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PRELIMINARY REPORT ON THE GEOLOGY OF THE MOUNT RAZORBACK-ORMISTON POUND AREA, NORTHERN TERRITORY

by

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SUMMARY

The area consists of a basement series of metamorphic rocks unconformably overlain by a largely unmetamorphosed cover series. The basement rocks are predominantly of poorly-foliated granitic gneiss in elliptical dome-like outcrops separated by belts of metasediments. At Ormiston Pound the gneisses grade into biotite granite, which is intrusive into the adjacent metasediments.

Before the deposition of the sediments of the cover the basement was affected by polyphase folding and metamorphism (the Arunta Orogeny). At least three phases of folding are identified. The first phase produced isoclinal folds and was accompanied by syntectonic metamorphism to amphibolite facies grade, producing the predominant metamorphic foliation of the area.

The second phase consisted of small, similar style folds with well developed axial structures. They were accompanied by syntectonic greenschist facies metamorphism and by the local retrogression of earlier metamorphic assemblages. Distribution of the second-phase fold axes indicates the presence of other fold phases. One of these is the large Mount Giles Fold, which refolds the first and second phase folds.

At some time after the deposition of the first two formations of the cover, both the basement and the cover were deformed by southwards-directed movements (the Alice Springs Orogeny). The basement moved southwards over the cover along E-W thrust faults and in the cores of large overturned folds and nappes. The maximum movement was in the nose of the Razorback Nappe. Deformation structures in the cover rocks such as folding and new fabric development are related to each other and to the degree of southwards movement.

The area can be thought of as being structurally equivalent to an early stage in the development of the Arltunga Nappe Complex.

1. INTRODUCTION

This Record describes the geology of the preliminary 1:50,000 geological map of an area between 100 and 150 km west of Alice Springs in the Northern Territory (Pl. 1). The area covers a section of the northern margin of the Amadeus Basin and includes wide outcrops of the basement rocks, the Arunta Complex, as well as the lowest two formations of the Basin itself.

Preliminary results of field examination carried out in the winter of 1971 are presented. Detailed work was concentrated in the eastern part of the area, around Ormiston Pound. The remainder of the area, between Ormiston Pound and Mount Razorback, was examined on a reconnaissance basis. The work is part of a continuing study; later work may modify some of the interpretations and conclusions presented here.

The Bureau of Mineral Resources provided a Landrover, field hand, and logistic support during field work. Plate 1 was drafted by Miss D.M. Pillinger (BMR). The study is a re-examination in detail of the Ormiston and Razorback Nappes, first described by Forman, Milligan & McCarthy, (1967). The work is also the beginning of structural and metamorphic studies of basement rocks typical of the Hermannsburg 1:250,000 Sheet area, and is aimed at assisting later systematic mapping.

2. STRATIGRAPHY - ARUNTA COMPLEX

The common rock types of the Arunta Complex in order of their areal importance are: granitic gneiss, granite, psammitic and semi-pelitic schist, orthoquartzite, amphibolite, and rare garnet schist. Also present are dolerite, pegmatite, and granite dyke rocks. Some of these units proved mappable but no stratigraphic sequence could be determined.

Granitic Gneiss

The boundaries of the gneiss are not well defined since it grades into quartz-biotite schist of the adjacent metasedimentary rocks. Gneiss-rich areas can nevertheless be roughly defined on the map as large rounded areas surrounded by narrow bands of metasediments. The boundaries of the gneiss are conformable with the foliation of the metasediments.

The gneiss is coarse-grained, typically poorly foliated, and consists of quartz, oligoclase, microcline, muscovite and biotite. The feldspars commonly occur as large augen up to 30 mm across. Numerous streaks, patches, or bands of amphibolite in disordered or swirling patterns are present throughout much of the gneiss.

Granite

Granitic gneiss, occupying the southwestern part of Ormiston Pound, grades eastwards into a non-foliated coarse biotite granite which occupies most of the area inside the Pound. The granite has sharp contacts with metasedimentary rocks in the northwest and east of the Pound; its main contacts are broadly conformable with the foliation of the surrounding schists and gneiss. Granitic dykes, originating from the main outcrop, cut across the adjacent rocks indicating that the granite is intrusive.

Metasedimentary Rocks

Semi-pelites and psammites with minor pelitic bands generally alternate on too small a scale to be mappable. However, the Chewings Range Quartzite and mafic-rich lenses cropping out between Damper Creek and Frews Yard are of sufficient areal importance to be distinguished on the map.

Chewings Range Quartzite

The Chewings Range Quartzite is a coarse-grained metaquartzite composed of clear glassy quartz grains. Towards the centre of the main outcrop of the Chewings Range, the rock is an orthoquartzite, but increasing impurities appear towards its margins. The impurities are mainly muscovite, iron oxide, and biotite, and they help define a foliation in the quartzite parallel to its contacts and largely parallel to the foliation in the surrounding metasediments. Marginal zones of the quartzite also display a strongly developed lineation within this foliation, caused by the elongation of quartz grains and orientation of mica. Few structures other than jointing can be made out in the orthoquartzite.

Mafic Rocks

Mafic rocks appear dark on air-photographs and were conveniently delineated as a unit, but in fact they contain a variety of rock types. Amphibolite and chlorite schist predominate over biotite schist and psammitic layers. These units are discontinuous along strike and have been complexly folded.

STRATIGRAPHY - PROTEROZOIC

Only two formations were mapped within the area, the Heavitree Quartzite and the Bitter Springs Formation.

