1949/34
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COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF SUPPLY AND SHIPPING.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

REPORT No. 1949/34
(Geol. Ser. No.17)

INTERIM (1948) GEOLOGICAL REPORT

TENNANT CREEK GOLDFIELD

NORTHERN TERRITORY

by

J.F. Ivanac
N.H. Krasenstein Geologists

CANBERRA A.C.T.

9th June, 1949.

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

DRAFT

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INTERIM (1948) GEOLOGICAL REPORT

TENNANT CREEK GOLDFIELDS

NORTHERN TERRITORY

Report No. 1949/34
(Geol. Ser. No. 17)

INTRODUCTION.

The Tennant Creek Gold Field lies between the 19th and 20th parallels of south latitude and on either side of the 134th meridian of longitude; it covers an area of approximately 2,000 square miles.

The Tennant Creek township is situated 313 miles north of Alice Springs. The Stuart Highway, which is the main connecting link between Alice Springs and Darwin, passes through the centre of the town.

The population of the Gold field is in the vicinity of 600, of whom 174 are actively engaged in the mining industry. The majority of those engaged in mining are employed by Eldorado Gold Mining Co., by Gold Boring and Prospecting N.L., and by the Australian Development Company, Northern Star. The remainder are owners of small prospecting leases.

Active exploitation of the lodes did not commence until as late as 1932 and since that time the field has known varying fortunes.

Geological investigation by the Bureau of Mineral Resources Geology and Geophysics commenced late in July, 1948, and continued until the end of October of that year.

The objects of the survey were:-

(a) To lay the foundation for future detailed studies of the mining field.

(b) To study the factors controlling ore localization.

(c) To assess the quantity and value of ore exposed to date.

(d) To estimate the potential value of the field.

In the search for ore bodies, a knowledge of the geological factors can be of great assistance, and it is felt that

the information given in this report and in the accompanying plans should be of considerable help in this respect. However, the prospector's methods - loaming, dollying, panning etc. are still quite fundamental to success in a prospecting field such as Tennant Creek and the suggestions made in this report are intended to supplement this type of work.

Information previously collected concerning the Tennant Creek field is contained in a geological report by Dr. W. G. Woolnough (1935) and in magnetic prospecting reports by J. H. Rayner and P. B. Nye (1936), by L. A. Richardson, J. H. Rayner, and P. B. Nye (1936) and by L. A. Richardson and J. H. Rayner (1937). H. B. Owen (1940) assembled much valuable geological information and C. J. Sullivan (1942) and C. L. Knight (1947) have described individual mines. L. C. Noakes and D. H. Traves, in the course of a general survey of parts of the Northern Territory, have established stratigraphic relationships which have a considerable bearing on Tennant Creek geology.

In the present investigation all of the above work is being freely used and its value is hereby acknowledged. The correct references are listed at the end of this report.

II. CLIMATE AND TOPOGRAPHY

Tennant Creek lies in the semi-arid region of Central and Northern Australia. It is, therefore, in the region of summer rainfall which averages 14 inches per annum, and generally falls between the months of December and February. Summer temperatures range up to 115°F; in winter temperatures seldom fall below 55°F. The prevailing wind is a south-easterly, but northerly and westerly winds blow during stormy periods.

The relief of the Tennant Creek district is low. Mt. Samuel, the highest point, rises to a height of 300 feet above the general level of the plain. The average elevation of the flat-topped, sub-parallel lines of hills, which form the MacDonnell Ranges, the chief topographic feature of the area, is about 200

feet above that of the alluvial plains. The bottoms of valleys which separate these low ridges are flat and featureless, the sides of the valleys rise very gradually until they encounter the steep (breakaway) sides of the ridges and mesas.

There are no well defined or permanent streams, as the region is one of low rainfall, and internal drainage.

Soil Types.

III. VEGETATION

Plant types and communities are typical of the semi arid to arid conditions prevalent at Tennant Creek. These plants include spinifex (Triodia and Plectrachore), mulga (acacia aneura), snappy gum (Eucalyptus pallidifolia), ghost gum (Eucalyptus papuana) and the tall white-barked tree (Eucalyptus comaldulensis). In addition there is a wide variety of flowering plants and shrubs, wattles, mallee, grevillea, and field grasses.

Sparse vegetation of Py masses.

IV. GOLD PRODUCTION

Mining operations commenced at Tennant Creek in 1933. The yearly production figures, which have been obtained from Administrators' reports on the Northern Territory and from Government Battery records, are listed below:-

Year ending 30th June	Long Tons	Gold Ozs.
1933	-	-
1934	63.0	425.
1935	2297.35	2983.42
1936	7092.0	8468.66
1937	9849.6	8400.0
1938	14,118.53	9138.80
1939	6538.69	5897.92
1940	11,435.88	13844.547
1941	24,732.137	15,406.827
1942	26,908.0	15,760.0
1943	7,737.5	6,065.5
1944	5,395.0	3,451.84

Year ending 30th June	Long Tons	Gold Ozs.
1945	5,156	7,147.16
1946	4,933	4,615.33
1947	9,308	9,930.0
1948	14,221.94	14,478.0
1949	16,614.00	27,522.0 ozs.
	149,786.6	126,002.7

These figures show that the average gold recovery per ton is 16.8 dwts. The actual gold content of the ore is somewhat higher because most of the sands from battery crushings have not been treated.

Gold Mining Companies and Prospectors endeavour to keep the grade of the ore, at least as high as 10 dwts. per ton because of the following reasons. Eldorado costs £ 10.15.0/ton

(1) High cost of production:- The production cost of the Eldorado Gold Mine is reported to be £4.12. 6 per ton of ore.

(11) Lack of suitable timber:- Sticks of timber twelve feet long and six to eight inches in diameter cost about 18/- each, delivered at the mine, because they have to be transported a considerable distance.

(111) Inferior Water Supply:- Most of the water used in mining comes from bores. Those bores which are sunk in slate country, are invariably salty. Potable water has to be carted from the town bores at the Old Telegraph Station, and the usual cost is 7/- per hundred gallons.

Present day drilling cost for water is about 32/6 per foot.

(1V) Unsuitable climatic conditions:- High summer temperatures (up to 115°F), dust, and flies tend to decrease the efficiency of the workers.

(V) Sporadic nature of the mineralization:- Though some of the ore gives very high assays, the mineralization is nevertheless sporadic. Some prospectors have been reduced to sampling every

High diamond drilling cost.

skip of ore hauled to the surface.

Surface percussion bores - new section

V. GENERAL GEOLOGY

The general geology of the Tennant Creek goldfield was briefly examined, but as yet, no general geological map has been produced.

The petrographic appendix contains detailed descriptions of rock specimens collected in 1948.

For the purposes of discussion the rocks may be divided into the following groups:-

(1) Warramunga "Series"
(2) Ashburton Sandstone (Noakes & Traves, 1948)
(3) Cambrian Sediments
(4) Granitic rocks
(5) Porphyry
(6) Quartz-hematite
(7) Quartz veins
(8) Cambrian lavas
~~(9) Laterite~~ new sect.

Warramunga Series:- The oldest rocks on the field belong to the Warramunga series, a sequence of interbedded sedimentary rocks which have been gently folded. The sediments are mainly tuffaceous sandstones, grits, slates and shales which outcrop over an area of approximately 2,000 square miles.

Rapid changes in lithology are common both along the strike and down dip. The dip of the bedding is on the whole, gentle, but dips of up to 75 degrees are found in places. Previous investigators, Woolnough (1935), Owen (1942, p.10) and Knight (1947, p.2) have commented on the strongly developed cleavage, which tends to obscure the bedding. This cleavage may have developed concurrently with the folding of the Warramunga sediments.

