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Basin inversion as a driver of fluid flow and Pb-Zn mineralization in the Paleoproterozoic-earliest Mesoproterozoic Mount Isa mineral province: evidence from deep seismic reflection profiling and gravity modelling

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Currently accepted ideas about the timing and depositional environment of sediment-hosted Pb-Zn mineralization in the Mount Isa region of northern Australia need to be modified in the light of recently published deep seismic reflection imagery and forward modelling of gravity data. Three vertically stacked and partially inverted sedimentary basins preserving a record of intracontinental rifting followed by passive margin formation are now recognized. Each superbasin comprises a syn- and post-rift component with depositional conditions changing progressively from fluviatile-lacustrine in half-graben of the older 1790-1740 Ma Leichhardt Superbasin to open marine in basins of the younger Calvert (1730-1640 Ma) and Isa (1635-1595 Ma) superbasins. Passive margin conditions were established towards the close of the Calvert Superbasin before being interrupted by plate convergence, crustal shortening and basin-wide inversion across the Mount Isa region at 1640 Ma in the two older superbasins. A prominent hairpin bend in the apparent polar wander path for northern Australia around this same time indicates that this phase of basin deformation (D1) is unlikely to have been simply linked to local events but owes its origin to changes in the external plate tectonic regime.

Crustal extension and thinning recommenced after 1640 Ma with formation of the Isa Superbasin and continued up to ca. 1615 Ma when extensional faulting ceased and a further episode of basin inversion commenced, driven by onset of the 1615-1550 Ma Isan Orogeny. This younger episode of syn-orogenic basin inversion was accompanied by deposition of carbonaceous sediments hosting the 1575 Ma Century Pb-Zn deposit and was largely accommodated on east- or northeast-dipping reactivated intrabasinal extensional faults and footwall shortcut thrusts. Basin inversion and fluid expulsion at this stage were entirely submarine, consistent with a syn-sedimentary to early diagenetic origin for Pb-Zn mineralization at, or close to, the seafloor. Basin inversion and

synorogenic processes may also have played a role in the formation of several other sediment-hosted Pb-Zn deposits in northern Australia, including the 1640 Ma McArthur River. A comparable depositional and tectonic environment (foreland basin) has been proposed for other types of Pb-Zn mineralization elsewhere in the world, including carbonate-hosted Mississippi-type deposits, highlighting the importance of basin inversion and orogenesis as drivers of fluid flow and mineralization.