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DIAMOND DRILLING AT COSMOPOLITAN HOWLEY MINE,
NORTHERN TERRITORY.

by

A. Vanderplank



The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

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SUMMARY.

The individual results of previous diamond drill holes at Cosmopolitan Howley Mine are reviewed and both the general geology of the area and the local geology of specific gold workings are discussed. Additional data from five recent diamond drill holes are presented and it is concluded that the two lodes encountered at the extremities of the present underground workings have inferred reserves of 25,000 tons of ore with a grade of 9 to 10 dwts/ton Au. Probable adjacent lodes could increase these reserves.

It is recommended that future exploration of the lodes mined from the main workings of the Cosmopolitan Howley Mine be undertaken mainly from the 175' level.

Attention is drawn to several untested possibilities of auriferous mineralisation in the area.

INTRODUCTION.

The Cosmopolitan Howley gold mine is situated $\frac{1}{2}$ mile north of the Fenton turn-off on the Stuart Highway, 110 miles from Darwin.

Five diamond drill holes were put down by the Northern Territory Mines Branch during the dry season of 1963. This report covers the results of that drilling programme and the investigations undertaken during the period of drilling.

HISTORY.

Mining on a significant scale started at the Cosmopolitan Howley in 1893 and continued until about 1904. About 50,000 tons of ore averaging 14-15 dwts/ton of gold were mined during that period.

In 1936 Anglo-Queensland Mining Pty. Ltd., sank a shaft to 175 feet and drove at that level for about 250 feet. Only one payable intersection was made (10.8 dwt/ton over 25 feet). Most of the exploratory driving on the 175 ft. level was confined to the footwall of the ore-bearing horizons - the pitch of the lodes being flatter than had been anticipated.

In 1939 the Aerial Geological and Geophysical Survey of North Australia surveyed the area, but due to the second World War the results were not published until 1952 (Bureau of Mineral Resources Bulletin 12). McKeown (1949) reported on the prospects for a syndicate. In 1955 Brocks Creek Uranium N.L. cleaned-out the Anglo-Queensland shaft and discovered a lode, 45 feet north of the shaft, which averaged 8.1 dwt/ton over 27 feet. Brocks Creek Uranium N.L. then started shaft sinking 350 feet along the strike to the east. A lack of funds brought that venture to a close before the shaft had gone to any depth.

In 1957 the northern limb of the Howley anticline was mapped on a scale of 1" to 40' by the Resident Geological Section (McQueen, 1959).

PREVIOUS DIAMOND DRILLING

A number of diamond drill holes have been put down at the Cosmopolitan Howley - all by Government agencies. They are:-

Hughe's No. 1 Bore.

Little information is to be obtained on this bore. McKeown states: "This hole was drilled early in the war period from a site west of No. 3 bore. Values not exceeding 3 dwt of gold per ton were obtained to a depth of 140 feet. It is stated that the bore reached a depth of 180 feet, but that the core from 140 ft. to 180 ft. was lost; this section was said to be heavily mineralised."

Mines Branch No. 1 Bore.

This bore was drilled in 1948 by the Mines Branch into the northern flank of the anticline, near the main shaft. The results of this bore have been reported on by Sullivan and Iten (1952). Core recovery was poor and no sludge samples were taken. Between 244 and 374 feet the core averaged 3.8 dwt/ton of gold. Sullivan considered the grade to be understated due to the poor recovery, but this is not necessarily so. The drill probably intersected graphitic shales down to about 244 ft. and the results to that depth are better than any which have been found in graphitic shale cores elsewhere.

Mines Branch No. 3 Bore.

This hole was drilled into the "nose" of the anticline, in the opposite direction to the pitch of the workings in No. 2 open cut. Recovery was very poor, but sludge samples were taken. Grades encountered in cores were similar to No. 1 Bore, but the sludge samples were much higher. Between 165 and 250 feet the sludges contain an average of 10 dwt/ton of gold.

B.M.R. No. 1 Bore.

This hole was drilled late in 1957 to a depth of 661 ft. The hole was in the same section as Mines Branch No. 1 bore, but it was collared further back and intersected the favourable horizon at a greater depth. Recovery was good. It appears, however, that plunge was not taken into account, and the hole probably passed below the lode worked in No. 5 open cut. No significant values were encountered.

B.M.R. No. 2B Bore.

This hole was drilled in 1958 to a depth of 382 feet. The target was the lode worked in No. 5 open cut on the northern limb. Recovery in the mineralised sections was fair. Two intersections were made; one of 25 feet averaging 3.6 dwt/ton of gold, and another of 16 feet averaging 8.6 dwt/ton of gold.

B.M.R. No. 3 Bore.

This hole was drilled in 1958 to a depth of 352 feet. The hole passed immediately east of No. 5 open cut and the intersection probably represents a lode which would have cropped out between the No. 5 and No. 7 open cuts and which the early miners made no attempt to mine. The 10 ft. intersection assayed 6.8 dwt/ton of gold.

STRATIGRAPHY.

The rocks in the vicinity of the Cosmopolitan Howley Mine are thermally metamorphosed sediments of the Lower Proterozoic Golden Dyke Formation and comprise the following succession:

STRATIGRAPHY (continued)

Limestone
Siltstone
Graphitic Shale
Chloritic Schist

Chloritic Schist

Chloritic schist occurs in the inner part of the Howley anticline, where the beds have been tightly compressed and subjected to a greater degree of dynamic and thermal metamorphism than the rocks in other parts of the area.

