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Geophysical imaging unveils the largest pull-apart basin in East Antarctica

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Abstract Text:

West Antarctica hosts one of the largest continental rift systems on Earth, the West Antarctic Rift System (WARS) that forms the lithospheric cradle for the West Antarctic Ice Sheet. The WARS is known to have experienced several stages of extension starting with distributed/wide mode extension in the Cretaceous, followed by narrower mode and variably oblique extension in the Cenozoic, the latter potentially triggered by the onset of oceanic seafloor spreading in the Adare Basin (Davey et al., 2016, GRL). However, the extent and impact of Cenozoic extension and transtension within the Transantarctic Mountains sector of East Antarctica is much less well understood.

Here we present results from a new project (REGGAE) that by analysing aeromagnetic, aerogravity and land-gravity and bedrock topography images and models provides key new geophysical constraints on the form, extent and kinematics of the largest Cenozoic pull-apart basin recognised so far in East Antarctica, the Rennick Graben (RG).

Potential field imaging reveals the extent of part of a Jurassic tholeiitic Large Igneous Province preserved within the RG and helps delineate the inherited structural architecture of the underlying Ross-age basement in northern Victoria Land, including highly magnetic arc basement in the northern Wilson Terrane and the subglacial extent of a thrust fault belt located between the western flank of the RG and the eastern margin of Wilkes Subglacial Basin (WSB).

We show that the RG is a major composite right-lateral pull-part basin that extends from the Oates Coast to the Southern Cross Mountains crustal block and propose that it is kinematically connected with both the western edge of the WARS and the eastern margin of the WSB. More cryptic evidence for an earlier phase of left-lateral strike slip deformation is also emerging from our recent geological field work in the study region and relatively subtle offsets in aeromagnetic anomaly patterns.

Our findings suggest that the RG is part of a distributed region of the continental lithosphere in East Antarctica that was preferentially deformed in response to Cenozoic transtensional stresses that likely also facilitated propagation of accelerated oceanic transform faulting in the adjacent oceanic lithosphere located between southeastern Australia and Tasmania.

Session Selection:
Observations and models of continental rifts, pull-apart basins, backarc basins, and rifted margins

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Initial materials from the REGGAE project were presented @ the AGU meeting 2018. Since then new geological field work has been performed in Antarctica revealing the first cryptic indications for an earlier phase of left-lateral strike slip deformation that occurred prior to the proposed right lateral intraplate strike slip deformation in the geophysically imaged Rennick pull-apart basin. Our new geophysical analyses include depth to source estimation from magnetic and gravity anomaly analyses and joint 2D forward modelling. This will enable a novel tectonic interpretation sketch map for the Rennick pull-apart basin to be presented @ AGU 2019 for the first time.

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