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Morphology and kinematics of the rifted margin of West Antarctica in relation to separation from Zealandia and Bellingshausen plate motion

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The final breakup of Gondwana occurred during Late Cretaceous time as rifted continental crust of New Zealand separated from West Antarctica. Geophysical data acquired using R/V Polarstern constrain the structure and age of Antarctica's rifted oceanic margin. The Marie Byrd Land sector resembles a typical magma-poor margin with a narrow steep slope and a 145 km wide continent-ocean transition zone (COTZ). Our transect modelled from gravity and seismic reflection data indicates initial continental crust of thickness 24 km that was stretched 90 km. The Bellingshausen sector, east of the Antipodes Fault, is broad and complex with abundant evidence for later volcanism. The COTZ is ∼670 km wide and substantial uncertainty remains as to the nature of crust within the COTZ. Extension estimates fall in the range of 106–304 km for this sector. Seafloor magnetic anomalies adjacent to the Marie Byrd Land sector at the longitude of the Pahemo Fracture Zone indicate a full-spreading rate during c33–c31 (80–68 Myr) of 60 mm/yr, increasing to 74 mm/yr at c27 (62 Myr), and then dropping to 22 mm/yr by c22 (50 Myr). Spreading rates were lower to the west. Extrapolation towards the continental margin indicates that initial oceanic crust formation was at ∼c34y (84 Myr). The high extension rate of 30–60 mm/yr during the initial margin formation is consistent with the relatively sharp and symmetrical margin morphology, but subsequent motion of the Bellingshausen plate relative to Antarctica was slow and complex, and modified the rift morphology through migrating deformation and volcanic centres to create a broad and complex COTZ.