Fine-grained chloritic schists predominate in this unit. Micaceous, biotitic, quartzitic and graphitic variants are interbedded in the sequence, but are difficult to map because of poor exposures. Compositional variations plus metamorphic effects have yielded the following rock types: fine-grained chloritic schists, coarse-grained chloritic mica schists, micaceous and chloritic schists with andalusite, micaceous chloritic argillite (a rock with mica grains which are barely visible to the naked eye, set in a light green matrix which is probably composed of iron-bearing silicates; the rock has no cleavage), carbonaceous slates and quartzite.

Thermal metamorphism has given rise to schists which are spotted in places by andalusite, chlorite rosettes and possibly garnet. Near the nose of the Howley anticline and towards the contact with the overlying graphitic shales, the chloritic schists have been metasomatically altered to yield a suite of rocks which are commonly silicified and in which schistosity has been destroyed to varying degrees. These rocks have also been heavily mineralised.

Graphitic Shale

The graphitic shale forms a 500 ft. thick unit which displays less lithological variation than the other sequences. The dominant rock throughout the unit is a sooty-black fine-grained graphitic shale. Towards the edges of the sequence some lithological variations are evident.

The graphitic shale has been referred to as "carbonaceous siltstone" by previous workers (McQueen, 1959). However, near the Cosmopolitan Howley Mine most of the shale is free of any clastic material. The graphite in the shale appears to have hindered the recrystallisation of the other constituents of the rock, which therefore has a lower apparent grade of metamorphism than the surrounding schists and phyllites.

The top of the graphitic shale is transitional and is identified by beds of micaceous, silvery-grey shale.

The lower contact of the graphitic shale is arbitrarily taken as being marked by the occurrence of the first rocks in which no graphite is megascopically visible, fault surfaces excepted. This division results in some graphite-bearing beds being included with the chloritic schist sequence. In drill cores this division is satisfactory, but on the surface the contact is difficult to locate.

Towards the lower contact of the graphitic shale some beds contain ash-grey shale intercalations composed of quartz and kaolin segregations. Other beds are more schistose and contain a diversity of tabular and acicular minerals. These

rocks are commonly similar to the chlorite schists but contain a higher graphite content. They are similarly metamorphosed and mineralised near the crest of the Howley anticline. A conspicuous feature of the mineralised portions along the graphitic shale/chlorite schist contact is the appearance of quartz lenses and nodules in the schists.

The term "schist with quartz lenses" is used to describe rocks containing lenticular to spheroidal quartz bodies in a silicate matrix. Where banded, the silicate matrix is not usually foliated.

The quartz lenses only occur in beds of the chlorite schist and graphitic shale sequences of the Golden Dyke formation - even in the graphitic shale, however, they are accompanied by a silicate matrix rather than one which is purely graphitic. The matrix is generally coarser grained and less foliated than in equivalent rocks which are unaccompanied by quartz lenses. The greatest concentration of quartz lenses occurs within 500 feet of the crest of the Howley anticline.

The quartz lenses vary greatly in size - some are pea-sized, others are six inches wide and a foot long. In the narrow stopes 100 feet southwest of No.2 shaft the lenses take on the form of thin, parallel rods up to 8 feet long.

At a few localities, spheroidal bodies can be seen to have been partially developed in siliceous bands. This suggests that the quartz lenses could, in part, be boudins. Many of the lenses, however, show no relationship to any particular band.

The schists with quartz lenses have, in the past, been referred to by a number of names including "nodular siltstone" and "silicified dolomite".

Siltstone.

This is the thickest of the locally exposed units and is composed of 2,000 feet of interbedded siltstones and phyllites. Siltstones predominate in the sequence. They are typically light grey-brown at the surface where quartz and mica are their only recognisable components. The rocks have a strong secondary foliation, and this imparts a sheen to the rocks, which is noticeable in even badly weathered specimens.

Although the present fabric is largely metamorphic, sedimentary structures are well preserved. Delicate cross-bedding was noticed in a few specimens.

Phyllite beds are intercalated in the sequence but they do not outcrop prominently. Some are highly micaceous, but all gradations to siltstone exist. Near the mine, a chistolite-bearing phyllite forms a useful marker at the base of the sequence.

Fine-grained quartzite is fairly common in the sequence. The quartzite, too, grades into the typical siltstone. A few pieces of chert were also found in scree shed by the formation.

Limestone.

The ferruginous outcrop which flanks the Stuart Highway south-west of the mine appears to have resulted in the weathering of limestone.

The outcrop is composed almost entirely of goethitic iron oxides and chert with minor amounts of manganese oxides. Chert is usually strongly fractured in a manner strongly reminiscent of desiccation cracking in mud, but some of the chert bands more than 6 inches thick are unbroken.

This unit forms a distinctive chocolate-brown soil which supports a thicker stand of vegetation than other local soils.

STRUCTURE.