Structure

The exact age of the Warramunga series is uncertain. Woolnough (1935) and Noakes (1948) have ascribed the rocks to Lower Proterozoic while Owen (1942, p.10) suggests that they are

either Archean or Proterozoic. This matter will be further investigated during the course of the present survey.

(2) Ashburton Sandstones (Noakes & Traves, 1948)

Quartzites and sandstone outcrop on the northern margin of the field, and have been reported 1½ miles south-east of the Rising Sun Gold Mine (Owen, 1942 p.9). Conglomerate underlies the quartzite.

Neither of these two areas has been examined by the writers, so that at present no estimation can be made of the thickness of the beds present, nor can their relation to the underlying Warramunga series be established.

Owen (1942, p.9) tentatively suggests that the rocks are of Proterozoic Age and this may well be so.

(3) Cambrian Sediments. Fossiliferous Cambrian sediments outcrop 1 mile east of the Blue Moon Gold Mine and continue to the north as a line of low, gently rounded ridges. The sediments, which overlie basaltic lavas are mainly cherts and sandy rocks which dip very gently northwards. Fossils recorded by Dr. Opik were trilobites Xystidura and Redlichia, several species of brachiopods, and the mollusc Hyalitus. The only record of thickness is from 1 mile east of the Blue Moon Gold Mine where the maximum thickness of sediments is 55 feet.

These rocks may be referred to the top of the Lower Cambrian and to the bottom of the Middle Cambrian.

(4) Granitic Rocks. Two large outcrops have been noted in the centre of the field, and Owen (1942, p.12) reports another mass of unknown extent six miles south of Mt. Samuel.

The granite is a reddish, even grained rock composed of acid plagioclase, microcline, quartz, muscovite and chlorite.

It is probable that the two large outcrops, north of the town, link up below the soil cover. Owen (1942, p.12) supports this assumption. Field investigations this season should throw more light on the distribution of the granitic rocks.

Owen (1942, p.12) records a biotite - granite from the Gosse River, on the eastern edge of the gold-field. The relationship between this occurrence, and that of the granite north of

the Tennant Creek township, is unknown.

(4) Porphyry. Quartz felspar porphyry dykes and sills occur in numerous localities on the goldfield and have been observed in close proximity to some of the gold mines. A porphyry apophysis ends a few hundred yards west of the line of quartz-hematite lenses in which the Wheal Doria mine is situated.

The age of the porphyry is uncertain but the porphyry is probably related to the granite which is younger than the Warramunga Series.

(6) Quartz-Hematite: The quartz-hematite bodies generally consist of intergrowths of quartz and hematite. Woolnough and Owen have described them at length, and detailed petrographic data concerning some of the masses examined by the present writers has been recorded in the appendix.

The quartz-hematite bodies probably represent residual magmatic fluids, which may have derived their origin from either the granite or porphyry intrusives.

The quartz-hematite deposits have the following structural characteristics:

1. They are markedly lenticular in shape both along the strike and down the dip.
2. They are mostly formed in brecciated zones which are aggregated into "lines" which have an east-west trend.
3. Localization of quartz-hematite bodies may have taken place along the more gently dipping portions of flat thrusts. En echelon fracture systems formed in favourable sedimentary horizons appear to have had important localizing influence.
4. Tension faults closely connected with flat thrusts may have been the guiding channel for ore solutions.

(7) Quartz Veins and Jasper Lenses. Quartz veins form long ridges trending across the country for distances up to ten miles. None of these larger bodies have been mapped in detail. They intersect most of the Pre-Cambrian rocks both sedimentary and igneous. Small quartz-tourmaline veins have been mapped on the Great Eastern Gold Mine Leases.

Jasper lenses and veins occur in close proximity to the porphyry masses and were probably formed by the silicification of country rock by the intrusives.

(8) Cambrian Lavas. One mile ~~west~~ east of the Blue Moon Gold Mine, pillow lavas of Cambrian age were observed. These lavas are highly weathered and lateritised basalts, and overlie the Warramunga series unconformably.

Near Gum Ridge Trig, in this locality, the maximum thickness of the lavas was observed to be about 45 feet.

(9) Laterite. Lateritisation of the whole Tennant Creek Area took place in Tertiary times, when probably moist tropical conditions prevailed and the land surface was comparatively flat. Intensive leaching of the various rock formations resulted in the formation of laterite.

Steep-sided residuals capped with ferruginous zone laterite are common in the area. Remnants of the pisolitic ferruginous zone have been observed on the Whippet Gold Mine leases, and near Mt. Samuel, 3 miles south of Tennant Creek.

VI. GOLD DEPOSITS.

The gold deposits of the area may be described under two headings:

(A) Lines of lode.
(B) Individual deposits.

A. Lines of Lode.

The mineralized zones are aggregated into "lines" which have a roughly east-west trend. Several of these lines outcrop on the gold-field and two of them were

examined.

1. Eldorado-Enterprise Line.

2. Mt. Samuel-Skipper Extended Line.

1. Eldorado-Enterprise Line.

This line is well marked by a series of disconnected steeply dipping quartz-hematite "blows". The mapping of the sediments carried out to-date is not sufficiently complete to reveal the full relationships, but it shows that along this line, the beds have been thrown into a number of minor folds where axes trend east-west, and which in most instances, pitch north or south at angles of 10 to 30 degrees. The Eldorado group of quartz-hematite masses are associated with a dome-like structure.

The ore-line as a whole, is parallel to the axial plane of the folds, but the individual quartz-hematite deposits, tend to strike at an angle to the fold axes; in many instances, they appear to fill minor en echelon tension faults branching from major axial plane faults or shears.

2. Mt. Samuel-Skipper Line. Conditions are similar here except that there are two well-defined lines; one extends between the Hammerjack Mine and the Southern Cross and the other from the Arcadia to the Skipper Extended. The limiting factors of the former line are beds of sandstone which appear to pitch into the main shear line. The general dip of the folded sediments appears to be to the south on the southern side and to the north on the northern side.

The rocks are interbedded shales, slates, sandy slates and tuffaceous sandstones of the Warramunga Series.

B. INDIVIDUAL DEPOSITS

Below are descriptions of the individual mines examined to date. The interpretations given may be modified as a result of work to be undertaken during the forthcoming field season.

1. ELDORADO GOLDMINE

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Plate E3, NT 1A-6	Geological Plan, 100' Level	1" = 10'
Plate E4, NT 1A-7	Geological Plan, 150' Level	1" = 10'
Plate E5, NT 1A-8	Geological Plan, 200' Level	1" = 10'
Plate E6, NT 1A-9	Geological Plan, 300' Level	1" = 10'
Plate E7, NT 1A-10	Geological Plan, 330' Sub Level	1" = 10'
Plate E8, NT 1A-11	Geological Plan, 400' Sub Level x	1" = 10'
Plate E9, NT 1A-12	NE SW Cross Section along Line EF	1" = 20'
Plate E10, NT 1A-13	NE SW Cross Section CD through Central Stope	1" = 20'
Plate E11, NT 1A-14	Section Along line AB	1" = 50'
Plate ES1, NT 1A-15	Eldorado-Mt Samuel Line Preliminary Structure Plan	4" = 1 mile
Plate Es2, NT 1A-16	Eldorado-Mt. Samuel Area Contours of Vertical Component of Magnetic Field.	1" = 200'

ELDORADO GOLD MINE

A. INTRODUCTION

The Examination of the Eldorado Gold Mine was carried out as part of geological field work during the 1948 field season. It was undertaken with the object of determining the geological features, which led to the emplacement of the ore and to suggest a possible relationship between the present mineralized area and the magnetic anomalies discovered by the Aerial Geological and Geophysical Survey of Northern Australia in 1936, (Rayner and Nye, 1936; Richardson and Rayner, 1937).

