Magnetic anomaly patterns over crustal blocks of the King Edward VII Peninsula, Marie Byrd Land, West Antarctica

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Abstract

Within the framework of the GITARA II project an aeromagnetic survey was performed during the GANOVEX VII expedition (1992/1993) over the King Edward VII Peninsula in northwestern Marie Byrd Land (West Antarctica). This region which may represent the eastern flank of the Ross Sea rift system had previously been explored only at reconnaissance level. New total field and upward continued (10 km) magnetic anomaly maps are produced and interpreted here to map and discuss the crustal structure of the Edward VII Peninsula. Two round-shaped, high-amplitude magnetic anomalies are recognised over the Alexandra Mountains block. The anomalies are difficult to interpret since susceptibility data indicate the prevalence of non-magnetic rocks at the surface. A possible interpretation is that the anomalies are due to Cretaceous mafic intrusives distinct from weakly magnetic Byrd Coast Granite of the adjacent Rockefeller Mountains block. Alternatively the anomalies could be related to buried pluton-sized Devonian Ford Granodiorite intruded by dikes. If Cretaceous in age, the former intrusives revealed from the magnetics could also be responsible for contact metamorphism of the adjacent Alexandra Mountains migmatites. Lower amplitude circular anomalies over the Central Plateau and Prestrud Inlet are likely to be caused by unexposed Devonian Ford Granodiorite which crops out in the Ford Ranges. Elongated high-frequency anomalies of the Sulzberger Bay are similar to those recognised over seismically constrained Cenozoic rift-related volcanics of the Ross Sea. A broad magnetic low over the Sulzberger Ice Shelf may be indicative of a fault bounded graben-like basin with sedimentary infill. Overall recognition of magnetic anomaly patterns and trends reveals segmentation of the Edward VII Peninsula and of the adjacent marine areas in distinct crustal blocks. Faults may separate these blocks and they are interpreted to reflect multiple Cretaceous and maybe Cenozoic crustal extension\uplift phases within this part of the West Antarctic rift system.

Key words *Edward VII Peninsula – aeromagnetic anomalies – tectonic blocks – West Antarctic rift system – Marie Byrd Land – Antarctica*

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1. Introduction

During the GANOVEX VII expedition (1992/1993) a regional aeromagnetic survey covering a 26 500 km^2 area at the northwestern edge of Marie Byrd Land over the King Edward VII Peninsula was performed (Damaske *et al.*, 2000). This survey was part of the international GITARA II (German ITalian Aeromagnetic Research in Antarctica) German-Italian cooperative research programme aiming at crustal investigations of the Ross Sea sector of Antarctica which includes both Victoria Land and Marie Byrd Land (Damaske, 1994; Bozzo *et al.*, 1997a,b).

The Edward VII Peninsula is adjacent to the eastern Ross Sea and is located at the northwestern edge of Marie Byrd Land (fig. 1), one of the several extensional blocks of West Antarctica. As shown in fig. 1 Marie Byrd Land is separated from the Transantarctic Mountains, by the asymmetric Mesozoic and Cenozoic Ross Sea rift, which is part of the continental scale West Antarctic rift system (Tessensohn and Wörner, 1991, Behrendt *et al.*, 1992).

The Transantarctic Mountains (TAM) are the highly elevated, mainly Cenozoic western shoulder of the rift system. Uplift of the mountains and subsidence of the Victoria Land basin was accompanied by Cenozoic alkaline volcanism (Davey and Brancolini, 1995 and references therein). Though major extension in the Ross Sea region is interpreted to have occurred in the Cretaceous (Lawver and Gahagan, 1994) only minor coheval uplift has been detected along parts of the TAM, and Cretaceous rifting in Victoria Land is thought to be amagmatic (Tessensohn, 1994). Aeromagnetics over the TAM and adjacent Ross Sea have revealed the extent and distribution of Cenozoic volcanism and plutonism, rift fabric trends, possible transfer faulting and more recently segmentation of the rift shoulder into discrete crustal blocks (Bosum *et al.*, 1989; Damaske *et al.*, 1994; Behrendt *et al.*, 1996; Ferraccioli and Bozzo, 1999).

Current knowledge of crustal structure and tectonic evolution of western Marie Byrd Land, which possibly represents the eastern shoulder of the West Antarctic rift, is not as detailed. Previous geophysical work was in fact only at reconnaissance level (Damaske *et al.*, 2000 and references therein). What is known is that the region is characterised by much less pronounced topographic relief and by rift-related Cretaceous as well as Cenozoic magmatism and uplift (Davey and Brancolini, 1995 and references therein). Geologic and geophysical investigation over the Ford Ranges, which are located about 200 km to the east of the Edward VII Peninsula area have revealed Mesozoic and Cenozoic crustal extension and subsequent formation of basin and range structure there (*e.g.*, Luyendyk, 1993).

In this paper we focus on magnetic anomaly patterns revealed by the GITARA II aeromagnetic survey and interpret them to suggest the existence of likely tectonic structural blocks linked to Cretaceous and possibly Cenozoic extension within the Edward VII Peninsula and adjacent areas.