The most prominent feature of the area around the Cosmopolitan Howley is the Howley anticline. At the mine, the plunge of the anticline is approximately 55° to the north-west. The anticlinal axis flattens to the north-west and eventually reverses its pitch, so that the chloritic schist/graphitic shale contact which plunges below the surfaces at the Cosmopolitan Howley, reappears at the Bridge Creek mine some 8 miles to the north-west. Graphitic shales, however, crop out along the entire length of the anticlinal axis (known as the Howley line). The graphitic shales appear to have been "squeezed" upwards in the axial plane.

Locally, the Howley anticline is a composite structure. A number of smaller anticlines and synclines have formed near the crest of the Howley anticline, within the upper portions of the chloritic schists and in the lower portion of the graphitic shales. These minor structures play a major role in ore localisation, but their geometry is complex and their attitude does not always reflect that of nearby larger structures. Moreover, the minor folds are often conical rather than cylindrical. Small faults with scalloped surfaces, which appear to have relieved local stresses, are frequent.

The axial plane of the Howley anticline was a zone of weakness in which shearing and some silicification occurred. A prominent east-west trending lineament passes through the workings on the northern limb of the Howley anticline.

MINERALISATION.

Gold mineralisation at the Cosmopolitan Howley Mine is localised in schist bands characterised by the presence of quartz lenses. Those bands are restricted to the vicinity of the contact between the chloritic schist and the graphitic shale, but they may occur on either side of this contact.

There is some evidence of structural control of the auriferous deposits. On a regional scale the lodes, as indicated by old workings, occur as separate ore bodies, conformable with the chloritic schist and graphitic shale bands, and found to be widest at the crest of the Howley anticline. Locally, individual lodes are concentrated in the axial portions of minor folds; for example, the workings around No. 2 open cut can be seen to coincide with the crests and troughs of smaller folds within the Howley anticline.

Other workings between the Cosmopolitan Howley and the Bridge Creek mine, 8 miles to the north-west, appear to be localised by fractures occurring in the axial plane of the Howley anticline.

MINERALOGY OF THE LODES.

The lodes show considerable mineralogical variation. The auriferous portion of D.D.H.2B consists largely of an intergrown mosaic of quartz and chlorite, with no distinct quartz lenses but only some diffuse siliceous bands. The auriferous material from D.D.H.6 consists of clearly outlined quartz lenses and sulphide blebs in a matrix composed entirely of intergrown plates of a dark, greenish grey, sectile mineral - possibly one of the chloritoid group.

Pyrite is the most common mineral in the lodes. Arsenopyrite is common in the area but does not appear to have any relation to the gold mineralisation, being earlier than the silicification and the introduction of the sulphides which accompanied the gold.

Some free gold occurs in the unoxidised ore but it tends to be very fine-grained. The gold distribution within the lodes, however, still has to be determined.

Minor amounts of chalcopyrite and pyrrhotite have also been observed (Appendix, McQueen, 1959).

GRADE.

The two batteries operating at the Cosmopolitan Howley between 1893 and 1904 reported recoveries averaging about 14 dwt. gold per ton. Since the batteries treated custom ore for tributors there is little likelihood of an overstatement of grade. Blanchard interviewed an old Chinese who maintained that specimen ore was never sent to a battery but dollied underground and the gold kept by the tributors.

Little is known of the vertical distribution of values. If it is accepted that supergene enrichment of gold has occurred, then ore milled in the past was probably richer than primary lode material at the Cosmopolitan Howley.

Anglo-Queensland Mining Co. carried out detailed surface sampling (Sullivan and Iten, 1952, Plate 2). Their results were consistently low, even where the sample channels passed over the backs of workings. This, together with the tendency of the tributors to leave backs, suggests that the gold content of the top 20 feet or so of the lodes was considerably reduced by leaching. The possibility of surface leaching of gold should, therefore, be taken into account in any future prospecting programme in this area.

AURIFEROUS AREAS AT THE COSMOPOLITAN HOWLEY.

Commencing at No. 7 open cut (Plate 2), and proceeding around the crest of the Howley anticline in a counter-clockwise direction, the main areas of earlier mining are as follows:

No. 7 open cut.

This lode occurs in a lenticular graphite-silicate shale band which is flanked on both sides by graphitic shale. The footwall graphitic shale is highly sheared and probably about 20 feet thick. The graphitic shale is in contact with unaltered graphitic schist. The mineralised graphite-silicate shale band is probably an "impure" member of the graphitic shale succession. Quartz lenses and ribbon-like siliceous bands are conspicuous in the lode.

7.

The downward extension of this lode has not been located. Sullivan (1946) considered that the lode plunges westward at an angle of 40° on the basis of orientation of the old workings. D.D.H. No. 5 was sited accordingly. A stratigraphic sequence similar to that at No. 7 open cut was intersected but quartz lenses were not seen and the gold assays ranged from a trace to 0.7 dwts per ton.

No. 9 open cut.

There is little similarity between the lodes exposed in No. 9 and No. 7 open cuts. The lode in No. 9 open cut is 5 feet wide and occurs at the contact between the graphitic shale and altered chlorite schist. The wall rocks of the lode are graphitic and the lode is thought to represent a silicate-rich member of the graphitic shale succession.

The lode has been offset from the lode at No. 7 open cut by folding and possibly faulting. The folding responsible for the offset appears to have formed a small west-plunging syncline. No. 9 open cut is on the northern flank of the syncline and it is possible that the lode could continue into the trough of the syncline. Diapiric folding could have caused the absence of the ore-bearing horizon in the axial regions of the fold, but such a structural control would be contrary to that normally found at the Cosmopolitan Howley.

