GEOLOGICAL OUTLINES

This part of northern Victoria Land (NVL) was systematically surveyed only in the sixties, by several New Zealand field parties, that established the overall framework of regional geology (see Crowder, 1968, Sturm & Carryer, 1970, Gair et al., 1969, and Nathan & Skinner, 1972, for geological maps and discussion of earlier work). During the 1981-82 International NVL Project New Zealand and USA geologists (Stump, 1986) investigated the field relations, petrology and geochemistry of the Paleozoic granitoids (Borg et al., 1986; 1987), of the Jurassic tohelites (Elliot & Foland, 1986), and the structural features of the Robertson Bay Terrane and the Millen Schist (Findlay & Field, 1982, 1983; Findlay, 1986). The papers by Adams et al. (1986), Collinson et al. (1986) and McIntosh et al. (1986) are also related to this quadrangle. During the 1982-83 season, NVL was visited by GANOVEX III. Investigations focused on the geology and petrology of the metamorphic basement complex in the Mountaineer Range (Kleinschmidt et al. 1984), on regional patterns of metamorphism (Grew et al., 1984) and on the geology and tectonic implications of the newly discovered continuation of the Bowers structural zone (Tessensonh, 1984). The papers by Mensing et all., (1983), Wright & Findlay (1984), Findlay & Jordan (1984) and Adams & Kreuzer (1984) are also related to this quadrangle. In the 1984-85 season the aeromagnetic survey by GANOVEX IV covered part of NVL (Durbaum et al., 1989). Damaske et al., 1989). Though GANOVEX IV was focused on geophysical investigations, some geological activity was carried out and a geological map of the area between Outback Nunataks and Reeves Gl. was produced (Roland et al., 1989). The Ganovex Team (1987) also produced a 1/500,000 geological map of NVL.

ItaliAntartide and Ganovex expeditions of the following years triggered the publication of a number of papers: contributions by Bozzo et al. (1995), Capponi et al. (1994), Tessensohn (1994), Giorgetti et al. (1998), are specifically related to the Freyberg

SHORT DESCRIPTION OF GEOLOGY

The Freyberg Mountains quadrangle encompasses an Early Paleozoic metamorphic basement (Ross Orogen) and a mostly flat-lying cover, spanning in age from Carboniferous-Permian to Quaternary, with large stratigraphic gaps. The basement consists of three main terranes: (1) the Wilson Terrane (WT) occurs in the central part and includes low to high grade metamorphic rocks, intruded by large bodies of Late Cambrian Granite Harbour Igneous Complex. (2) The Bower Terrane (BT) crops out in the central-north-eastern part of the map and consists of three low-grade metamorphic sequences, showing primary sedimentary contacts (Laird et al., 1982) and regressive trend from marine to fluvial - deltaic continental environment; the age spans from Middle Cambrian or older to Late Cambrian. (3) The Robertson Bay Terrane (RBT) crops out in the north-eastern corner of the map and consist of very thick monotonous, low-grade metamorphic sequence of quartzose turbidite greywacke, alternating with silty mudstone; the age is Cambrian to Lower Ordovician (Tremadocian). A minor belt, the Millen Schist, intervenes at the boundary between BT and RBT, the regional contacts dip generally SW. After the Early Paleozoic Ross Orogeny the area was uplifted and eroded. The Devonian Admiralty intrusive and Gallipoli volcanic rocks were emplaced in the three terranes and supply an upper time constraint for the docking of the WT, BT and RBT. After the Admiralty - Gallipoli magmatic event, the area was further uplifted and eroded. On the resulting peneplain surface, the deposition of a Carboniferous - Permian moraine occurred (Neall Massif Tillite). Both the basement and the tillite were covered by the sedimentation of the Takrouna sandstone, that was in turn covered by large flows of Jurassic Kirkpatrick Basalt; the coeval Ferrar Dolerite formed sills chiefly along the basal sandstone horizon. The youngest event was the emplacement of the Melbourne alkali-volcanic suite, which pertains to the Cenozoic McMurdo igneous complex.

