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REPORT ON THE ENTERPRISE MINE, TENNANT CREEK, NORTHERN TERRITORY.

by

J. Hays.

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CONTENTS

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SUMMARY

There has been no systematic exploration at the Enterprise Mine since 1950, although there appear to be several zones favourable to gold mineralization. Ore has been found at the quartz-hematite/sediment interface, where the quartz hematite lode and its surrounding crush zone are thickest. Within these limits, the distribution of gold appears to be controlled by three weathering profiles and the economic concentration of gold is thought to be due to secondary enrichment. Exploration should aim at confirming the relationship between ore, weathering profiles, thickness of crush zones, and secondary enrichment, as well as finding ore. The west side of the 183 foot level is selected as a starting point because no capital outlay is necessary before work is started. The second level to be explored should be the 295 foot level where a full programme of exploration involves some capital expenditure unless the preliminary drilling on this level is a complete failure. Because work on the 160 foot level involves greater expenditure than at either of the other places, work should not be started until fresh data from the other levels have been studied.

INTRODUCTION

The Enterprise Mine is in the Tennant Creek Goldfield, 3¼ miles south of Tennant Creek. Access is by the Stuart Highway for 3 miles south of the township, and thence 1 mile east by rough all-weather track. A full description of the mine has been published in B.M.R. Bulletin No.22 (Ivanac, 1954). The description is accompanied by a surface geological map, on a scale of 40 feet to 1 inch, and plans and sections of the underground workings. The present report is intended as a supplement to the published description.

The mine was examined on 10th, 11th and 12th of April, 1960, at the request of the Director of Mines, Northern Territory, after the present lessee, Mr. G. F. Richards, had applied to Northern Territory Administration for a loan to finance exploration. The purpose of the examination was :-

(1) to advise whether the lodes could be adequately explored on a £2,000 loan; and

(2) to suggest an exploration programme.

The mine was re-visited on the 27th and 28th August to map accessible workings completed since April. Plates 1 and 2 were prepared from this mapping.

RECENT DEVELOPMENT

The mine has been worked intermittently since 1952. Options over the mine were obtained from Mr. Richards by the Merloo Gold Mine N.L. in July, 1953, and by the New Merloo Gold Mines N.L. in September, 1956. During the term of these options, these companies spent a total of £163,394. 12. 0 (including £56,913.18. 5 on machinery) and put in 882 feet of development (including 221 feet of raising and winzing) on the Enterprise

and other leases. Of this total, only 300 feet of driving and cross-cutting on the 160 foot level, and 107 feet of winzing from the 223 foot level to the 330 foot level, could be identified by the writer at the Enterprise Mine. The mine reverted to Mr. Richards in 1957; since then the main shaft has been deepened to 295 feet; and 130 feet of driving and cross-cutting, and 5 feet of raising, have been done at the 295 foot level. The shaft is fully equipped down to the 183 foot level but could be used for hoisting material from the 295 foot level.

The only inaccessible parts of the mine are the west side of the 160 foot level, the ore passes, and the stopes. The main stope is partly filled with material of doubtful economic value, including waste from the 160 foot level east and low grade ore.

PRODUCTION

The mine produced 6,137 tons of ore containing 18.5 dwts of gold per ton between 1935 and 1952. Production since 1952 has been 3,840 tons of ore containing 4.8 dwts of gold per ton. No sampling records are available and the exact source of the ore mined since 1952 cannot be ascertained. Comparison of the present excavations on the 183 foot level with the 1952 plans indicates that most of the ore was obtained by stripping the walls of the old stopes and possibly by extending the main stope to the west. No mining and treatment costs are available, but it is probable that such ore could not be mined profitably, even if adequate reserves were available, as the normal minimum economic grade at Tennant Creek is between 8 and 10 dwts. per ton.

EXPLORATION

The only exploration attempted since October, 1950, (the date of preparation of the published plans) was the development detailed above and shown on plates 1 and 2. It is not known whether longhole drilling was attempted from all these workings. There are no written records of such attempts but local reports suggest that longhole drilling has been used to test several areas.

No details of exploration above the 122 foot level are available, but it is known that some work was done in the early history of the mine, and it is assumed that further search is not justified. Local reports state that longhole drilling from the 160 foot level east was unsuccessful. The present lessee states that longhole drilling west of the 183 foot level has indicated that the western limits of the ore shoot have not yet been reached. Ex-employees of Merloo and New Merloo Gold Mines state that sludge samples from such longholes assayed 12 dwts. to 15 dwts. of gold per ton. These reports have been partly confirmed by Mr. A. Campbell, who was in charge of operations at the time, but it is not possible to ascertain whether these reports refer to the same drill holes.

