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REPORT TO ACCOMPANY

GEOLOGICAL MAPS, SECTIONS AND BLOCK DIAGRAMS OF THE

BUTLER DOME AREA OLIA CHAIN NORTHERN TERRITORY

PREPARED FOR PLANET MINING COMPANY PTY. LTD.

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TERMS OF REFERENCE

We were requested by Planet Mining Company Pty. Ltd. to examine the geology of the Butler Dome with a view to the further evaluation of the Prospect and to recommend drill sites if warranted.

S.E. Shaw was employed to produce a geological fact map of the area, to carry out petrological investigations and run a ground magnetometer survey.

P.F. Williams was employed to interpret the geological structure and to produce suitable block and section diagrams.

SUMMARY

The structure of the Opera House Valley is interpreted as an antiform plunging at a low angle to the south. An antiform has been suggested rather than an anticline since basement Olia gneiss overlies successively younger Pinvinna Beds and Dean Quartzite.

The gossans present within the folded Pinvinna Beds are interpreted as concordant leases. The significance of the above is that the ore-bearing rock is far greater than would result from the alternative synclinal structure postulated by Geophoto Resources Consultants. Further, the structure as suggested here is in agreement with the regional synthesis of the southern margin of the Amadeus Basin given by Forman and Hancock 1964.

Detailed ground magnetometer traverses failed to produce meaningful results across positive anomalies which were known to exist over several gossans of the Opera House Valley. The Instrument provided by Wongela Geophysical Pty. Ltd. was later shown by them to be suspect.

Because of the apparent structural homogeneity throughout the area, the subsurface geology (see accompanying block diagram) is believed to be as
reliable as is possible in any complexly folded area. On this basis
and on the assumption that the gossans or their sulphide equivalents
persist down plunge, drilling targets have been nominated.

GEOLOGICAL METHODS

In consultation with Mr. G. A. Brown it was decided to map as much of
the area as was possible in the available time while still preserving
adequate ground control. To obtain an accurate topographic base map
and for plotting geological data in the field, a surveyor and his
assistant were employed to accompany the party during the survey.

The method of surveying was by tacheometry. Aerial photographs were
used to plot geological data outside of the surveyed area only.

The field party consisted of a field assistant, the surveyor and his
assistant and the writers. The party was equipped with two landrovers
from Alice Springs carrying camping equipment, food and water adequate
for three weeks. One of the writers (P. F. Williams) stayed in the
field for ten days; the other (S. E. Shaw) stayed for the duration of
the field trip which was from August 31, 1966 to September 17, 1966.

The initial camp site situated near the Opera House Gossan was shifted
1/2 miles south after the second week so as to provide easier access to
that end of the valley.

PETROLOGY OF THE OPERA HOUSE VALLEY

A representative number of hand specimens from each of the major rock
types of the valley were collected for geochemical analysis and
mineralogical examination. Where specimens were collected for analysis
such as the gossans the minimum size was approximately 4 lbs.
Identification of the minerals were made with a polarizing microscope on
thin sections.
Olia Gneiss and Granite

Geophoto Resources Consultants in their structural interpretation map of the Opera House Valley distinguish the basement rock into Olia Gneiss lying to the east of the valley and granite lying to the west. Forman and Hancock (1964) recognise the presence of a granite at Butler Dome and describe it as a lineated coarsely porphyritic coarse-grained biotite-quartz-feldspar gneissic granite. "The contact with the augen gneiss of the Olia Gneiss is gradational. The contact with the Dean Quartzite is gradational through porphyroblastic, augen-biotite-granite gneiss to biotite-sericite-quartz schist, sericite-quartz schist and quartzite." Of the Olia Gneiss Forman and Hancock describe it as a well-foliated coarse porphyroblastic gneiss with bands (up to a few hundred feet in thickness) of fine grained gneiss. The mineralogy of typical specimens consists of microcline 50-60%, quartz 20-30%, plagioclase (albite-oligoclase) 5-20%, biotite 10-20% with epidote (up to 10%) and garnet. Muscovite occurs only in small quantities. Accessory magnetite occurs in euhedral grains up to 1.5 mm. together with zircon and apatite.

