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# Crustal architecture and tectonic evolution in the South Pole frontier, East Antarctica, in light of recent aerogeophysical observations

Fausto Ferraccioli (1), Tom Jordan (1), Rene Forsberg (2), Arne Olesen (2), Graeme Eagles (3), Kenichi Matsuoka (4), and Tania Casal (5)

(1) British Antarctic Survey, Geological Sciences, Cambridge, United Kingdom (ffe@bas.ac.uk), (2) Danish Technical Institute, Lyngby, Denmark, (3) Alfred Wegner Institute, Bremerhaven, Germany, (4) Norwegian Polar Institute, Tromso, Norway, (5) European Space Agency, Noordwijk, Netherlands

Our knowledge of interior East Antarctica has increased significantly in recent years, aided by major aerogeophysical exploration efforts conducted by the geosciences community since the International Polar Year. Aerogeophysical and satellite imaging is helping unveil cryptic crustal provinces and this is enabling new studies of the major tectonic process that shaped East Antarctica through the supercontinent cycle (e.g. Ferraccioli et al., 2011, Nature; Aitken et al., 2014, GRL).

However, the South Pole itself has remained one of the largest “poles of ignorance”, as very little data have been acquired here since pioneering aerogeophysical surveys performed in the 1970’s and a single more detailed US survey flown in the late 1990’s from the Transantarctic Mountains to South Pole (Studinger et al., 2006, EPSL).

During the 2015-2016 Antarctic campaign we flew a major aerogeophysical survey over the South Pole frontier, collecting ca 30,000 line km of new radio echo sounding, laser altimetry, airborne gravity and aeromagnetic data. The main aim of the PolarGAP project, supported by the European Space Agency was to fill in the data void in GOCE (Gravity Field and Steady-State Ocean Circulation Explorer) satellite gravity south of 83.3°S.

Here we present the new ice thickness, bedrock topography, and gravity and magnetic anomaly images derived from the survey and interpret them to investigate the crustal architecture and tectonic evolution of the South Pole region. The Free-air gravity and radar data reveal the form and extent of the Pensacola-Pole Subglacial Basin that stretches from the Weddell Sea to South Pole. Linear free-air gravity lows within the basin are interpreted here as a system of glacially overdeepened grabens flanked by uplifted horst blocks, including the Pensacola Mountains, Patuxent Range and the Argentine Range. The grabens are inferred to be linked to the Jurassic Transantarctic rift system, which at regional to continental-scale, is associated with voluminous tholeiitic magmatism of the Ferrar Large Igneous province. Whether these grabens were reactivated in post-Jurassic times in response to intraplate stresses following Gondwana breakup, such as proposed in some sectors of the Transantarctic Mountains (e.g. Ferraccioli and Bozzo, 2003 Geol. Soc. London) or the Shackleton Range (e.g. Paxman et al., 2017 JGR in review) remains to be more fully evaluated.

To investigate the potential influence of basement provinces and their tectonic boundaries on the Pensacola-Pole basin, we combined the new PolarGAP aeromagnetic data with recent aeromagnetic data acquired over the Recovery Glacier region and also examined satellite magnetic (MF7) patterns. Our new compilation reveals that part of the eastern flank of the basin is controlled by a major inherited crustal boundary, interpreted here as the southern edge of a hitherto unrecognised composite Precambrian microplate, extending from the Shackleton Range to the Pensacola-Pole basin. We further hypothesise that this inferred microplate is a key “missing link” between the southern end of the subduction-related Ross Orogen and the inferred Pan-African age collisional suture and transpressional shear zones of the Shackleton Range region.