2. Tectonic framework

Prior to Mesozoic and Cenozoic rifting in the West Antarctic rift system the Marie Byrd Land crustal block shared a history of deep-water sedimentation (Swanson Formation) and Devonian-Carboniferous plutonism (Ford Granodiorite) with the Robertson Bay Terrane (Robertson Bay Group and Admiralty Intrusives) of northern Victoria Land (fig. 1). These Paleozoic rocks are likely associated to subduction and terrane accretion along the Paleo-Pacific margin of Gondwana (Weaver *et al.*, 1991). An active margin tectonic setting continued in the period from Middle Jurassic to late Early Cretaceous from New Zealand through West Antarctica.

A sudden change from a convergent to an extensional tectonic regime occurred at about 105 Ma along the east Gondwana active margin. This change has been interpreted as resulting from oblique subduction of the Pacific-Phoenix spreading center with the trench (Bradshaw, 1989) or by slab capture (Luyendyk, 1995). Whatever the mechanism may have been, the mid-Cretaceous igneous rocks (Byrd Coast Granite) of central Marie Byrd Land (124-95 Ma) record this rapid change from subduction-related I type magmatism to rift-related A type magmatism (Weaver *et al.*, 1994).

The Edward VII Peninsula anorogenic granites (95-100 Ma) were emplaced at a later stage during the actual initiation of continental rifting along the Marie Byrd Land-New Zealand margin (Weaver *et al.*, 1992). Strain indicators in the mid-crustal rocks of the Fosdick Metamorphic Complex (Smith, 1997) of the Ford Ranges (figs. 1 and 2) indicate N-S to NNE-SSW extension which is compatible with transtensional and dextral rifting (see fig. 2B in Richard

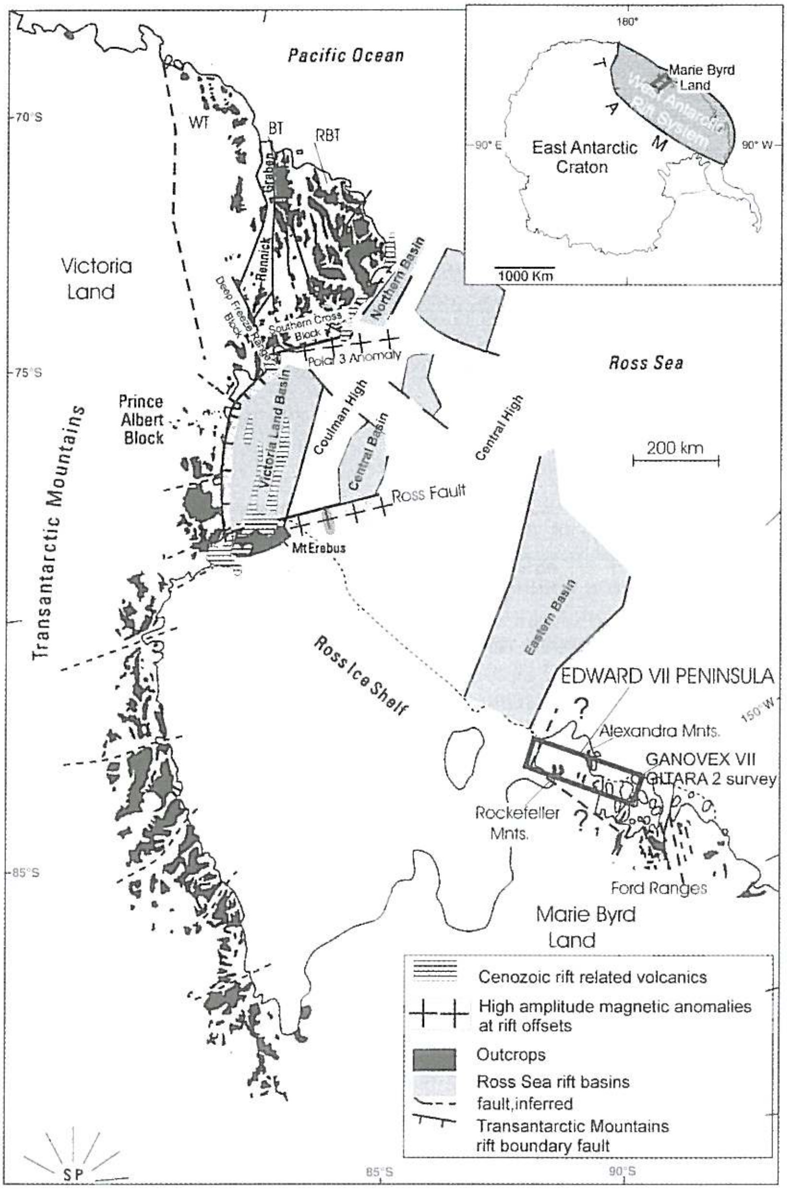

Fig. 1. Location of the Edward VII Peninsula within northwestern Marie Byrd Land at the eastern side of the Ross Sea rift. The inset shows that the study area as part of the West Antarctic rift system. Note the rift basins within the Ross Sea (see Davey and Brancolini, 1995 and references therein). Within the TAM basement three terranes are recognized: WT - Wilson Terrane; BT - Bowers Terrane; RBT - Robertson Bay Terrane. Basement of the Peninsula is similar to RBT of the TAM. Discrete crustal blocks of the TAM rift shoulder have been recognized from several lines of geological and geophysical evidence. Segmentation of the TAM rift shoulder is particulary evident from aeromagnetics (see Ferraccioli and Bozzo, 1999). Crustal blocks of the Edward VII Peninsula are instead largely unknown and are investigated in the present aeromagnetic study (bold rectangle).