A brief reconnaissance of the basement both east and west of the Opera House Valley suggests some differences in mineral composition although no more than would be expected from a series of gneisses with variations in lithology and layering thicknesses. The dominant structure in the basement is the gneissic layering and the presence of large (1" x 1" x 3/4") porphyroblasts (augens) of microcline feldspar aligned parallel with the dominant foliation. On the western side of the valley the foliation plane has an average dip of 18\(^\circ\) in a direction 178\(^\circ\). The lineation plunges 24\(^\circ\) in a direction 153\(^\circ\). To the east the lineation plunges 20\(^\circ\) in a direction 185\(^\circ\). Pegmatite layers and what appear to be amphibolite layers up to 10 feet thick were found to the east, but to the western side of the valley the lithology is mainly augen gneiss.

In thin sections the gneiss to the east of the Valley is composed of well twinned microcline feldspar 30-40%, plagioclase (An\(_{42-44}\)) altering
in part to saussurite 10-20%, quartz 30%, shredded biotite 10%, muscovite 5%. Accessory minerals are apatite, magnetite octahedra, up to 2 mm., sphene with leucoxene alteration. Near the contact of the gneiss and the overlying Dean Quartzite the gneiss becomes distinctly more lineated, the alkali feldspar has recrystallised; porphyroblastic structures disappear, biotite is more strongly aligned and is arranged in stringers with muscovite, magnetite granules and apatite crystals. The biotite shows no evidence of warping, a feature suggestive of recrystallisation during or after deformation. The stringers are separated by lenses of quartz and finer grained aggregates of microcline and plagioclase (An$_{32}$).

The gneiss to the west is identical in mineral composition to the gneiss east of the Valley. Microcline, quartz, plagioclase, biotite and muscovite are the main minerals with accessory sphene magnetite and apatite. A noticeable feature of the gneisses is the amount of accessory apatite and magnetite present, which in some instances may be up to 1% by volume of the total rock. Little can be said about the origin of the gneiss because of the localised area examined. Quoting from Forman and Hancock (1964) --

"The gneiss is considered to have formed by metamorphism of sediments underlying the Dean Quartzite during the regional folding. These sediments are probably equivalent to the Mount Harris Basalt and the Blooms Range Beds in the western part of the Blooms Range Sheet area and on the Scott and Rawlinson Sheet areas. Quartz-a epidote rock, with possible relict amygdalites and the pelitic members of the gneiss are considered to be gneissic equivalents of the basaltic and argillaceous members of the Mount Harris Basalt and Blooms Range Beds. A transition from schist of the
Bloods Range Beds to gneiss has been described in the section on the Bloods Range Beds.

Hence most of the gneiss is considered to be formed by granitization and metamorphism of the Bloods Range Beds and Mount Harris Basalt. Some of it, however, particularly that in the northern foothills of the Musgrave Ranges, may be an original gneissic basement or a gneissified sedimentary sequence older than the Mount Harris Basalt."

No origin has been suggested for the granite, but if as Forman and Hancock (1964) and the Geophoto interpretation map suggest, namely that the gneiss and granite can be separated by mapping, the granite must have originated from similar material as the gneiss, or alternatively the granite-gneiss contact is further to the west than visited by the writers.

Dean Quartzite

The name Dean Quartzite was applied by Forman (1963) to a sequence of tough varicoloured, cross-bedded quartzite, which overlies porphyroblastic schist, the Mount Harris Basalt, Bloods Range Beds and granite and is conformably overlain by the Pinyinna Beds.

The Dean Quartzite is a unique marker bed in the succession and according to Forman and Hancock (1964) provides evidence for a major recumbent fold hypothesis. It is correlated with the Heavitree Quartzite of the northern margin of the Amadeus Basin. It has been described as a predominantly medium-to coarse-grained moderately sorted, moderately rounded, white and brown quartzite and sandstone with thin bedding, laminae and cross laminae. In other areas the quartzite has been metamorphosed to fine to medium quartzite, sericitic quartzite and sericite-quartz schist all of which may be strongly lineated.

