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Back arc basin unveiled at South Pole along an irregular East Antarctic craton margin

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An Andean-style convergent margin was active between ca 580 and 460 Ma along the margin of Gondwana. It led to the emplacement of a major magmatic arc, which is in parts exposed along the much younger Transantarctic Mountains (TAM). Arc magmatism, thrusting, deformation and metamorphism are hallmarks of the long-lived subduction-related Ross Orogen (RO).

Despite the wealth of knowledge on the RO, the location, structure and evolution of the unexposed boundary between the Precambrian Mawson Craton and the RO remains very poorly known, particularly in the South Pole (SP) region- one of the largest poles of ignorance in the whole of East Antarctica.

Here we combine new aeromagnetic data collected during the ESA PolarGAP campaign with vintage ADMAP 2.0 (Golynsky et al., 2018- GRL) aeromagnetic datasets in the SP region and level these using the satellite magnetic LCS-1 model to investigate the craton margin and RO. The final levelled data were draped at 2800 m above the bedrock topography (Morlighem et al., 2020, Nature Geo.) and reduced to the pole.

To enhance magnetic signatures and reveal subglacial basement terranes we applied pseudo-gravity transforms, derivatives and upward continuation. We also computed new airborne gravity residual maps and compared these with enhanced magnetic anomaly images. We applied a variety of depth to source of the magnetic and gravity residual anomalies, including tilt depth, Werner and Euler Deconvolution and constructed simple 2D models of the crustal architecture of the RO and the adjacent Precambrian craton margin.

Using the information from enhanced aeromagnetic imaging and combined magnetic and gravity modelling we propose a new tectonic model for the region. In our model, a former late Neoproterozoic rifted margin that developed along an irregular cratonic margin of the Mawson

continent evolved during the Ross Orogen in a wide back-arc basin tectonic setting, linked to a predominantly retreating accretionary subduction-related setting from ca 530 Ma to 500 Ma. This led to the emplacement of magnetite-rich ribbons of arc crust, which are magnetically imaged for the first time in this sector of the active margin. Complex deformation of these ribbons is also imaged from aeromagnetic signatures and appears to resemble some of the deformation patterns observed in the Tasmanides in Australia in evolving retreating accretionary arc and back arc systems (e.g Moresi et al., 2014, Nature).