No. 5 open cut.

No. 5 open cut is situated in altered chlorite schists near the black shale contact on the limb of the anticline. It is possible that a number of discontinuous lodes were mined from the open cut: at least two are indicated by D.D.H. No. 2B.

In the absence of any evidence to the contrary it has been assumed that the lode(s) plunge 55° west parallel to the regional plunge. The ore intersected by Brock's Creek Uranium on the 170 ft. level, then, is part of the Open Cut No. 5 system, but the values encountered in B.M.R. D.D.H. No. 3 are part of a separate lode situated east of the open cut.

No. 1 open cut.

No. 1 open cut occurs at the crest of the northernmost of the minor anticlines which have formed within the Howley anticline. The deepest portions of the open cut are on the western and southern edges of the open cut. The walls are graphitic shale. This suggests that the richest ore was in the chloritic schists at the contact of the graphitic shale unit. D.D.H. No. 6 which was intended to test the downward continuation of this lode intersected fault gouge at this horizon and no values, indicating that the lode had probably been sheared out.

No. 2 open cut lode system.

The No. 2 open cut lode system comprises those lodes which were mined from the very large stope - the largest in the Cosmopolitan Howley Mine - which leads off No. 2 open cut, a 6 ft. wide vertical stope which leads off the south-west corner of the large stope, and some smaller adjoining stopes.

The overall structure of this area is synclinal.

The stratigraphic position of the lodes is difficult to ascertain since the rocks have been highly altered. They have been tentatively included in the silicate zone of the graphitic shale on structural grounds.

The workings occur where the contact-zone rocks have been tightly folded in the axial plane of the Howley anticline and could therefore be expected to be high grade.

Attempts at obtaining underground intersections of these lodes have not proved successful. D.D.H. No.3, described by Sullivan and Iten (1952, as well as D.D.H. 7A of the recent programme both yielded unsatisfactory recoveries but gave encouraging indications. The crosscut on the 170 level passed through the footwall portion near the lodes (see Plate 3).

No.2 shaft area.

Minor lodes in the anticline at No.2 shaft were worked immediately south-east of the shaft. The surface workings extend no deeper than some thirty feet. The lode, however, was intersected on the 170 ft. level where it had grown to appreciable dimensions. Surface workings indicate that the anticline widens downwards and this is confirmed by the underground data.

No.3 open cut lode system.

The mineralised zone worked in No.3 open cut and associated stopes is separated from the zones mentioned above by a "blank" in both information and mining activity. Plans of claims registered in 1893 indicate that these workings were among the earliest in the field.

No.3 open cut is not deep, but workings which can be traced down to water level, at a vertical depth of 105 feet, lead off the north-western extremity of the open cut. They are easily accessible from the round opening in the open cut. To the south-east of No.3 open cut a number of shafts and surface workings have exposed a lode which is controlled by an anticlinal structure, but no other information is obtainable. McKeown (1949) considers it likely that the workings extended to the large shaft to the south-west of the south-eastern extremity of the open cut. He reports that the shaft was said to have been equipped by the Chinese with an engine and a pump, and produced ore of 6 oz. gold per ton.

The lodes which have been stoped occur within the chloritic schist some distance from the graphitic shale - the stopes to the south-east being the furthest removed from the contact.

No.4 open cut.

A line of workings stretch from No.4 open cut to the south-east. They appear to have been stoped down to water level which stands at 40 feet. The stopes near No.4 open cut have caved and their former extent is not discernible. These stopes occur at the contact of the chloritic schist and the graphitic shale, in an altered section of the chloritic schist which is only 40 feet across. The overlying graphitic shale contains a thick band of siliceous shale, which has been recrystallised with extensive development of quartz lenses.

No.4 open cut is in the trough of a syncline which becomes tighter in a downward direction. The syncline has an orientation similar to the syncline to the east of open cut No.3 and it seems probable that the two sets of workings occur on different horizons in the same structure.

Other workings.

There are many other workings away from the nose of the Howley anticline. The old records state that only a small portion of the Cosmopolitan Howley's gold came from the nose, - the size of the workings, however, offers little support for such a contention.

The hematite outcrop at the nose of the inner fold was tested by D.D.H. No. 8 but no significant values were obtained. McKeown (1949) reports that the hematite, at the surface, contains between 0.5 and 6.2 dwts./ton of gold.

CURRENT DRILLING.

Two N.T.A. Mines Branch drill rigs were moved to the Cosmopolitan Howley in July 1963. The first two sites were those chosen by Sullivan and Iten (1952) in B.M.R. Bulletin 12 as D.D.Hs. No. 4 and 5 respectively. No significant values were encountered in the cores.

No. 4 appears to have penetrated the downward continuation of the unstoped flank of the open cut. The copper assays were undertaken because of faint malachite stains.

No. 5 appears to have missed the No. 7 open cut lode. Sullivan calculated the pitch of the lode to be 40° which appears to be low by regional standards. It is not known whether the hole passed above or below the lode, - assuming that the lode continued to the target zone.