B. SITUATION, ACCESS, TREATMENT

The Eldorado Gold Mine is situated approximately 3½ miles south of the Tennant Creek township.

The mine is approached either by a gravel track which runs direct from the town to the mine, or by following the Stuart Highway southward for about three miles, and then turning eastwards along a graded track for about a mile and a half.

The Mine has its own battery treatment plant, which is operated for about eight hours per day. A cyanidation plant has been erected on the lease but has not yet been used for ore treatment.

The mine is managed by Mr. H. Thomas.

C. HISTORY, PRODUCTION, WORKINGS.

The Eldorado deposits were discovered in 1932 but large scale production did not commence until 1934.

In the years of 1935-36 the Aerial Geological and Geophysical Survey of Northern Australia conducted a geophysical survey of the Eldorado and adjacent leases. Three major anomalies were found (see Plate 12) in close proximity to the Eldorado Gold Mine, (Rayner and Nye, 1936).

The recorded production from the mine is shown below in Table I :-

TABLE I.

TABLE I.

Date	Tonnage Long Tons		Gold Won fine ozs.		dwts/ton
July 1934 - June 1935	489		275		11.2
" 1936 - June 1937	3914		2160		10.8
" 1937 - June 1938	5834		2663		9.1
" 1938 - June 1939	3349		2131		12.8
" 1939 - June 1940	6702	6681	3350	3349	11.5
" 1940 - June 1941	7966	7945	4631	4632	11.6
" 1941 - June 1942	8355	8355	4945	4946	11.7
" 1942 - June 1943	6017	6037	5264	5279	17.5
" 1943 - June 1944	5395	5385	3452	3497	12.8
" 1944 - June 1945	5121	5121	7126	7172	27.8
" 1945 - June 1946	4911	4844	4532	4520	18.4
" 1946 - June 1947	6056	6534	5242	5646	16.8
" 1947 - June 1948	8103	6188	5133	4424	12.6
Total	72,212	5148	51,354	3092	14.6
	548	75,682		3892	

48/49 The ore deposits have been worked from an opencut and from underground workings. 75,682

4
50594
53696

The open cut (Plate 1) is 150 feet long, 35 feet wide and approximately 50 feet deep. Ore was extracted from two-thirds of the opencut, while the material obtained from the other third was used for stope filling.

Several shallow pits, Nos. 2, 3, 4 (Plate 1) have been sunk to depths of 15, 6, 5 feet respectively. All of the long, narrow costeans except one (Plate 1) were used in the early exploration of the deposits and have been covered with superficial material.

No. 1 shaft, from which all of the ore is hauled to the surface, has been sunk to a depth of 300 feet. It is a three compartment shaft, 10 feet long 6 feet wide. Development underground has been carried out by driving at the 50, 100, 150, 200, and 300 levels. (Plates 2, 3, 4, 5, 6). Winzes and rises connect the drives and serve as manways and ore-chutes.

A winze 100 feet in depth, has been sunk from the 300 foot level (Plate 6), and levels from this winze were driven at 30 feet (Plate 7) and 100 feet (Plate 8) below the collar.

All ore is now hauled to the surface through the main shaft (No.1) and is then tipped through a grizzly, into a cracker, from whence it is conveyed by rubber belt to battery stamps and treatment plant.

P. 3 is missing from the hardcopy of record 1949/34.

The exploitation of the ore has necessitated over 3000 feet of driving. The workings are in good condition, and the ground "holds" exceptionally well. Timber is used only in the main shaft, winze collars and stope chutes.

Ventilation is not a great problem as the 50 and 100 foot levels are connected to the opencut which allows for an effective downdraught of air. The east stope also reaches the surface east of the open cut.

D. GEOLOGICAL SETTING

The Eldorado Gold Mine is situated on an east-west trending ridge which falls steeply to the south of the mine and grades gently into the 'bulldust plains to the north.

Rock exposures in the close proximity to the mine have been partly concealed by superficial material.

The main rock types are interbedded medium and fine grained tuffaceous sandstones, blocky well bedded slates and pink slates.

The ferruginous zone of lateritization is evident at the surface. This laterite is believed to be of Tertiary age, and indicates that the Tertiary land surface was extremely close to the present surface.

The most marked zone of weathering in country rocks extends to 250 feet below the surface and not to the present water table which is some distance below this.

E. ECONOMIC GEOLOGY.

(a) AURIFEROUS DEPOSITS.

The lode consists of quartz-hematite bodies of varying size surrounded in part by a hematite-rich slate breccia. Because of their large size, the quartz-hematite bodies occurring on this lease, attracted very early attention. The largest body is 60 feet long and averages 30 feet wide, while the smallest is 10 feet long and 2 feet wide.

These bodies vary from hard massive rock consisting of quartz, hematite and jasper in varying proportions to a soft type with hematite, brownish kaolin-like material and muscovite. The

ironstone bodies are not confined to a selected sedimentary horizon at the surface (Plate 1), but lie in both slaty and sandy facies. They are mostly associated with a brecciated slate in depth. Gold does not occur in any large quantity within the massive quartz-hematite bodies ("ironstone") though auriferous ironstone has been mined on the 100 foot level. Most of the gold occurs in a crush zone which links the quartz-hematite deposits.

At the surface, the crush zone is mottled yellow, red and brown in colour, and contains quartz veins and quartz-hematite stringers.

The underground workings show that the gold-bearing lodes consists of crushed slate which within the oxidized zone at least, has been highly kaolinised and contains numerous massive quartz-hematite segregations as well as ramifying quartz veinlets and dense, black quartz-hematite. The outline of the mineralized zone is funnel-shaped and tapers down-pitch to the north-east.

A considerable amount of manganese oxide is present, but the patches of this material are very sporadic in occurrence. Limonite occurs in some parts of the ore, and is an indicator of high values. Muscovite is present in most ore samples and appears to be associated with an early period of quartz injection. This quartz shows the effects of strain while later quartz is comparatively free from distortion.

The gold-bearing lode has been mined in three places:-

(i) East Stope

(ii) Central Stope

(iii) West Stope

(1) <u>The East Stope</u>

Plate 9 shows the general outline of the East Stope, which has been worked on the 100, 200 and 300 foot levels. The stope is divided into two sections, the south-western portion and the north-eastern portion which are separated by the Thomas fault. On the 100 foot level, the south-western Section of the orebody is 35 feet wide and 52 feet long which would yield approximately 180 tons per vertical foot. This part of the East lode extends from the surface to about 10 feet above the 200 foot level.

25 (assay end)

The ore boundary is determined to the west by the ~~Exxit~~ Pug Seam fault (plate 3) and to the north by the Thomas Fault (the latter forming the hanging wall). The southern and eastern limits of stoping are determined by economic limits

The north-eastern portion of the ore-shoot (plates 5 & 9) has its maximum dimensions on the 200 foot level where it is 40 feet wide and 50 feet long, and averages approximately 180 tons per vertical foot. It is bounded to the west and south by the Pug Seam and Thomas faults. respectively. The ore gradually decreases in value to the eastward and northward. This part of the lode overlaps considerably on the south-western shoot. It originates (about 35) just below the 100 level (Plate 9), and continues as an uninterrupted pipe to the 300 level, where the orebody splits into several channels. The high-grade ore also leaves the Thomas fault at the 300 level and follows Fault B, (Plate 9), which follows the contact between the mineralized area and the country rock. Exploration of the East shoot at the 400 sub-level reveals that lenses and narrow channels indicative only of high-grade ore have continued, (and there is the possibility that the enriched zone may cut out completely.) delete rewrite more cautious.

not proved split in value character throughout

Present production on the Eldorado Gold Mine is solely from the north-eastern portion of the East Shoot.

