Crustal architecture of the largest pull-apart basin in East Antarctica unveiled

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The West Antarctic Rift System (WARS) is known to have experienced distributed/wide mode extension in the Cretaceous, followed by narrow mode and variably oblique extension/transtension in the Cenozoic, the latter potentially linked to the onset of oceanic seafloor spreading within the Adare Basin (Davey et al., 2016, GRL). However, onshore the extent and impact of Cenozoic extension and transtension within the Transantarctic Mountains sector of East Antarctica is currently much less well-constrained from a geophysical perspective.

Here we combine aeromagnetic, aerogravity, land-gravity and bedrock topography imaging to help constrain the extent, architecture and kinematics of the largest Cenozoic pull-apart basin recognised so far in East Antarctica, the Rennick Graben (RG).

Enhanced potential field imaging reveals the extent of a Jurassic tholeiitic Large Igneous Province preserved within the RG and the inherited structural architecture of its basement, including remnants of uplifted ca 530-500 Ma arc basement in the northern Wilson Terrane and a ca 490-460 Ma subglacial thrust fault belt separating the Cenozoic western flank of the RG from the eastern margin of Wilkes Subglacial Basin (WSB).

The architecture of the RG is best explained in terms of a major composite right-lateral pull-part basin that extends from the Oates Coast to the Southern Cross Mountains block. We propose that Cenozoic strike-slip deformation kinematically connected the RG with both the western edge of the WARS and the eastern margin of the WSB. An earlier phase of left-lateral strike slip deformation is also emerging from recent geological field work in the study region but only relatively subtle offsets in aeromagnetic anomaly patterns are visible in currently available regional datasets.

We conclude that the RG is part of a wider distributed region of the continental lithosphere in East Antarctica that was deformed in response to an evolving Cenozoic transtensional tectonic setting that may have also affected enigmatic sub-basins such as the Cook Basins in the adjacent WSB region.