C21F-1515 - Enhanced images and new models of the Wilkes Subglacial Basin help constrain the variability in geological boundary conditions for the East Antarctic Ice Sheet

Abstract

The Wilkes Subglacial Basin (WSB) is a huge tectonic feature formed by Cenozoic lithospheric flexure coupled with Mesozoic to Cenozoic extension localised in sub-basins (Paxman et al., 2019, JGR). The deep northern WSB underlies the catchments of the Matusevich, Cook, Ninnis and Mertz glaciers that are largely marine-based, which renders them more vulnerable to past and predicted future ocean and climate warming.

Here we present airborne radar and enhanced magnetic and gravity views of the northern WSB that help unveil the spatial variability in geological boundary conditions for this key sector of the East Antarctic Ice Sheet (EAIS). Residual gravity anomalies obtained by stripping out Moho effects were compared with aeromagnetic anomaly images to glean new perspectives into intra-crustal features. Depth to magnetic and gravity source estimates were then used to help derive the first combined 2D forward models for the region.

We first examine a model crossing the northern WSB extending from the Matusevich Glacier to the deep Cook Basins. The model reveals a major crustal boundary along the eastern margin of the WSB interpreted as separating the Ross Orogen from a composite Precambrian Wilkes Terrane buried beneath Devonian to Jurassic sediments and early Cambrian metasediments. By analogy with the better understood Rennick Graben in northern Victoria Land, the Cook basins are interpreted as glacially over deepened grabens.

The Cook basins clearly play a major role in EAIS dynamics, as they steer fast glacial flow deep into the interior of East Antarctica where they connect to the Central Basins. Our new model across these basins shows that the inferred Precambrian basement is both shallower and of more felsic bulk composition compared to the Cook basins. This fundamental difference in basement depth, bulk composition and thickness of sedimentary cover is likely to exert major influences on geothermal heat variability in this key sector of the EAIS.

Authors

- Alessandro Ghirotto
  - University of Genoa
- Fausto Ferraccioli
  - NERC British Antarctic Survey
- Egidio Armadillo
  - University of Genoa
- Duncan A Young
  - University of Texas
- Donald D Blankenship
  - University of Texas
- Martin J Siegert
  - Imperial College London