phibolite facies metasediments (Wa) (equivalent to Priestley Schist and Rennick Schist in the surrounding quadrangles) crop out in the SE part the quadrangle at the Retreat Hills, which supply the local name of Retreat Hills Schist and in the northern slopes of the Mt Supernal; they consist fine-to medium-grained biotite schist, with minor intercalations of quartz-biotite metasandstone. At Niagara Icefalis and Mariner Plateau the currence of large microcline and plagiocolase porpohyroclasts suggests a volcanic origin.

gmatite gneiss (Wmg) occurs in the Salamander Range and consists of stromatic migmatite with minor agmatitic varieties; other rock types are cosomes and Mg-hornblende gneiss, including small, irregular amphibolite layers. the metamorphic conditions of amphibolite facies metasediments and migmatite gneiss, Castelli et al. (2003) provide the following data, per attures, estimated by garnet - biotite geothermometry, decrease from Mt Murchison area (742° - 695° C) to Retreat Hills (533° - 505° C), assures decrease with the same trend, from Mt Murchison (6.5 kb at 742° C and 4.9 kb at 695° C), to Mt Kinet (4.7 kb at 686° C and 3.0 kb at 695° C), to Retreat Hills (4.2 kb and 3.1 kb at 515° C).

Retreat Hills Vita-Scaillet & Lombardo (2003) obtained K/Ar cooling ages of 488 and 489 Ma: as a consequence, the metamorphic re-equilibrations clearly pertain to the Ross cycle.

No granulite relics were found within these high grade metamorphic rocks, although granulites are present in the Mt Melbourne quadrangle (on the western side of the lower Campbell Gl. and at Kay Island).

On the whole, protoliths of all the metasediments appear to belong to a unique very thick sequence of fine- to medium-grained siliciclastic sediments, with some volcanic supply, that underwent metamorphic re-equilibration at different metamorphic grades during the Ross Orogeny (Carmignani et al., 1987; Lombardo et al., 1987; Casnedi & Pertusati, 1989; Skinner, 1989).

In the Retreat Hills and Mountaineer Range the peak metamorphic conditions and retrograde re-equilibration define a clockwise P-T path (Castelli et al., 1994 and Castelli et al., 2003); it is noteworthy that this metamorphic evolution contrasts sharply with the anticlockwise P-T trajectories established for metasediments of the Deep Freeze Range and surroundings (Borghi & Lombardo, 1994; Palmeri et al., 1994). The relationships between the areas with contrasting metamorphic evolution are under debate.