Throughout the Opera House Valley the quartzite has been metamorphosed
and is marked by a distinct lineation plunging south at an average of 11°. Where folding has occurred in the quartzite, the lineation is more intense, and within fold closures layering may be completely lost and instead a strong quartz rodding developed. The fold closures for this reason are easily identifiable in the field, and in addition the quartz rodding, being more resistant to erosion than the layered quartzite of the fold limbs, gives rise to fold hinges which tend to be physiographically prominent as elongated ridges.

Sedimentary features were recognised on the hinge of a large fold in the creek containing the aboriginal paintings (1620. 3700). Current bedding and ripple marks were present but, because of poor preservation, facings could not be determined. Elsewhere sedimentary features were not observed and the presence of isoclinal fold hinges indicates that the sequence as a whole is partly transposed.

A rodded specimen of the Dean Quartzite was examined microscopically (specimen DP). It has a strong structure imparted by the mutual alignment of augen-like rods of quartz elongated with the foliation and the alignment of muscovite "books" associated with granular quartz between the rods. The average size of the quartz rods is 1/4" x 1/8" and they are elongated down plunge some 6°. The rods are composed entirely of sutured quartz grains approximately equant in shape and somewhat larger in grain size (2 mm. diameter) than the granular quartz separating the rods. Muscovite comprises between 5% and 10% of the rock. Accessory minerals are rounded crystals of zircon and an altered opaque iron-bearing mineral, possibly limonite after pyrite.

The contact of the Olla Greiss with the Dean Quartzite was examined and found to be folded. There were no signs of faulting parallel to the

* The term here is used strictly in the sense of brittle deformation.
contact and it is believed that the contact is sedimentary and unconformable.

Considerable structural adjustment in the zone immediately above and below the contact has converted the porphyroblastic augen gneiss to a lineated biotite schist and the Dean Quartzite to a lineated sericite schist. It is interesting to note that a layer of sericite schist or a layer of the feldspathic sericite schist sometimes separates the Dean Quartzite from the basement gneiss. At least one so-called "basement window" of gneiss interpreted by Geophoto Resources and lying on the western side of the Valley has been found to be a feldspathic schist (specimen 204, location (1890.15530)). It may be that the gneiss immediately underlies this schist.

**Pinyinna Beds including the gossans**

Forman (1963) defined the Pinyinna Beds as a poorly exposed sequence of crystalline dolomite, limestone (with a few poorly preserved stromatolites) and siltstone which conformably overlies the Dean Quartzite. In the Olia Chain and the southern half of the Ayers Rock sheet, the Beds have been recrystallised to medium-grained lineated schist and slate. The metamorphosed basal unit of the Pinyinna Beds is poorly exposed in the core of flat lying isoclinal folds in Tornpakura Hill, Stevenson Peak, Butler Dome and Foster Cliff of the Olia Chain. The lithology is grey schistose slate, grey phyllite and grey medium- to fine-grained quartz-sericite schist. The schistosity is parallel to the axial planes of the tight isoclinal folds and the lineation developed is parallel to the axes of the folds (Forman and Hancock 1964).

The Pinyinna Beds are less resistant to erosion than the Dean Quartzite, and the topographic expression of the Opera House Valley and Butler Dome is directly related to the underlying geology. Soil cover in the Valley, although not very deep over the Pinyinna Beds, is of sufficient depth to hamper detailed mapping. Before more extensive methods of prospecting are made, it would be advisable to channel across the floor of the Valley along several sections to uncover the underlying schists for
structural examination.

The lithology of the Pinyinna Beds in the Opera House Valley is mainly a grey to green fine-grained muscovite schist with intercalations of quartz-muscovite schist and quartzite. The quartz-muscovite schist (specimen 396) in thin section is seen to consist of alternate layers (0.1 to 0.2 mm. thick) of quartz and muscovite. The muscovite is aligned along two foliation planes, S2 lying oblique to the lithologic layering, the other lying with the lithologic plane (S1). With more intense folding, transposition of the lithologic layering occurs, and S2 becomes the dominant foliation. It is possible that S1 is equivalent to the slaty cleavage (B1) of the isoclinal folds and S2 equivalent to B2 or B3 of the less tightly appressed folds. In common with the gneisses, the lack of bent muscovite plates and the identical texture of the muscovite lying within both foliation planes of the schist suggest a period of metamorphic recrystallisation associated with deformation.

