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Conjugate Continent Ocean Transition structure of the rifted margin of South Australia and Antarctica

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We study the tectonic structure and analyse its relation to crustal thinning of the conjugate Australian and Antarctica rifted margins using the re-processed and pre-stack depth migrated (PSDM) regional seismic lines GA199/05 and GA-228/24. The seismic images display a laterally varying complex tectonic structure with different generations faulting styles that possibly evolved as the crystalline basement was being progressively thinned. The strong lateral variation in velocity in synrift sediments and uppermost basement causes the PSDM images to display a fault pattern that is difficult to recognize in images from their two-way travel time. We also identify clear Moho and top basement reflections and have been able to map crustal thinning along these profiles. The location of final break up appears to be well determined from seismic images as the Moho shoals to meet top basement at both conjugate margins. Seismic, magnetic and well data are used to map tectono-stratigraphic units during end of rifting, breakup, and possible mantle exhumation phases the onset of mature before seafloor spreading. However velocity uncertainties are too high to fully constrain this.

Previous work on the Great Australian Bight has shown there is a 10-15km Cretaceous sedimentary unit that is affected by gravity driven deformation. The sediment patterns of this basin show four major phases of rifting and thermal subsidence. Extension occurred during the Upper Jurassic-Lower Cretaceous, with fault systems forming several large grabens such as the Eyre or the Ceduna sub-basin. The timing of continental break-up and the onset of the oceanic crustal production is less certain.

We explore the symmetry/asymmetry of the opening by combining mapped conjugate structures and a first order interpretation of the sediment units. We show that crustal thinning is accompanied by a change in the style, and possibly the timing, of faulting and also show that possible mantle exhumation is associated with “Andersonian faulting” instead of the large-scale low-angle detachment faulting that was previously hypothesized.