The granitic rocks cropping out in this quadrangle can be assigned to the northern dominantly granitic-granodioritic batholith according to the subdivision of Gair et al., (1969) and Nathan & Skinner (1972). This batholith by age and composition is comparable to the Cambrian-Ordovician Granite Harbour Intrusives of the Central Transantartic Mountains (Gunn & Warren, 1962), a typically kalk-alkaline orogenic suite. In the last twenty years new field observation, petrographic and geochemical analysis have been performed. Borg (1984), Borg et al. (1986), and Vetter & Tessensohn (1987) stated that these intrusive rocks occur in two belts, an eastern and a western one. The western belt is made up of S-type, peraluminous, two-mica and mainly K-feldspar porphyritic granite; coeval I-type hornblende granodiorite, diorite and tonalite form minor plutons and dykes. The eastern belt consists of I-type, mainly granodioritic to tonalitic intrusive rocks. Contrasting features are also in the isotopic signature (Rocchi et al., 1994). These belts trend NW-SE throughout the WT, and were interpreted as the magmatic signature of an active continental margin. Granite Harbour Granodiorite and Granite (GHgr). These rocks form the wide massif cropping out in the Alamein Range and in the Monte Cassino area; minor outcrops are on the northern slopes of the Mt Supernal. In the Alamein Range, granitoids are quite homogeneous with few inclusions. Borg et al. (1986) supply a Rb/Sr isochron age of 536 Ma and Stump et al. (unpublished data) a 3-points isochron of 531 ±18. In the Monte Cassino area, granitoids are more heterogeneous, with abundant inclusions of metasediments and different phases of magma. Rb/Sr dating on biotite/whole rock pair supplied an age of 427 Ma, that was interpreted by the authors (Borg et al. 1986) as resetted by a thermal event subsequent the crystallization. Borg et al. (1986, 1987) underlined also that in this area the composition of plutonic rocks varies significantly with temperature solid-state deformation (Mu a syn-metamorphic and syn-kinematic emplacement of the rocks. In places, intrusive contacts with the WT metasediments, sometimes with "lit par lit" structures, are exposed. Granite Harbour gabbro and ultramafite (GHga). In the WT mafic and ultramafic rocks occur in some outcrops at the Mariner Plateau and north of it, an area which is informally known as Niagara Icefalls (Tessensohn & Roland, 1987). They consist of a layered sequence of dunites, harzburgites, orthopyroxenites, mela- gabbronorites and gabbronorites of cumulus origin. In most cases these rocks are unmetamorphosed and undeformed; in places the rims of 0.1- to 1- km wide bodies are deformed and re-equilibrated in amphibolite facies metamorphic conditions. Locally these rocks suffered a widespread greenschist facies overprint: the deformative and metamorphic reworking along greenschist facies shear zones was severe and in places the rocks are transformed in chlorite-actinolite schists. Trace element signature in clinopyroxenes indicate a derivation from a boninite melts (Tribuzio et al. 2008): this suggest that the formation of the sequence was associated with the development of a back-arc basin and corroborates the model proposed by Federico et al. (2006) for this active margin. U-Pb dating on zircon separated from a gabbronorite constrains the age of emplacement of the Niagara Icefalls sequence at ca 514 Ma (Tribuzio et al. 2008).

The occurrence of inherited zircons dated at ca 538 Ma indicates that the boninitic melts suffered crustal contamination

DESSENT HIDGE UNIT

This Unit (Dm) does not crop out in Freyberg Mountains quadrangle and it is only inferred at depth in (ABC) geological section; for this reason it will be described briefly. The Dessent Ridge Unit occurs as a narrow fault bounded tectonic strip from the Ross Sea (Coulman Island quadrangle) to the Gair Glacier where it wedges out. This lithotectonic unit caractherized by occurrence of kyanite, is made of garnet-zoisite amphibolites with minor quarzites, marbles and metapelite layers (Kleinschmitd et al. 1984). Garnet granulites of basic composition (T = 730° C, P = 6 kb) followed by amphibolite facies (T = 650° C, P = 4-6 kb) are also present (Scambelluri et al. 2003). The unit was then affected by a generally static retrogressive metamorphism to greenschist facies. The amphibolite metamorphism has been dated at 472-484 Ma by the 40Ar/39Ar method on metamorphic horneblende (Scambelluri et al. 2003).

ris quadrangle the BT comprises Black Spider Greenschist and the Bowers Supergroup of Cambrian age. The Bowers Supergroup shows a lamorphic grade between the prehnite-pumpellyite facies and the chlorite zone of the greenschist facies.

Black Spider Greenschist.

These rocks (Bbs) do not crop out in the quadrangle, but their occurrence is inferred at depth (see cross section ABC). The Black Spider Greenschist forms a narrow NW-SE trending belt along the western boundary of the BT. They mainly consist of green metapelite and metaconglomerate and also of metavolcanic rocks. The metapelite is represented by grey-greenisch schist, black slate and phyllite with occasional psammitic and calcalso of metavolcanic rocks. The metapelite is represented by grey-greenisch schist, black slate and phyllite with occasional psammitic and calc-silicate intercalations (Gibson et al., 1984). The metamorphic grade corresponds to the biotite zone of the greenschist facies close to the contact with the overlying Dessent Ridge Unit and decreases moving eastward.

