GEOLOGICAL REPORT NO. 1
on
NORTHERN STAR COPPER-GOLD PROSPECT
Tennant Creek N. T.
by
J. L. Morton
L. M. Cordner
GEOLOGICAL REPORT NO. 1

on

NORTHERN STAR COPPER-GOLD PROSPECT

Tennant Creek, N. T.

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J. L. Morton
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November, 1965

Accompanying Report:

(i) Locality Plan
(ii) Geochemistry Overlay - Surface Copper
(iii) Geological Plan
(iv) Longitudinal Projection
(v) Cross Section 4200E
(vi) Cross Section 4500E
(vii) Cross Section 4800E
(viii) Cross Section 4700E
(ix) Cross Section 5400E
(x) Lease Boundary Plan
(xi) Geophysical Overlay with magnetic contours
(xii) Geophysical Plan with IP grid

Scale:  
1" = 4 miles
1" = 100 feet
1" = 100 feet
missing
1" = 100 feet
1" = 100 feet
1" = 100 feet
1" = 100 feet
1" = 100 feet
1" = 100 feet
1" = 100 feet
1" = 200 feet
1" = 200 feet

Sect.  
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R. HARE & ASSOCIATES

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Scale: 1" = 4 miles
1" = 100 feet
1" = 100 feet
1" = 100 feet
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1" = 200 feet
1" = 200 feet
1" = 200 feet

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SUMMARY

The Northern Star Copper-Gold prospect is located 26 miles north of Tennant Creek, Northern Territory.

Four large gossan bodies outcrop within an area 2,000 by 1,200 feet. A gold orebody has been worked out from one of these gossans which produced 14,000 tons of ore grading 8.3 dwts Au/ton before the mine closed down. A considerable amount of prospecting in the form of magnetic surveys, diamond drilling and geochemistry has been carried out by the B.M.R. and three separate exploration companies. The resulting data from this prospecting has been collated and presents the following exploration targets:

1) A gold-copper prospect based on the extension of a gold intersection averaging 23.4 dwt Au/ton over a core length of 30 feet, core length at 905 feet vertical depth in hole No. 15 and 2.43% Cu over 39 feet core length at 973 feet vertical depth in Hole No. 14.

2) A copper prospect based on geochemically anomalous copper zone in lens No. 2 with a potential of 5,000 tons per vertical foot.

3) A copper prospect based on results of two magnetic surveys.

A programme of geophysics and drilling is recommended to carry out an initial test on these targets for an expenditure of £12,000 over a period of about five months.
INTRODUCTION

Developments leading up to the drilling by Metals Exploration N. L. of diamond drill hole No. 15 at Northern Star Mine in 1962 are set out in reports by R. Hare dated 23rd September, 1960 and 16th June 1961.

Results from this hole were thought to be disappointing and the leases were surrendered in January 1963. However, the subsequent discovery by Government geologists of gold values averaging 23 dwt/ton over a core length of 30 feet between 895 and 1025 feet in DDH No. 15 has focused attention on the property as a gold prospect.

During January 1965, Metals Exploration N. L. received approval from the Northern Territory Administration to re-apply for the Northern Star leases, which had been held as a Government Reserve since discovery of gold in the drill core.

Further exploration and drilling is now planned and this report - based on results of previous geological, geochemical and geophysical surveys - outlines the prospect and sets out proposals.

The authors and D. Larsen of the consulting firm of R. Hare and Associates carried out a short survey and mapping programme on the property during April and May 1965. Previous work carried out is summarised as follows:

1) Ground magnetic survey by the Aerial Geological and Geophysical Survey of Northern Australia (AGGSNA) during 1935-1937.

2) Aeromagnetic survey at 1/5 mile line spacing and 500 feet flight height by the Bureau of Mineral Resources during 1956.

3) Aeromagnetic survey at 1/10 mile line spacing and 250 feet flight height by the Bureau of Mineral Resources during 1964.

4) Geochemical survey over the south-western part of the area incorporating 44 percussion drill holes on nominal 80 ft. grid by the Bureau of Mineral Resources during 1964.

5) Thirteen diamond drill holes totalling 6,835 feet completed between 1950 and 1954 by Northern Mines Development N. L.

6) Diamond Drill Hole No. 14 drilled to a depth of 1,040 feet completed by Peko during 1957.