On the 295 foot level, New Merloo Gold Mines are reported to have done some successful longhole drilling and sampling in the lode but no records exist. The present lessee has continued exploration in the crush zone on the same level and results are encouraging. A raise started at 50W in the crush zone was grab sampled in February 1960, by the Inspector of Mines, Alice Springs, and the assay value given by the Government Assayer, Alice Springs, was 188 dwts. of gold per ton. The Inspector of Mines also collected a sludge sample from a long-drill hole east from the crosscut to lode, in the crush zone. This sample assayed 11.6 dwts. of gold per ton. The length of the drill hole is not known. The area has not been resampled but panning at the mine confirmed that gold occurs in the crush zone although the 188 dwt. assay is not typical. Work was stopped in this area pending a decision on the request for a loan.

QUARTZ-HEMATITE BODIES

The lodes consist of two quartz-hematite bodies on the northern limb of an open pitching anticline. The outcrops consist of two teardrop shaped masses occurring on the crest of a hill. Both masses dip steeply north and taper to the west. The maximum thickness is 60 feet and the combined strike length is 500 feet. The two outcrops appear to overlap, the eastern outcrop extending about 30 feet along the southern side of the western outcrop. There is a pronounced saddle in the hill immediately east of the overlap zone, 100 feet east of the main shaft. This saddle is the topographic expression of a constriction in the combined outcrops. The minimum thickness of the lode across the saddle is one foot at the centre of the saddle and the maximum is 10 feet at the edges. There is a corresponding constriction 150 feet east of the main shaft on the 160 foot level but no overlap is exposed and the two lodes may be continuous at this level.

The western lode appears to be an asymmetrical lens, its maximum thickness being about 70 feet at a point 30 feet east of the main shaft at a depth of 130 feet. The thickness at the main shaft at a depth of 320 feet is 10 feet; at 150 feet east on the 160 foot level the thickness is less than one foot. Unless the lens is very irregular, these relations can be most easily explained by a steep easterly rake of the lens.

The material is generally massive, dense crystalline quartz-hematite in which are crush zones of pulverulent hematite. Small quantities of bornite and chalcopyrite have been noted in the massive lode at the surface on the 295 foot level. The country rock is mostly slate dipping north at between 20° and 45°, and having vertical cleavage that strikes between 90° and 100°. Minor lenses and bands of greywacke occur within the slate. The contact between lode and country rock is marked by intense shearing. The King, Anderson and Tom faults are shear planes of sufficient importance to have been named. In the shear zones the country rock may be altered to chlorite and sericite schist by local dynamic metamorphism and there is much brecciation and ferruginization. Gold has been detected near both the north and south contacts of the lodes and within the lodes, but has been mined only on the south side of the western lode. It is finely disseminated in the crush zone around the lode above the 183 foot level and in a crush zone within the lode on the 223 foot level. It may occur in both crush zones on the 295 foot level but has not yet been mined from that level. Bismutite is associated with the gold in some of the higher grade patches.

CONTROL OF MINERALIZATION

Little is known of the structural control for the quartz-hematite lodes and it is assumed that they are associated with en echelon faults, parallel to the crest of an easterly plunging anticline whose axis is south of the mine. The quartz-hematite bodies have controlled later structures that have been important in localising mineralization.

The emplacement of the lodes in slate and greywacke of the Warramunga Group was followed by north-south compression. The sediments were crushed against the lodes and crushing was most severe where the lodes were thickest. In the constriction between the lodes the strike of the sediments was modified so that it now swings parallel to the boundary of the lodes. On the southern side, the swing is so clearly exposed that it has been mapped as a dragfold by previous workers. A complex joint pattern has been developed more fully in the slate than in the lodes. The major directions are 30° to 70°, 90° to 100°, and 120° to 130°. The dip of the planes ranges from 30° north through vertical to 30° south. The complexity of the joint pattern may indicate several periods of tectonic activity operating along different axes. This is confirmed by the nature of the crush zones. In some places, the crush zones consist only of sheared chloritized and sericitized slate, in others this altered slate has been brecciated after alteration. The main crush zone appears to have been offset by a fault, dipping 45° north-west between the 183 foot and 223 foot levels.