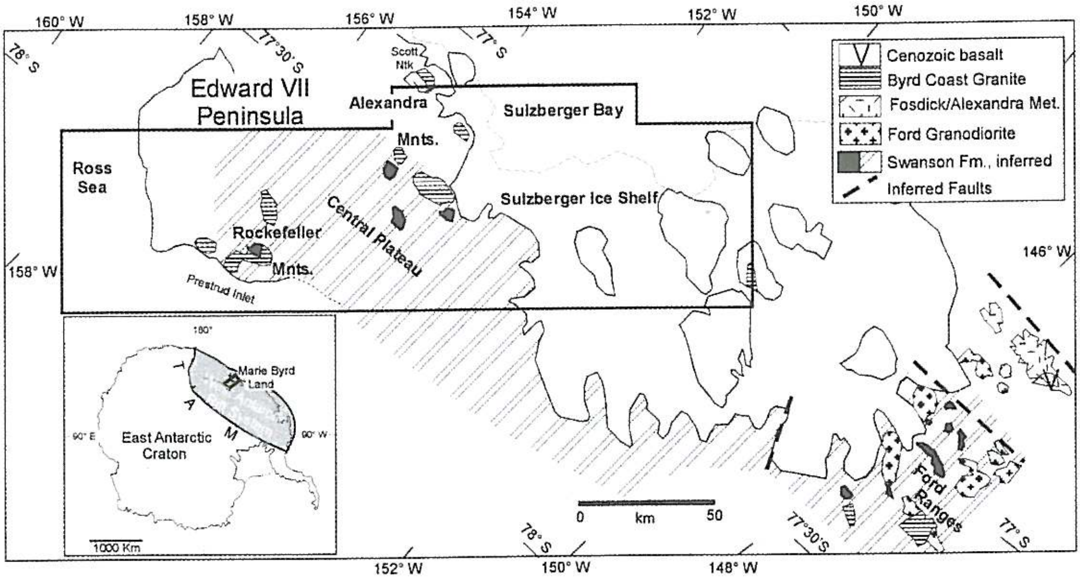

Fig. 2. Geologic sketch map of the Edward VII Peninsula and adjacent Ford Ranges (modified from Kleinschmidt and Brommer, 1997 and Luyendyk, 1993). The aeromagnetic survey is indicated with a bold rectangle.

et al., 1994). A Late Cretaceous to early Tertiary erosion surface of very low relief over most of West Antarctica formed in a period of prolonged stability after 70 Ma (LeMasurier and Rex, 1994).

At 28-30 Ma volcanic activity started in Marie Byrd Land (LeMasurier and Wade, 1990) contemporaneous with block faulting and minor uplift, giving rising to basin and range structure in the northern Ford Ranges. Plio-Pleistocene volcanics are aligned approximately E-W indicating that this Late Cenozoic extension was N-S to NE-SW directed, that is close to the Cretaceous extension directions (Luyendyk, 1993; Luyendyk *et al.*, 1994).

3. King Edward VII Peninsula geology

The geology of the King Edward VII Peninsula has been combined with the Ford Ranges in fig. 2 for a synoptic view of geologic units and tectonic features which may be imaged by the aeromagnetic maps. The units of the Alexandra Mountains Quadrangle, which includes the Rockefeller and the Alexandra Mountains, are summarised mainly from the 1:250000 map of Wade *et al.* (1977). A New Zealand Antarctic Research Programme expedition worked on the Peninsula in 1987/1988 and made numerous additions and amendments to the previous map (Adams *et al.*, 1989). More geological work was done during the GANOVEX VII expedition (*e.g.*, Smith, 1996).

From a general point of view three main rock units can be recognised on the Peninsula:

1) A low grade metasedimentary suite, correlated with the Swanson Formation of the Ford Ranges. Rb-Sr ages indicate a late Ordovician age of the metasediments (421-432 Ma) which is significantly younger than early Ordovician Robertson Bay Group metamorphism of Northern Victoria Land (Adams *et al.*, 1995). Devonian-Carboniferous Ford Granodiorite intruding the metasediments in the Ford Ranges does not outcrop on the Peninsula.

2) The Alexandra Metamorphic Complex formed by heterogeneous paragneisses of Scott Nunatak. These rocks are an isolated exposure of migmatitic paragneisses and have been com-

pared to the migmatites of the Fosdick Metamorphic Complex of the Ford Ranges (Smith, 1996).

3) A granitoid suite, well developed in the Rockefeller Mountains, correlated with the Cretaceous Byrd Coast Granite of the Ford Ranges. Two types of granite have been recognised: monzogranites and syenogranites. They have been classified as anorogenic (A-type). Their emplacement age is 95-100 Ma, that is younger than part of the Byrd Coast equivalents in the Ford Ranges).

Cenozoic volcanic rocks which outcrop in the Ford Ranges do not crop out on the Peninsula.

4. Magnetic anomaly maps

In fig. 3 we display the total field magnetic anomaly image of the Edward VII Peninsula region. The survey was set up with a 4.4 km profile line spacing (WSW-ENE profiles) and 22 km tie line interval flown at a constant altitude of 2000 m. Further details regarding the survey lay-out, the instrumentation and execution can be found in Damaske *et al.* (2000). Standard processing techniques were applied to the aeromagnetic data and included flight line positioning, base station correction, IGRF removal and levelling. Microlevelling in frequency domain (Ferraccioli *et al.*, 1998) was also applied to the statistically levelled map to improve upon the signal to noise ratio along the profile line direction.

