A Precambrian odyssey in East Antarctica: more pieces, more tectonic stages and less puzzle?

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East Antarctica is the least understood piece of continental crust on Earth. With an extension comparable to the conterminous United States of America, it contains cryptic clues into the origin, evolution and demise of three supercontinents, and it forms the lithospheric cradle for the largest ice sheet remaining on our planet. While rock exposures and provenance studies provide glimpses into up to 3 billion years of its geological history, extensive ice sheet cover and the lack of drilling, restricts our knowledge of Precambrian geology and crustal architecture in its interior. Consequently, many different aspects regarding the geodynamic processes that were responsible for the growth and amalgamation of East Antarctica during the Precambrian still remain elusive and controversial. This adds uncertainty to our knowledge of how East Antarctica linked up with major Precambrian domains of Australia, India, Africa and Laurentia, further hampering our ability to unravel Earth's early supercontinental cycle, in particular from the assembly and demise of the Nuna supercontinent to its successor Rodinia.

To enhance our understanding of parts of the Precambrian evolution of East Antarctica, we present new interpretations derived from the recent ADMAP 2.0 magnetic compilation and satellite magnetic views, combined with the AntGG gravity compilation, and the latest satellite gravity gradient GOCE datasets; we also include selected insights from new aerogeophysical imaging over the Recovery and South Pole regions. We then combine Antarctic geophysical and geological data with global magnetic, gravity and geological, geochronological and paleomagnetic datasets in a plate tectonic reconstruction framework.

Our main goal is to develop new interpretations and reconstructions that re-address the key stages of East Antarctic tectonic evolution between ca 1800 and ca 1300 Ma, in particular as part of long-lived and predominantly accretionary phases in Nuna's supercontinental history.

We show that our interpretations provide new views into several key crustal elements in interior East Antarctica, including a proposed Archean ribbon microcontinent, an inverted Paleoproterozoic rift system, and a Paleoproterozoic to Mesoproterozoic continental margin arc, and two inferred Mesoproterozoic intra-oceanic accretionary belts. We suggest that these proposed crustal elements were affected by four major Paleoproterozoic and Mesoproterozoic tectonic stages, which we link with key tectonic and magmatic events recognised in the Gawler Craton, the Mt Isa Province, and the Coompana Block and Madura Province in Australia.

Our geophysical reconstructions of East Antarctica and Laurentia also enable tantalising new perspectives into the so called proto-SWEAT hypothesis, which links these two key components of Nuna in Paleoproterozoic to Mesoproterozoic times.