the Lawn Hill Platform and Mount Isa province. Despite localised significant exploration and discovery in these basins, large areas remain underexplored, especially in areas under relatively shallow cover.