7) Diamond Drill Hole No. 15 drilled to a depth of 1,104 feet by Metals Exploration N. L. during 1962.
LOCATION AND ACCESS

The Northern Star Mine is 23 miles north of Tennant Creek in the Northern Territory of Australia. Access from that town is via the main bitumen Stuart Highway - Northerly for 23 miles, thence westerly along a dirt track for 3 miles (see fig. (1)).

Tennant Creek is situated on the Stuart Highway which connects Alice Springs and Darwin, and is 315 miles and 638 miles respectively from these two towns. 421 miles of branch highway connect Tennant Creek and Mt. Isa. The nearest capital city if Adelaide which is linked to Alice Springs by 1,047 miles of railway and 1,081 miles of gravel road. Daily air services connect Tennant Creek to Adelaide and Darwin.

POWER RESOURCES

None.

WATER RESOURCES

Water for drilling is available from a small dam located about ½ mile north easterly from the main Northern Star headframe. During the working years of the mine, water was obtained from a bore 2,000 feet to the north east and from the 280 ft. shaft, in which seepage water collected below water table.

EXISTING HOLDINGS

Adequate surface outcrop and depth extension coverage is held jointly by Metals Exploration N. L. and Parings Mining & Exploration Co. Ltd. in the form of 13 Gold Mining Leases (see fig. (x)).

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TOTAL 203.7 acres
REGIONAL GEOLOGY

The Tennant Creek area is dominantly one of deformed and intruded Lower Proterozoic sediments. Gold and copper orebodies are associated with quartz-magnetite and quartz-hematite lodes which occur in folded fine-grained sediments of the Warramunga Group. It is generally believed that the ironstone bodies, aligned in a general east-west direction, represent the intermittent replacement by iron oxides of brecciated sediments along east-west trending shear zones. The subsequent emplacement of granite and associated rocks was accompanied by the intrusion of mineralising solutions for which the ironstone lenses were favourable host rocks for the deposition of gold and sulphides. Weathering has converted magnetite to hematite to depths of up to 500 feet.

The outstanding characteristic of ore shoots is their occurrence at the intersections of main west and west-north-westerly shear or crush zones with the north and north-westerly trending mineralising channels. They are generally pipe-like in form and there is a notable association of gold with bismuth. Gold is also generally associated with quartz and hematite in its bladed or specular form, apparently derived by solution and re-deposition of martite (hematite derived from the oxidation of magnetite). Gold-bearing shoots generally constitute up to 10% of the ironstone masses. Ore mined in the Tennant Creek field up to the present has averaged about 20 dwt Au per ton. The comparatively few known copper deposits do not allow much generalisation concerning their associations; however, they appear to be connected with the gold mineralisation.

STRUCTURAL GEOLOGY

All directions in this report are referred to grid north, which is aligned 30 degrees west of magnetic north.

Two major structural types occur at Northern Star -

1) Fold structures.

2) Zones of shearing and attenuation.

1) Fold Structures

The most prominent structural features of the area are four masses of ironstone numbered 1, 2, 3 and 4, as shown on the 100-scale geological plan. These bodies represent replaced fine-grained sediments at the crests of folds. The pitch of No. 4 body is 55 degrees west-south-west. This has been established from results of diamond drilling which tests a portion of the structure to a depth of about 600 feet. (see fig. (iv).)
Zones of Shearing and Attenuation

The Northern Star gold orebody, 20' wide at the surface, was mined along a shear zone passing through No. 1 lens. This zone is shown on the 100-scale geological plan centred at about 5900N: 42800E striking south-easterly and dipping steeply south.

A well defined zone of attenuation with associated faults and shears occurs between lens numbers 2 and 3. Two lenses of ironstone and a number of minor lenses occur on schelon within the zone where it links the two major ironstone bodies. One of the lenses contains a shear centred at about 4750N: 44000E from which a minor amount of ore has been won. General strike of the zone is north-easterly. Individual associated shears observed in the vicinity of 4750N: 44500E vary in strike between north-east and east, and in dip between 45° and 85° southerly. A fault (referred to in previous reports as "Higgins Fault") cuts off the Northern Star orebody. This fault is shown projected to surface on the 100-scale plan. It is parallel with the line of attenuation linking lenses 2 and 3, and lines up with a boomerang shaped ironstone outcrop at the northern end of the projected fault which is suggestive of attenuated lenses in the former zone.

MINERALOGY OF THE IRONSTONES

The ironstone outcrops consist of dense hematite quartz and jasper in varying proportions with minor quantities of bladed and specular hematite limonite botryoidal goethite and residual magnetite. Sections of the ironstone have a distinctly gossanous appearance and these are outlined on the 100-scale geological plan.