Heavitree Quartzite

The Heavitree Quartzite is an arenaceous sequence resting with strong angular unconformity upon all the units of the Arunta Complex described above. No detailed section was measured, but its thickness in the area (calculated from outcrop widths and measured dips) is approximately 320m. It can be divided into three units, although on the map the lowest two units have not been differentiated.

Lower Heavitree Quartzite

The lowest unit consists of generally well-bedded, slightly impure, pale yellowish-brown sandstone, with many pebbly and gritty horizons and thin shale partings. Cross bedding and ripple marks are common. At the northeastern end of Ormiston Pound the beds are an estimated 60m thick, but there is a strong overstep onto the underlying Chewings Range Quartzite, marked by lenses of coarse quartzite-boulder conglomerate, which thin and die out away from the Chewings Range. The boulders in the conglomerate are up to 200 cm across and are identifiable as Arunta quartzite. Eastwards from the Chewings Range, the Lower Heavitree Unit itself thins and loses its identity, and it has not been possible to distinguish it west of Ormiston Gorge.

Middle Heavitree Quartzite

The Middle Heavitree Quartzite has a uniform lithology across the whole area. It consists of about 200m of massive pale grey fine-grained orthoquartzite. Bedding is marked by faint light and dark colour-banding, reflecting differences in grainsize. Sedimentary structures are rare. Towards the top of the unit there are occasional thin shale horizons.

Upper Heavitree Quartzite

The uppermost unit consists of 60m of interlayered dark grey shale and quartzite in the ratio of about 2:1.

The reference section for the Bitter Springs Formation (Wells et al., 1967) is at Ellery Creek, 25 km east of Ormiston Pound. It is described by Prichard & Quinlan (1962, p.11). At Ellery Creek, some 60 m of siltstone crops out between the main quartzite and the lowest dolomite horizon of the Bitter Springs Formation. The siltstone is thought to be equivalent to the Upper Heavitree Quartzite Unit described here. Prichard & Quinlan place the contact between the two formations at the top of a quartzite horizon within the siltstone. There is no such unique marker quartzite in the Razorback-Ormiston area that can be correlated with that described by Prichard & Quinlan. Quartzite bands up to 4m thick occur throughout the siltstone in the area, and it seems more logical to place the base of the Bitter Springs Formation at the base of the lowest dolomite horizon.

At Ormiston Pound the Upper Heavitree Quartzite is important as a slip zone in which the large Ormiston Thrust is located for much of its outcrop.

Bitter Springs Formation

The Bitter Springs Formation consists largely of dolomitic limestone with minor siltstone. Its stratigraphy in the area has been described by Prichard & Quinlan (1962).

ARUNTA OROGENY - METAMORPHISM AND STRUCTURE

The Arunta Orogeny is the orogeny which, as defined by Forman, Milligan, & McCarthy (1967), 'folded and metamorphosed the Arunta Complex before the Heavitree Quartzite was deposited'. It resulted in at least three and probably more superimposed fold systems and at least two periods of metamorphism. A period of granitization produced extensive granitic gneisses and led to the, at least partial, intrusive emplacement of a granite body - the Ormiston Pound Granite.

F_1 - Folds

Lying within the main metamorphic foliation of the metasedimentary rocks are many rootless, intrafolial fold hinges. These tight fold hinges are the earliest folds seen in the area. They will be termed F_1 folds (Fig. 1). On the scale of the map, the outcrop of the mafic rock unit northeast of Frews Yard is probably that of a large intrafolial F_1 fold hinge; the main metamorphic foliation is axial plane to the structure. The outcrop pattern of the Chewings Range Quartzite is interpreted as two large F_1 isoclinal folds. Noses of large F_1 folds in the Chewings Range can be seen on the map 300m north and 1.75km east-southeast of Mount Giles.

The foliation is syntectonic with the F_1 folding and is marked by mineral orientation and differentiated layering largely parallel to the axial planes of the folds. The layering grades in coarseness from that of a fine schist to that of a gneiss. In much of the area the foliation is developed in psammitic and semi-pelitic rocks which are not suitable as indicators of metamorphic grade. However, hornblende and andesine (circa An_{50}) bearing amphibolite bands are common within the F_1 foliation, and garnet schists have been found at two localities. The metamorphic grade reached during the F_1 folding over much of the area is thus tentatively put at amphibolite facies.

F_2 - Folds

The F_1 axial-plane foliation is commonly itself folded by small 's' or 'z' folds (Fig. 2 and 3), which generally have an axial-plane cleavage cutting across the F_1 banding. In the pelitic and semi-pelitic rocks immediately northeast of Ormiston Pound, this F_2 cleavage can be seen progressively obliterating the earlier F_1 foliation. Thin bands of quartzite within the pelites are boundinaged on the limbs of the folds to become rods lying within the new cleavage and parallel to the F_2 fold axes (Fig. 2). Well developed mineral orientation within the F_1 foliation is always also parallel to any adjacent F_2 folds, and marks the intersection of the F_2 axial plane with the F_1 banding. Rarely, F_1 folds have been refolded by F_2 generation folds. Two such examples are figured (Fig. 3).

Small F_2 folds have been found throughout the outcrop of the metasedimentary rocks in the area, but no larger examples have been identified. These folds can be correlated on their style (small near-similar folds) and their well-developed axial structures which crosscut earlier metamorphic layering of F_1 age.