The most remarkable features of the map are the round-shaped anomalies «A» and «B». The amplitudes are well above 400 nT with peaks of 500 nT. Anomaly A is centred over the Alexandra Mountains, just north of Butler Glacier. Anomaly B lies over an ice-covered area to the north of the Rockefeller Mountains. High-frequency anomalies, with amplitudes around 100-200 nT are placed in between the two circular anomalies. An approximately SW-NE trending magnetic lineament (L2) seems to divide the Alexandra Mountains area from an area denoted as Central Plateau in fig. 3. Here amplitudes are in the order of 50-150 nT for anomalies «C» and «G» respectively.

Possibly separated from the Alexandra Mountains magnetic unit by an E-W trending magnetic lineament (L4), the Sulzberger Bay area is characterised by a number of positive elongated anomalies or chains of anomalies with different trends (NW-SE, NNE-SSW and approximately E-W). Amplitudes are varying from 100 to 400 nT. In the northern corner of the survey area at Vollmer Island a 150 nT round-shaped positive anomaly «V» can be recognised. A NNE-SSW trending magnetic lineament (L1) separates the Sulzberger Bay anomalies from the Sulzberger Ice Shelf which is a broad magnetic low.

A broad magnetic low with isolated NE-SW trending high-frequency anomalies dominates the survey area closest to the Eastern Ross Sea. This low continues inland including the Rockefeller Mountains where high frequency anomalies appear to have a more E-W trend. To the south, at the mouth of Prestrud Inlet, a broad low-amplitude positive anomaly «M» is recognised.

Other magnetic features can also be recognised (*e.g.*, L3) but their definition appears to be more unsecure from the shaded relief map. A more detailed and «objective» boundary analysis approach based upon the Blakely and Simpson (1986) method was also applied to interpret a maximum horizontal gradient map of pseudo-gravity (Cordell and Graunch, 1985). The main magnetic lineaments we «subjectively» define in this paper from the sharp gradients of the shaded relief image are in good agreement with the maximum horizontal gradient map.

Regional magnetic trends and patterns generally become more evident in upward continued magnetic anomaly maps. This was indeed the case over the TAM where an upward continued map (10 km) was particulary effective since it considerably enhanced deep crustal variations within the basement terranes by smoothing out the anomalies related to thin Jurassic and Cenozoic volcanics (fig. 4 in Ferraccioli *et al.*, 1999). For the Marie Byrd Land data enhancement obtained by upward continuation to 10 km, *i.e.* 8 km above the observation level (fig. 4) is much less significant. However the fact that anomalies A and B of the Alexandra Mountains still stand out as the most remarkable anomalies of the Peninsula is an argument in favour of the prob-

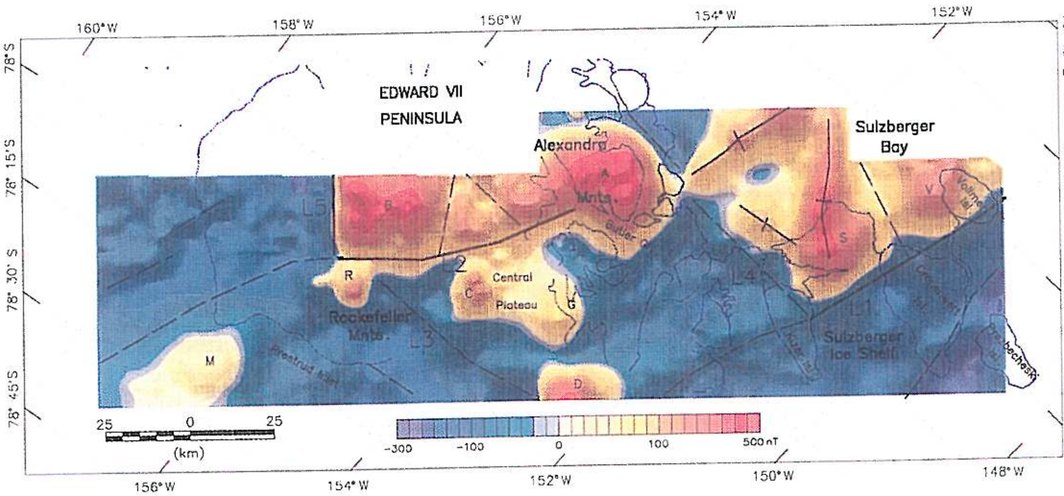

Fig. 3. Total field magnetic anomaly map of parts of the Edward VII Peninsula and adjacent Sulzberger Bay. Colour and shading are combined to best display magnetic anomaly patterns and trends. Illumination is from NW at 60 degrees inclination. Solid lines denote the major magnetic lineaments.