Economic mineralization appears to be restricted to the lode/sediment interface where the shear zone and lode are thickest. Within that zone there are two, perhaps three, areas of economic importance in which irregular ore shoots developed. Most of the ore extracted to date has been taken from between the 110 foot and 183 foot levels. The 183 foot level coincides with the base of an ancient (pre-laterite) deep weathering profile and it is probable that the economic mineralization is the result of secondary enrichment during this weathering. A few hundred tons of ore have also been extracted from below the 32 foot level to about 90 feet below the shaft collar. Most of this came from between 60 feet and 80 feet below the shaft collar. The base of the lateritic profile is between 80 feet and 90 feet below the shaft collar. Secondary enrichment during lateritization may be responsible for this accumulation of gold. The small quantity of gold at this level may be explained by the fact that the source rocks had been leached of much of their gold content during the earlier weathering. A little ore has been mined from the 223 foot level and there is an unknown quantity of partly developed ore on the 295 foot level. The ore on and below the 223 foot level may be due to secondary enrichment in the zone above the modern water table which is between the 295 foot and 330 foot levels. If this is the case, comparison of intensity of weathering in the various profiles indicates that ore shoots in association with the moderate modern weathering may be smaller or of lower grade than those associated with the intensive ancient weathering. This may be offset to some extent by the fact that the gold is being derived from enriched sections of the lode. If there has been no disruption of the zone of maximum thickness, other than the apparent north-south movement between the 183 and 223 foot levels, there is greater hope of enrichment east of the shaft on the lower levels.

There is no evidence of sedimentary control of the original gold mineralization. The fact that gold is associated in payable quantities only with argillaceous beds may be due to a combination of two factors. Such beds constitute the bulk of the country rock in contact with the lodes, and shear zones that appear to be ideal loci for secondary enrichment form more readily in the incompetent argillaceous beds than in the greywackes.

CONCLUSIONS AND RECOMMENDATIONS

Economic mineralization is found at the quartz-hematite/sediment interface but, to-date, only 20,000 square feet out of more than 150,000 square feet of interface on the south side of the west lode have been explored adequately. The gold/interface association may be restricted to the thickest part of the crush zone, at levels within the weathered profile. Future exploration should aim in part at confirming these relationships which appear to be valid on the upper levels where no further search is warranted. Work did not extend far on the 183 foot level west of the shaft, and some further exploration appears to be warranted in order to ascertain whether any reserves exist beyond the present limits of the workings. If exploration on the 183 foot and 295 foot levels confirms the association between economic mineralization, crush zones, and weathering profiles, attention should then be directed to the east lode.

As three-quarters of the area explored to-date contains no ore, it is clear that diamond drilling is not a desirable means of exploring the lodes; the pattern of drill holes would need to be closely spaced to be certain of locating possible ore shoots. Moreover, diamond drilling would have to be done from the north side, through the lodes, to avoid drilling down dip. The cost of such drilling would be prohibitive. The alternative to diamond drilling would be a programme combining longhole drilling and underground development.

183 FOOT AND 223 FOOT LEVELS - WEST SIDE

Because the ore shoot above the 183 foot level is the biggest worked and because of unverified reports of a western extension, exploration should start on this level. An important fact is that the mine is equipped to hoist any ore found at this level. The west drive should be extended, controlled by longhole drilling, until the limits of economic mineralization have been reached. The first drill holes should be along the line of the proposed drive, in the crush zone. If the results indicate a substantial thickness of high grade ore, the drive should be extended to the limit of mineralization in the hole. When that point is reached, the holes should be extended and the process be repeated. If any hole indicates low grade or barren material, extra holes should be drilled before the drive is abandoned. If the programme is a complete failure, then the maximum amount of work needed would be about six long holes each fifty feet long at a cost of about ten shillings per foot - a total of about £150. 0. 0. A successful programme would cost very much more - up to 100 feet of driving and between 1000 feet and 2000 feet of longhole drilling - but might pay for itself in development ore before mining starts. Work on the 183 foot level can be started immediately.