The development of the F_2 folds is accompanied by the growth of quartz, biotite, muscovite, epidote, and rarely albite within the axial plane, and oriented parallel to the fold axes.

The syntectonic mineral growth accompanying the F_2 folding is tentatively put at upper greenschist facies. It was probably developed by hydration reactions from a pre-existing F_1 metamorphic assemblage. The extent and importance of this retrogression has yet to be determined.

Post-F_2 Folding

Plots of F_2 axial lineations show wide variations in trend and plunge (see Fig. 4). If, as has been assumed in the preceding section, the F_1 folding and associated metamorphism produced uniformly-trending foliation and lithological layering throughout the area, then the intersection of the F_2 axial planes with this early foliation should also be everywhere parallel. The large fold seen at Mt Giles refolds structures of both F_1 and F_2 generations. It is, however, a single large fold with apparently no associated minor folds or axial structures, and can only explain a small part of the variation in the measured F_2 axial directions (see Fig. 4, 1). Five possibilities exist:

(a) Some of the measured lineations do not belong to the F_2-fold generation but to some other generation, for example F_1. Where intrafolial F_1 fold-noses are observed a mineral orientation lineation is present parallel to the F_1 fold axes and indistinguishable from F_2 axial lineation. Such lineation, lying within the main F_1 foliation, in the absence of small F_1 or F_2 folds, or of a crosscutting F_2 axial-plane foliation, cannot with certainty be identified. Since F_1 fold closures are rare, and F_2 folds fairly common, and everywhere the lineations adjacent to the F_2 folds are parallel to their B-axes, almost all the mineral orientation lineations measured have been ascribed to F_2 folding.

(b) The foliation due to the first folding episode may not have been uniformly oriented over the entire area before the F_2 folds were superimposed. Another, undetected folding episode may have intervened between F_1 and F_2. Alternatively, F_1 folds may have been more open than they are at present, in which case the F_2 folds developed on different limbs of an F_1 fold would have different hinge orientations. Tightening of the F_1 folds and boundinage of their limbs to their present style may have been the result of a later fold episode and may even have accompanied the development of the F_2 folds.

(c) Folds identified as F_2, although similar in style to each other and having similar axial structures, may belong to different generations of folds. Williams (1970) and Park (1969) have criticized the use of the criteria of fold style and axial structure in correlating widely separated folds in the absence of any other structural control.

Figure 4:

The sketch map of the Ormiston Pound Area (bottom of Figure 4) shows the sub-areas into which structural data have been divided on the accompanying stereographic diagrams.

Stereographic plots from sub-areas I-Va are of mineral elongation lineations and of B-axes of F_2 generation folds. The lineations mark the intersection of the F_2 axial planes with the F_1 foliation, and are parallel to the F_2 fold axes (see text).

In sub-area I, lineations from the east-west limb of the Mount Giles Fold plot in the zone marked 'A'. Lineations from the north-south limb of the fold plot in zone 'B'. If the effect of the Mount Giles Fold upon the lineations 'A' is removed by 'unrolling' the fold about its axis, then zone 'A' is brought to lie within the field of points of zone 'B'. Thus the F_2 fold structures are probably earlier than the Mount Giles Fold and have been refolded by it.

Note the wide scatter of points especially in sub-areas II and IV. This is probably caused by post-F_2 folding (see text).

Plot Vb shows the effect of the Alice Springs Orogeny upon F_1 structures in this sub-area. Contours at 1 point and 3 points per 1% area. Solid line contours are drawn on 23 poles to F_1 axial foliation. The poles have a girdle distribution (dashed line) with a II-axis trending 80° and plunging 52° . This II-axis lies within the plot of 17 measured B-axes of Alice Springs Orogeny folds affecting Arunta rocks (dotted contours). 17 poles to axial planes of these Alice Springs Orogeny folds are also plotted (dashed contour). The mean position of intersection of the F_1 foliation and the Alice Springs Orogeny folding axial plane (mean B-axis) likewise lies within the field of the measured B-axes.

(d) The F_2 folds may all belong to the same generation but yet may have formed as the result of a non-uniform stress field. The stress field may have varied on a regional scale to develop differently oriented folds in different localities (Park, 1969) or even within the domain of a single fold, thus developing a non-linear fold hinge (as described by Ramsay, 1962).

(e) An additional fold phase may post-date F_2 but precede the formation of the Mount Giles fold. There is some evidence for such a fold phase south of Mount Giles, where the F_1 foliation is affected by broad open folds with gently plunging axes. The axes of these folds are marked by a crenulation on the F_1 foliation. These folds appear to be refolded by the Mt Giles fold, but have not been observed elsewhere in the area.

It is hoped that further detailed mapping will help to exclude or confirm some of the alternatives given above. However, the only reliable method of structural correlation in terrain of this type is by superposition criteria, and this is only reliable over relatively small areas in which exposures are continuous or nearly so (Park, 1969). In the area dealt with, exposure is fairly continuous, but so far only the main foliation (F_1 age) has been reliably traced from one outcrop to another across large areas.

ALICE SPRINGS OROGENY - STRUCTURE AND METAMORPHISM

Earlier mapping and descriptions (Forman, Milligan, & McCarthy, 1967) of the area indicated that the basement and cover rocks were folded in two large southward-directed nappes, each nappe having basement rocks in its core. The upper nappe was called the Razorback Nappe and the lower one the Ormiston Nappe.