No. 6 was intended to test the downward continuation of the No. 1 open cut lode. The bore is positioned slightly south of and nearer the open cut than Sullivan's D.D.H. No. 2. The shift southward was undertaken in the hope of penetrating the No. 2 open cut lode as well. Some heavily mineralised sections were encountered, but the only significant gold assays came from pyritic schists with quartz lenses - 4.33 dwt. over 15 feet. These are probably part of the No. 2 open cut lode system. The No. 1 open cut lode appears to have been sheared out.

No. 7 was drilled near Sullivan's D.D.H.3. A large solution cavity was encountered at 100 feet and the drill was moved further away from the workings. No. 7A was drilled in the same section as D.D.H. 7 and similar conditions of poor, cavernous ground were encountered. It was decided, however, to continue with the hole despite a shortage of casing, and extensive use had to be made of cement and bentonite. Recovery was extremely poor and the values encountered can hardly be taken to have any significance. It is interesting that while sludge of the old D.D.H.3 had considerably higher gold values than the core, the reverse was true in D.D.H.7A. Poor sludge values were probably the result of the very weak outflow of water from the bore. The 7 inches of quartz fragments recovered from between 145 and 175 feet assayed 11.6 dwt; the 1 ft. 6 inches of quartz fragments recovered from between 115 ft. and 124 ft. 5 inches assayed 7.7 dwt, and the 3 ft. 9 inches of schist and quartz recovered from between 124 ft. 5 inches and 130 ft. assayed 4.2 dwt. Below 130 ft. typical footwall schist was intersected.

D.D.H. No. 8 was drilled to test the hematite crescent of the inner fold. Recovery was fair but no significant values were encountered.

Late in November, 1963, the drills were moved to Pine Creek.

FUTURE PROSPECTS.

Because of the irregularity of the lodes at the Cosmopolitan Howley, the considerable expenditure at the mine in the past has not always yielded satisfactory results. However, some encouraging intersections have been made. The two lodes encountered at the extremities of the underground workings could yield about 25,000 tons of ore (inferred reserves) grading between 9 and 10 dwt. of gold per ton. Other lodes which are almost certain to be in close proximity to the present underground workings could considerably increase the available tonnage.

Future exploration of the lodes which were mined from the main workings at the Cosmopolitan Howley mine can more effectively be undertaken from the 175 ft. level. The Brock's Creek Uranium N.L. drive should be extended in both directions as shown in figure 3. Further driving should proceed from the Anglo-Queensland Mining Pty. Ltd. crosscut into what can be expected to be the heart of the No. 2 open cut lode system. Further development should await the completion of a programme of long hole drilling from the workings.

A large area of schist with quartz lenses in the vicinity of the mine, particularly south of No. 4 open cut, remains untested, and the grade of this material is not necessarily uneconomic because the rocks have been ignored in the past.

Furthermore, gold mineralisation along the graphitic shale/chloritic schist contact at the crest of the Howley anticline might well continue for a considerable distance, and this zone might be fairly close to the surface in many places.

The Golden Dyke mine about ten miles east of the Cosmopolitan Howley is very similar to the Cosmopolitan Howley mine, and there is no reason why additional occurrences of auriferous quartz-lens schists should not be found in the Brocks Creek district.

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APPENDIX

LOGS AND ASSAY RESULTS OF DIAMOND DRILL HOLES.

COSMOPOLITAN HOWLEY MINE

DIAMOND DRILL HOLE No. 4

LOCATION: South-west of No. 3 open cut

BEARING : 54° (magnetic) DEPRESSION: 50°

DRILLING STARTED: 22nd July, 1963 DRILLING FINISHED: 6th September, 1963

DRILLER : D. Daniels

FINAL DEPTH: 249' 6"

<u>DRILL RUN</u>			<u>CORE DESCRIPTION</u>	
<u>From</u>	<u>To</u>	<u>Recovered</u>		
0'	6'	1'3"	0'-6'	Brown Soil
6'	10'	4'	6'-28'	Soft graphitic shale of poor fissility
10'	12'9"	2'9"		
12'9"	19'9"	6'		
19'9"	29'	8'4"	28'-28'6"	Massive vein quartz-no hematite.
29'	37'	3'6"	28'6"-30'	Soft graphitic shale
			30'-32'	Quartz veins in graphitic shale, vuggy and slightly hematitic.
			32'-36'	Soft graphitic shale, faintly gossanous in places.
37'	39'6"	10"	36'-37'3"	Quartz veins in graphitic shale, slightly hematitic.
39'6"	43'	2'6"	37'3"-40'	Crumbly graphitic shale containing bleached patches.
43'	47'	2'10"	40' - 61'	Soft, weathered graphitic shale, poorly fissile and slightly contorted.
47'	49'6"	1'5"		
49'6"	50'	6"		
50'	54'	3'9"		
54'	55'6"	1'6"		
55'6"	57'	1'		
57'	59'	1'4"		
59'	61'	1'9"		
61'	63'8"	2'	61'-71'	Poorly fissile graphitic shale with occasional bleached fracture surfaces.
63'8"	66'6"	2'5"		
66'6"	75'	7'8"	71'-77'	Graphitic shale with flaggy lamination.
75'	79'6"	3'10"		Lamellae separated by thin, very soft layers, -inter-lamellar variation minimal.
79'6"	80'6"	1'	77'-79'	Hard graphitic shale breaking into angular fragments.
			79'-80'6"	Gossanous, fractured vein quartz. Gossan is massive hematite with occasional cavities.
80'6"	81'	4"	80'6"-86'6"	Slightly gossanous vein quartz with a few pyrite specks. The vein quartz is massive and coarsely crystalline.
81'	82'2"	6"		
82'2"	83'10"	4"		
83'10"	86'6"	8"		
86'6"	95'	1'5"	86'6"-98'	Indurated graphitic shale.
95'	105'	2'	98'-105'	Highly gossanous, red-stained graphitic shale with patches of massive hematite.
105'	111'6"	10"	105'-125'	Massive graphitic shale with sugary quartzite. Individual graphite grains visible to the naked eye
111'6"	125'	1'		
125'	130'	1'4"	125'-130'	Sugary quartzite with massive vein quartz and massive hematite.