183 FOOT AND 223 FOOT LEVELS - EAST SIDE

Ivanac (1954) suggested that the quartz-hematite bodies plunged to the west. It is now known that there may be an easterly rake but, at the time of preparation of the report, no work had been done on the 160 foot and 295 foot levels, and the western body appeared to cut out near the shaft on the 183 foot and 223 foot levels. A study of the plans of the 183 foot and 223 foot levels suggeststhe possible existence of a fault which displaces the quartz-hematite lode between these levels and acccunts for the apparent cut-out. This fault would strike approximately north-east and dip about 45° north-west. Mr. Richards, in a personal communication, states that the great thickness of the ore shoot on the 160 foot level was caused by a dragfold. The dragfold may be a fault of small displacement, the lode being offset to the north on the east side of the fault. The lessee also states that longhole drilling to the north-east on the 223 foot level has indicated that the lode has been displaced in a similar manner but to a greater extent. Unfortunately, no records of the drilling have been kept. The evidence indicates the existence of a hinge fault, rotating about the 160 foot level, but, until more information is available about this area, no final recommendation for drilling can be made. Longhole drilling to the northeast, from the extreme eastern end of the 183 and 223 foot levels is necessary to confirm that such a fault exists, to measure the displacement, and to locate the eastern part of the lode.

295 FOOT LEVEL

Exploration must be undertaken by means of longhole drilling to ascertain whether drives east and west should be driven in the lode or in the crush zone. The drives should then be controlled by longhole drilling as for the 183 foot level. A raise in the rich patch of ore at 50 W should be put in at an early date to establish the quantity of high grade ore in this section. Complete failure at this level would involve about twelve longholes totalling 600 feet if there is no evidence to justify extending the drive west or starting a drive east. It may be more expedient to drill from the 255 foot sub-level in the winze from the 225 foot level. As this winze extends to 330 feet, in the hanging wall of the lode, exploration could be attempted at this depth if other results are encouraging.

A disadvantage of work on the 295 foot level is the fact that it may be necessary to improve ventilation and equip the shaft below the 183 foot level before work can be started.

EAST LODE

The easiest access to the east lode is the 160 foot level east. Unfortunately, the drive stopped before reaching the thickest part of the lode, the most favourable position for an ore shoot. It may be necessary to drive east in barren ground for 100 feet, with supplementary longhole drilling to reach the most favourable position. As a temporary measure, waste rock could be dumped in the main stope. This stope contains between 1,000 tons and 2,000 tons (estimated) of broken rock of unknown value. If ore is found on the 160 foot level, it would be necessary either to clean out most of this rock, in order to clear the main ore pass, or to construct a new ore pass. The total cost of these operations may exceed the balance of the loan after paying for unsuccessful exploration on the 183 and 295 foot levels. It is recommended that no exploration be undertaken on the 160 foot level until more data are available from the other levels. If the other levels contain adequate reserves, exploration on the 160 foot level should be paid for out of profit.