This survey confirms the presence of the Razorback Nappe; the nose of the nappe crops out just south of Davenport Creek in a klippe containing inverted Heavitree Quartzite and Arunta gneiss. The root zone of the nappe lies in the Razorback Thrust between Mount Sonder and Mount Razorback (see Figs 5 and 6) and in the Arunta rocks to the north of that thrust. The minimum southwards movement of the nose of the nappe along the Razorback thrust is 9.6km. The block diagram (Fig. 5) illustrates this interpretation.

Beneath the Razorback Nappe is a series of southward-directed folds and thrusts. The uppermost fold corresponds to the fold which was previously termed the 'Ormiston Nappe'. As the minimum southward movement which one can calculate from this structure is only about 2km, I have renamed it the Mount Sonder Fold (see Figs 5 & 6).

Eastwards, from a point 3km west of Ormiston Gorge, the lower limb of the Ormiston Fold is sheared out and replaced by the Ormiston Thrust. This southward-dipping thrust forms the northernmost contact between basement and cover rocks to the north of Ormiston Pound.

Underlying the Ormiston Thrust, at Ormiston Pound, are other southward-directed overturned folds called the Ormiston Folds (Fig. 6). Some have sheared out lower limbs. In a ½km wide zone, immediately underneath the Ormiston Thrust and parallel to it, the Heavitree Quartzite is folded into near isoclinal similar-style folds (the 'deformed zone' of Figure 6), whose axes are subhorizontal and trend east-west. Axial planes dip $40^\circ - 60^\circ$ north, parallel to the adjacent Ormiston Thrust. The quartzite of this zone is fine-grained with a strong foliation parallel to the axial planes of the folds. There is no prominent lineation on the foliation surface. In some beds there are north-south quartz-elongation lineations (i.e. normal to the fold axes and parallel to the assumed direction of movement). At other localities within this zone, similar lineations rarely develop parallel to the fold axes or at various angles to them.

In thin section the quartzite from the deformed zone has a mylonitic texture. Precrystallization is greatest in specimens near the Ormiston Thrust. Individual quartz grains show extreme flattening in a direction normal to the mylonite foliation, and a uniform extension within that plane. Their shape generally corresponds to uniaxial oblate ellipsoids within the flattening field (Flinn, 1962).

Specimens with a quartz-elongation lineation in hand specimen show no observable linear orientation of elongated crystals in thin section. Thus the lineation observed cannot be penetrative and is probably a surface feature caused by localized constrictive strain at the boundaries of adjacent quartzite bands.

Underlying and to the south of this highly-deformed zone, the 'Ormiston Folds' are overturned to the south but are more open than the folds of the deformed zone, and the degree of fabric modification is less. South of Ormiston Gorge the folds in the autochthonous cover rocks are open, upright, parallel folds and their original sedimentary fabric is preserved unchanged.

From north to south the basement and cover rocks can be divided into east-west zones according to the degree of southward translation which they have undergone during the Alice Springs Orogeny (Figure 6). The northernmost zone shows the greatest amount of movement. The zones are:

(a) The Allochthon: The Razorback Nappe with a root zone in the Razorback Thrust between Mount Sonder and Mount Razorback.

(b) The Parautochthon: A zone of southward-directed folds and thrusts underlying the Razorback Nappe. Southward movements within this zone are less than those of the Allochthon.

(c) The Autochthon: Upright folds of the cover rocks to the south of Ormiston Gorge.

Effect of the Alice Springs Orogeny on the Arunta Complex

The degree of deformation of basement rocks by the Alice Springs Orogeny shows a similar variation from north to south as that seen in the cover. Underlying and adjacent to the highly-deformed quartzites of the Ormiston Thrust zone, the basement rocks are refoliated parallel to the thrust, and structures of the Arunta Orogeny are obliterated. Accompanying this there is retrogression manifested by the metamorphism of amphibolite bands to chlorite schist. These refoliation and retrogressive effects die out within a few hundred metres north of Ormiston Thrust and are more marked in the mafic and pelitic rocks.

To the south of the Ormiston Thrust, underlying the parautochthonous zone in the cover, basement structures have been refolded by Alice Springs folds. These superimposed folds are superficial and are only present in the Arunta rocks near to the basement-cover contact.

Figure 4 (Vb) illustrates the effects of this superimposed folding upon Arunta quartzites and pelites containing F_1 axial foliation. The plotted measurements for this example were taken from the northeastern corner of Ormiston Pound, where north-trending, near-vertical, axial-plane foliation to F_1 Arunta Folds is intersected by approximately west-trending, southward-overturned Alice Springs folds. The resulting superimposed folds plunge at around 45° in an E or ENE direction.

The basement rocks under the autochthonous cover show no retrogression or refoliation attributable to the Alice Springs Orogeny.

The basal thrusts of the large overturned folds developed in the cover rocks originate in the basement. They trend east or northeast and cross-cut basement structures. For example, the north-south trend in the metasediments to the north of Ormiston Pound is truncated by the Ormiston Thrust. North of the thrusts, the basement rocks appear to have moved southwards as rigid blocks and, apart from narrow zones adjacent to the thrusts, they show no folding or refoliation of Alice Springs Orogeny Age.

COMPARISONS WITH THE ARLTUNGA NAPPE COMPLEX

The effects of the Alice Springs Orogeny in the Mount Razorback-Ormiston Pound area are relatively simple. Deformation structures such as folding and the degree of fabric modification are genetically related. They depend on the southerly variation in intensity, which in turn is related to the extent of southward movement.