ECONOMIC GEOLOGY

The only known orebody of importance is the old Northern Star. This is a typical Tennant Creek type gold occurrence associated directly with a shear in ironstone. 14,263 tons of ore grading 9.3 dwt/ton Au/ton were produced from this body between surface and 235 feet. An east pitch extension of the orebody was tested for by two diamond drill holes without success. No holes have been drilled to effect a west pitch test. There are four significant diamond drill intersections, two copper and two gold. Together with geochemical and magnetic results these are the most important known mineral occurrences associated with the prospect. They are shown on the 100-scale plan, longitudinal projection and cross sections and are summarised as follows:

1) Gold Intersections

D.D.H. No. 15 23.4 dwt/ton gold bearing magnetite intersected over 30 feet core length centred 905 feet vertically below surface and 4.1 dwt/ton gold bearing magnetite over 10 ft. core length centred 1,033 feet vertically below surface. (see fig. (vii))

D.D.H. No. 7 22.2 dwt/ton gold recorded from a sludge sample of unstated length at a vertical depth of 245 feet below surface (see fig. (vi))
2) Copper Intersections

D. D. H. No. 14  2.4% copper bearing magnetite and chlorite schists over 38 feet core length centred at 973 feet vertically below surface. (see fig. (vii)

D. D. H. No. 3A  1.1% copper in unknown host rock over 30 feet core length centred 535 feet vertically below surface (see fig. (v)

Results of the ground magnetic survey carried out by AGGSNA during 1935-1937 are shown on the accompanying 200-scale composite magnetic overlay. This is the anomaly tested by Holes Nos. 14 and 15. Also shown on the overlay are results of a low level aeromagnetic survey conducted by the Bureau of Mineral Resources during 1954. The latest magnetic work shows the centre of the anomaly offset about 600 feet to the north-west from that outlined by the earlier survey.

During 1964 the Bureau of Mineral Resources conducted a geochemical programme comprising 44 percussion drill holes averaging 60 and ranging up to 120 feet in depth. Mean values of copper concentration have been determined for each hole by averaging each 3 ft. sample over a depth of 46 feet and the results set out as a contour plan. Results of surface sampling have likewise been contoured and the two compare suitably. Please refer 100-scale geochemical overlay. This work outlines an anomalously copper rich zone which correlates closely with gossanous ironstone within lens 2.

DISCUSSION

There are three prospects to be investigated within the Northern Star area:

1) A gold-copper prospect based on the extension of the known diamond drill intersections in Holes Nos. 14 and 15.

2) A copper prospect based on the possibility that a geochemically anomalous copper zone represents the leached upper section of a copper orebody, which may occur at depth to the west.

3) A copper prospect indicated by results of two magnetic surveys, assuming centre of magnetic body further west than indicated by the original survey and thus not effectively tested by diamond drill holes Nos. 14 and 15.

1) The Gold-Copper Prospect

With reference to the longitudinal projection, the intersections in both D. D. H. No. 15 and D. D. H. No. 14 are clearly within the down pitch extension of lens No. 4. Generally speaking, a shear localises a gold orebody within the ironstone, and three such structures capable of producing a shear can be projected to the point of D. D. H. 15 gold intersection. If a gold orebody is localised by one of these it can be expected to strike between north-east and south-east and have a steep southerly dip. Initial requirement of the test will be to establish strike and dip.
Further exploratory drilling for extensions of gold values will be planned in detail after check magnetometer work, as described further on this report, has been completed.

2) The Copper Prospect

Structurally, No. 2 lens can be expected to have a similar pitch to No. 4 lens. Surface observations place the pitch at between 45 and 70 degrees in a direction between west and south-west. The occurrence of anomalous copper and gossanous ironstone at surface indicates a leached copper orebody. The area of gossanous ironstone suggests a potential of some 5,300 tons per vertical foot. D.D.H., No. 3A which intersected 1.1% copper over a core length of some 30 feet may be on the margin of this zone (see fig. v). A high degree of leaching can be expected to 500 feet, and the intersection in the Hole No. 3A may, in fact, represent a partially leached body. In any case, if a copper orebody of the dimensions indicated by surface outcrop occurs below the leached zone, it should constitute a suitable target for testing by Induced Potential (IP) An IP test could be carried out quickly, and successful results could greatly facilitate the layout of drill holes. However, due to the possibility of leaching or partial leaching to depths beyond the limits of IP technique, an unsuccessful test would not rule out the copper prospect, and for this reason at least one diamond drill hole should be provided for, which would be laid out after IP results are known.