The group was proposed by Laird & Bradshaw (1983) and comprises two heterogeneous, partly interfingering formations, the Glasgow volcanic cocks (Bgl) and the Molar Formation (Bmo). The Glasgow basalts, spilites, volcanic breccia and tuff (Laird & Bradshaw 1982) are also called Glasgow Formation (Laird & Bradshaw, 1983); major outcrops are at Mt McCarthy and in the Barker Range. The overlying Molar Formation was defined by Laird et al. (1982) and comprises sandstone with volcanoclastic component and minor siltstone, conglomerate and mudstone; in this quadrangle toccurs basically in a NW-SE strip parallel to the Millen Range and at Neall Massif. In the area of the Neall Massif several fossil occurrences have een reported (Cooper et al., 1983). Trilobite fauna, found at the north-east corner of the Massif and immediately to the east (Houliston GI), indicates

Mariner Group (Bma). This Group, defined by Laird et al. (1982), crops out in the upper Mariner Glacier at Eureka Spurs that is considered the type locality (Ganovex Team, 1987). The Group is characterized by marine mudstone, limestone and sandstone which at the Eureka Spurs form a regressive sequence; conglomerate, slumps, olistostromes and exotic blocks also occur in the sequence. Andrew & Laird (1976) distinguished two formations: the lower, 900 m-thick, Spur Formation of mudstone and sandstone and the upper, 700 m-thick Eureka Formation of limestone and sandstone. At the top of the Eureka Formation, red beds consisting of fine grained sandstone and shale, represent the end of the succession. A late-Middle to early-Late Cambrian age of these sediments was determinated on the basis of fossils content.

Leap Year Group (Bly). This group rests with a regional unconformity on the older formations. The sequence broadly represents an upward-fining clastic sediment, i.e. the basal pebble and cobble conglomerate passes upwards into the thicker central part of the sequence, consisting of quartzite, pebble conglomerate and pebbly mudstone, which in turn gives way to quartzite and siltstone. No fossil other than trace fossils were found in the Leap Year Group; a Late Cambrian to Ordovician age is inferred from indirect evidence. In this quadrangle, Leap Year rocks occur in the northern slopes of Mt Montreuil, south of the Webb Nèvè and in both the East and West Quartzite Range.

MILLEN SCHIST
The Millen Schist crops out in the north-eastern corner of this quadrangle; it has been first recognized and described by Findlay & Field (1983) and it constitutes a strongly deformed low-grade metamorphic belt separating the Bowers and Robertson Bay Terranes; stratigraphic age is unconstrained. It consists of two tectonically superposed elements.

1) The upper element (MSu) is made of clastic to volcanoclastic metasediments with minor mafic metavolcanics in which relics of effusive texture and pillows structures are preserved. This element is very similar to the Glasgow and Molar formations.

2) The lower element (MSI) comprises black phyllite, metasilitie and minor metagraywacke with thin metalimestone lenses. This element resembles the Robertson Bay arenaceous sequences. the Robertson Bay arenaceous sequences.

The tectonic contact between the two elements is spectacularly exposed on the slopes of Crosscut Peak, Mt. Aorangi and surrounding minor ridges. It is marked by a cataclastic-milonitic, several-meter-thick, blackish phillonite. Recent field work dedicated to this outcrop (Crispini et al. 2007) evidenced clear top to E-NE kinematic indicators, thus supplying evidence for southwest-over northeast thrust (Capponi et al. 1994, 2003a,b). According to Findlay (1986), the metamorphic assemblages indicate the chlorite zone of the greenschist facies. Wright & Dallmeyer (1991) suggested that the age of deformation is 480-490 Ma, as indicated by K/Ar whole-rock data and by a few 40r/49Ar data; nevertheless some of such determinations are older than the supposed sedimentation age of the rocks involved (see next paragraph), possibly because of the survival of detrital minerals (Bradshaw 2007) or because of the problems in the correlation between radiometric and paleontological ages.