The Arltunga Nappe Complex consists of a large nappe (the White Range Nappe) overlying a fold-thrust complex (the Ruby Gap Nappe) (Forman, 1971). On a smaller scale the Razorback Nappe is structurally equivalent to the White Range Nappe, and its underlying parautochthonous zone is equivalent to the Ruby Gap Nappe.

However, in the root zone of the White Range Nappe four superimposed phases of deformation have been identified (J. Funk, personal communication). The earliest consisted of large thrust nappes with interpenetration of basement and cover. The folding assumed to be associated with this process has been obliterated by the subsequent fold episodes. One of the most important aspects of the study of the Razorback-Ormiston area is that the folding and thrusting seen there are probably equivalent to this early deformation phase in the White Range Nappe.

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Figure 1 : Examples of small F_1 fold closures:

(a) Quartz-biotite schist. 1 km east Redbank HS. Looking down plunge

(b) Quartz-biotite schist. Head of Damper Creek

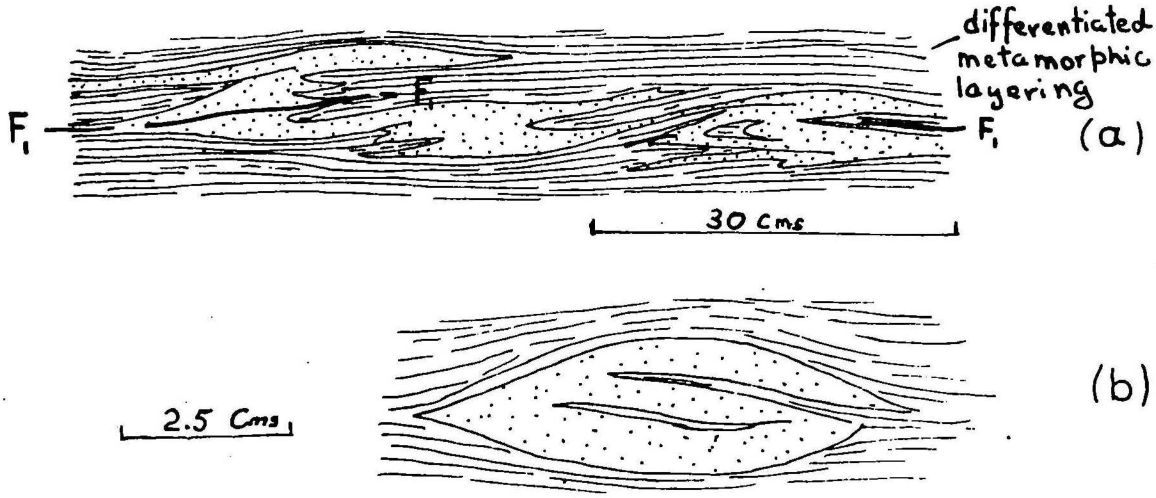

Figure 2 : Examples of small F_2 generation folds.

(a) Quartzite band in pelitic rock. 5 km north of Mount Giles

(b) Ditto.

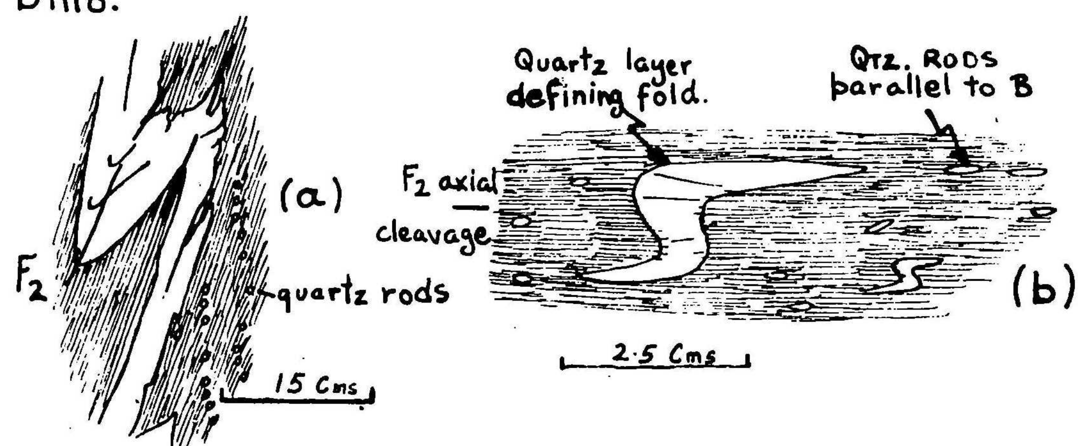

Figure 3: Examples of the superposition of F_2 folds on F_1 folds.

(a) Quartz-biotite schist. Normal to F_1 fold axis. 3 km WSW Frews Yard.

(b) Quartz-biotite schist. Normal to F_2 fold axis. 2 km E Redbank HS.