DIAMOND DRILL HOLE No. 4. (continued)

<u>DRILL RUN</u>			<u>CORE DESCRIPTION.</u>
<u>From</u>	<u>To.</u>	<u>Recovered</u>	
130'	132'	1'8" 130'-133'	Massive, fine-grained (\pm 0.5mm), dark green granoblastic chlorite schist. Bedding still preserved. Rock stained brown-red in places. Pyrite blebs - oxidation has destroyed finer grained sulphides. Sulphide content of rock 1%
132'	134'	1'3"	
134'	137'	2'6" 133' -138'3"	Grey granular quartzite with faint malachite staining along fracture planes. Minor pyrite in scattered specks, 1%.
137'	140'	3' 138'3"-155'	Fairly massive, fine-grained granoblastic schist containing isolated garnet porphyroblasts. Patches of rock altered to grass-green material composed of a rather tabular mineral which is too green to be chlorite. Bedding and cleavage are destroyed by this alteration. Hematite is found in the form of -
140'	142' 7"	2'7"	(a) Bright red powdery bands and blebs.
142' 7"	143' 6"	8"	(b) Fine-grained specularite, normally bedded but also occurring as irregular masses within the grass-green patches..
143' 6"	144' 9"	1'2"	Sulphides - mainly pyrite with minor arsenopyrite show a distinct preference for particular beds. Transgressive pyrite blebs only where rock is fractured or altered to bright green mineral. Sulphides compose 5% of the rock.
144' 9"	145' 3"	3"	
145' 3"	151'	4'5"	
151'	155' 3"	2'2"	
155' 3"	159'	3'6" 155' - 158'	Dark, almost black fine-grained biotite schist containing porphyroblasts of garnet and chlorite.
159'	160' 6"	1'4" 158' - 160'9"	Spotted chlorite schist containing porphyroblasts of garnet and feldspar. Some small seams of chrysotile along fracture planes. 2% disseminated sulphides.
160' 6"	162'	1'2" 160'9"-162'	Fine-grained, granular quartzite containing intermixed garnet and some blebs of bright green silicate.
162'	168' 6"	4'5" 162' - 165'	Chlorite schist with numerous porphyroblasts of actinolite (?) and feldspar. Disseminated pyrite 1%.

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DIAMOND DRILL HOLE No. 4 (continued)

<u>DRILL RUN.</u>			<u>CORE DESCRIPTION.</u>
<u>From.</u>	<u>To.</u>	<u>Recovered.</u>	
168' 6"	173' 8"	5' 165' - 170' 6"	Chlorite schist with some garnetiferous beds. Rock considerably altered - large patches of bright green silicate with blebs of coarse pyrite; pyrite 5% of rock.
173' 8"	180' 6"	1' 9" 170' 6" - 178' 6"	10" recovered. Garnetiferous quartzite with chlorite patches containing disseminated pyrite and arsenopyrite. 2% sulphides.
		178' 6" - 180' 6"	Chlorite schist with boudins of garnetiferous quartzite. Schist contains feldspar and garnet porphyroblasts.
180' 6"	182' 4"	1' 180' 6" - 185'	Broken core, mainly quartzite with some chlorite schist.
182' 4"	185'	1' 3"	
185'	190'	4' 1" 185' - 194'	Dense, dark green, fine-grained chlorite schist which is probably graphitic (graphite along shear planes). Chlorite growths gives rock a knotted appearance. Quartzite bands and boudins veined by sulphides, particularly around circumference. 2% sulphides.
190'	195'	4' 4"	
195'	201'	2' 2" 194' - 208'	Dark green, hornfelsic phyllite containing disseminated pyrite and arsenopyrite as well as blebs of coarser pyrite. No vein quartz. 5% sulphides.
201'	208'	7'	
208'	212'	4' 208' - 215'	Dark green, hornfelsic phyllite without sulphides.
212'	215' 6"	2'	Quartzite.
215' 6"	220' 6"	5' 215' - 216'	Fine-grained chlorite schist containing some quartz veins and boudins.
		216' - 220'	Coarse-grained arsenopyrite and minor pyrite disseminated within particular bands. 5% sulphides.
220' 6"	225' 6"	3' 1" 220' - 249' 6"	Dark green, fine-grained chlorite schist and hornfelsic phyllite with negligible sulphide content.
225' 6"	235'	4'	
235'	236' 2"	1' 1"	
236' 2"	239' 1"	1' 10"	
239' 1"	241'	1' 11"	
241'	242'	8"	
242'	244' 5"	3"	
244' 5"	249' 6"	Nil	

ASSAY RESULTS

COSMOPOLITAN HOWLEY - DIAMOND DRILL HOLE NO. 4.

