STRUCTURAL EVOLUTION OF THE S-BEND REGION
EAST ALBANY–FRASER OROGEN

THE S-BEND: OVERVIEW AND KEY FINDINGS

The Albany–Fraser Orogen is situated along the southern and southeastern margins of the Yilgarn Craton (Fig. 1) and is an important and prospective example of Archean craton margin modification and deformation. This is because it hosts the Tropicana gold mine within the reworked Archean rocks of the Tropicana Zone, and the Nova–Bollinger Ni–Cu deposit within the mafic to ultramafic, Mesoproterozoic granulite facies rocks of the Fraser Zone. Understanding the tectono-metamorphic and magmatic evolution of the orogen is therefore paramount in establishing temporal and structural frameworks for the formation of these mineral systems.

The informally named S-bend region (Fig. 2) is an asymmetric interface between the reworked Archean rocks of the Northern Foreland, the Paleoproterozoic orthogneiss-dominated rocks of the Biranup and Nornalup Zones, and the Mesoproterozoic interlayered mafic and felsic gneisses of the Fraser Zone. The tectonic units within and adjacent to the S-bend region preserve differences in their structural grain and evolution. Key structures and relationships are presented in Figures 3–10.

The structural evolution of the S-bend region preserves at least three regionally significant orientations of folds and associated structures: north–south trending, northwest–southeast trending and northeast–southwest trending. The regional-scale S-fold geometry likely developed by the overprinting of multiple structures oriented at high angle to one another, as opposed to a straightforward sinistral shear development as might be expected to produce such geometry. The Fraser Shear Zone (FSZ) preserves a dextral shear-dominated kinematic evolution. However, an earlier history of sinistral kinematics is locally preserved. The FSZ is interpreted as a relatively old structure that was later folded about the S-bend with associated northeast-trending folds. Younger sinistral and east-side-up components of relative motion along the Newman Shear Zone (NSZ) subsequently produced an apparent regional-scale drag fold that overprinted northeast-trending folds, accentuating the S-bend geometry.

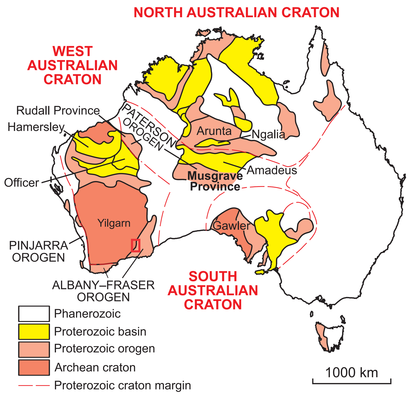

Figure 1: Tectonic map of Australia. The Albany–Fraser Orogen is situated in the West Australian Craton, along the southern and southeastern margins of the Archean Yilgarn Craton. Red box marks the position of Figure 2.

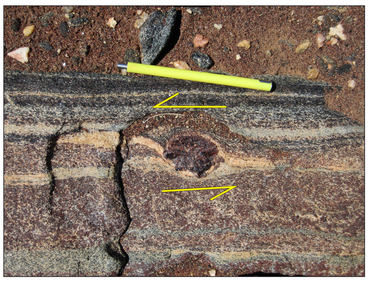

Figure 3: Plan view of the Fraser Shear Zone (FSZ) with large delta-type garnet porphyroclast indicating sinistral strike-slip shear sense. Stretching lineation on main gneissic layering is subhorizontal. The FSZ shows dominantly dextral kinematics, however rare localities such as this preserve an early sinistral shear history. Pen magnet points north.

Figure 4: A gently northeast-plunging antiform and synform pair in interlayered garnet-bearing sedimentary gneiss, metagabbro and metagranite on the northwestern margin of the Fraser Zone. Photo faces due northeast.

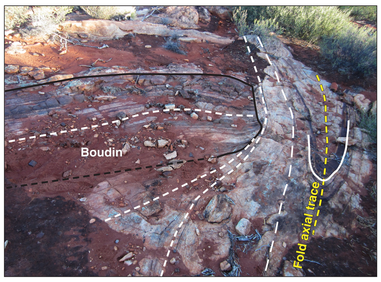

Figure 5: Interlayered metagabbro and psammitic gneiss in the Fraser Zone. Dashed white lines show the orientation of layering and layering-parallel foliations. Large ~2m long mafic boudin to the left (outlined in black) has sharp contacts and shows ~90° of apparent rotation relative to the surrounding structures. Solid white line shows layering affected by a northeast-trending isoclinal fold (dashed yellow line marks axial trace). Photo faces due southeast.

