Potential-field data such as aeromagnetics are often used to produce geological interpretations of regions that are poorly exposed. However, when integrated with surface mapping, potential-field data can also elucidate crucial information on the regional structural architecture and tectonic evolution of areas which are well exposed with excellent structural control.

One such area is the Leichhardt River Fault Trough (LRFT) which is located within the western Mt Isa Inlier of northwest Queensland, Australia. It is comprised of Proterozoic sedimentary and volcanic successions that formed during repeated cycles of rifting and thermal subsidence, and have undergone several basin inversion events. The region is well exposed but is also characterized by a spectacular aeromagnetic imagery, which highlights several structural features of the Mount Isa Inlier.

To better understand the deformation history and complex overprinting relationships that formed the LRFT, aeromagnetic, gravity, and radiometric data are coupled with geological data to produce a structural interpretation map of the region. These data are then used to constrain 2D forwards models of the gravity and magnetic data, to better understand the 3D geometry of the folds and half-grabens within the LRFT.

Our interpretation suggests the N-S trending Leichhardt anticline formed before the development of E-W oriented normal faults bounding the half graben, which are infilled with ca 1690-1640 Ma succession. The implication of this interpretation is that a major inversion event pre-dates the development of the ca. 1710 Ma – 1690 Ma Calvert Superbasin. The implication of this interpretation is that the bulk of the crustal shortening within the LRFT pre-dates the Isan Orogeny (1620-1520 Ma). Consequently, there is a requirement to reassess the correlation of shortening events across the Mount Isa Inlier and the tectonic drivers for such a large inversion event and its implications on the tectonic evolution of the North Australia Craton.