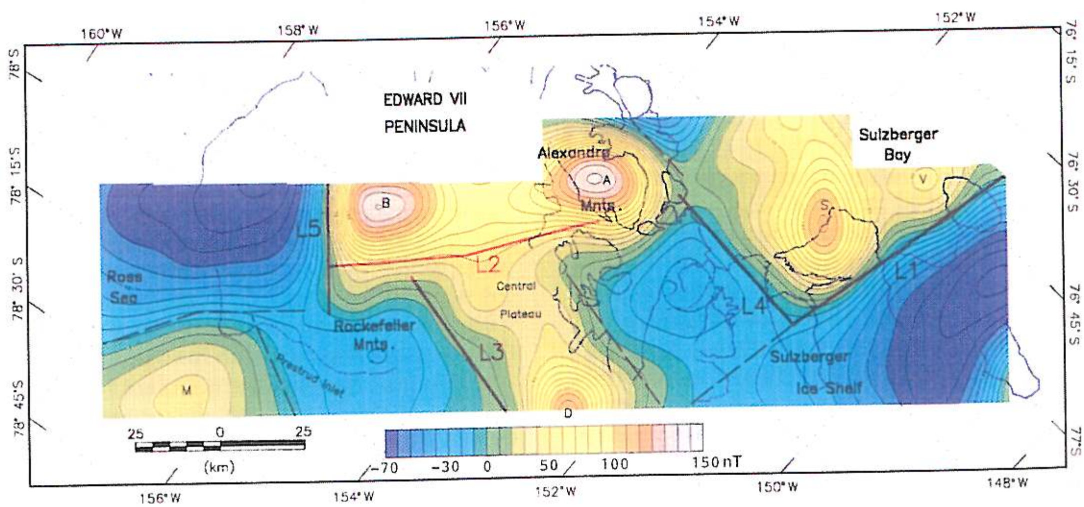

Fig. 4. Magnetic anomaly map upward continued to 10 km. Contour interval is 10 nT. Regional trends are marked by solid lines.

able deep-seated origin of the sources. From this map the Central Plateau is a WNW-ESE positive area with a sharp anomaly break across L3 to the negative area of the Rockefeller Mountains. Though smoothing effects also need to be taken into consideration it appears from the upward continued map that at depth the magnetic contrast between the Alexandra Mountains, the Central Plateau and also the Sulzberger Bay area is not as large as might seem from the total field data. It now appears that they all form – in the deeper level – one «central block» distinguished from the more negative areas of the Rockefeller Mountains, Sulzberger Ice Shelf and the eastern Ross Sea. This may be an indication for similar magnetic basement throughout the region.

5. Susceptibility measurements

It is well known that geological and geophysical interpretation of magnetic anomaly maps is facilitated if magnetic properties of outcropping rocks of the survey area are evaluated. The susceptibility database of Victoria Land, for example, led to considerable advancement in interpretation of magnetic anomalies over the western TAM rift shoulder (Bozzo *et al.*, 1992, 1995). Some information derived from the Victoria Land susceptibility database is relevant for interpretation of magnetic anomalies over the Marie Byrd Land rift flank: a) recognition over the TAM of a magnetic suite of Devonian-Carboniferous Admiralty Intrusives (age

Table I. Table of susceptibility measurements acquired during the GANOVEX VII. Note the weakly magnetic low grade metamorphic and granitoid rocks, and the more highly magnetic high grade rocks. The last section of the table includes samples from the Ford Ranges (not within the aeromagnetic survey area) and shows that there Cenozoic mafic volcanics are highly magnetic.

Location	<K> (10^{-6} SI)	Rock type (No. of samples)	
Alexandra Mountains			
Scott Ntk.	9354	High-grade Met.	(6)
Mt. Swadener	28	Byrd Coast Granite	(1)
Mt. Manger	80	Byrd Coast Granite	(1)
Central Edward VII Peninsula			
LaGorce Pk.	146	Low Met. (Swanson Form.)	(1)
Drummond Pk.	207	Low Met. (Swanson Form.)	(1)
Clark Pk.	152	Byrd Coast dike	(1)
Rockefeller Mountains			
Mt. Nilsen, Mt. Franklin	99	Low Met. (Swanson Form.)	(5)
Mt. Frazier, Mt. Fitzsimmons	90	Byrd Coast Granite	(2)
Mt. Paterson, Mt. Schlossbach Washington R.	100	Byrd Coast Granite	(1)
Tennant Pk.	45	Byrd Coast Granite	(2)
Sulzberger Ice Shelf			
Barela Rock	7535	Byrd Coast Granite (?)	(2)
Ford Ranges			
Mt. Kinley	3308	Byrd Coast Granite (?)	(1)
Radford Island, Chester Mnts.	66	Ford Granodiorite	(2)
Mt. Avers	45680	Cenozoic Olivine Basalt	(3)

equivalents of the Ford Granodiorite); b) the high susceptibility values over the Cenozoic rift-related volcanic and plutonic rocks (Mc Murdo Igneous Group).

At present no systematic database of magnetic susceptibility exists for the Edward VII Peninsula also because of the considerable amount of ice-cover over the peninsula. The few magnetic susceptibility measurements were performed with a KT5 kappameter *in situ* and on samples. The results are summarised in table I. The location of the samples is reported in fig. 5 for easier correlation with the geology. From this table and fig. 5 it can be recognised that outcropping Cretaceous Byrd Coast Granite of the Rockefeller Mountains is very weakly magnetic just like the Swanson Formation metasediments. In the Scott Nunataks area, just north of the survey area, the high grade metamorphic rocks of the Alexandra Complex (and apparently not the granite itself) are instead quite magnetic. The only exception within the Byrd Coast Granite (?) occurs at Barela Rock on Prezbecheski Island at the eastern edge of the survey, which is quite strongly magnetic. At Mount Avers outside the survey area in the Ford Ranges, highly magnetic Tertiary olivine basalt is present.

