



Magnetic anomalies in East Antarctica: application to definition of major crustal boundaries

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Crustal terranes of East Antarctica are characterized by different magnetic signatures that reflect such factors as their ages and lithologies, the degree of reworking, deformations and metamorphic variations. In the shield areas of East Antarctica, the aeromagnetic data provide a unique window on basement geology and structural architecture and allow for better defining the boundaries between the Archean stable blocks and the Proterozoic mobile belts, and tracing them beneath the ice sheet. The great uncertainties in the tectonic boundaries beneath the Antarctic ice sheet are due to the general lack of outcrops and limited amount of precise and exhaustive geochronology data. The compiled magnetic anomaly data provide a new window on the poorly known geology of the Antarctic. When interpreted with other geological and geophysical information, they offer considerable promise for developing new insights on the breakup of Gondwana and Rodinia evolution and the creation of the seafloor in the Antarctic.

Well-defined zonations and distinctive patterns of magnetic anomalies are recognized in Western Dronning Maud Land at the edge of the East Antarctic Shield. Broad featureless magnetic low and weak linear short-wavelength magnetic anomalies delineate the extent of the Archean to Mid-Proterozoic Grunehogna Province. The pronounced Sverdrupfjella-Kirwanveggen Anomaly and alternating bands of elongated positive and negative anomalies define the boundaries of the Middle to Late Proterozoic orogenic belt. The intricate anomaly pattern over Coats Land defines the extent of the Coats Land crustal block that might be Archean to Early Mesoproterozoic in age. It delineates various structural elements and characteristic trends of the Shackleton and

the Argentina Ranges that are largely composed of high-grade metamorphic basement rocks.

In Enderby Land, a roughly oval belt of mostly positive anomalies differentiates the Archean Napier Terrane from the negative magnetic effects of the Mesoproterozoic Rayner Terrane to the south. The boundary between the Rayner Terrane and the neighboring Lützow-Holm Bay Terrane to the west is clearly identified by a 350-nT anomaly and the difference in the anomaly trends on either side of this anomaly. The elongated, fragmented magnetic highs and intervening lows of the Lützow-Holm Bay Terrane are associated with rocks metamorphosed under granulite facies conditions.

The detailed aeromagnetic data of the Prince Charles Mountains and surrounding areas provide a rather complex but surprisingly coherent image for studying the geology and tectonic history of this region. Several distinct structural units may be differentiated in the magnetic anomaly data. The intense short-wavelength, high-amplitude positive anomalies that extend around the Vestfold Hills are presumably associated with high-grade metamorphic Late Archean craton. The northern Prince Charles Mountains display a predominantly northeasterly trending magnetic fabric that continues to the eastern shoulder of the Lambert Rift. The negative and positive anomalies largely reflect Athos supracrustals and Porthos orthogneisses, respectively, related to the Proterozoic charnockite-granulite terrane of the Beaver Terrane. Elongate and moderate magnetic banding appears to characterize the Late Proterozoic rocks of the Fisher sub-terrane. The prominent alternating system of linear NE-SW positive and negative anomalies over the eastern shoulder of the Lambert Rift may reflect the western boundary of the newly discovered Princess Elizabeth Land cratonic block like those observed in the Vestfold Hills block and the Ruker Terrane. Metamorphic rocks of the Archean Ruker Terrane are mainly associated with low-amplitude anomalies. These cratons potentially belong to a single stable proto-craton of Archaean to Paleoproterozoic age. The aeromagnetic data clearly indicate no obvious link of the Pan-African mobile belt in Prydz Bay with Lützow-Holm Bay, and provide no evidence that it extends inland towards the Mawson Escarpment or Grove Mountains. The aeromagnetic patterns distinctly evident for the Cambrian belts within the Prydz Bay and southern Prince Charles Mountains lack evidence for their possible continuations to support the recent suggestion that East Gondwana may be divided into Indo-Antarctic and Australo-Antarctic sectors.

The compiled map offers a powerful new interpretation tool for extending our knowledge about Gondwana and its evolution. For example, the southern margin of the Dharwar Craton in India makes a convincing fit with the margin of the Napier Complex in Enderby Land. Correlative magnetic anomalies are common between southwestern Australian and East Antarctic blocks that were adjacent to each other in conven-

tional Gondwana reconstructions. The Archean Queen Mary Land craton delineated by the Bunger Anomaly may represent a southern continuation of the Yilgarn craton, whereas the Bunger Hills–Windmill Islands mobile belt may extend into Australia as the Albany-Fraser Orogen.