<u>DEPTH</u>	<u>GOLD</u> dwts. per ton.	<u>SILVER</u>	<u>COPPER</u> %
0'-10'	0.3	Nil	
10'-20'	Nil	Nil	
20'-30'	Nil	Nil	
30'-40'	Nil	Nil	
40'-50'	Trace	Nil	
50'-60'	0.2	Nil	
60'-70'	Trace	Nil	
70'-86'6"	0.3	Nil	
86'6"-95'	0.2	Nil	
95'-105'	Trace	Nil	
105'-111'6"	Trace	Nil	
111'6"-125'	Trace	Nil	
125'-130'	Nil	Nil	0.15
130'-133'	2.9	Nil	0.1
133'-138'	0.3	Nil	0.05
138'-140'	Trace	Nil	0.15
140'-142'7"	1.1	Nil	0.1
142'7"-145'3"	1.3	Nil	0.1
145'3"-147'	1.9	Nil	0.2
147'-149'	0.7	Nil	0.1
149'-153'	0.8	Nil	0.1
153'-155'3"	0.4	Nil	Nil
155'3"-160'	Trace	Nil	
160'-165'	Trace	Nil	
165'-170'	Trace	Nil	
170'-175'	Trace	Nil	
175'-180'	Trace	Nil	
180'-185'	Trace	Nil	
185'-189'	0.6	Nil	
189'-195'	0.2	Nil	
195'-201'	1.4	Nil	
201'-206'	2.0	Nil	
206'-212'	0.8	Nil	
212'-217'	1.6	Nil	
217'-220'	2.4	Nil	
220'-244'	0.4	Nil	

COSMOPOLITAN HOWLEY MINE

DIAMOND DRILL HOLE NO. 5

Location: 90 feet north of the eastern extremity of open cut No. 9.
Bearing: 202 degrees magnetic depression: - 50°
Drilling commenced: 8th July, 1963, Drilling finished: 10th August, 1963
Driller: S. A. Berger. Final Depth: 297' 4"

DESCRIPTION OF CORE.

<u>Drill Run.</u> <u>From To.</u>		<u>Core Recovery.</u>
<u>0' - 43'</u>	Mottled, earthy and deeply weathered rock of undeterminable origin.	30%
<u>43' - 47'</u>	Similar mottled rock, coloured light grey in places by graphite	66%
<u>47' - 49'</u>	Weathered shale, crumbly and coloured red with occasional pallid patches.	100%
<u>49' - 53'</u>	Pallid, weathered shale.	100%
<u>53' - 63'</u>	Weathered graphitic shale; grey with occasional pallid patches.	60%
<u>63' - 82'</u>	Grey, graphitic and probably chloritic shale. Except for rare appearances of bleached fracture surfaces, the rock is very homogenous, although it is generally coarsely laminated, but poorly fissile.	45%
<u>82' - 87'</u>	Graphitic shale, more fissile than above.	90%
<u>87' - 90' 4"</u>	Broken core; grey shale of low fissility	60%
<u>90' 4" - 96'</u>	Very fissile graphitic shale. White and red discolouration of fracture surfaces. In places, the rock is finely bedded and laminated. Cleavage is occasionally slightly oblique to bedding - the only instance of slaty cleavage seen in this core.	100%
<u>96' - 98'</u>	Graphitic shale, crumbly, possibly brecciated.	50%
<u>98' - 110'</u>	Graphitic shale, fissile, and in places laminated. Bedding almost parallel to axis of core.	80%
<u>110' - 113'</u>	Somewhat brecciated graphitic shale, slightly gossanous in places	50%
<u>113' - 113' 3"</u>	Vuggy vein quartz	
<u>113' 3" - 129' 6"</u>	Fissile, coarsely laminated graphitic shale. This consists of homogenous beds 1/16 - 1/8" thick, separated by paper thin, weak surfaces now composed largely of voids, quartz and clay. Occasional gossanous seams up to 2" thick. Average attitude of bedding is at about 30° to axis of core.	100%
<u>129' 6" - 151'</u>	Similar to above, except that bedding is parallel to axis of core. Occasional gossanous seams provide only variation to the coarsely laminated, almost flaggy, graphitic shale sequence. At two places, the shale adjacent to gossanous seams is hornfelsic - probably due to silicification.	100%

Diamond Drill Hole No. 5 (continued)

