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The Pensacola-Pole Subglacial Basin in light of recent aerogeophysical exploration

Fausto Ferraccioli (1), Jordan Tom (1), Rene Forsberg (2), Arne Olesen (2), Kenichi Matsuoka (3), and Tania Casal (4)

(1) NERC/British Antarctic Survey, Geology and Geophysics, Cambridge, United Kingdom (ffe@bas.ac.uk), (2) Technical University of Denmark, National Space Institute, Lyngby, Denmark, (3) Norwegian Polar Institute, Tromso, Norway, (4) European Space Agency, ESTEC, Noordwijk, Netherlands

During the 2015-2016 Antarctic campaign we flew a major aerogeophysical exploration effort (PolarGAP) over the previously largely unknown South Pole frontier in East Antarctica, collecting ca 30,000 line km of new radio echo sounding, laser altimetry, airborne gravity and aeromagnetic data.

Here we present the new ice thickness, bedrock topography, and gravity and magnetic anomaly images derived from the survey and interpret these to investigate the crustal architecture and tectonic evolution of the South Pole region. Linear free-air gravity lows within the Pensacola-Pole Basin reveal glacially overdeepened grabens flanked by uplifted horst blocks, including the Pensacola Mountains, Patuxent Range and the Argentine Range. The grabens are interpreted as having first formed in association with the Jurassic Transantarctic rift system, which is characterised by voluminous tholeiitic magmatism of the Ferrar Large Igneous province. We propose that these narrow grabens are kinematically linked to the broader Weddell Sea Rift System. Both the wider and the narrower-mode extensional features may have formed along a long-lived and distributed plate boundary between East and West Antarctica, which we speculate was repeatedly reactivated in the Mesozoic in response to far field stresses along the Paleo-Pacific active margin of Gondwana.

To investigate the influence of pre-existing basement provinces and their tectonic boundaries on the proposed Mesozoic Pensacola-Pole basin, we combined the new PolarGAP aeromagnetic data with previous aeromagnetic datasets and satellite magnetic (MF7) data. The magnetic compilation indicates that part of the eastern flank of the basin is controlled by a major inherited crustal boundary. The boundary forms in turn the southern edge of a composite Precambrian microplate extending from the Shackleton Range to the Pensacola-Pole basin itself. Specifically, this composite crustal block is interpreted here as being composed of Paleo to Mesoproterozoic and Archean crustal ribbons and younger Grenvillian-age crust, similar to arc-related crust previously imaged from aeromagnetic surveys in Dronning Maud Land. The proposed microplate forms a key “missing link” between the subduction-related Ross Orogen and the Pan-African age collisional suture and transpressional shear zones of the Shackleton Range.