6. Interpretation

In fig. 6 we display a structural interpretation map constructed by superimposing the patterns and trends of the magnetic anomaly maps we produced over the geologic sketch map of the region. We propose that Edward VII Peninsula and adjacent marine areas are formed by a series of tectonic blocks.

Alexandra Mountains block – The two main round-shaped magnetic anomalies (anomalies A and B) including the anomalies in between the two belong to this block. What is the source (or the sources) of the anomalies? At Mount Swadener of the Alexandra Mountains the outcropping Byrd Coast Granite is non-magnetic. According to Adams *et al.* (1995) Mount Swadener is a Cretaceous monzogranite. Cretaceous syenogranites occur further south, but these are also apparently non-magnetic. To the north of Mount Swadener at Prestrud Rock of Scott Nunatak the high grade migmatites of the Alexandra Mountains, which are magnetic, occur. Since the Alexandra Mountains block is bordered by evident magnetic lineaments (L2, L4, L5) separating the block from the adjacent

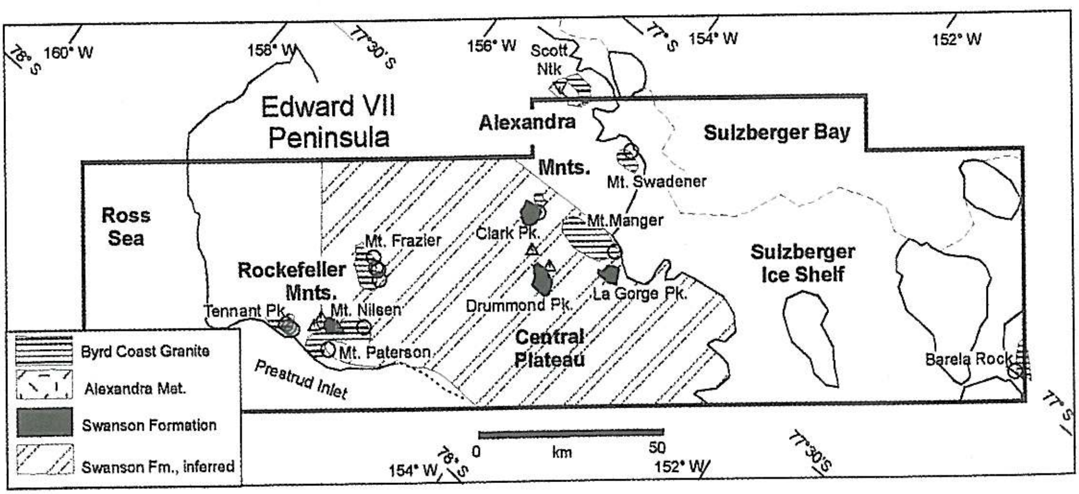

Fig. 5. Location of susceptibility measurements within the study area, super-imposed upon the geologic sketch map. The inverted triangle indicates the samples of high-grade metamorphic rocks, the triangles the location of measured low-grade metamorphic rocks and the circles stand for Byrd Coast Granite samples.

