

Rift geometry and fracture zone development along Australia's southern continental margin: influence of basement structure and implications for reconstructions of the Australian and Antarctic conjugate margins

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Paleogeographic reconstructions of the conjugate Australian and Antarctic rifted continental margins based on geological versus plate tectonic considerations are rarely, if ever, fully compatible. Possible exceptions include a recently published plate tectonic reconstruction combining ocean floor fabrics and magnetic anomalies with revised rotational poles for successive extensional events in the region that coincidentally brings about a match between the Kalinjala Mylonite Zone in South Australia and Mertz Shear Zone in Antarctica (Whittaker et al., 2007). A match between these two crustal-scale shear zones has been previously proposed on isotopic and geological grounds (Di Vincenzo et al., 2007; Goodge and Fanning, 2010). However, whereas the Mertz Shear Zone marks the western limits of ca. 500 Ma magmatic activity in Antarctica (Delamerian-Ross Orogen), the Kalinjala Mylonite Zone lies well to the west of this magmatic front and is bounded either side by rocks of the Mesoarchean-Mesoproterozoic Gawler craton. An alternative geological match for the Mertz Shear Zone in Australia is the hitherto unrecognised Coorong Shear Zone in South Australia (Fig. 1), tracts of which have been intruded by gabbro and granite of Delamerian-Ross age and west of which such rocks are either completely absent or greatly reduced in volume. The north-south-trending Coorong Shear Zone lies directly along strike from the (Spencer-) George V Fracture Zone and is clearly visible in aeromagnetic images and offshore deep seismic reflection data as a steep to subvertical crustal-penetrating basement structure across which there is an abrupt change in the orientation of magnetic fabrics and sedimentary basin fault geometries. An equally conspicuous change of direction is evident in ocean floor fabrics immediately offshore, inviting speculation that the along-strike George V Fracture Zone originated through reactivation of the older Coorong Shear Zone and shares the same orientation as the original basement structure.

Correlation of this basement structure with the Mertz Shear Zone leads to a reconstruction of the Australian and Antarctic continental margins in which Antarctica and the entrained Mertz Shear Zone are located farther east than some recent restorations allow (Fig. 1). These restorations commonly fail to take into account an episode of NE-SW to NNE-SSW-directed extension preserved in the sedimentary and seismic record of the neighbouring Otway Basin and which is intermediate in age between initial NW-SE directed rifting in the Bight Basin and later N-S rifting that affected all of the continental margin and produced most of the ocean floor fabrics, including all of the major oceanic fracture zones. The Coorong basement structure was briefly reactivated as a sinistral strike-slip fault during this phase of NE-SW extension, but failed to evolve into a continental transform fault as was the case farther east off the southwest coast of Tasmania. There, an analogous pre-existing north-south-trending basement structure identified as the Avoca-Sorell Shear Zone was optimally oriented for reactivation as a strike-slip faulting during

north-south rifting (Gibson et al., 2011). This reactivated structure is continuous along strike with the Tasman Fracture Zone and shares many similarities with the Coorong Shear Zone, separating not only basement domains with opposing magnetic fabrics but sedimentary rift basins with differently oriented sets of normal faults. Together, these two basement structures constitute an important first order constraint on palaeogeographic reconstructions of the Australian and Antarctic margins, and serve as a critical test of future palaeogeographic reconstructions based on ocean floor fabrics and plate tectonic considerations.

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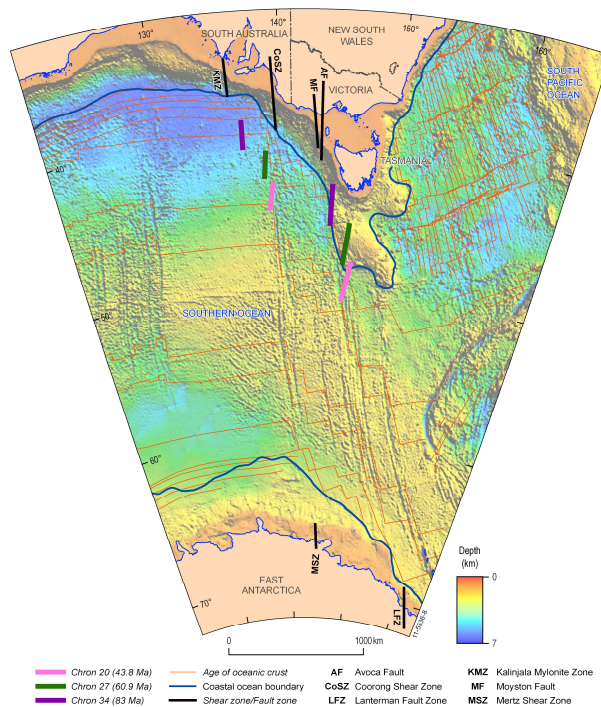


Figure 1. Australian and Antarctic shear zones (bold lines) restored back to selected times and magnetic anomalies using GPlates software (modified after Whitaker et al., 2007) showing that while the Lanterman Fault Zone (Antarctica) sensibly aligns with the offshore extension of the Avoca Fault at 83 Ma; the Mertz Shear Zone projects to a position between the Kalinjala Mylonite Zone and Coorong Shear Zone. Continent-ocean boundaries from Stagg & Reading (2007).