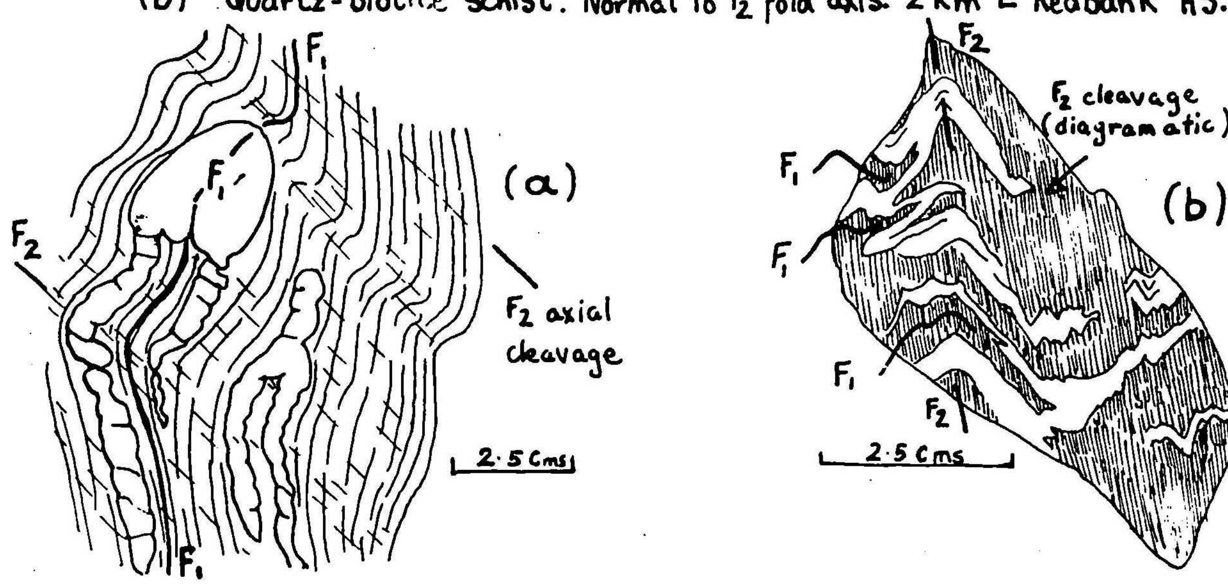

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Figure 4

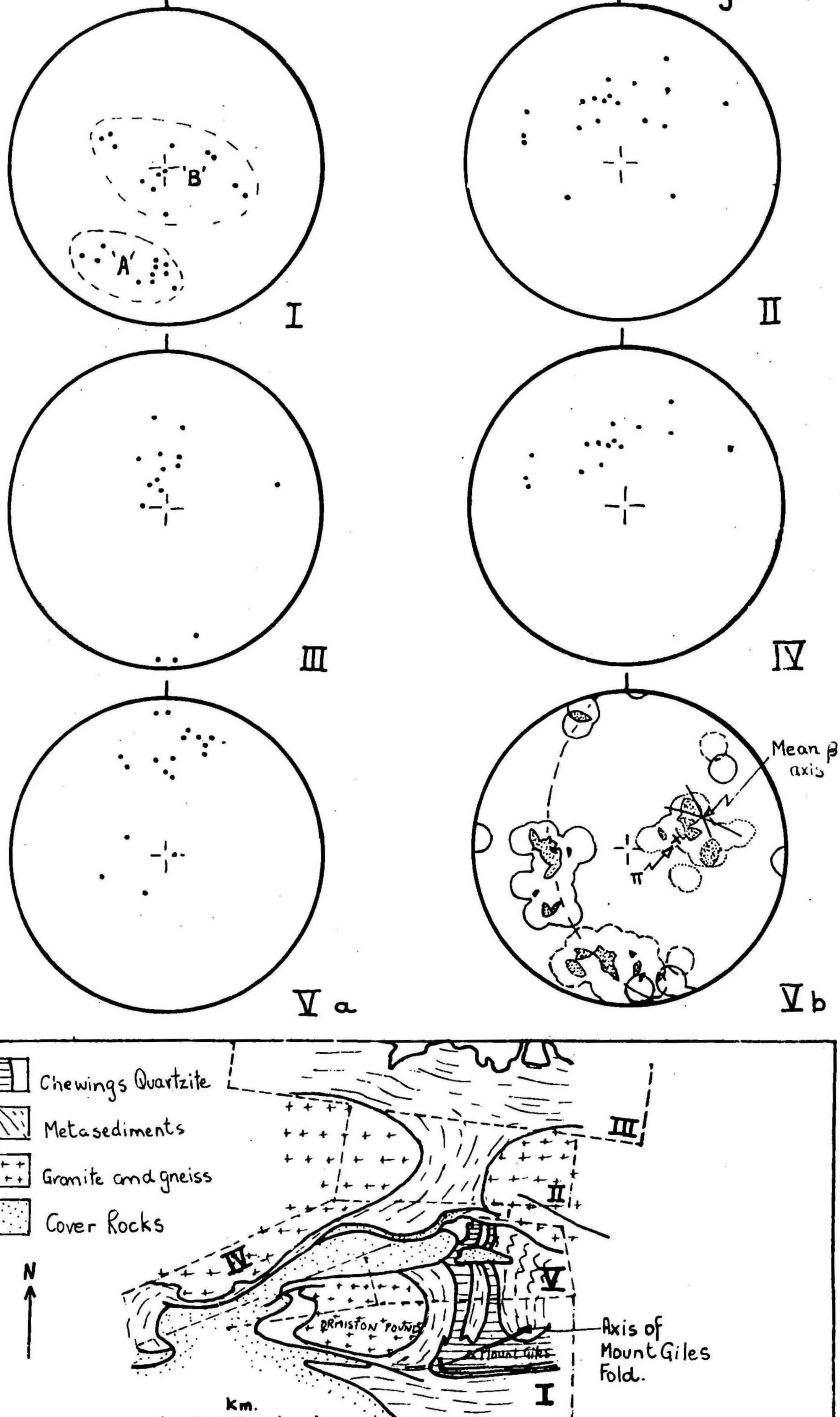

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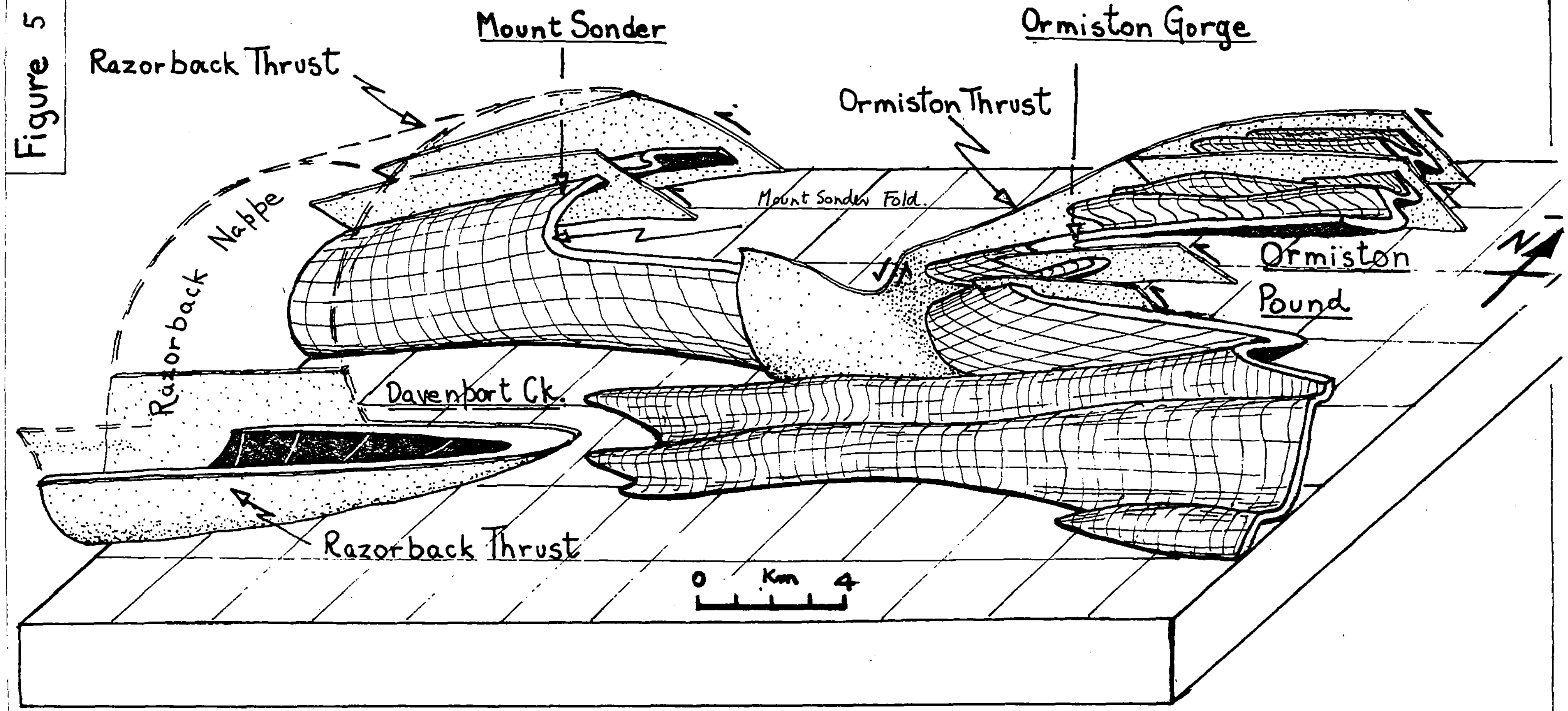
Figure 5



Block diagram of basement-cover contact in Mount Sonder-Ormiston Pound Region.
Heavitree Quartzite-Arunta contact coloured black; Heavitree Quartzite-Bitter Springs Formation contact with linear ornament; thrust surfaces dot ornament.