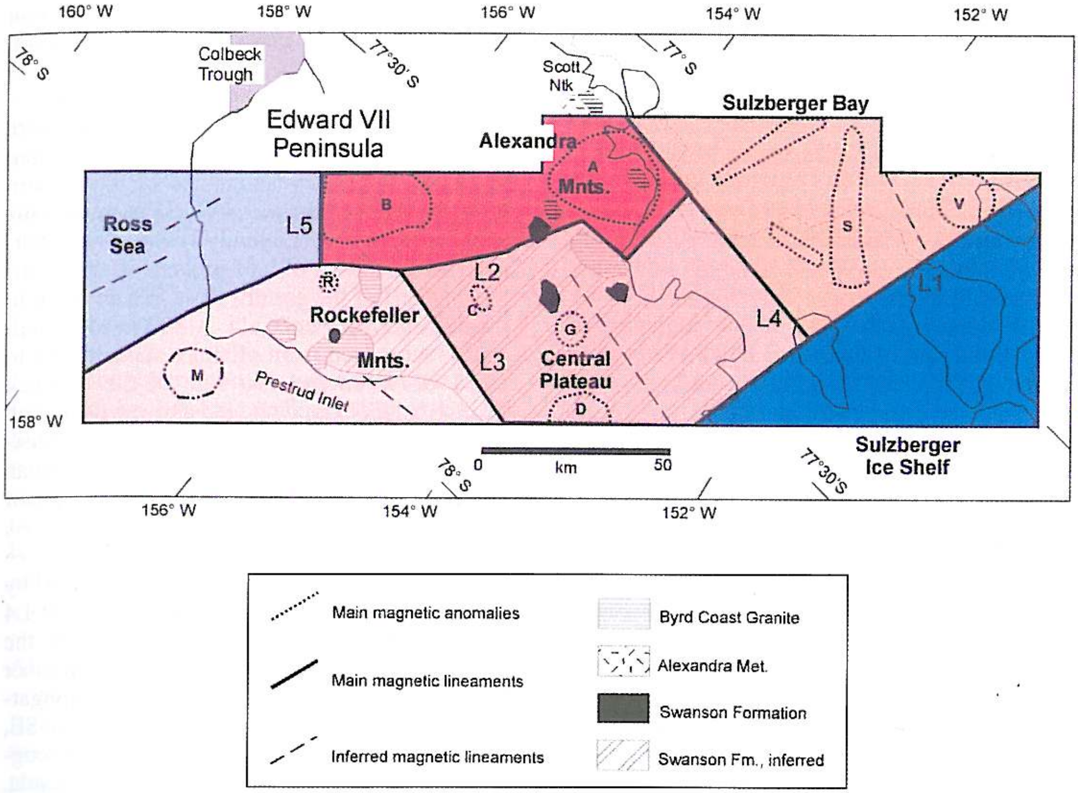

Fig. 6. Structural interpretation map of the Edward VII Peninsula and adjacent marine areas. Each magnetic unit is interpreted in terms of a tectonic crustal block and is assigned a different grey colour.

ones, one might speculate that a fault bounded horst of high grade rocks could explain the observed anomaly field. However, the outcropping high grade rocks, though admittedly close by, are not within the anomaly itself, making this solution possible, but not probable. Considering the high amplitude (up to 500 nT) and the wavelength of the anomalies (25 km) the magnetic sources are likely to be intrusives at depth beneath (?) or maybe intruding (?) weakly magnetic Byrd Coast Granite.

Cretaceous mafic rocks do not outcrop on the Edward VII Peninsula. In central Marie Byrd Land, however, «A type» granitoids of the Byrd Coast Granite suite are associated with mafic rocks in form of layered gabbros, dikes and sheets (Weaver *et al.*, 1995). It is therefore geologically reasonable to hypothize that the magnetic anomalies reveal the existence of such rocks beneath the Alexandra Mountains of the Edward VII Peninsula also.

It is also noteworthy that new aeromagnetic data over the TAM in Victoria Land has revealed the existence of similar wavelength though lower amplitude anomalies over the Admiralty Intrusives (Ferraccioli *et al.*, 1999) that represent the age equivalent Ford Granodiorite rocks of Marie Byrd Land. The two samples of Ford Granodiorite of the Ford Ranges reported in table I are however virtually non-magnetic. We infer that the two samples may not be representative of the magnetic properties of the Ford Granodiorite of Marie Byrd Land as a whole. In fact the Admiralty Intrusives of Victoria Land present a bi-modal distribution and have been recognised to be at times highly magnetic (Bozzo *et al.*, 1995). If this holds true it is reasonable to infer that buried Ford Granodiorite could also contribute to the observed magnetic anomalies instead of Cretaceous mafic dikes or intrusives alone.

Central Plateau block – This block is separated from the Alexandra Mountains block by an approximately SW-NE trending lineament (L2) and from the Rockefeller Mountains by a WNW trending one (L3). At the southeastern edge of the survey area anomaly D is similar to A and B. Anomaly C occurs in an area of no outcrop. The easiest explanation is to assume mafic dikes (likely also Cretaceous in age) as a source. The low amplitude circular anomaly G is also hard to explain. A low grade thermal metamorphic overprint (360 Ma) of Swanson Formation metasediments (clearly non magnetic) occurs at Drummond, La Gorce and Clark peaks (Adams *et al.*, 1989) which lie close to anomaly G. According to the previous authors this metamorphic overprint is likely indicative of the presence of buried Ford Granodiorite which we believe could be the cause of anomaly G.

Rockefeller Mountains – This block is characterised by a broad magnetic low. Weakly magnetic Byrd Coast Granite (monzogranites and syenogranites alike) and metasediments occur in the area. Apparently no mafic bodies were intruded at depth associated to the Byrd Coast Granite within this block. A low amplitude positive anomaly (M) does, however, occurs at the mouth of Prestrud Inlet and can be assumed to represent a thick intrusion, since it is clearly recognisable in the upward continued map (fig. 4). This anomaly is of lower amplitude compared to anomalies A and B. One plausible solution could be that the anomaly source is the same as A and B but that the intrusive is buried at considerably greater depth. The positive anomaly R in the northern corner of this block resembles anomaly C of the Central Plateau and may have the same source, that is Cretaceous mafic dykes.

Overall the magnetic interpretation that Ford Granodiorite is present on the King Edward VII Peninsula is independently supported by dredge samples in the Prestrud Inlet area which reveal hornblende-bearing granitoids similar to Ford Granodiorite (Kizaki, 1958).

Ross Sea – It is separated from the Alexandra Mountains by a prominent NW-SE lineament L5. High frequency anomalies of the eastern Ross Sea have a distinct NNE-SSW trend. Offshore seismic data (Luyendyk *et al.*, 1996) indicates the presence of half-grabens in the continental shelf of the eastern Ross Sea adjacent to the Edward VII Peninsula. A 800-m high fault scarp recognized from offshore seismic data to trend NNW on the east side of the Colbeck Trough might extend on land and correlate with the L5 magnetic lineament bordering the Alexandra Mountains horst. This feature may be an important structure defining the western edge of the Peninsula.

