# CONNECTING GEOLOGY AND GEOPHYSICS: THE GEODYNAMIC EVOLUTION OF DRONNING MAUD LAND FROM RODINIA TO GONDWANA

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East Antarctica consists of a number of cratonic fragments that amalgamated along distinct orogenic belts in late Neoproterozoic to early Palaeozoic times. These mobile belts include the c. 640 to 500 Ma old East African-Antarctic Orogen (EAAO) and the Kuunga Orogen, which seem to converge in Dronning Maud Land in the Atlantic sector of Antarctica. The polymetamorphic basement of Dronning Maud Land is characterized by rocks with Grenville-age protolith ages of c. 1130 to 1000 Ma in the west and rocks with early Neoproterozoic protolith ages of c. 1000 to 900 Ma in the east. These two provinces are separated by the prominent Forster Magnetic Anomaly, which is therefore interpreted to represent a suture zone.

Four joint AWI-BGR international expeditions within the WEGAS (West-East Gondwana Amalgamation and Separation) and GEA (Geodynamic Evolution of East Antarctica) programmes between 2010 and 2015 have provided new combined geological and geophysical data that reveal a complex crustal architecture between central Dronning Maud Land and Lützow-Holm-Bay. The magnetic anomaly pattern changes significantly east of the Forster Magnetic Anomaly with apparently no indication of Maud-type crust. Particularly, the GEA II campaign (2011-12) targeted a series of previously unvisited nunataks in the largely ice-covered Borchgrevink-Isen between central Dronning Maud Land and Sør Rondane from Urna and Sørsteinen in the west to Blåklettane and Bergekongen in the east. This region is characterized by NW-SE trending distinct linear magnetic anomalies. This pattern is referred to as the SE Dronning Maud Land Province and was previously interpreted as a fragment of potentially older cratonic crust south of an Ediacaran to Cambrian mobile belt that crops out in Sør Rondane. New SHRIMP/SIMS U-Pb zircon ages and geochemical analyses, however, indicate that this region consists of Rayner-age (c. 1000 to 900 Ma) juvenile arc and metasedimentary cover rocks, which were intensely reworked by medium- to high-grade metamorphism and felsic melt injections between c. 630 and 520 Ma. The juvenile rocks are very similar to a gabbro-tonalite-trondhjemite-granodiorite (GTTG) suite in the southern SW Terrane of Sør Rondane, which yield crystallization ages of c. 1000 to 920 Ma based on U-Pb zircon geochronology. The juvenile character of this suite suggests a long-lived accretionary setting in early Neoproterozoic times. While the rocks in the Borchgrevink-Isen further west were intensely reworked in Pan-African times, the GTTG complex in Sør Rondane shows evidence of Pan-African up to lower amphibolite-facies thermal overprint, but still contains large domains with apparently only weak deformation. An exception is the northern margin of the GTTG complex where high-strain dextral shear is related to the prominent Main Shear Zone that is estimated to be of latest Ediacaran to early Cambrian age (c. 560 to 530 Ma). This structure, which we interpret as part of a fault system related to NE-directed lateral extrusion of the EAAO, separates the Rayner-age GTTG complex from a series of greenschist- to granulite-facies metasupracrustal rocks of mainly volcano-sedimentary origin. They in turn are separated from the amphibolite- to granulite-facies NE Terrane in the north and north-east by the Main Tectonic Boundary that is postulated by researches of the Japanese National Antarctic Programme. Available literature and our own new geochronological data indicate that peak and retrograde metamorphism in the NE and SW terranes was at c. 640 to 530 Ma. Both terranes were intruded by several granitoid magmatic pulses between c. 650 and 500 Ma. In contrast to "Indo-Antarctic" affinities of the GTTG complex south of the Main Shear Zone and the similar rocks of the SE Dronning Maud Land Province to the west, these units thus appear to have rather "East African" affinities. Furthermore, grey heterogeneous gneisses and augen-gneisses of the aforementioned meta-volcanosedimentary supracrustal rocks of the SW Terrane close to the Main Shear Zone gave zircon crystallization ages of c. 750 Ma. Such ages are unknown from the EAAO in central and western Dronning Maud Land west of the Forster Magnetic Anomaly.

Taking all evidence together, we propose that the Forster Magnetic Anomaly separates distinctly different parts of the EAAO. These are (i) a reworked, mainly Grenville-age crust of the Maud Belt to the west representing the overprinted margin of the Kalahari Craton, and (ii) a part of the orogen dominated by early Neoproterozoic accretionary tectonics to the east, which we refer to as Tonian Ocean Arc Super Terrane (TOAST). The contrast between these two crustal units is also reflected in the geochemistry of voluminous late-tectonic granitoids across the whole belt. Based on our new geological and aerogeophysical evidence, the regional crustal structure of eastern Dronning Maud Land as a whole may tentatively be interpreted as reflecting large-scale lateral extrusion of the EAAO post-dating continental collision in the late Neoproterozoic and early Cambrian.