3) Results of the 1935-1937 magnetic survey were used as the basis to design diamond drill holes Nos. 14 and 15. The 1964 magnetic survey has altered the position of the anomaly and thus throws doubt on the effectiveness of D.D.H.'s 14 and 15 as a suitable test.

Up to its present stage of development the Northern Star prospect shares certain similarities with the early development of the Peko copper orebody. Following gold mining at Peko, and the definition of a major magnetic anomaly by the AGGSNA survey of 1936, further development revealed the gold ore to be the top part of a replacement copper orebody averaging 300 ft. in length and 50 ft. in width. Since 1955, production from this mine down to about 1,000 feet has totalled some 1,200,000 tons of ore for an average yield of 5.6% Cu and 2.0 dwt Au per ton, valued at £18.5 per ton on present day prices. As indicated by the accompanying sketch, the Peko orebody comprises massive iron and copper sulphides with some magnetite, within a quartz-magnetite envelope.

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**LEGEND**

- | Sulphide-magnetite ore material. About 8% copper.
- | Magnetite with slight sulphides. About 0.4% copper.
- | Sandstone and shale.

**SCALE** 1" = 85'

**SKETCH PLAN OF 530 FT. LEVEL, PEKO MINE, TENNANT CREEK**
It is quite possible that Holes Nos. 14 and 15 at Northern Star passed through the low grade envelope material. No diamond drilling can be planned to re-test the anomaly at this stage because of conflicting magnetic results. The position of the magnetic body will have to be determined to closer limits than is known at present. A check ground magnetometer survey will achieve this object.

Though a great deal of work has been carried out in the Northern Star area, no completely integrated study has been made until now. This report is a summary of significant facts, based on the compilation of all presently available data to 40-scale plans and sections.

Considering the extreme depth of exploration targets already evident in broad outline, an important feature of this project will be the careful selection of specific diamond drill targets. Any method which may assist in their selection must be considered with the aim of obtaining a significant intersection at an early stage of the drilling programme.

In view of the extremely low cost of both an IP and a ground magnetometer survey in comparison to the expensive diamond drilling at stake, these studies are to be prerequisites for drill planning.

The programme outlined in the following pages of this report is designed to yield information significant to all three aspects (as listed on page 5) of the Northern Star Prospect.

A ground magnetometer survey, which would be expected to take only several days to complete, is considered desirable in view of the conflicting results of the two previous magnetic surveys. In addition to eliminating doubt on the position of the magnetic anomaly this work may add something extra to the considerable information already held with regard to further drilling to test Hole No. 15 gold intersection. The IP work is expected to yield vital information concerning any extensions underground of the anomalously copper rich portions of ironstone lens No. 2. Provision is made for drilling the down pitch extension of this copper prospect.

RECOMMENDATIONS

The following work is recommended:

1) Grid layout as shown on fig. (xii)

2) Magnetic survey with ground magnetometer readings at 100 ft. intervals as shown on fig. (xii)

3) Induced polarisation survey consisting of 11 double set-ups spaced 200 feet apart and with an electrode separation at least 400 feet. fig. (xii)
Diamond drilling of two holes, the details of which will be finalised upon results of previous work.

**SCHEDULE & BUDGET**

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### Programme

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**November 1965**

J. L. Morton

L. M. Cordner
This Report was compiled from the "titles" database on 29/11/94 at 10:22 with the compliments of the Titles Administration Branch.

**TENEMENT APPLICATIONS**

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Total No. = 11

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METALS EXPLORATION N. L.

NORTHERN STAR PROJECT
CROSS SECTION
AT 4200'E
(Looking East)

Approximate centre of 'sphere' magnetic body indicated by aeromagnetic survey

SCALE: 1 INCH = 100 FEET

Drafting by GEOGRAFING SERVICES
Date: August, 1965
Drg No. ME/252 (S)
METALS EXPLORATION N.L.

NORTHERN STAR PROJECT
CROSS SECTION
AT 4500'E
(LOOKING EAST)

SCALE: 1 INCH = 100 FEET

Drafting by GEOGRAPHIC SERVICES
Drg. No. ME/253(S)
Date: AUGUST 1965
METALS EXPLORATION N. L.

NORTHERN STAR PROJECT

CROSS SECTION

AT 5400' E
(Looking East)

SCALE: 1 INCH = 100 FEET

Drafting by GEOGRAPHING SERVICES
Date August, 1965
Drg No. ME / 255 (S)