(ii) Central Shoot.

/central

The shoot (Plate 10) was 80 feet long and 35 feet wide at the surface (Plate 1) but decreased to 50 feet in length and 10 feet in width at 100 feet below the surface. The change is due to the interplay of fault A and the Thomas fault.

A cross section of the ore shoot (Plate 10) shows that the high-grade ore continues from the surface to 10 feet above the 200 foot level. The boundaries of the orebody are determined to the east and west by the Pug Seam Fault and by Fault A respectively, and to the north by the 70 degrees dipping Thomas fault.

The orebody has an average width of 20 feet and an average length of 50 feet; thus it has yielded in the vicinity of 100 tons of ore per vertical foot.

(iii) Western Lenses

These have been worked in a number of irregular stopes which have yielded ore with very sporadic gold content. Part of the ore is in hard dense quartz-hematite and part is in much softer hematite-rich brecciated slate.

The ore shoot represents enriched patches, in the low-grade mineralized area, which lies on the western side of the breccia fault (Plate 3). Other smaller faults have also helped to localise the ore.

(b) STRUCTURAL CONTROL OF OREBODIES.

A study of the structure of the Eldorado deposit has revealed a number of localizing factors which partly help to explain the present ore deposit, and the significance of geophysical anomalies No. 1 and No. 2 (see Plates 11 and 12).

(1) Plate I shows that the quartz hematite bodies and the lodes are localised in northerly dipping interbedded slates and sandstones, which pitch 8 degrees E on the eastern side of the deposit and 8° - 10° west on the western side. Underground mapping of the country does not show the regularity of dip and strike of the surface outcrops, but tends to confirm that the sediments are broadly domal in structure.

(2) The orebodies are localized along tension faults (Plates 9 and 10) with which brecciated slates are associated. The tension faults are complementary to Fault B, a fault which varies in dip from 25 degrees on the 100 foot level to 55 degrees on the 300 foot level. (Plate 11). It appears that the tension faults branch most frequently from the more flatly-dipping portion of fault B.

The change in dip of Fault B may be due to the fact that on the 200 foot level it is confined to sandstones, while on the 300 and 400 it cuts through slates. Plate 11 shows a structural interpretation of Geophysical Anomaly No. 2 (Richardson, 1937). The section shows that the hematite causing this anomaly may have been localized by the downward continuation.

(3) A series of mineralized shoots may have formed along the sandstone-slate contact. Plate 12 shows a tentative explanation for Anomaly No. 1. This anomaly may have been due to replacement in a crushed zone caused by faulting along the sandstone-slate contact.

C. SECONDARY ENRICHMENT.

The gold content of the ore worked to-date is not considered to have been due to primary mineralization only, but to have resulted to a considerable extent from a process of secondary enrichment. This enrichment probably took place not only during the present cycle of weathering but may have been in progress since Tertiary times when the surface of the earth was very close to the present land surface. Lateritization, which formed the ferruginous zone (mentioned previously) noted on the leases of the Eldorado, is a process of extensive leaching under tropical conditions with high rainfall. Seasonal fluctuations of the watertable are very marked. These conditions would have facilitated secondary enrichment.

The zone of weathering in the country rocks extends to about 250 feet below the surface, where comparatively unaltered country rock is entered. This zone of weathering is independent of the present watertable which is about 100 feet below this level.

It is possible that the grade of ore will drop quite markedly, when the zone of intensive leaching and kaolinization is passed through.

However there is some hope in the fact that the brecciated zone which contains the orebodies is strongly leached at the 400 level on the Eldorado. It is not perfectly clear as yet what the relationship is between the strongly leached and weathered lode and the unweathered country rock into which it persists, but it is probable that the brecciated zones in which the lodes occur, have provided passage ways for the circulation of ground water during the present cycle of weathering.

F. PROSPECTS OF FURTHER DISCOVERY

It is suggested that the No. 2 Geophysical Anomaly

re check : present developm

which lies about 800 feet from the main shaft on a bearing a few degrees north of east, be investigated from the four hundred foot sub-level by means of diamond drilling (Plate 11). The hole would have to be at least 350 feet long, along a bearing north 28° East, and depressed 28 degrees. If payable material is located, the hole should be continued.

Another drill hole from the 300 foot level is suggested in order to test the No. 1 Anomaly. The collar of the hole would be at 10'N 3'E (Plate 6) and the hole should be at least 250 feet long, bearing 151 degrees magnetic, depression 5 degrees. Diamond drilling has already proved that this anomaly represents a mineralized body. It lies below the perched zone of weathering and hence, would not be expected to have been enriched by secondary processes.

exploratory stoping

not sufficient openings below 300' L. to test lode.

high grade shots sporadic no contour possible.

E shoot Central } probably bands ? Low grade.

2. WHIPPET GOLD MINE.

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LIST OF PLANS

A. SITUATION AND ACCESS.

The Whippet Gold Mine is situated approximately 30 miles by road north-east of Tennant Creek township and is reached by following the bituminized Stuart Highway for 23 miles north of Tennant Creek, and then following a gravel track which branches eastward from the main highway. The mine is approximately 7 miles east of the Stuart Highway.

The No. 1 Government Battery at which the ~~ore~~ ore is treated has been temporarily leased by the company. It is situated about 22 miles south-west of the mine.

B. HISTORY AND PRODUCTION.

The orebody was discovered in 1938 by J. English and partners who loamed around the small hematite outcrops shown on Plate I. Traces of gold were discovered in the present vicinity of No. 3 shaft (Plate 1) and this was the first working on the lease. The owners, however, did not consider the results of this work very

encouraging, although it is reported that they obtained ore up to 12 dwts. in grade at a depth of approximately 20 feet. The shaft now called No. 2 shaft (Plate 7) was then sunk and this intersected ore containing 1-2 ozs. gold per ton at a depth of some 35 feet from the surface.

The recorded production from the mine is shown on Table I below:

TABLE I.

DATE	ORE Long Tons	RECOV. BY AMALG. dwt/ton
July 1938-June 1939	40.42	24.3
39- 40	30.53	4.3
40- 41	55.08	5.1
41- 42	208.38	22.3
42- 43	153.79	50.1
46- 47	938.80	78.1
47- 48 ~~July~~	513.337	34.1
48- Dec. 48	807.55	61.7
TOTAL	2747.887 2309 5054	56.2

From this table it will be seen that the average recovery per ton by amalgamation has been 56.2 dwt. The ore contains up to 1 per cent bismuth oxide (Sullivan, 1942) and this has had an adverse effect on recovery by amalgamation. As shown in Plate 4, the past production has been obtained by selective mining, and there is no reason to assume that this grade can be obtained from the orebody as a whole.

In 1948 the property was purchased by a Melbourne company known as Gold Bearing and Prospecting, N.L., and this company has commenced to sink a three-compartment main shaft (Plate 1) and has also explored the known orebody at the 90 foot and 150 foot levels.

C. GEOLOGICAL SETTING.

The Whippet gold mine is situated in a very flat-lying area bounded on the east, west and south by low rounded hills. To the northward the topography is very flat.

Rock exposures are poor, and, as a result, the mapping shown on Plate 1 reveals only limited information.

The main rock types are slate and sandstone which are closely interbedded, though there is a suggestion that sandstone predominates to the north of the lodes and slate to the south. From underground mapping, it is seen that these rocks are folded, but the exact nature of the folding throughout the lease has not yet been determined, though it is probable that the regional mapping which will be undertaken in the forthcoming year will throw more light on this matter.