Many of the quartzite layers in the schist are up to 50' in width and are stained with iron and in some cases manganese. There appears to be a gradation from barren quartzite in the Pinyinna Beds through loosely consolidated sandy type gossans to the massive haematite gossans of the Opera House. Reference to the geological section suggests a possible connection of the massive gossans lying along the western side of the valley and the sandy type of gossans along the eastern side. All available geological and structural evidence suggests the conformable nature of the gossans with the Pinyinna Beds, but it is probable that thickening and thinning of the gossans or their sulphide equivalents will occur down plunge.

In a report dealing with the mineral prospects of the Petermann Ranges, Professor Wilson has discussed the relationships of the gossans to the schist, possible sedimentary features within the gossans and the geochemistry of the gossans. Some additional samples of gossan
material were collected for petrological study and chemical analysis, but apart from obtaining structural data over the gossans, there was not sufficient time to examine the outcrops in greater detail than Professor Wilson.

The appended geological map includes the alphabetical notation of the gossans as used by the original prospecting party, but for other gossans found during the present survey and including the sandy varieties, notations have not as yet been given.

Specimens of the massive gossans (D, E and P) in thin section are seen to consist of concretionary aggregates of well crystalline haematite and remnants of quartz grains which have been incompletely replaced. Veins of haematite are clearly seen crosscutting and crystallising along fracture planes of the quartz. The vein haematite occurs as fine grained aggregates and develops (on a micro scale) the typical concretionary form of botryoidal haematite. The coarse grained crystals of haematite up to 2 mm x 2 mm are blood red in colour and show an apparent micaceous parting. Many crystals are curved suggesting deformation during crystallisation. Several remnants of what appear to be magnetite are present in gossan D (specimen 500) but no boxwork structures of any sulphides were noticed.

The sandy gossans (J and other outcrops to the south) called "false gossans" by Professor Wilson contain a greater proportion of quartz relative to haematite and limonite than the massive gossan outcrops. Muscovite forms up to 10% in some specimens but in all it tends to be partly replaced by haematite or limonite, particularly along the muscovite cleavage planes. Tourmaline is an occasional accessory mineral. There is no massive or vein replacement of the micaceous quartzite by haematite, the iron oxide typically occurs along grain boundaries.

It is probable that the gossans represent sedimentary ore-bearing intercalations in the schist, and that the differences in iron content
are a reflection of stratigraphic and structural effects. The concentration of the ore of the oxidised zone to the fold closures of antiforms and recumbent folds serves to emphasise the structural control and there is little reason to doubt that this control will also occur at depth.

As an alternative suggestion the gossans may represent vein deposits of ore introduced later than sedimentation of the Pinyinna Beds and that during folding migration of the ore to favourable horizons took place. This alternative would explain the presence of the massive gossan P outside of the Valley and to the east of the Dean Quartzite.

ADDITIONAL GEOCHEMICAL DATA

The main purpose of the analyses carried out by Geochemical and Mineralogical Laboratories Pty. Ltd., was to compare the metal values of the massive haematite gossans with those of the sandy gossans. Additionally two specimens of iron-stained schist associated with the massive gossans and two specimens of normal (unmineralised) sericite schist were analysed.

The analytical data are presented in Table 1 and may be compared with the data of Table II which gives the average metal values of the massive gossans (Professor Wilson Report). Of the new analyses two specimens were collected from similar localities as Professor Wilson, specimens 500 and 505 from gossan D (Table 1) appear to have come from the same outcrops as 182 and 178 of Professor Wilson (A.F.W. Table 10). Considering the range of metal values found in gossan D it is not surprising that there is a lack of correlation between supposedly similar specimens. It will be noted that specimen 507, an iron stained sericite schist adjacent to the gossan, contains lower metal concentrations than the gossan, and that this decrease is continued in to the unmineralised sericite schist (specimen 511, 100 yards east of gossan D).

