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Imprints of a Pan-African transpressional orogen superimposed on an inferred Grenvillian accretionary belt in central East Antarctica

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The Gamburtsev Subglacial Mountains in interior East Antarctica are underlain by 50-60 km thick crust imaged by gravity and seismic models (Ferraccioli et al., 2011; An et al., 2015). In contrast, the composite Archean to Mesoproterozoic Mawson craton that occupies the Wilkes and Terre Adelie sector of East Antarctica typically features only 40-45 km thick crust (Aitken et al., 2014). Over 200 km thick and seismically fast lithosphere underlies the Gamburtsev Province, as typically observed over Precambrian lithosphere that has not been substantially reworked during Phanerozoic subduction or collision. Satellite and airborne magnetic data indicate that the Gamburtev Province is sandwiched in between distinct Precambrian lithospheric blocks including the Ruker, Princess Elizabeth Land, Vostok, Nimrod (Goodge and Finn, 2010), South Pole and Recovery provinces.

Ferraccioli et al., (2011) proposed that a segment of a stalled orogen (i.e. an orogen where widespread orogenic collapse and root delamination has not occurred) is preserved in the Gamburtsev Province and further hypothesised that its origin relates to widespread accretionary and subsequent collisional events at ca 1 Ga, linked to the assembly of the Rodinia supercontinent. However, recent passive seismic interpretations (An et al., 2015) indicate that crustal thickening may relate instead to Pan-African age assembly of Greater India, East Antarctica and Australia within Gondwana (at ca 550 Ma).

Here we interpret a set of enhanced magnetic and gravity images, depth to magnetic and gravity sources and preliminary 2D and 3D forward and inverse models to characterise in detail the crustal architecture of the Gamburtsev Province. Enhanced aeromagnetic images reveal a system of subglacial faults that segment the Gamburtsev Province into three distinct geophysical domains, the northern, central and southern domains. Apparent offsets in high-frequency magnetic anomalies within the central domain are interpreted here as revealing a right-lateral predominantly transpressional fault system roughly parallel to the previously proposed Gamburtsev Suture flanking the northern domain. Simple magnetic modelling provides support for the existence of potential positive flower structures and basement push ups.

An analogy with well-known modern strike-slip fault systems in New Zealand also supports our magnetic interpretation for a transpressional orogenic belt within the composite Gamburtsev Province. We propose that large-scale Pan-African age transpression in interior East Antarctica is kinematically linked with collision of Greater India and a mosaic of distinct lithospheric provinces in East Antarctica. Pan-African transpression likely reactivated pre-existing fault systems that may have formed during Grenvillian-age accretion of arc terranes, as recently hypothesised in the interior of Eastern Dronning Maud Land, in the so called Tonian Ocean Arc Superterrane (Jacobs et al., 2015).

By compiling aeromagnetic, airborne gravity, and satellite magnetic and satellite gravity data over the Gamburtserv Province and Eastern Dronning Maud Land we test whether these two areas could potentially be linked together during the inferred Grenvillian and Pan-African accretionary and collisional stages of tectonic evolution.