A notable point is that a small outcrop of laterite occurs to the southwest of No. 3 shaft (Plate 1). This laterite is believed to be of Tertiary age and indicates that the Tertiary land surface was extremely close to the present surface. This point will be discussed later in connection with the secondary enrichment of the ore deposit.

space

D. ECONOMIC GEOLOGY.

(a) MINERALOGICAL COMPOSITION AND DIMENSIONS OF LODES.

Two quartz-hematite bodies of the type generally associated with the gold deposits in the Tennant Creek area occur on the lease (Plate 1), and it was these that first attracted attention. The easterly body is 40 feet in length and averages some 12 feet in width. Three hundred feet west of this outcrop there is a second outcrop of quartz-hematite which is 140 feet long and may average 10 feet in width. These bodies are massive and appear to carry very little gold. The latter occurs in a crushed zone which, from underground mapping (Plates 2 and 3), appears to link the two outcrops of hematite. At the surface this crushed zone is mottled yellow, red and brown, and contains quartz and quartz-hematite stringers. The underground workings show that the gold-bearing lode con-

sists of crushed slate which has been highly kaolinized, and contains numerous massive quartz-hematite segregations as well as ramifying quartz veinlets. A considerable amount of manganese dioxide and some limonite are present; as already mentioned, the ore may contain up to 1 per cent Bi_2O_3 in the form of oxide and carbonate minerals (Sullivan, 1942).

As shown in longitudinal section (Plate 4), the kaolinized crushed zone has been worked in a rather irregular fashion. At the 90 foot level it has beenworked over a length of 70 feet and a width of about 10 feet. At the 144 foot level, the stope length at the time of examination was 50 feet, and the ore had been mined over a width of 28 feet (Plate 3). As shown in the longitudinal section (Plate 5) and on Plate 3, the driving at 144 foot level has shown that hematite-rich crushed slate occurs over a length of 150 feet, and all of this material probably carries some gold. It was suggested by the management at the time of examination, that the gold content of this larger body of material at the 144 foot level may be in the vicinity of 10 dwt. per ton, but this figure has not been confirmed by independent sampling. The width of the ferruginous crush-zone at the 144 foot level probably averages 25 feet.

From the above approximate figures, it will be seen that the main known lode aggregates approximately 375 tons of ferruginous slate per vertical foot, but that its average grade has not been proved. Within this lode there is a shoot of ore which may be 60 feet long and 20 feet wide, and thus contains approximately 120 tons of ore per vertical foot. In the past, this shoot has yielded an average of 56.2 dwts per ton by amalgamation.

(b) STRUCTURAL CONTROL OF ORE DEPOSITS.

The geological structure of the Whippet deposit is not yet fully known, and further study is necessary, particularly as new openings become available. How-

ever, a number of localizing factors, which may be important, have emerged from the brief study undertaken to date.

(1) On Plate 1 it will be seen that, although outcrops are extremely meagre, there is a suggestion that the rocks occurring to the north of the lode are generally sandy, whereas those to the south of the lode are mainly slate. This, although not yet proved, suggests that the orebody may lie close to a contact between rocks of differing competency; it is further notable that the western end of the more westerly quartz-hematite outcrop terminates in sandstone, which appears to have been unfavourable for mineralization. The contact of this sandstone with the hematite lode is likely to pitch to the westward, possibly at an angle of 20 to 30 degrees, and thus the favourable slate and, with it, possibly, the zone of orebodies, may pitch in that direction.

(2) Cross section A-B (Plate 5) suggests that the ore occurs on the sheared southern flank of a small anticline which was mapped in the eastern cross-cut at the 144 foot level. In general, the pitch of this anticline will be to the west, as is that of the slate-sandstone contact described above.

(3) The study of the plan of the 144 foot level (Plate 3) reveals what appears to be a most important control. This plan indicates that the high-grade ore occurs where the iron-rich crush-zone has approximately an east-west trend, and that the grade decreases very markedly where this crush-zone changes to a N.W. -S.E. trend. Similar changes of grade with strike is quite common in many orebodies and is related to the existence of relatively open ground where the strike is favourable. The relationships at the Whippet suggest that the northern wall of the crush-zone has moved westerly relative to the southern wall. The high-grade shoot

mined to date is apparently confined largely to the area of favourable east-west strike. As will be seen from the longitudinal section (Plate 4), the east-west striking portion of the lode and also the zone of high gold content has a steep easterly pitch.

It seems then, that the occurrence consists essentially of east-pitching pipes of ore in a zone of orebodies which probably pitches west.

C. SECONDARY ENRICHMENT.

(c) The very high gold content ore worked to date is not considered to have been due entirely to primary mineralization, but partly to have resulted from a process of secondary enrichment. This enrichment probably took place not only during the present cycle of weathering, but may have been in progress since Tertiary times when, as suggested by the presence of laterite, the level of the surface of the earth in this district was very close to that of the present land surface. Evidence obtained elsewhere at Tennant Creek suggests that gold enrichment may not extend down to the present water table, but may be related rather to the depth of the water table in Tertiary times which is considered to have been less than that of the present water table. The leached and oxidized zone associated with the Tertiary weathering is characterized by intensive development of kaolin. There is a possibility that below this zone of intensive kaolinization, the grade of ore will drop markedly.

E. PROSPECTS OF FURTHER DISCOVERY.

Spare

At the time of the examination of this deposit, the suggestion was made to the manager, that, although the orebodies are pitching east, the zone of ore-pipes is pitching west, and hence it was recommended that the lode material existing in the vicinity of No. 3 shaft should be tested at depth. This work was undertaken and resulted in the discovery of high-grade ore which, it is understood, is now being mined.

This result suggests that westward exploration from No. 3 shaft also should be undertaken in the hope of discovering non-outcropping shoots lying beneath the slate-sandstone contact. (See Plate 4).

Magnetic prospecting by the Bureau is recommended; further geological study should also be made as the mining and exploration progress.es

3. SKIPPER EXTENDED GOLD MINE

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PLANS AND SECTIONS

A. INTRODUCTION.

The examination of the Skipper Extended Gold Mine was carried out as part of geological field work during the 1948 field season. It was undertaken for the purpose of determining the geological features which led to the emplacement of the ore, and to suggest a programme for future development and exploration. The results obtained have helped considerably in planning the investigation of the regional geology to be undertaken during the 1949 field season.

B. SITUATION AND ACCESS.

The Skipper Extended Gold Mine is situated 6½ miles from Tennant Creek Township on a magnetic bearing of W 25°S. It is approached by travelling 4 miles south

from the town along the Stuart Highway and thence about 5 miles west along a graded gravel track.

The mine is situated on the most westerly outcrop of the Arcadia-Skipper line. It is owned by Skipper Extended Gold Mines, N.L.

At present the ore is treated at No. 3 Government Battery, 9½ miles distant from the mine.

C. HISTORY AND PRODUCTION.

The deposit was found by systematic loaming along the line of quartz-hematite outcrops. The work was carried out by J. Smith and S. Price. They detected a few colours only, but these, together with the "favourable" look of the country, induced them to sink a shaft. However, the orebody was reached only by driving 30 feet north from a depth of 54 feet.

The lease has been developed by two shafts, one of which (No. 1) is used in mining the orebody and the other (No. 3) being an exploration shaft. No. 1 shaft has been sunk to a depth of 135 feet and short north drives have been put in at the 53, 85 and 135 foot levels. No. 3 shaft was sunk to 95 feet below the collar. A drive has been completed from this level south for 57 feet and then south-west for another 42 feet, but no ore has been intersected to-date.