Specimens AL1, AL2 and AL3 are from gossan P which lies to the east of the valley and for which no results have previously been available. Copper,
<table>
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<tr>
<th>Sample</th>
<th>Description</th>
<th>Cu</th>
<th>Pb</th>
<th>Zn</th>
<th>Co</th>
<th>Ni</th>
<th>Bi</th>
<th>Ag</th>
<th>Au</th>
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<td>30</td>
<td>33</td>
<td>37</td>
<td>42</td>
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<td>332</td>
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<td>121</td>
<td>50</td>
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<td>505</td>
<td>GOSSAN D</td>
<td>73</td>
<td>41</td>
<td>107</td>
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<td>61</td>
<td>50</td>
<td>2</td>
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<td>23</td>
<td>13</td>
<td>11</td>
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<td>15</td>
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<td>414</td>
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<td>32</td>
<td>17</td>
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<td>32</td>
<td>13</td>
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<td>AVERAGE ALL GOSSANS</td>
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<td>105</td>
<td>49</td>
<td>77</td>
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lead and zinc are significantly lower than for the gossans within the
Opera House Valley and if these results are typical of gossan F, it would
suggest a difference between this gossan and those of the Opera House
Valley. It is possible however that variations in ground water pH,
climatic aspect and rate of erosion are factors which could affect the
leaching and secondary deposition of metals within the oxidised zone of
sulphide mineral deposits.

Specimens 239 (gossan J), 384, 386, 414 and 425 were collected from three
sandy gossans. Copper varies considerably between samples, with lead
and zinc showing less variation. Lead in 386 is higher than in most of
the massive gossans as is bismuth. By comparison, 415, a specimen of
normal schist, is fairly high in metal values, particularly copper.

It would appear that the spread of metal values obtained from the several
gossans make only the broadest generalisations possible. Copper, lead,
zinc, cobalt, bismuth, silver and antimony are highest in the massive
gossans, they decrease in the sandy types and as to be expected are lowest
in the unmineralised schist. Because of the very manner of formation of
a gossan, namely by leaching of sulphides below the water table and their
redeposition as metal oxides in the oxidised zone, much of the more soluble
metal salts such as copper, lead and zinc will be lost so that metal
values in a gossan are at best only an indicator of the underlying
mineralogy and give no indication of grade.

The significant contribution of the geochemical results so far has been
to establish the fact that trace amounts of copper, lead and zinc are
present in the gossans which consist principally of iron and manganese
oxides. Other prospecting methods must now be used to establish the
presence of ore bodies at depth.

STRUCTURE OF THE OPERA HOUSE STRUCTURE

Preparation of section
The section has been prepared by projecting geologically significant points
parallel to the fold axis on to a single section plane (Section 2000N)
located immediately south of the mapped area.

The section for each section line is identical to a portion of adjacent sections by virtue of the construction. Instead of drawing several sections therefore the one has been drawn with the different ground surfaces for each section line represented.

All projected points have been corrected for height.

The line of points 2000N - 17000W represents the position of points of RL5000 lying on co-ordinate 5000 ft. east at 0 to 15000 ft. north of Section 2000N.

Reliability of section

Interpretation of fold geometry consists of projecting data observed at the surface below ground level. To do this successfully the projection must be in a direction which does not change.

If a fold is ideally cylindrical (i.e., the fold axis is straight and is the linear generator of the fold) its profile (section perpendicular to its axis) does not change, so that the shape as seen at point A may be projected parallel to the fold axis to point B. This is the only reasonable basis for interpretation in folded areas, since projection in any other direction requires a knowledge of the rate of curvature of the folded surface in the direction of projection. This information is not normally available.

The accompanying sections have been produced by projecting data recorded at the surface down a fold axis plunging 11° - 198°. Reliability of the section is dependent on: (1) The folds of the area approximating closely to the ideal cylindrical model. (11) Correct identification of the plunge of the fold axis.
(1) Orientation data has been collected for lithological layering throughout the area by Dr. Shaw and Mr. Williams. This is plotted stereographically* in Figure 1 and the diagram indicates that folding approximates very closely to the ideal model. Various portions of the area have been plotted separately and the departure from the Ideal is as great in the small areas as in the total area. No greater approximate to the ideal can be achieved, therefore, by dividing the area into small domains.