ROBERTSON BAY TERRANE

The RBT comprises the Robertson Bay Group, first described by Harrington et al. (1964). Its base is nowhere exposed. This group, cropping out in the northeastern corner of the Freyberg Mountains quadrangle, is represented by a very thick sequence of quarzose turbidite greywacke with silty mudstone intercalations. Quarzitic conglomerate horizons are also present, locally with clasts of up to 10 cm in size. The age is constrained by exotic blocks of shallow-water fossiliferous limestone, included in the sequence at Handler Ridge (Cape Hallet quadrangle) on top of the Robertson Bay turbidites. Though the geometric situation is complicated by fold deformation, there is evidence that the blocks are included in the upper part of the sequences. These fossiliferous limestones were collected by Findlay and Wrigth during the GANOVEX III expedition (1982/83); the fossil content includes Tremadocian trilobites, conodonts of the Cambrian-Ordovician boundary, crinoids, algae, brachiopods and ostracods (GANOVEX Team 1987, with further references). Burret & Findlay (1984) and Wrigth et al. (1984) on the basis of reported species of conodonts established a Late Cambrian to Early Ordovician age. Buggisch & Repetski (1987), by algae and conodonts assemblages established a Tremadocian age of most of the limestone clasts. The occurrence of Tremadocian fossil content from top of the sequence makes it likely that the bulk of the RBT is Cambrian in age. On the whole, the metamorphism is of very low grade; only along the southwestern terrane boundary there is an increase up to chlorite zone of the greenschist facies.

rmrany Grandolonic Suite sees I-type plutonic rocks (Agr) form discordant scattered plutons and minor batholiths. They range from tonalite to monzogranite, with a clear evalence of granodiorite. In this quadrangle the Admiralty granodiorite occurs in the southern part of the Salamander Range, in the Monteath Hills d at Inferno Pk, where it stitches the contact between the BT and RBT. Henjes-Kunst (1990) reported intrusive contact of the Salamander Granite the poly-metamorphic rocks of the Wilson Terrane. From the same zone, Henjes-Kunst & Kreuzer (2003) reported K/Ar and 40Ar/39Ar total-gas to a 15 to 1.1 Market biother within the time area of Admiralty the integer of State International Contractions. dates of 354 ± 1 Ma for biotites, within the time span of Admiralty-type igneous activity elsewhere.

Gallipoli Andesite-Hryolite Sequence
This quadrangle includes the Gallipoli Heights, which are the type locality of the Gallipoli volcanic suite (Gv). Other major outcrops are at Lawrence
Peaks. Henjes-Kunst & Kreuzer (1993) have demonstrated the geochemical similarity of the Gallipoli and Admiralty suites. In addition, a number of
dates for these volcanites confirms the close age relationship of the two units. A Rb/Sr whole-rock isochron based on samples from the Gallipoli
suite on the Mariner Plateau, north of Mt Montreuil, yelded an age of 356±16 Ma. This result is corroborated by a K/Ar and ⁴⁰Ar/3⁹Ar mean model
age of 357±2 Ma on biotite from one of the same samples. These data confirm that the Admiralty-type intrusives and the Gallipoli-type extrusives

BEACON SUPERGROUP
In this Quadrangle the Beacon Supergroup is represented by two Formations: the lower Neall Massif Tillite and the upper Takrouna Formation. The Neall Massif Tillite unconformably rests on many lithotypes of the underlying basement, lying on a remarkable peneplain surface which is the younger equivalent of the Kukri Peneplain as defined in the Dry Valleys. The clastic Beacon deposits unconformably rest on Neall Massif Tillite and on many lithologies of the underlying basement; this clastic sequence is referred to as the Takrouna Formation (Collinson et al., 1986).