Production from the mine is as follows:-

Date.	Long Tons	Fine ozs. by amalgamation	Average dwts. per ton by amalgamation
January 1947	18.7	24.75	26
April, 1948	508	2071.86	81
	526.7	2096.61	98.5

There has been a recent crushing, but the results are not yet available.

Up to the present the average grade has been 3.9 oz. per ton. The company expects this grade of ore to continue.

D. GENERAL GEOLOGY (Plate 1)

The mine is situated on a low spur which tapers gently to the west. At 350 feet west of the mine, talus slopes grades into a superficial deposit of white powdery soil, generally known as bulldust.

Outcrops of country rock are infrequent and disconnected.

Red and purple tuffaceous sandstones and reddish slates are the predominant sedimentary facies.

Interbedded cherty slates and chlorite schist were noted on the 135 foot level of No. 1 shaft. These rocks are outside the oxidized zone, which terminates at 120 feet below the collar of the shaft. A microscopic study of the schist shows that it consists of small rod-like crystals of hematite, randomly arranged, in a greenish, cryptocrystalline groundmass of chlorite and sericite.

With the present limited extent of the underground workings, it is difficult to determine the relationship between the surface and sub-surface geology.

E. ECONOMIC GEOLOGY

(a) AURIFEROUS DEPOSITS

The surface geological plan (Plate 1) shows two en echelon groups of massive quartz-hematite outcrops. These bodies are lenticular in shape; their length ranges from 140 feet to 10 feet and their width from 30 feet to 5 feet. Slickenslides are common features on surface outcrops of the ironstone.

The quartz hematite bodies vary remarkably in composition; all gradations are present from a lustrous, black hematite rock, with no visible quartz, to one which contains well over 50% quartz in ramifying veinlets and vughy accumulations. A sample collected from the shallow opencut, 10 feet east of No.3 shaft, superficially resembled a "plum-pudding" in texture. It consisted of closely intergrown

hematite and quartz in the proportions of 30 : 70. Lamellar twinning in the colourless mineral was originally thought to indicate the presence of felspar. It proved, however, to be the result of shearing stresses on the intergrown quartz crystals.

The quartz-hematite bodies are separated from one another by a brecciated slate, which has been impregnated with quartz and quartz-hematite stringers.

With the present knowledge of the field it appears that there have been two periods of quartz injection, one probably associated with the introduction of iron, the other filling fractures in the quartz-hematite masses.

The quartz-hematite bodies are associated with gold introduction but whether they played the part of precipitators, or whether their presence gave rise to the crushing of country rock near their perimeters to form breccia which could readily become injected with auriferous veins, cannot be said with certainty.

The orebody exposed in No.1 shaft is 40 feet long and 10 feet wide. It has been proved over a vertical extent of 65 feet. The strike of the orebody is N.57 degrees E, dip, 80 degrees N.E. and pitch 72 degrees N.E.

The ore is a reddish brecciated slate with gold-bearing limonite stringers and numerous thin hematite veins. Occasional patches of massive quartz-hematite are included in the orebody. It is not known at present how much of the gold is of primary origin but it is suspected that secondary enrichment has been widespread in this deposit.

The zone of oxidation in the country rock extends to 115 feet below the surface while the present water-table level is at least 100 feet below this again. Thus, on this mine, there may be present, a perched zone of oxidation, and, possibly secondary enrichment, quite independent of the present water table. It is thought that the perched zone may be related to the intense leaching and kaolinization ~~with~~ which took place during the Tertiary lateritisation period, when the land surface was of very low relief.

(b) STRUCTURAL CONTROL OF ORE DEPOSITS. PROSPECTS OF FURTHER DISCOVERY.

Plate 1 is an outcrop map which shows the extent and position of the outcrops on the Skipper Extended Lease.

Plate 2 represents an inferred structural plan setting out the present conception of the geology of Skipper Gold Mine.

The inferred structure is as follows:- An anticline which pitches at approximately 23 S.W. has been broken by later faulting which has considerably distorted the fold and has produced a series of en echelon tension faults, which may recur in one horizon of the Warramunga sediments.

These shears have been penetrated by silica-and-iron bearing solutions or vapours, from which lenticular quartz-hematite bodies were deposited.

Later movement may have caused the brecciation near the quartz-hematite bodies and resulted in the formation of suitable loci for gold deposition.

Sections drawn through the mine (Plates 8, 9, 10) show that the orebody lies in a crush zone parallel to a quartz-hematite mass, which determines the western margin of the ore. The eastern margin is determined solely by economic limits. Some faulting was noted near the northern end of the orebody but it is difficult to say what are the terminating features at this and the southern end.

The orebody bottoms on a strong shear zone, Fault A. This fault is probably a pre-ore fault and there seems no reason why other quartz-hematite bodies having a similar orientation to that exposed in shaft No.1. should not have orebodies in close proximity to them.

4. GREAT EASTERN GOLD MINE.

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PLANS.

A. SITUATION AND ACCESS.

The Great Eastern Gold Mine is situated 9½ miles east of the Tennant Creek Township. It is reached by gravel road which commences near the centre of the township. The ore is crushed at No. 3 Government Battery, 9 miles distant. Messrs. M. Bradwell and T. Stitt are co-partners in the mine.

B. HISTORY AND PRODUCTION.

The shear zone exposed at the surface was costeaned at regular intervals about the years 1934/1935. Three shallow shafts were sunk before the present ore body was found. This small body was then worked on the open cut method. Later a shaft was sunk at the western end of the open cut and has been continued by the present owners.

Recorded production from the mine is as follows:-

Date	Long Tons	Recovery dwts/ton by amalgamation
July 1935/June 1936	160	6.7
" 1936/ " 1937	24	6.2
" 1937 " 1938	97	6.2
" 1938 " 1939	106	5.6
" 1939 " 1940	97	4.3.
TOTAL	484	5.5

C. GEOLOGICAL SETTING (Plate 1).

The Great Eastern Gold Mine is situated on a flat stretch of country which slopes gently to the south. To the west, north and east, the country rises to form the typical low hills characteristic of the Tennant Creek gold-field.

Sedimentary outcrops in close proximity to the mine are scarce and are disconnected.

The predominant facies are interbedded tuffaceous sandstones and slates. Outcrops of sandstone are more frequent on the northern side of an east-west shear zone and are of coarser grain than those on the southern side.

Conformable bands of pinkish brown sandstone and well-bedded shales were examined in the shaft; they dip north at 56° as do the surface rocks.

D. ECONOMIC GEOLOGY.

(a) Auriferous Deposits:

No large quartz-hematite masses outcrop on this property, and the only one visible is about 1 foot in diameter. It is found in a shear zone at the eastern end of the open cut. The shear zone is parallel to the bedding and varies in width from 2 feet to 14 feet. It cannot be traced to the west of the shaft on the surface, but has been noted as far as 160°E, 15°N, on the eastern side. This zone consists of brecciated sandstones and shales impregnated with quartz and quartz-hematite stringers, which have been thoroughly weathered.

The ore body is lenticular in shape and has formed at the greatest width of the shear zone. It is 45 feet long, 14 feet wide, and 40 feet in depth. Below the 30 foot level, the ore diminishes to a small but payable body 2-4 feet wide and 16 feet long. However, the width of the lode channel (18 feet) has not changed. The dip of the ore body is from vertical to steeply north, and the pitch is 76° west. The richest values occur in a fine-grained reddish sandstone, rich in quartz-hematite stringers occurring along a minor crush zone. A fine-grained slate is also present. It is not known to what extent the deposit has been enriched by secondary processes.

