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Polyphased rifting to post-breakup evolution of the Coral Sea region, Papua New Guinea

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The Coral Sea Basin, offshore Papua New Guinea, is generally described as a rift propagator that opened through the Australian craton during the Late Cretaceous. Rifting was later followed by spreading activity during Palaeocene to lowermost Eocene times and basin inversion during the Cenozoic. Herein, we specifically describe the extensional structures and show that the area has actually a much longer history that dates back from the Late Palaeozoic. A special focus is made on the northern margin of the Coral Sea Basin along which subsurface and HD topographic data were recently acquired.

Extension took place discontinuously from the Late Palaeozoic to the Lower Cenozoic through several rift megacycles that include extensional pulses and relaxation episodes. The first rift megacycle (R1), poorly documented, occurred during the Triassic along an old Permo-Triassic, NS-trending structural fabric. Evidence of Permo-Triassic features is principally observed in the western part of the Coral Sea near the Tasman Line, a major lithospheric discontinuity that marks the eastern limit of the underlying Australian craton in Papua New Guinea. This early Triassic framework was reactivated during a Jurassic rifting stage (R2), resulting in small ($\sim$10/20km) tilted basins bounded by major NS, NE-SW and EW normal faults. Extension formed a large basin, floored by oceanic crust that might have connected with the Tethys Ocean. The Owen Stanley Oceanic Basin containing deep-marine sediments now obducted in the Ocean Stanley Thrust Belt are likely to represent this oceanic terrane. Both R1 and R2 megacycles shaped the geometry of the Jurassic Australian margin. A third Cretaceous extensional megacycle (R3) only reactivated the largest faults, cutting through the midst of this early stretched continental margin. It formed wider, poorly tilted basins and terminated with the onset of the Coral Sea seafloor spreading from Danian to Ypresian times (61.8 to 53.4 Myr). Then, the overall region underwent thermal subsidence through the Middle Eocene prior the first regional compressional episode (Late Eocene to Oligocene).

Rift-megacycles, although poorly dated, are probably pulsed, implying that internal sequences are of specific nature and age and are bounded by unconformities. The controlling factors may include the distribution of underlying basement highs and the response to regional stress variation driven by plate motion. In particular, the set of unconformities is thought to mark a series of uplift episodes that characterise the initiation of the rifting, or else seafloor spreading and subsidence (tectonic/thermal) during each specific rift megacycle.

The current study more specifically shows that: (1) the early rifting phases of the crust (R1 and R2) were controlled by pre-existing continental features whereas the late Coral Sea propagator (R3) cut through the rifted margin independently from earlier structural trends. This last rifting is also more restricted to the area near the continent-ocean transition. (2) the set of rifted basins of the northern margin of the Coral Sea are now underthrusted below the Owen Stanley Basin initially located northward.