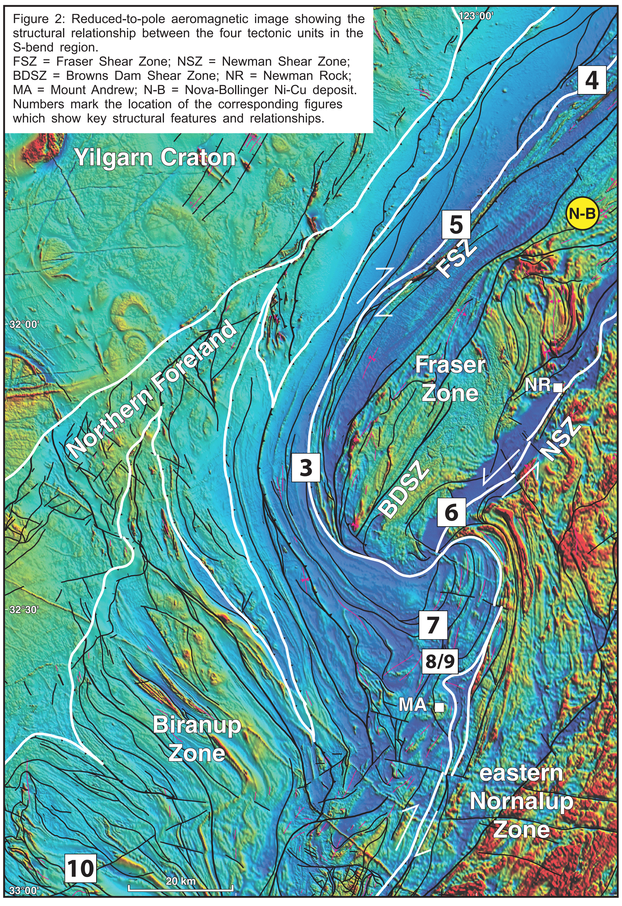

Figure 2: Reduced-to-pole aeromagnetic image showing the structural relationship between the four tectonic units in the S-bend region.
FSZ = Fraser Shear Zone; NSZ = Newman Shear Zone; BDSZ = Browns Dam Shear Zone; NR = Newman Rock; MA = Mount Andrew; N-B = Nova-Bollinger Ni-Cu deposit. Numbers mark the location of the corresponding figures which show key structural features and relationships.

Figure 6: Plan view of the dominant northeast–southwest striking mylonitic foliation of the Newman Shear Zone (NSZ). Large sigma-type feldspar porphyroclasts indicate sinistral strike-slip shear sense. Pencil tip points north.

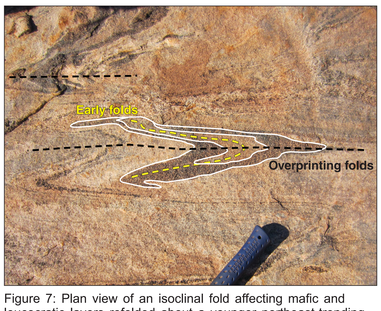

Figure 7: Plan view of an isoclinal fold affecting mafic and leucocratic layers refolded about a younger northeast-trending fold. White lines show layering; yellow dashed line shows axial trace of early fold; black dashed lines show axial traces of overprinting folds. Hammer handle points south.

Figure 8: Upright, gently south-plunging antiform in orthogneiss of the Biranup Zone north of Mount Andrew. Hammer head points north.

Figure 9: Plan view of steeply east-plunging open fold in metagabbro to the north of Mount Andrew (dashed yellow line shows axial trace). These folds deform an earlier foliation (solid white line) and leucosomes parallel to it. Hammer head points north.

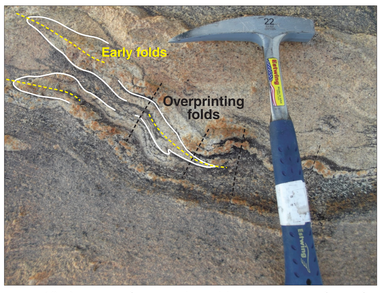

Figure 10: Plan view of early northwest-trending isoclinal folds of gneissic layering and leucosomes in the Biranup Zone, refolded about steeply northeast-plunging, open folds. Solid white lines show layering; dashed yellow lines show axial traces of early folds; dashed black lines show axial traces of overprinting folds. Hammer head points north.

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