(b) Structural Control of Ore Deposits:

Field observations have shown that the mineralized zone lies close to the contact of coarse and fine-grained sediments. Movement along this contact has caused brecciation of the country rock, which has been subsequently impregnated with quartz stringers and quartz-hematite stringers, carrying gold. The sediments have also been buckled, to form anticlines and synclines which pitch at 60° to 80° north. Plate I shows that the mineralized zone transgresses these folds and dies out approximately 5 feet west of the shaft, at what may be the sandstone-slate contact. This possible contact is obscured by soil and talus. The eastern end of the mineralized zone dies out 160 feet east of the shaft, probably where the zone passes from a fine to a coarse facies.

In vertical section, the mineralized zone has been gently folded, but the axes of the folds have a very flat pitch, probably to the west. The ore shoot has formed on the footwall of the lode (Plate 2) and payable ore has been concentrated in the valleys of the folds. Plate 2 also shows that a thin band of ore lies along the footwall side of the lode.

(c) Proximity of Igneous Bodies:

The presence of tourmaline in the quartz veins at the surface indicates the proximity of an acid igneous body. Tourmaline occurs in cone-like forms which are intergrown with

the quartz; the base of the cones abut on one wall of the vein and the apices extend almost to the other edge of the vein.

A microscopic study of a specimen of this quartz-tourmaline vein shows the cone shaped bodies of tourmaline to consist of aggregates of long and short prismatic crystals, the former being of the order of 0.3 mm. in length. It may be schorlite or iron-rich tourmaline.

The depth at which the acid igneous body is likely to occur cannot be postulated with any certainty.

E. PROSPECTING SUGGESTED.

Suggested exploration (with reasons) is given below:-

(i) Continue the present programme of mining the lode to its payable limits. It is possible that the structural conditions, which localized the extracted ore body, may be repeated in depth.

(ii) Drive west from the bottom level to investigate the mineralized fracture zone. This is to determine the extent of the zone and to investigate the possibility that further ore may be found in it.

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5. THREE KEYS GOLD MINE.

TABLE OF CONTENTS.

PLANS AND SECTIONS.

A. INTRODUCTION.

The examination of the Three Keys Gold Mine was carried out as part of the geological programme during the 1948 field season. It was undertaken for the purpose of determining the geological features which led to the emplacement of the ore and to suggest a programme for future development and exploration.

B. SITUATION AND ACCESS.

The Three Keys Gold Mine is situated 9 miles from Tennant Creek township on a bearing N63°E. A graded track leads from the township to the mine.

The No. 3 Government battery is 9 miles south of the mine.

At present, the mine is manned by the McGrath brothers.

C. HISTORY AND PRODUCTION.

It appears that about 1938 prospectors were favourably impressed by the "look" of the outcropping ironstone blow at 00 and 70S, (see Plate I), and decided to put an adit into the hillside about 50 feet below the highest point of the outcrop. No. 1 orebody was intersected at 80 feet from the mouth of the adit. The discovery of this orebody may be considered very fortunate as the ore did not outcrop at the surface.

After the ore had been extracted, a winze was sunk which followed the contact of quartz-hematite and hematite-rich brecciated slates (Plate 4). The war prevented further exploration at that time. At the end of the war, the McGrath brothers drove a second adit, (No. 2 adit), 30 feet below the previous one, and 188 feet in length. A little very coarse gold was found at 178 feet from the portal (Plate 4).

Recorded production from the mine is as follows:-

Date	Ore Long tons	Gold Fine Ozs. (by Amalgamation)	Av. Recovery by Amalgamation dwt./ton
July 1938-June 1939	296	207	14.0
1940- 1941	122	55	9.1
1941- 1942	40	31	15.5
TOTAL	458	293	12.8

The gold content of the sands is unknown to the authors. Private reports indicate that all of the above ore did not come from the Three Keys Mine. There has been no production since July, 1942.

D. GEOLOGICAL SETTING.

The Three Keys Gold Mine is situated on the northern slopes of a steep-sided residual of the Old Tertiary peneplain. Outcropping quartz-hematite bodies, which are the dominant features of the hill, appear to project above the level of the former Tertiary peneplain, indicating that they were possibly monadnocks in the old land surface. The flat surrounding country is generally referred to as the "bulldust" plain.

The country rocks in the area covered by the lease are chiefly blocky slates, shales and tuffaceous sandstones. In some places, jasper bands lie parallel to the bedding of the slates. Interbanding of the slates and sandstones is very common, and it is difficult to draw a boundary which would divide areas in which sandstone predominates from those mainly composed of slate. However, the mapping shows that the older rocks on the lease are mostly sandstone, and are overlain by predominantly fine-grained beds.

No. 1 adit intersected shales, purple tuffaceous sandstones and blocky well bedded slates, dipping at 50° south, and at 85 feet from the portal No. 1 orebody was encountered.

No. 2 adit (Plate 3) intersected shales, and slate for a distance of 139 feet, at which distance the lode was entered.

E. ECONOMIC GEOLOGY.

(a) AURIFEROUS DEPOSITS.

Two large lenticular quartz-hematite bodies, 190 feet long and 70 feet wide, and 87 feet long and 30 feet wide respectively (Plate 1), occur on the leases. Several very small ironstone bodies outcrop near the south-west corner of the area mapped. These quartz-hematite masses are strongly jointed, and slickenslides are present on some of the surfaces exposed. Underground, the joints are invariably filled with a kaolin-like, white clay. Underlying the largest mass of ironstone is a zone of white leached breccia, conformable with the bedding of the surrounding sediments.

Closely associated with the quartz-hematite bodies is a hematite-rich slate breccia in which the orebody has been localized. A cross-section of the hematite-rich slates (Plate 4) shows a decrease in the width of the lode from 36 feet on the upper adit to 25 feet on the lower adit. It is possible that the lode may bottom on the sandstone-slate contact at 60-70 feet below No. 2 adit (Plate 5). No. I orebody (Plate 2) is of extremely small size, its dimensions being as follows:- Length, 26 feet;

width, 6-11 feet; vertical extent, 22 feet. In shape, the oreshoot is semi-rectangular, and is bounded by faults on the western margin and by quartz-hematite on the southern and eastern margins.

A shallow shaft sunk in the larger quartz-hematite body at 210W, 130S (Plate 1), is reported to have exposed low-grade ore. The gold may be confined to the kaolin which fills joints in the ironstone mass.

(b) STRUCTURAL CONTROL OF ORE DEPOSITS:

Bedding and pitch readings show that the sediments have been folded to form a broad basin-like structure with the major axis trending east-west. This structure may be repeated, to the south, where the folding is more intense, and where there has been some drag-folding on the limbs of the folds.

The main quartz-hematite bodies have been localized in the slates of the basin where faults have intersected them. The smaller bodies of ironstone which occur in the southern portion of the area mapped are associated with minor folds.

Post quartz-hematite movement has formed a crush zone on the north-western side of the quartz-hematite body which contains No. 1 orebody. The ore closely follows Fault A. An enrichment was found in No. 2 adit (Plate 3) closely associated with kaolin-filled shears. The full extent of post-hematite faulting is unknown. The well-defined breccia layer at 300W, 160 S (Plate 1) may have played some part in providing a passage into the basin for the introduction of silica and iron.

A north-south striking fault has given rise to the abrupt scarp about 110 feet east of No. 2 adit (Plate 1), and it appears to have considerable throw.

(c) PROSPECTS OF NEW DISCOVERY:

Although new discoveries of ore in close proximity to No. 1 orebody may be possible, exploration costs and the very small size of the known orebody render such a venture unattractive.

