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Crustal architecture of the Gamburtsev Province in East Antarctica

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The Gamburtsev Subglacial Mountains in interior East Antarctica are underlain by remarkably thick (50-60 km) crust in stark contrast with the Archean to Mesoproterozoic Mawson craton, which typically features only 40-45 km thick crust. The Gamburtsev Province is also underlain by 200 km thick seismically fast lithoshere, as typical for Precambrian lithosphere that has not been substantially reworked during Phanerozoic subduction or collision.

Ferraccioli et al., (Nature 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 hypothesised that its origin relates mainly to accretionary and subsequent collisional events at ca 1 Ga, likely linked to Rodinia assembly. However, subsequent passive seismic interpretations of An et al. (2015 JGR) attributed crustal thickening to much later Pan-African age assembly of Gondwana at ca 550 Ma.

Here we interpret a set of enhanced magnetic and gravity images, depth to magnetic and gravity sources and 2D models to characterise the crustal architecture of the Gamburtsev Province in greater detail than previously attempted. Enhanced aeromagnetic and residual gravity 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 as revealing an inferred transpressional fault system parallel to the previously proposed Gamburtsev Suture.

Our magnetic and gravity models, combined with independent age constraints from sediment provenance studies, are interpreted here as revealing thrusted arc and back arc terranes of inferred Grenvillian age in the northern and Central domains of the Gamburtsev Province. Distinct magnetic anomalies image inferred Paleoproterozoic crust of the Lambert Terrane, which flanks the Archean Ruker Province, and trace the extent of the South Pole Province, an inferred Mesoproterozoic igneous province, which may be linked to the previously proposed Nimrod Igneous Province further north.

We propose that reactivation of the Gamburtsev Province, which is sandwiched in between these different Proterozoic provinces may have occurred in response to Pan-African age collision and suggest a possible kinematic connection between the previously inferred Kuunga Suture and the Gamburtsev Suture, through the poorly known Princess Elizabeth Land (PEL) region. This hypothesis is viable based on our analyses of satellite magnetic and satellite gravity anomaly patterns and may be further tested with the aid of ongoing Chinese-led aerogeophysical exploration efforts over the PEL region. However, we acknowledge that constraining the age and evolution of all these provinces requires launching ambitious new bedrock drilling efforts, as well as carrying out higher resolution airborne surveying, a challenge that is already being actively assessed by several nations.