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Rifting in East Antarctica: new views from the Rennick Graben and Wilkes Subglacial Basin

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Multiple continental rifting stages are known to have affected the Phanerozoic West Antarctic lithosphere throughout the Cretaceous and Cenozoic, leading to the formation of one of the largest continental rift systems on Earth- the West Antarctic Rift System (WARS). However, much less is known regarding both the extent and influence of inferred extensional and transtensional processes within the Precambrian lithosphere of the East Antarctic craton, which may have heralded and potentially even followed the separation of East Antarctica from Australia, as part of Gondwana breakup.

Two major topographic basins are known in the Victoria Land segment of the Transantarctic Mountains (TAM) and its ice covered hinterland: the Rennick Graben (RG) and the Wilkes Subglacial Basin (WSB). The RG has been interpreted either as an extensive left lateral Cretaceous(?) pull-apart basin linked to the development of the early WARS, or as a more localised Cenozoic right-lateral basin un-connected to the WARS itself. The WSB is instead often depicted as an intracratonic flexural basin related to the Cenozoic uplift of the TAM, an interpretation that broadly matches the results of recent flexural modelling in this part of East Antarctica (Paxman et al., 2019- JGR). However, our interpretations of aeromagnetic and topographic data indicate that extensional and transtensional processes also affected the rigid cratonic lithosphere in the WSB -at least at upper crustal level.

Here we present results from a new project (REGGAE) that aims to re-investigate the architecture and evolution of the RG and evaluate its potential linkages with the WSB by analysing aeromagnetic, aerogravity and land-gravity and bedrock topography data together with new structural and thermochronology constraints in the Victoria Land segment of the TAM. We show that enhanced aeromagnetic and isostatic residual gravity maps provide tantalising new geophysical views of the RG and several distinct sub-basins within the WSB. Here we interpret these sub-basins within the WSB as upper crustal grabens and pull-apart basins, whose topography was significantly modified by the superposition of glacial erosion. The new geophysical images reveal the spatial extent of part of a Jurassic tholeiitic Large Igneous Province within the RG and WSB and also help define the inherited structural architecture and the Ross-age and Precambrian basement provinces underlying the two basins respectively.

Our geophysical interpretation leads us to hypothesise that the RG is kinematically connected with both the western edge of the WARS and the eastern margin of the WSB, possibly in Cenozoic and Cretaceous times respectively. However, gravity inversions demonstrate that neither the RG nor the WSB exhibit comparably thin crust or lithosphere as observed within the WARS, suggesting that the more rigid Precambrian lithosphere responded markedly differently to the evolution of the regional Mesozoic and Cenozoic stress field. Additionally, potential field images confirm that both the RG and the WSB were un-affected by voluminuous rift-related Cenozoic alkaline magmatism and thick post-Jurassic sedimentary infill is also presently lacking, in stark contrast to the deep Ross Sea Rift basins within the WARS.