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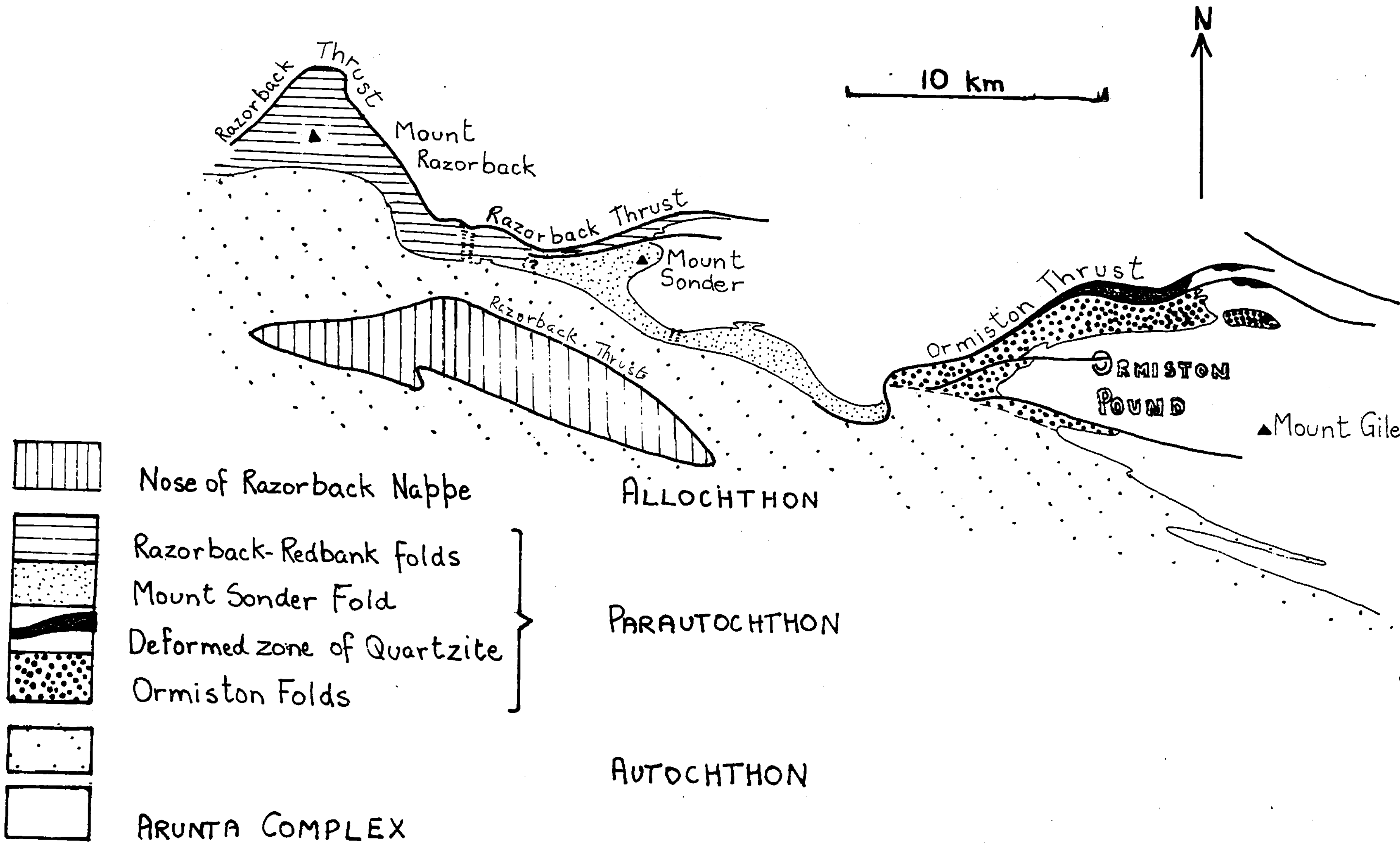

Figure 6

PLATE I

PRELIMINARY GEOLOGICAL MAP OF THE MOUNT RAZORBACK—ORMISTON POUND AREA

QUATERNARY		Qa	Alluvium, Sand
TERTIARY		Tc	Conglomerate
		Ts	Sandstone, Sandy clay, Laterite
PROTEROZOIC	PERTATATAKA FM	Pup	Siltstones and sandstones
	Bitter Springs Fm	Pub	Dolomitic limestone, shales and siltstones
	Heavitree Quartzite	Puh	Undifferentiated
	Upper Heavitree Qtzite	Puh_2	Interbanded grey shale and massive quartzite in ratio 2:1. Quartzite bands to 4 m in thickness
		Puh_1	Upper $\frac{2}{3}$ (approx) consists of massive, light grey orthoquatzite. Lower $\frac{1}{3}$ of generally well bedded pale yellow-brown sandstones with conglomerate and grit horizons. Abundant cross-bedding
PRE-HEAVITREE QUARTZITE ARUNTA COMPLEX		p€a	Undifferentiated
	Meta sedimentary Rocks	p€c	Mainly quartz-biotite schist
	Chewings Range Qtzite	p€d	Massive, pale grey coase metaquartzite. Generally strongly lineated
	Mafic—rich Bands	p€b	Amphibolite, biotite and chlorite schist, minor quartz-biotite schist and metaquartzite
	Granitic Gneiss	p€e	Quartz oligoclase-microline-muscovite-biotite gneiss. Foliation poor. Contains abundant streaks of amphibolite
	Ormiston Pound Granite	p€g	Biotite-granite
			Dyke, do—dolerite, p—acid pegmatite

Geological Boundary
Unconformity. Top of 'u' towards younger rocks
Axial plane trace of anticline with plunge
Axial plane trace of syncline with plunge
Axial plane trace of overturned anticline
Axial plane trace of overturned syncline
Fault, q—quartz filled
Low angle Thrust Fault. 'T' indicates upper plate
Transcurrent Fault, showing relative horizontal movement
Where location of boundaries, folds and faults is approximate, line is broken; where inferred, line is queried
Trend lines
Plunge of drag fold
Plunge of minor syncline
Plunge of minor anticline
Plunge of fold, showing 'z' vergence
Strike and dip of bedding
Vertical bedding
Horizontal bedding
Overturned bedding
Where a dot is present on the bedding symbol, e.g. or , correct way up has been proven by field criteria

Strike and dip of schistocity
Vertical schistocity
Horizontal schistocity
Strike and dip of cleavage
Vertical cleavage
Strike and dip of joint surface
Plunge of lineation (mineral orientation)
Horizontal lineation (mineral orientation)
Plunge of lineation (intersection of two 's' surfaces
Plunge of lineation (minor crenulations)
Foliation with plunge of lineations. (crenulation and mineral orientation)

KILOMETRES 1 0 1 2 3 4 5 KILOMETRES
MILES 1 0 1 2 3 MILES

To accompany Record 1972/46

F53/A13/37