



## **The evolution of the southern Chatham Rise margin: Cretaceous rifting and initialisation of seafloor spreading between Zealandia and Antarctica**

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Passive continental margins are commonly classified as of magma-poor and magma-rich types with their extensional and breakup processes are associated with far-field tectonic stresses or upwelling mantle plumes. The Chatham Rise east off New Zealand records a Cretaceous tectonic history from subduction and collision with the oceanic Hikurangi Plateau to continental extension and breakup in the Cretaceous. The mechanisms triggering the change from lithospheric convergence to extension at the south Chatham Rise margin are poorly understood but potentially address open questions in the formation of passive continental margins and the Wilson cycle. We acquired seismic wide-angle reflection/refraction, multi-channel seismic and potential field data along three profiles across the south Chatham Rise margin and adjacent Chatham Terrace, an area of anomalously shallow seafloor and numerous seamounts, to reveal their crustal structure, define the continent-ocean transition zone, and derive breakup mechanisms. Differences in crustal thickness along the Chatham Rise are most likely related to the pre-breakup collision with the Hikurangi Plateau. We found evidence for high-velocity lower crust, but high-volume magmatic activity is absent. On the other hand, the southern Chatham Rise margin as well as the Chatham Terrace are strongly affected by block rotation and normal faulting, but mantle exhumation is not present. The P-wave velocity structure of the Chatham Terrace is close to oceanic crust, but also to hyper-extended continental crust, and we interpreted it as hybrid crust consisting of very thin continental crust affected by magmatic activity. According to our observations, the south Chatham Rise margin is neither a magma-poor nor a magma-rich passive margin. On the basis of our geophysical data and geochemical data from the Chatham Terrace Seamounts we propose a multi-stage evolution for the southern Chatham Rise margin. (i) Passive rifting was initiated around 105 Ma oblique to the former subduction zone and southern Chatham Rise margin, reactivated pre-existing E-W structures along the Chatham Rise and resulted in new NE-SW normal faulting. The Hikurangi Plateau in the north probably retained further extension along the western Chatham Rise. (ii) Following to slab detachment after 90 Ma, hot ascending mantle material intruded the Chatham Rise crust, formed the high-velocity lower crustal zones and triggered magmatism of the Chatham Terrace Seamounts and Southern Volcanics on the Chatham Islands between 85 and 79 Ma. (iii) The southwestward propagation of the young Pacific-Antarctic ridge led to the formation the first oceanic crust at the eastern extremity of the Chatham Rise at 90 Ma. The ridge propagation most likely favoured pre-existing extensional structures from the former rifting episode resulting in oblique and asymmetric spreading and further crustal extension along Chatham Terrace. (iv) Between 85 and 79 Ma, seafloor spreading became contiguous and less oblique leading to the final separation of Zealandia from Antarctica. In conclusion, we interpret the southern Chatham Rise margin as a unique hybrid rifted margin, which tectonic history was influenced by both passive continental rifting and plume-related magmatic activity.