Neal Massif Tillite
This Formation (Nt) is referred to a sequence of massive to well bedded matrix supported diamictite cropping out in the northeastern slope of Neal Massif and on the unnamed E-W ridge (proposed name Elter Ridge) just south of Jago Nunatak. Poligenic pebbles and boulders float in abundant greenish-violet sandy mudstone matrix; very few of them are tipically striated. In the Neal Massif this diamictic moraine rests unconformable on the Molar Formation belonging to Bowers Supergroup; in places it fills some m-deep open cracks of the same Molar Fm. The thickness of the tillite is 40-60 m at Neal Massif and 60-80 m in the E-W ridge south of Jago Nunatak.

The tillite is capped by clastic deposits of Takrouna Formation and this stratigraphic position indicates that the Neall Massif Tillite can be referred to an Upper Carboniferous - Permian age. This tillite can be correlated with the unnamed glacial diamictite occurring in the downfaulted side of the western Lanterman Range (Roland and Tessensohn, 1987).

Collinson et al. (1986) and McKelvey et al., (1970) correlated the glacial beds of northern Victoria Land with the Metschell Tillite of Southern Victoria Land. We agree with the above correlation, that implies that the base of the Takrouna Formation rests on the equivalent to the Pyramid erosion surface of SVL and Neal Massif Tillite rests on the equivalent to the Maya erosion surface (Faure & Mensing, 2010). This means that the original Kukri peneplain has been reworked by younger erosion surfaces and can eventually coincide with them.

Takrouna Formation
The Takrouna Formation (Tf) was named by Dow & Neall (1972, 1974) and encompasses a sequence of sandstone and carbonaceous shale. The type locality is at Takrouna Bluff, in the northern tip of Alamein Range, just north of Freyberg Mountains quadrangle. At Takrouna Bluff this clastic formation forms a 300 m-thick sequence of arkosic sediments, containing a characteristic volcanic detritus, which lies above the peneplaned surface of the Granite Harbour Igneous Complex and below the Ferrar Dolerite. Major outcrops are between Mt Strandmann and Gallipoli Heights and at Neall Massif. Several 10 to 100 m wide slices and bodies of Beacon sandstone are incorporated in the Ferrar volcanic rocks. The founding of Glossopteris flora south of Monte Cassino and at the eastern slope of Neall Massif indicates a Permian age.

FERRAR VOLCANIC SUITE
Two formations are distinguished in this suite: Kirkpatrick Basalt and Ferrar Dolerite.

black shales and flora relics.

The lowermost part of the sequence was distinguished as a separate formation by Elliot et al. (1986), who named it the Exposure Hill Formation. It consists of volcanoclastic matrix-supported sediments with elements up to 1 m in size; vegetal relics are common. This part of sequence is dated to the Early Jurassic (Musumeci et al., 2006), (Bomfleur et al., 2007), (Bomfleur et al., 2011), (Schöner et al., 2011). In this quadrangle the Kirkpatrick basalt occurs in the Mesa Range, at Monument Nunataks, Sculpture Mountain, Solo Nunatak (Mensing et al., 1983) and Intention Nunatak. An 40Ar/39Ar date of 174.2±1 Ma was obtained by McIntosh et al. (1986), and K/Ar dates from the Mesa Range (at Mt Frustum in the adjoining Mt Murchison quadrangle) indicate 178 Ma as minimum age for the whole lava pile (Elliot & Foland, 1986).

McMurdo Igneous Complex
This complex comprises plutonic and volcanic rocks of general alkaline character and bimodal composition. The plutonic rocks (known as Meander Intrusives) do not occur in this quad, whereas the volcanic rocks are alkali basanite to trachyte/riolite.