(11) The plunge of the statistically defined fold axis has been determined by plotting all the minor folds and lineations recorded in the area. They are known to belong to at least two generations of folds, but since these generations are believed to be coaxial (cf. mesoscopic geometry) the statistical norm defined by this diagram (Figure 2) is believed to represent the plunge of the overall structure.

The writers are of the opinion, therefore, that the reliability of the section is reasonably high. However, local deviation may be expected and accuracy will decrease downwards in each section. Furthermore, projection of the gossans is speculative, but if they do persist in three dimensions it is believed that persistency parallel to the fold axis is most likely. While it is unlikely that each lens persists the full length of the area, it is believed that the projection of the lenses outlines an area in which the gossan-forming material can be expected to occur.

Dips cannot necessarily be taken from a section and correlated directly with dips on the ground since the section does not represent all the minor folds.

*All details plotted on an equal area net.
PLUNGE OF FOLDS IN GOSSAN

7 Points
There are two outcrops of quartzite occurring in the Pinyiana Beds isolated from the Dean Quartzite. These outcrops may be lenses of quartzite in the Pinyinna sequence or they may be bodies of Dean Quartzite. If the latter is true then those bodies represent irregularities in the structure, that is the structure must deviate from the ideal synclinorial model. Such deviation is to be expected locally.

**Mesoscopic structure**

Mesoscopic analysis is made difficult by the shortage of good outcrops of schist. It is difficult to distinguish different generations of folds in the quartzites.

Three groups of folds were recognised. One (B₁) is isoclinal (Figure 4a and 4b) and appears to have a slaty cleavage developed parallel to its axial plane. The other two groups (B₂ and B₃) are less tightly compressed (Figure 4a and 4b) and appear to have a strain slip cleavage parallel to their axial plane. All three folds have the same plunge and it is parallel to the quartz rodding prominent in the area. Orientation of the B₁ axial plane is very variable. The B₂ axial plane dips at moderate angles to the west while B₃ dips at shallow to moderate angles to the east.

B₂ and B₃ both fold the B₁ axial plane which they must therefore post date. B₂ and B₃ were never found together and their relationship is therefore unknown. They may be a conjugate pair resulting from a single deformation.

The significance of the mesoscopic observation is that the large scale fold geometry can be expected to be complex in profile but constant parallel to the fold axis. This is borne out by the geological section and the statistical data in Figures 1 and 2. The similarity between Figure 4a and the section is striking.

The presence of three groups of folds means that "drag folds" cannot be used in the normal way for determining facing. For instance, in Figure 4b, B₃

**Smaller scale** lenses of quartzite are fairly common in the Pinyiana Beds.
Mesoscopic Folds in Pinyinna Beds
would indicate that one is on the west limb of an anticline while B3 would indicate that one was on the lower limb of an anticline overturned to the east.

At the head of the valley at point A on the geological section, small scale isoclinal folding is common and is rather complex. Both of these facts are compatible with this area being the closure of a large scale B, fold which has been refolded by later deformation. Two folds seen in section in this outcrop are completely closed (Figure 4c) and in three dimensions they are found to be very tight dome or basin structures (Figure 4d). The folded layer in both cases is quartz and could be vein quartz. The structure may not be representative, therefore of folds in bedding.

**Macroscopic geometry**

From the point of view of drilling, the structure may be thought of as a simple rod plunging $11^\circ$ to $193^\circ$ with a cross-section as shown in the geological section.

The structure can be interpreted in two ways (Figure 5). In (a) it is a syncline with the schists terminated by a thrust sheet. In (b) it is interpreted as an antiformal syncline. The writers favour interpretation (b) for the following reasons:

(i) Small scale $B_1$ folds are common at A (Figure 5a) as would be expected in the closure of a large scale $B_1$ fold.

(ii) No evidence was seen of the large scale thrusting required by (a).

(iii) Large $B_1$ folds were found in the contact of the Dean Quartzite with basement. These folds are represented diagrammatically in Figure 5b and it can be seen that their asymmetry is compatible with an antiformal structure rather than a synform.
POSSIBLE INTERPRETATIONS OF THE BUTLER DOME STRUCTURE

LEGEND

- Pinyinna beds... shown thus...
- Dean Quartzite
- Basement
(iv) Outcrop of Dean Quartzite has a general V-shape opening to the north. This outcrop pattern is difficult to explain in terms of a syncline in view of the southerly plunge.