Sulzberger Bay – This block is separated by the approximately E-W trending lineament L4 from the Alexandra Mountains block and the Central Plateau. With the exception of the Vollmer Island Anomaly V, it is characterised by elongated positive magnetic anomaly chains (NW-SE, NNE-SSW and approximately E-W), unrecognised elsewhere over the Edward VII Peninsula. Similar positive magnetic anomaly chains (but with a distinct N-S to NNW orientation) have been recognised over the western Ross Sea adjacent to the Transantarctic Mountains and interpreted to be associated with Cenozoic volcanics emplaced along rift-related fault zones. In those regions this magnetic interpretation is supported by extensive seismic and gravity work.

Recent seismics in the Sulzberger Bay region (Luyendyk *et al.*, 1996) strongly suggests that the Sulzberger Bay is an early Tertiary (?) fault-controlled basin. A positive gravity anomaly in the Kizer Island region has been interpreted to reflect the presence of dense volcanic rocks (Luyendyk and Smith, 2000). Cenozoic (?) rift-related volcano-tectonic activity within the Sulzberger Bay area interpreted here would be consistent with the gravity pattern.

Sulzberger Ice Shelf – The NNE trending lineament (L1) separating this block from the Sulzberger Bay is the most prominent linear feature of the region. The Sulzberger Ice Shelf minimum is much more pronounced than the Rockefeller Mountains one. A possible interpretation is that the Sulzberger Ice Shelf Block is a fault bounded extensional basin structure, possibly with sedimentary infill. Comparison with gravity data over the ice-shelf is however needed to verify this interpretation (Luyendyk and Smith, 2000).

7. Discussion

The magnetic anomaly maps we display provide the first geophysical constraints on the Edward VII Peninsula crustal blocks. The magnetic data cannot be easily interpreted since virtually all exposed rock units with the exception of isolated high grade rocks of the Peninsula and Cenozoic volcanics of the Ford Ranges are apparently non-magnetic (see table I). However the magnetic maps may well suggest the presence of intrusions at depth beneath the Alexandra Mountains block.

Mid- Cretaceous mafic rocks of central Marie Byrd Land have been interpreted to be indicative of upwelling of the lithospheric mantle in response to crustal extension (Weaver *et al.*, 1994). Isotopically enriched Cretaceous A type granites of the Edward VII Peninsula can be explained by ponding of mafic magmas in crustal chambers, despite the fact that these rocks are not recognised in outcrop (Weaver *et al.*, 1992). The interpretation of a Cretaceous age for the magnetic bodies of the Alexandra Mountains block is also consistent with contact metamorphism of the intrusives on the adjacent Scott Nunataks high grade rocks (Smith, 1996).

An alternative or possibly additional explanation for the pluton-like sources of the Alexandra Mountains may be that the metasedimentary basement is pierced at depth by unexposed Devonian-Carboniferous (?) Ford Granodiorite which outcrops extensively in the Ford Ranges. This interpretation is particulary attractive for the lower-amplitude anomalies of the Central Plateau and at Prestrud Inlet where independent geological findings (metamorphic overprint and dredge samples) support the magnetic interpretation for buried Ford Granodiorite.

Whatever the sources may turn out to be it is clear that major magnetic lineaments could define tectonic blocks of the Edward VII Peninsula area. Adams *et al.* (1989) hypothesized a possible subdivision of the Peninsula in Central Plateau, Rockefeller and Alexandra Mountains blocks from geologic findings. This is supported by magnetic lineaments L2 and L3 dividing the Peninsula in three areas characterised by different magnetic anomaly patterns. Adams *et al.* (1995) described differential uplift of the Alexandra Mountains with respect to the Rockefeller Mountains during Late Cretaceous-Early Tertiary and possible separation of the two blocks by a fault. Magnetic lineament L3 can be interpreted as a fault dividing the Central Plateau from the Rockefeller Mountains. More recently however Lisker and Olesh (1997) argued against segmentation of the Edward VII Peninsula into discrete crustal blocks and show that the blocks share a common uplift history.

Richard *et al.* (1994) reported N-S to NNE extension to have occurred in the Ford Ranges during Cretaceous transtensional rifting of New Zealand and the Campbell Plateau from Marie Byrd Land. Over the King Edward VII Peninsula magnetic lineaments L3 and L4 directed E-W to WNW-ESE might fit such extension direction. Luyendyk (1993) also noted that Cenozoic extension, likely associated to the Cenozoic phase of West Antarctic rifting was approximately N-S to NE-SW in the Ford Ranges. If Cretaceous and Cenozoic extension directions are similar, then in turn this implies that it is difficult to establish timing of approximately E-W faulting of the Peninsula blocks interpreted from the magnetics.

The linear positive anomaly S in the Sulzberger Bay and L5 at the edge of the Alexandra Mountains block may be interpreted to represent Cenozoic (?) volcanic and fault structures respectively. These features would be compatible with NE-SW extension.

Two major magnetic lineaments oblique to exposed topography are particularly intriguing. Lineament L2 trends NE-SW and separates the Alexandra Mountains block from the Central Plateau and L1 trends NNE-SSW and divides the Sulzberger Bay from the Sulzberger Ice Shelf. Since L2 seems to cut L3 this may imply that L2 represents a more recent (Cenozoic ?) feature. Structures with such an orientation are unrecognised elsewhere on the Peninsula and adjacent Ford Ranges.

Overall the structural interpretation map of the King Edward VII Peninsula we present is compatible with multiple Cretaceous and Cenozoic extension\uplift phases within this sector of the West Antarctic rift system.

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