Melbourne Alkali-Basanite to Trachyte/Rhyolite
This strongly differentiated alkali-volcanic suite (Mev) forms the volcanic district of The Pleiades, where several cones are recognizable. Rafts of granites (Admiralty Intrusives?) floating in the volcanites suggest that the host rock of The Pleiades lavas has granitic composition. Two papers by Kyle (1982, 1986) are dedicated to the volcanic geology of The Pleiades; though no conclusive age determinations is supplied, Kyle stated that The Pleiades are one of the youngest (perhaps less than 140 ka old) phases of activity in 7 Myr history of the Melbourne volcanic province. Minor volcanic centres occur at the southern shoulder of the upper Mariner Gl. and at the southern termination of the Retreat Hills. **TECTONICS**

ROSS TECTONICS

Castelli et al. (2003): they recognized at least three deformation events, the first two responsible for folding (F1 and F2) with a pervasive axial plane schistosity (S1 and S2), and the third related to shearing along discrete bands and related phyllonitization. S2 is the most evident surface in the field and S1 is preserved only inside microlythons. F1 and F2 folds are rather uncommon at the meso and megascale, and their interference patterns are rare as well. On the whole, the second deformation event was characterized by a non-coaxial strain regime which generated both folding and shear bands. The shear deformation produced widespread stretching lineations, and a high dispersion of hinge lines of the folds on their own axial planes. S-C surface systems are also widespread and indicate a northeastward tectonic transport.

The contact with the BT occurs without the interposition of the Dessent Ridge Unit, which apparently fades out north of Mt Supernal. Its occurrence is inferred at depth in cross-section ABC.

BOWERS I ERRANE
Bowers Supergroup
Unlike the WT, in this Supergroup the well defined lithostratigraphic units and their internal bedding allowed reconstruction of some anticlines and synclines at a scale ranging from a few to several kilometres. In this quadrangle four major structures occur, in the area between the upper Mariner GI. and the Neall Massif: two Molar/Glasgow cored anticlines and two Leap Year cored synclines. These structures continue to the SE in the adjacent quadrangles (Mount Murchison and Coulman Island). The folds are mainly parallel and have a major closed shape. An axial planar slaty cleavage is well developed mainly within the fine-grained layers of these folds. The foliation and the axial planes have medium to steep dips toward the SW, and the folds face NE. The axes show a mean NW-SE trend, with both northwestward and southeastward plunge variations. This tectonic framework is weakly deformed by late crenulation events.

THE WILSON-DESSENT BOUNDARY
The contact between the WT and the BT, occurring in the eastern part of the quadrangle, is completely masked by snow and ice. This boundary was studied in detail during the ItaliAntartide and Ganovex expeditions of the past years in the adjoining Mount Murchison and Coulman Island quadrangles, where it is well exposed; the results are summarized in Capponi et al. (2003b). Along this contact, the contrast in metamorphic grade between the high-grade WT and the low-grade BT, as well as the occurrence of the magmatic arc granites close to the suture, requires that a major part of the crust in between the two has been cut out by the suture fault. A greenschist facies retrogressive metamorphism has affected the western margin of the high-grade units: greenschist facies shear zones cut the Niagara Icefalls mafic and ultramafic rocks, which in places are transformed in chlorite-actinolite schists; the tonalitic intrusions are sheared under greenschist facies conditions and transformed into S-C tectonites at the Mariner Plateau. This points to a dynamically activated metamorphic event along thrust surfaces during the docking of the units. The relative sequence of deformation and metamorphism for the same boundary was studied in detail by Capponi et al. (1999) in the Lanterman Range.

THE BOWERS-ROBERTSON BOUNDARY
The contact between the BT and the RBT, occurring in the northeastern part of the quadrangle, is characterized by the in-between Millen Schist, that can be considered a high-strain equivalent of rocks belonging to both terranes.
The upper element (MSu), resembling rocks of the Glasgow and Molar formations, overlies the lower element (MSI), that resembles rocks of the Robertson Bay sequence. The thrust surface between the two elements is in turn deformed and spectacularly exposed on the slopes of Crosscut Peak and Mount Aorangi. Clear top to E-NE kinematic indicators supply evidence for southwest-over-northeast thrust of the Bower onto the Robertson Bay Terrane (Capponi et al. 1994, 2003a,b). We think that an early syn-metamorphic pattern of isoclinal folds, linked to the southwest-over-northeast thrusting of the Bowers Terrane was later deformed by a second deformative pulse, that produced a crenulation cleavage (Capponi et al., 2003a). This deformation caused the Bowers Terrane to further override the Robertson Bay Terrane and folded the thrust surface. Capponi et al. (1994, 2003a) suggested that the Bowers and Robertson Bay terranes were originally lateral equivalents and that the thrust surface nucleated by tectonic inversion of the normal faults accomodating the deepening from the proximal basin of the Molar Formation to the more distal basin of the Robertson Bay sandstone.