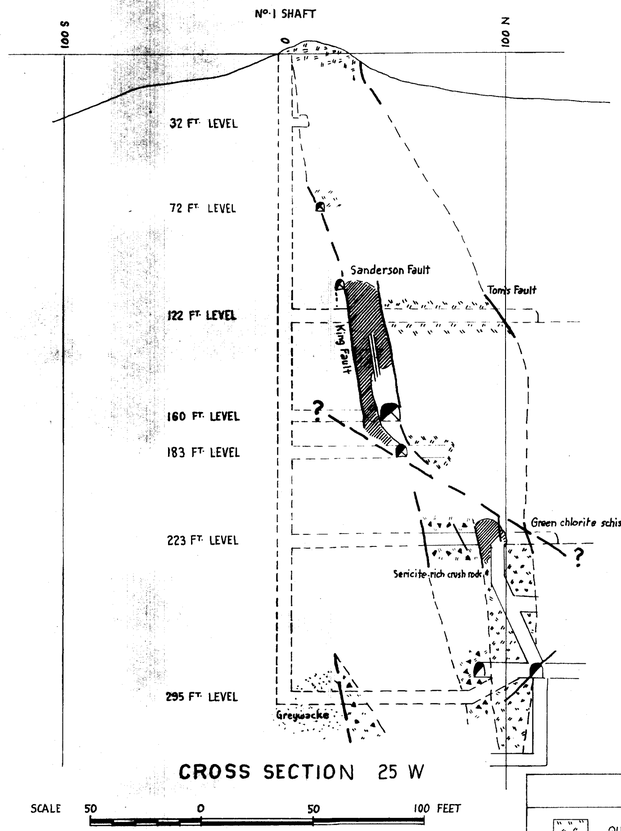
GENERAL

During exploration, every opportunity should be taken to drill through the lode to ascertain the grade of the quartz-hematite, the grade of the crush zone on the north interface, and the thickness of the lode. This is most important on the 183 foot level where lode thickness appears to be the controlling factor in mineralization. Some attempt should be made to maintain a drilling log, even if such a log refers only to hardness and colour. Drilling samples should be separated into five foot sections, quartered, and half the sample panned as a guide to grade; the other half should be kept as a check sample. The cost of assaying longhole drilling samples is not justified because the samples themselves are not sufficiently reliable. Exploration costs will be held to a minimum if assaying is restricted to channel samples in ore of marginal value.

REFERENCE

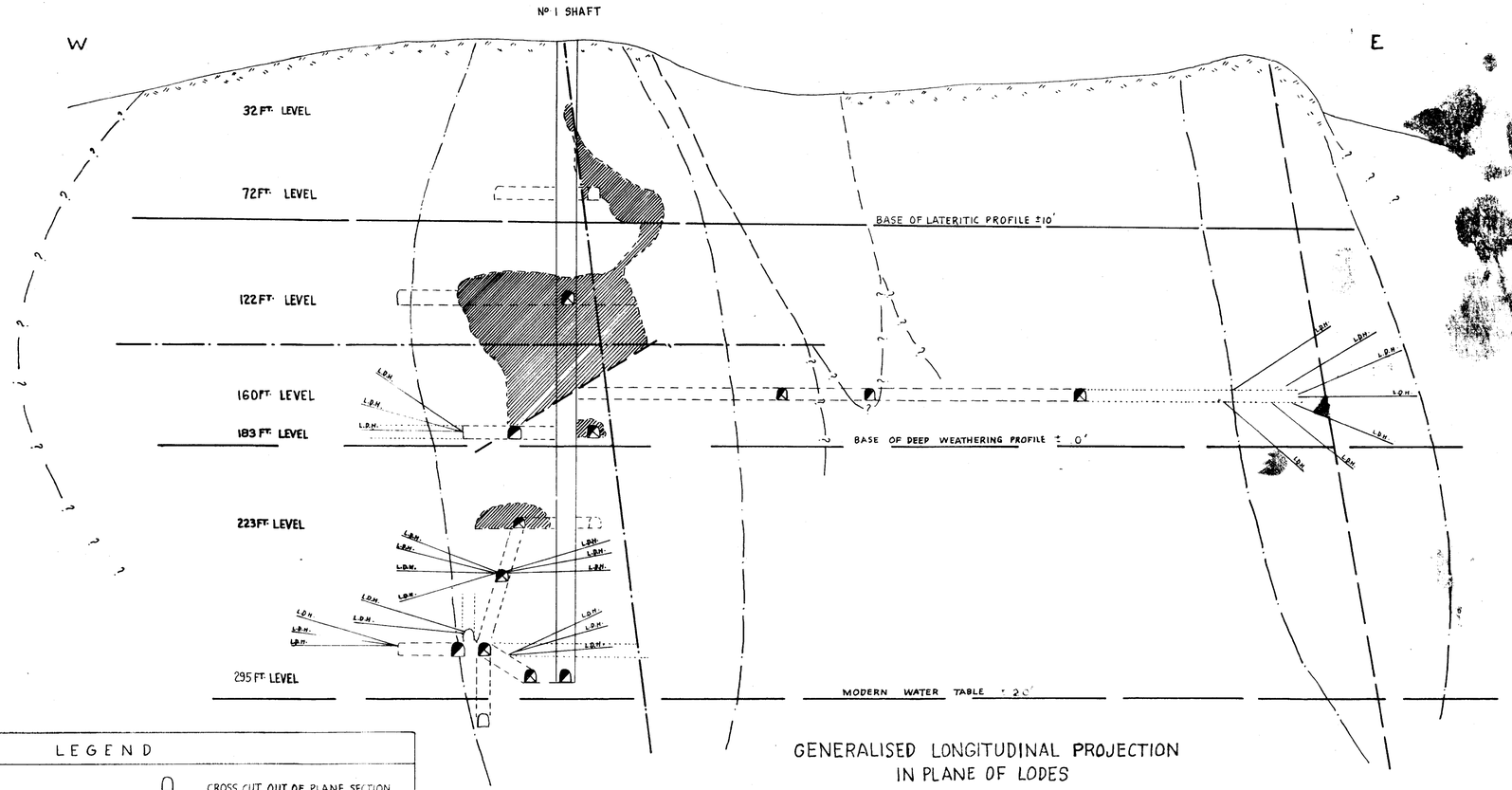
IVANAC, J.F., 1954 - The Geology and Mineral Resources of the Tennant Creek Goldfield, Northern Territory. Bur. Min. Resour. Aust. Bull. 22.