There remains the possibility that the structure is that of a tight basin as in the small scale fold in Figure 4d. However, there is no evidence for this interpretation in the area mapped.

Structure of the Gossans

A poorly developed layering is visible in the gossans. It is folded and the folds have the same plunge (Figure 3) as the folds in other rock types. This suggests that the gossans are concordant with the layering in the country rock.

If the gossans are concordant, it appears that they occur in two layers (cf Geological section). The two layers may represent opposite limbs of the same structure. The westernmost layer is richer in iron and manganese than the other. The gossan which forms the easternmost outcrop on Map No. 2 is in basement rocks. This outcrop has the same appearance in hand specimen as the gossans in the Pinyinna Beds. If it has the same origin and they are all gossans, the simplest interpretation would be that the gossans represent vein deposits.
RECOMMENDATIONS

As discussed with Mr. Graham Brown and Professor Kilson, the writers recommend shallow drilling to test the nature of the gossan-forming rock at depth. If these holes prove that the gossans have weathered from sulphide bodies and the grade is sufficiently high to maintain interest, then it is recommended that deeper holes be drilled to test the full mineralised zone. It is suggested that a line of vertical holes be drilled from a section 6000N between co-ordinates 5000E and 3800E to depths of between 2000 and 3000 f.

The writers are of the opinion that any further work in the area designed to explore surface extent of the Pinyinja Beds would be best carried out by surface mapping. The necessary structural analysis is not possible from aerial photographs. The most economical approach would be to map the area on enlargements of the present photographs. These would offer adequate area control; height control could be achieved by the use of an altimeter.

It is considered that further photographic work would be of no value since structural interpretation of the photographs is not possible and the identification of gossans is more economically and readily carried out by an observer from a light aeroplane.

Work carried out on gossans D and E so far has been only of a preliminary type. It appears that there is a plunge reversal, and it is recommended that further surface mapping be carried out in the immediate vicinity to verify if the plunge reversal is a local or general feature of the area before drilling is carried out.
REFERENCES


WILSON, A. F., 1966 - A geological report on the mineral prospects in the vicinity of the Petermann Ranges, Northern Territory, as prepared for Planet Mining Company Pty. Ltd. (unpubl.).
Northern approach to the Opera House Valley looking south-west. The large hill is a recumbent fold of quartzite (closely to the left) and is underlain by basement Olia gneiss.

Looking west across Opera House gossan and old mine workings from approximately (4500, 16000).
Co-ordinates (2220, 2950). Looking north-east across Opera House Valley and towards the Olgas (left centre) and Ayers Rock (faint blue, right centre). Foster Cliff is to the left.

Co-ordinates (1210, 3050). Looking south-west. The base of the Cenozoic rocks that lie on the surface is shown here. In the foreground is a part of the older (Triassic, Jurassic) rocks.
Co-ordinates (3090, 10230). Looking west at the Dean Quartzite on the western side of the Opara House Valley showing roding of quartz plunging south at 14° and the foliation dipping 78° in 98°.
BLOCK DIAGRAMS OF BUTLER DOME AREA NORTHERN TERRITORY

Diagrams are orthographic projections and both are drawn to the same scale. In diagram (a) the gossans and the contact between Bonan Quartzite and Pinyine beds are represented. Present topography has been ignored in this diagram. Diagram (b) gives the topography and general structure of the area but does not show the gossans except in outline.

LEGEND

Gossan
Pinyine beds
Bonan Quartzite
Basement

In diagram (a):
- Mapped contacts and geological contacts based on down plunge projection of mapped contacts.
- Interpretive geological contacts based principally on down plunge projection of contacts occurring outside the area of accurate mapping. Such contacts were mapped approximately on aerial photographs.

Note: It is improbable that the gossan forming material persists as continuous bodies for the full length of the area as shown. However, the gossans are projected as such since their distribution is believed to delineate a zone in which elongate pods of the gossan forming material may be expected to occur.