POST - ROSS TECTONICS

Both post-Ross contractional and extensional structures occur in this quadrangle.

In the northern part of the quadrangle, between the eastern shoulder of Rennick Glacier and Neall Massif, the cover rocks (Beacon Supergroup and Ferrar Dolerite) are deformed by folds and reverse faults. The folds, oriented NNW-SSE, are very gentle, with average wavelength around 5 km. Two major reverse faults occurs at Monte Cassino and in the Elter Ridge. Both east-verging reverse faults lead the Paleozoic basament (the Granite Harbour at Monte Cassino, the Molar Formation at Elter Ridge) to overrides the Mesozoic cover sequence. Analogue structures have been described in the Lanterman Range (Roland & Tessensohn, 1987 and references therein). The shortening direction appears to be NE-SW, and associated to WNW-ESE Riedel sinistral shear zone. Such structures could be correlated with the Cenozoic strike - slip tectonics described by ossetti et al. (2003a)

Extensional Tectonics
The most evident feature related to extensional post-Ross tectonic evolution is the lozenge-shaped area of the Mesa Range, at the SE termination of the Rennick Graben. The Rennick Graben consists of two rhomboidal basins filled by Kirkpatrick Basalt, corresponding to the areas of Litell Rocks and the Mesa Range. The Rennick Graben was interpreted in different ways:

- as a failed rift arm during the breakup of Australia and Antarctica (Fleming et al., 1997);

- as the result of Mesozoic to Cenozoic extensional faulting during the Ross Sea rifting (Roland and Tessensohn, 1987);

- as Mesozoic left-lateral strike-slip faulting during the breakup of Australia and Antarctica (Tessensohn, 1994).

In the model by Tessensohn (1994) the Rennick faulting is viewed in the framework of the tectonic evolution of the Southern Ocean and interpreted as a system of continental transcurrent faulting, which accommodates the transtensional strain between two symmetric areas of spreading, i.e. the SE Indian Ridge and the mid-Pacific Ridge. The rhomboidal basin of the Mesa Range can be considered as a pull-apart structure, linked to the transtensional regime, and the inferred faults running from Archambault Ridge to Lichen Hills and from Mericle Rock to Forgotten Hills can be considered the boundary faults of the basin. To the same event of crustal thinning can be ascribed the Cretaceous thermal event at 110 Ma (Delisle & Fromm, 1989) which is probably responsable for the anomalous age dates found in the Mesa Range rocks (Elliot & Foland, 1986; Foland et al., 1993). 1993).

More recently, Rossetti et al. (2003b) supplied apatite fission track data, demonstrating that the last significant denudation stage of the Rennick Graben shoulders started from Eocene times. Rossetti et al. (2003b) propose a direct structural connection between Cenozoic denudation and the activation of the dextral strike-slip regime in north Victoria Land during the Cenozoic and question the commonly assumed link between Mesozoic Ross Sea rifting and opening of the Rennick Graben.

The folding and contractional faulting can be related to the same tectonic phase: NW-SE right-lateral strike-slip shearing caused local positive inversion of the boundary faults of the Rennick Graben (Rossetti et al., 2003a) and guided the emplacement of plutons, dyke swarms, and volcanic edifices since Middle Eocene (Rocchi et al., 2003c).

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