PLATE . I.



CROSS SECTION 25 W

SCALE 50 0 50 100 FEET



GENERALISED LONGITUDINAL PROJECTION
IN PLANE OF LODES

SCALE 50 0 50 100 FEET

LEGEND

- QUARTZ HEMATITE
- HEMATITE RICH ALTERED COUNTRY ROCK
- SLATE WITH SANDY BANDS
- STOPED ORE
- FAULT OR SHEAR PLANE
- " " " INFERRED
- INFERRED BOUNDARY
- CROSS CUT OUT OF PLANE SECTION
- " " INTO " "
- " " THROUGH " "
- L.D.H. LONG DRILL HOLE
- PROPOSED NEW DRIVES
- LIMITS OF ZONE MOST FAVOURABLE FOR MINERALIZATION

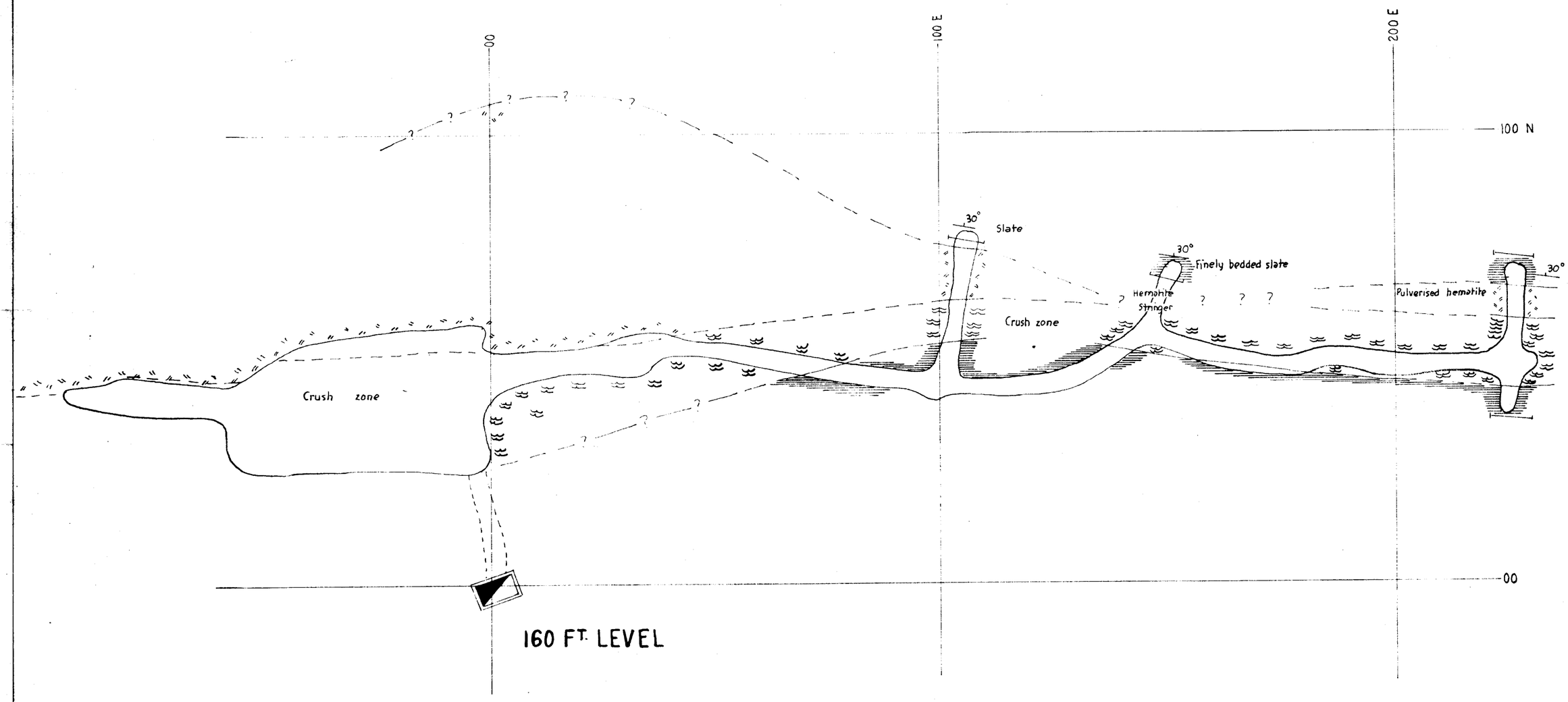
ENTERPRISE GOLD MINE

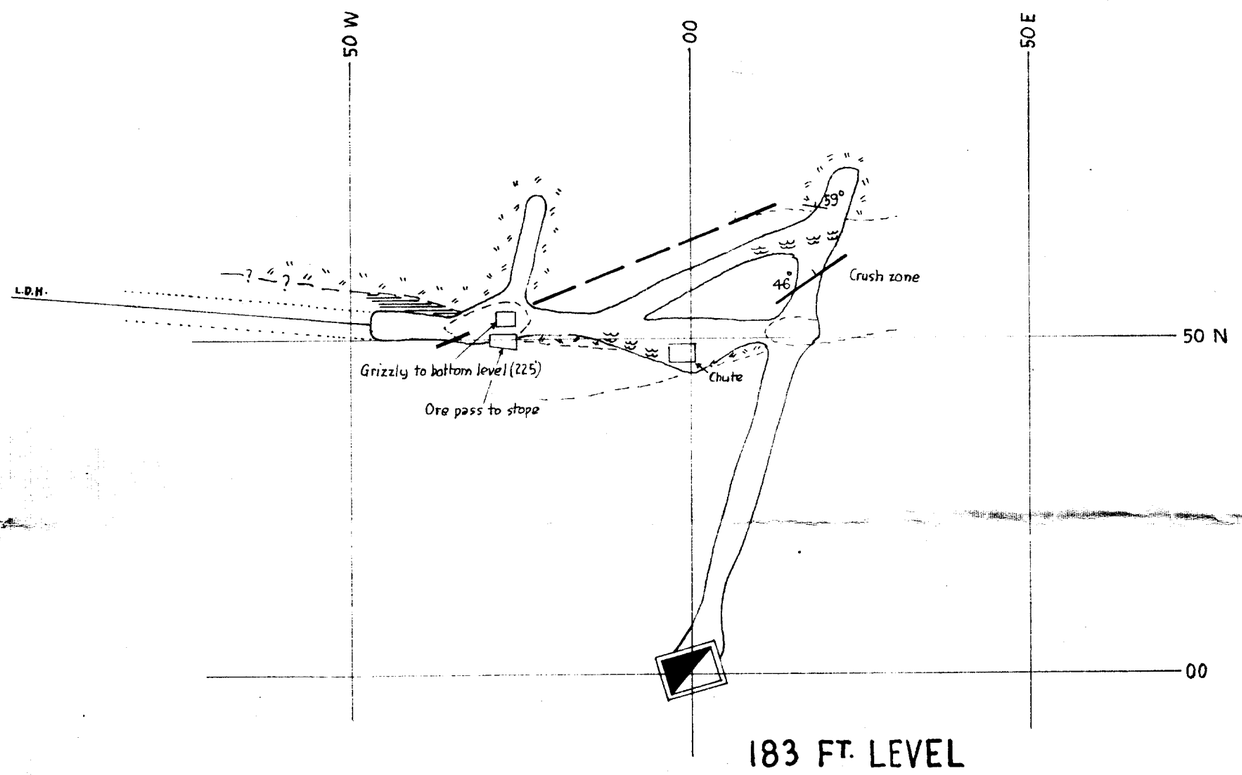
TENNANT CREEK GOLD FIELD

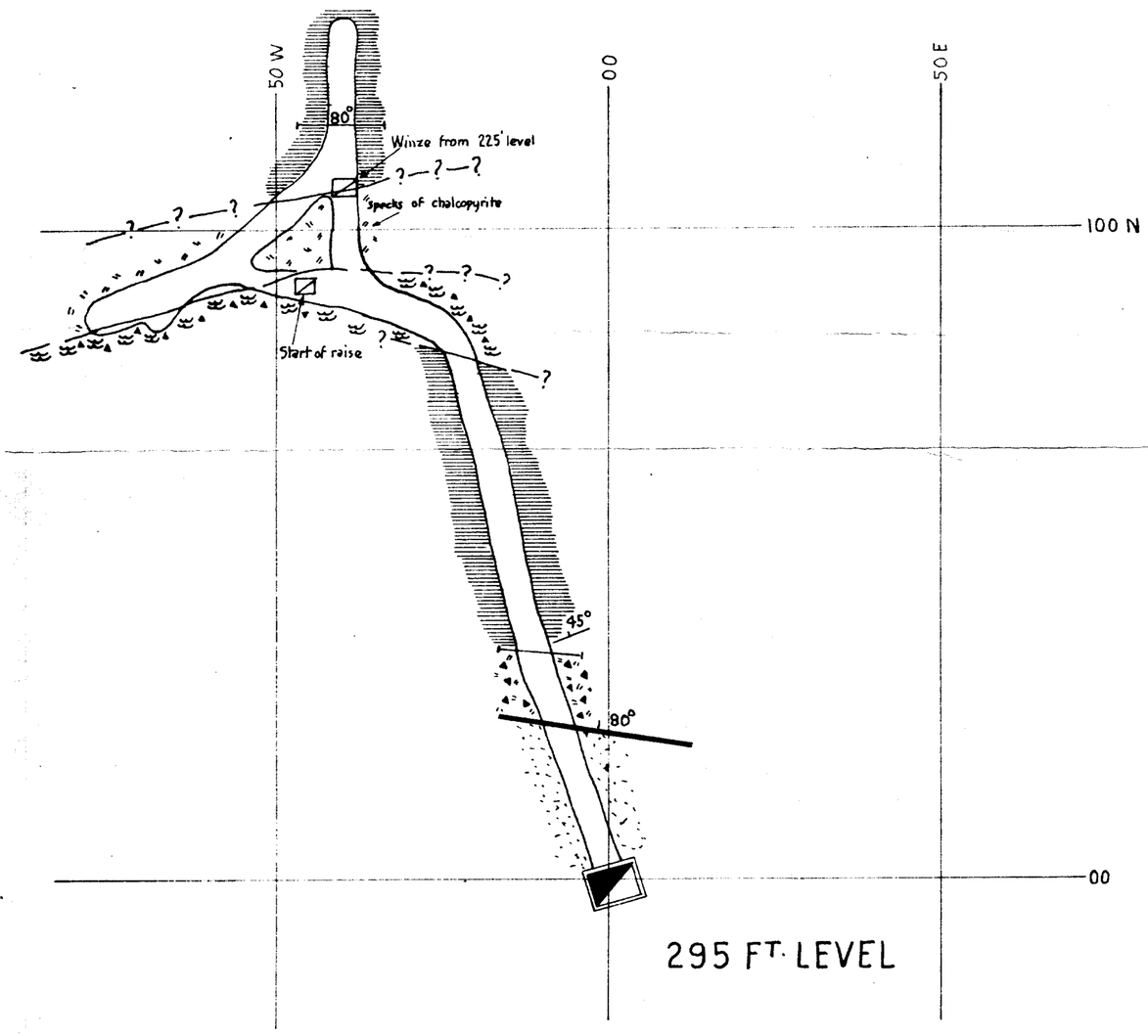
NORTHERN TERRITORY

RESIDENT GEOLOGISTS OFFICE BUREAU OF MINERAL OF MINERAL RESOURCES, DARWIN, N.T. OCTOBER 1960

PLATE.2.







LEGEND

- CRUSH ZONE - SERICITISED AND CHLORITISED SLATE
- " " " " " " BRECCIATED
- HEMATITISED COUNTRY ROCK
- SLATE WITH FEW SANDY BANDS
- QUARTZ-HEMATITE LODE
- SLATY GREYWACKE
- DIP AND STRIKE OF BEDDING
- LARGE SHEAR PLANE
- VERTICAL CLEAVAGE
- DIP AND STRIKE OF CLEAVAGE
- INFERRED FAULT

LEVEL PLANS
ENTERPRISE GOLD MINE
TENNANT CREEK GOLD FIELD
NORTHERN TERRITORY

SCALE 25 0 25 50 FEET

RESIDENT GEOLOGISTS OFFICE, BUREAU OF MINERAL OF MINERAL RESOURCES, DARWIN, N.T. OCTOBER 1960