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3D Fault Network of the Murchison Domain, Yilgarn Craton

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The architecture of Archean granite-greenstone terranes is often controlled by networks of 10 km to 100 km-scale shear zones that record displacement under amphibolite facies to greenschist facies metamorphic conditions. The geometry of such crustal scale 'fault networks' has been shown to be highly relevant to understand the tectonic and metamorphic history of granite-greenstone terranes, as well as the availability of structural controlled fluid pathways related to magmatic and hydrothermal mineralization.

The Neoarchean Yilgarn Craton and the Proterozoic orogens around its margins constitute one of Earth's greatest mineral treasure troves, including iron, gold, copper and nickel mineral deposits. Whereas the Yilgarn Craton is one of the best studied Archean cratons, its enormous size and limited outcrop are detrimental to the better understanding of what controls the distribution of these vast resources and what geodynamic processes were involved the tectonic assembly of this part of the Australian continent.

Here we present a network of the major faults of the NW Yilgarn Craton between the Yalgar Fault, Murchison's NW contact with the Narryer Terrane to the Ida Fault, its boundary with the Eastern Goldfields Superterrane. The model has been constructed from various geophysical and geological data, including potential field grids, Geological Survey of Western Australia map sheets, seismic reflection surveys and magnetotelluric traverses.

The northern extremity of the modelled area is bounded by the Proterozoic cover and the southern limit has been arbitrarily chosen to include various greenstone belts. In the west, the major faults in the upper crust, such as the Carbar and Chundaloo Shear Zones, dip steeply towards the west and then flatten off at depth. They form complex branching fault systems that bound the greenstone belts in a series of stacked faults. East of the Ida, the far east of the model, the faults have been integrated with Geoscience Australia's pmd*CRC Eastern Goldfields model. In the central portion, the major faults such as the Youanmi and Wattle Creek, dip to the east and can be followed into the fabric of the Yarraquin Seismic Province. The Wattle Creek Shear Zone in particular can be traced on all three of the Youanmi seismic lines. The greenstones are cradled between these major faults and antithetic westward dipping subsidiary faults such as the Edale Shear Zone. While the Ida Fault cannot be located with great confidence, the slight drop in Moho depth toward the east and the overall change of seismic texture delineate the Youanmi-Eastern Goldfields boundary. The Lawler's Anticline, presumably located in the hanging wall of the Ida Fault, again changes the style of faulting with the Lawler's tonalite forming the core of a 10 km-scale antiform.

The fault network presented here is a milestone to a craton-wide integrated structural model and will hopefully contribute to provide a better spatial context for geological, geochemical and geophysical data in our quest to understand the tectonics and mineral potential of the Yilgarn craton.