



Aeromagnetic data reveal crustal structure and tectonic history of the northern Prince Charles Mountains region, East Antarctica

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Near complete coverage of the East Antarctic shield by ice hampers geological study of the crustal architecture important for understanding global tectonic history. Limited exposures in the northernmost Prince Charles Mountains (PCM) region of MacRobertson Land, however, show that Proterozoic rocks of the shield all indicate a Grenville-age basement that does not underwent severe Pan-African thermal overprint and reworking. To extend the known geology of the region to ice-covered areas, we conducted a draped aeromagnetic survey flown by fixed-wing aircraft over the northern PCM region and costal areas of MacRobertson Land. We flew 6375 line km covering an area of nearly 20,000 km² at an average altitude of 300 m (average line spacing 5 km and 15 km spacing for tie-lines). The objective of this investigation was to extend the magnetic data to the west from previous surveys flown by the PMGRE, and also acquire ice penetrating radar data to assist in understanding of the northern continuation of the PCM under ice-cover. Ice radar data will also contribute to ice mass balance analysis of major ice drainage area in Antarctica (Lambert Glacier - Amery Ice Shelf system). This research presents the methodology, data and interpretations of the airborne data acquired as part of the scientific program of the PMGRE in 2004.

Analysis of the aeromagnetic data has allowed distinction of two major geological blocks and magnetic trends, which can be correlated with the known geology of the northern PCM and adjacent areas. The aeromagnetic image is characterized by short

to long wavelength magnetic anomalies which display different trends. The northern region of the magnetic anomaly map is associated with a broad magnetic low at least 80-90 km in width. It is interrupted sporadically by local short-wavelength (10-15 km) circular and elongated anomalies. This low can be continued in western direction up to the Prince Olav Coast coastal area. Its fabric and position suggest that the Mesoproterozoic-Neoproterozoic Rayner Complex may be the source of this magnetic unit. The Rayner Complex displays a similar magnetic response in Enderby Land where it is well recognized. The spatial relationships between the characteristic magnetic anomaly patterns and outcropping geological units suggest that short wavelength magnetic anomalies may reflect Neoproterozoic intrusive charnockites which are recognized in the Gustav-Bull Mountains and widely known over Kemp Land. As show previous studies, the magnetic variations over the Rayner Complex reflect the differences in metamorphic grades and lithologies within the sub-ice crust.

Broad, moderate-high amplitude magnetic highs and lows over the southern part of the study area resemble those inferred for the Beaver terrane to the south, suggesting a similar origin. The negative anomalies of the northern PCM largely reflect Athos supracrustals related to the Proterozoic charnockite-granulite terrane of the Beaver Complex. The causative sources of positive magnetic anomalies are not known within the study area, however, they can be related with the Porthos orthogneisses and/or intrusive charnockites due to distinctive affinity to magnetic anomaly pattern observed over the neighboring regions of the northern PCM. Complex positive bands (50-100 km) of moderate to high amplitude (up to 700 nT) elongated and irregular anomalies are common for the northern and central PCM, and partly for the Amery Ice Shelf and its eastern flank, as well as for both shoulders of the Lambert-Amery rift system. The most conspicuous feature of the region is the Amery Lineament which up to 35 km wide and approximately 625 km in total length with anomaly amplitudes up to 1000 nT. This magnetic lineament is one of the most striking features ever recorded by aeromagnetic surveying within the East Antarctic Shield. Hence, understanding of its origin is critical to appreciating the complex geological history of the Prydz Bay coast area and the northern part of Prince Charles Mountains.