Attention is directed to the need for exploration of the large quartz-hematite body. Small quantities of gold have been reported from this "blow". The western end of the mass has been investigated, but the shaft (280 W, 130 A, Plate 1) and drive have penetrated only rubble and breccia, and may not have been continued far enough. There are no assays available from this shaft and drive. Further ore might be discovered by driving westwards (Plate 5) from No. 1 adit to explore the northern edge of this quartz-hematite mass, but the exceedingly small size of the known orebody suggests that it will be difficult to pinpoint another shoot either by driving or by diamond drilling, and also sets a limit on the amount of exploration which should be undertaken.

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6. NEW MOON GOLD MINE

GOLD FIELD, NORTHERN TERRITORY.

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PLANS.

Plate 1. Surface Outcrop plan.

11. Geological plan of 60' & 30' levels.

111. Section along magnetic bearing 52°(Plate 1).

A. INTRODUCTION.

The New Moon Gold mine was examined as part of geological field work during the 1948 field season. Although no orebody has been discovered on this lease, sufficient exploratory work has been carried out to warrant geological investigation. The results obtained have helped considerably in planning the investigation of the regional geology to be undertaken during the 1949 field season.

B. SITUATION AND ACCESS

The New Moon Gold Mine is situated 12 miles from Tennant Creek township on a magnetic bearing of N 70° E, and is reached by following a graded, gravel track which runs from Tennant Creek to the mine.

The No.3 Government Battery is about 12 miles to the south-east.

The lease is owned and prospected by Mr. C. Jenkyns.

C. HISTORY.

The lease has been prospected intermittently for about seven years and although some gold has been found, no orebodies have been discovered. Residual and outcropping quartz-hematite bodies have been thoroughly sampled by the owner. The exploration was no doubt encouraged by the close proximity of the Blue Moon Gold Mine,

producer of £200,000 of gold to date.

Besides extensive surface exploration, the lode has been investigated by a vertical shaft 60 feet . Short drives have been completed from this level.

D. GEOLOGICAL SETTING (PLATE I)

The mine is situated on the southern side of conical hill which rises to height of about 35 feet above the surrounding "bulldust" plains.

Rock exposures are very poor and only two sedimentary outcrops were located. These outcrops together with the exposures in the shaft and drives, show that the sediments are interbedded banded slates, sandy shales and pale purple tuffaceous sandstones, which have been markedly leached.

E. ECONOMIC GEOLOGY

The quartz-hematite bodies exposed on the lease are more siliceous, than those noted in other parts of the mining field. They are lenticular in shape, and are seldom more than three feet wide (Plate 1). A well leached brecciated zone, mottled red and brown in colour, surrounds the quartz-hematite bodies. The brecciated zone is 85 feet wide at the surface but decreases to a width of about 45 feet on the 60 foot level. Manganese oxide is a very common mineral on the 60 foot level where it occurs as thin streaks and clots.

The fracture zone (Plate III) is localized on the crest and limbs of an anticline pitching 30° southward.

Up to the present no orebodies have been discovered.

F. PROSPECTING RECOMMENDED

The work carried out to the present date has not given very promising results, but the prospect is sufficiently encouraging to warrant the continuation of the west drive at the sixty foot level, which is exploring a fault.

Deepening of the shaft may be warranted later, but this would depend on the results of driving at the 60 ft. level.

7. LITTLE WONDER GOLD MINE.

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PLANS.

A. SITUATION AND ACCESS.

The Little Wonder Gold Mine is situated approximately 9 miles from Tennant Creek township, on a bearing of north 65 degrees east. The mine is reached by following a graded track which runs from the township to the mine. No.3 Government Battery is 9 miles south of the lease. At present the lease is manned by Mr. W. Spredborough Senior. and Mr. W. Spredborough Jun.

B. HISTORY AND PRODUCTION.

Prior to the war, shallow pits and costeans were sunk and it is reported that 110 tons of ore, which yielded 28 ozs. of gold, were mined. In view of the limited size of the mine workings, it is difficult to see how 110 tons of ore could have been extracted.

After the war, the Spredboroughs took over the lease and carried out some prospecting, including a considerable amount of costeaning (Plate 1). No.2 shaft was sunk in lode material but was abandoned in favour of the present shaft, No.1. This latter shaft has been sunk to a depth of 60 feet, but to-date no production has resulted from this work, and no ore was in sight at the time of inspection.

C. GEOLOGICAL SETTING (Plate 1).

The Little Wonder Lease is situated on the southern

side of a steep spur which tapers to the eastward and is bounded on the northward by a flat plain covered with a fine white soil, generally known as bulldust. To the south, the country slopes gently, and may represent part of the old Tertiary land surface.

The main rock types consist of interbedded blocky shales, jaspers and sandstones, all of which dip to the south. The shales form a well-defined bend and have been used as a marker bed in mapping (Plate I-).

D. ECONOMIC GEOLOGY.

(a) NOTES ON LODE AND ORE SHOOT.

The only indication of quartz-hematite at the surface is a small outcrop 5 feet in diameter exposed in a costean at 15W, 20S. In the 38 foot level drive from No.1 shaft, a hard dense quartz-hematite mass, with a steep northerly dip, has been intersected. The mass is fractured and many of the fractures are filled with kaolin but no gold has so far been found in this rock.

A hematite-rich, brecciated slate has been exposed in No.2 shaft, and over a width of 20 feet, is reported by the owners to assay 7 to 8 dwts. per ton.

Ore of payable grade is reported from the elongated pit at 30 S 20 W (Plate I). A sample of the ore shows that the gold is bright yellow in colour, and occurs in fractures in quartz. The quartz occurs as ramifying veins and is dull white in colour and exceedingly vughy. The ore represents a local concentration, and has not been traced beyond the limits of the open cut.

Coarse gold has been found in the soil south-east of the opencut, and "colours" extend from the present mine workings to the shallow shaft near the road. Efforts to find the source of gold have not been successful and it seems likely that this surface gold has been shed from an eroded orebody.

(b) STRUCTURAL FEATURES OF THE MINERALIZED DEPOSIT.

The quartz-hematite body and the hematite-rich brecciated slates are localised in the northern limb of south-

easterly pitching syncline. The dip of the sediments varies from 42 to 70 degrees southy minor drag-folds pitch at 55 degrees south-east.

Plate 2 shown that the dip of the quartz-hematite body varies from vertical to 85 degrees north. The pitch of the ironstone mass is unknown, but is thought to be in the same direction as the pitch of minor drag folds though considerably steeper.

Two probable faults, of uncertain dip, have been noted on the surface, (Plate I-), and may have been caused by the same stresses which gave rise to the folding.

The precise nature of the features which controlled the localization of the mineralized zone, are unknown. However, some tentative suggestions are listed below:-

1. The fracture zone is localized along the contact of slates and sandy beds.
2. The fracture zone, in which the quartz-hematite bodies occur, may pitch south-east, parallel to the pitch of minor drag-folds.
3. Quartz-hematite bodies may be localized along shears complementary to the movements which caused the brecciation.

F. PROSPECTS OF ORE DISCOVERY.

As there is no known orebody present in the workings or on the surface, it is difficult to state what the prospects of future discovery are. A tentative development programme, pending further geological investigation, is proposed as follows:-

1. Sink No. 1 shaft to a depth of 100 feet to determine whether, at the contact of the jasper lenses and quartz-hematite (Plate 2), there is a zone of brecciation which could contain a payable shoot.
2. Drive east along the lode to determine if the suggested north-south fault at 2003 36S (Plate 1) is present. Ore may occur where the fault cuts

the mineralised zone.

Oreshoots previously discovered on this mine, appear to have been quite small and low-grade. Thus, any expenditure on exploration is a gamble which however, is warranted in view of the discovery of rich non-outcropping shoots at Tennant Creek.

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