<u>Drill Run.</u>		<u>DESCRIPTION OF CORE.</u>	<u>Core Recovery.</u>
From	To.		
<u>151'</u>	<u>159'</u>	Coarse-grained pyrite occurs at 151' - the first pyrite of the sequence. At 154' even the finer grained pyrite, which occurs as very thin beds, is preserved. Pyrite, occurring as both coarse-grained transgressive seams and blobs, and as bedded pyrite, comprises 1% of the rock of this section.	100%
<u>159'</u>	<u>162'5"</u>	AX core. Graphitic shale with veinlets of pyrite and a single quartz vein. Pyrite comprises 3% of section.	100%
<u>162'5"</u>	<u>169'9"</u>	Core badly broken and ground. Coarse grained pyrite (20% of rock) and quartz conspicuous in broken core. Redrilled material shows that it was largely shale which was ground away.	25%
<u>169'9"</u>	<u>175'</u>	Fairly fissile, but only slightly laminated graphitic shale, locally contorted and veined by pyrite seams up to 1" thick. Pyrite comprises 5% of the section.	80%
<u>175'</u>	<u>176'</u>	Coarse grained pyrite with occasional occluded shale fragments.	
<u>176'</u>	<u>184'</u>	Graphitic shale, varying between massive, poorly fissile and laminated (which is also lightly pyritic) shale. Locally, pyrite may comprise up to 50% of the rock, but the section as a whole contains about 10% pyrite.	100%
<u>184'</u>	<u>186'</u>	Brecciated shale with white, argillic alteration along fractures and cut by quartz and pyrite veins and blebs. 10% pyrite.	100%
<u>186'</u>	<u>187'</u>	Fine grained, massive, quartz-kaolin rock, similar to, but denser and softer than typical hydrothermal porcellanite.	100%
<u>187'</u>	<u>220'</u>	Hard grey, laminated and flaggy shale. Thin white coatings occur on cleavage planes and on occasional cross-cutting fractures. Intralamellar fissility is poor and fracturing is slightly conchoidal in places. There is no interlamellar variation although the thin bedded seams of pyrite may approach 1/8 inch, which approximates the thickness of the finer lamellae. Thicker (up to 1/2 inch) pyrite veins and blebs are transgressive and often accompanied by vein quartz. Pyrite may constitute up to 5% of the rock. Quartz appears in occasional segregations up to 2 inches across, but they are usually separated by 3 feet, or so, of quartz-free shale.	100%
<u>220'</u>	<u>235'</u>	Flaggy grey carbonaceous shale, similar to above except that interlamellar differences are more marked. Most of the shale is still typically argillaceous, but lamellae up to 1/4 inch of coarser grained, probably crystalloblastic shale, occur in limited amounts. In addition, the coarser lamellae show grading in both directions, which tends to destroy the lamellar appearance of the coarser grained material. The crystalloblastic grains are mere milky specks, and are not determinable in hand specimens. These lamellae are fairly gritty and generally very pyritic, - there being a sympathetic relationship between pyrite and granularity. Pyrite comprises 3% of the section.	100%

Diamond Drill Hole No. 5 (continued)

<u>Drill Run.</u>		<u>DESCRIPTION OF CORE.</u>	<u>Core Recovery.</u>
<u>From</u>	<u>To.</u>		
<u>235'</u>	<u>239'</u>	Carbonaceous shale, rather broken up with argillitic alteration along fracture planes. Vein quartz is conspicuous in this section, where it is accompanied by massive pyrite which comprises 10% of the rock as a whole.	100%
<u>239'</u>	<u>248'</u>	Carbonaceous shale of poor fissility with some contrast between beds - both fairly soft and hard, apparently siliceous beds, a few inches thick, are present. Except for minor amounts of bedded pyrite, most of the visible pyrite is in the form of thick transgressive veins and blebs, usually associated with quartz. Pyrite comprises 5% of the section.	100%
<u>248'</u>	<u>257'</u>	Well laminated graphitic shale in which granular lamellae are quite common. There is, however, no associated bedded pyrite. Pyrite only appears in the form of transgressive veins, amounting to 2% of the rock as a whole.	100%
<u>257'</u>	<u>261'</u>	Fairly fissile graphitic shale containing some slickened bedding planes. Blebby pyrite comprises 2% of the section.	100%
<u>261'</u>	<u>270'</u>	Graphitic shale of very low fissility, cut by numerous slickened, subparallel shears. Fairly large fragments of unsheared shale, however, are still preserved. Pyrite blebs comprise 10% of the rock, - no quartz was noted.	100%
<u>270'</u>	<u>293' 10"</u>	Soft, slickensided black shale. The rock consists entirely of flakes and fragments of a highly graphitic sediment which has been fragmented by innumerable small, subparallel, shearplanes. The individual shear planes are invariably scalloped. The slickensided shale is identical to footwall material of No. 7 open cut. Pyrite content is probably as high as 20%.	85%
<u>293' 10"</u>	<u>294' 8"</u>	Graphite-pyrite sludge, of which pyrite comprises 40%. The walls are evidently collapsing as the volume of sludge is far greater than that which the 10" drilled would normally yield.	
<u>294' 8"</u>	<u>295' 4"</u>	Highly slickened graphitic shale, 20% of which is pyrite.	
		The walls collapsed and the hole was stopped at 297' 4".	

COSMOPOLITAN HOWLEY MINE

DIAMOND DRILL HOLE NO. 5

			<u>Gold-dwts</u> <u>per ton.</u>	<u>Silver</u>
0'	-	10'	Trace	Nil
10'	-	20'	nil	nil
20'	-	30'	nil	nil
30'	-	40'	nil	nil
40'	-	50'	Nil	nil
50'	-	60'	nil	nil
60'	-	70'	Trace	nil
70'	-	80'	Trace	nil
80'	-	90'	Trace	nil
90'	-	100'	Trace	nil
100'	-	110'	Trace	nil
110'	-	130'	nil	nil
130'	-	140'	nil	nil
140'	-	150'	nil	nil
150'	-	160'	Trace	nil
160'	-	169' 5"	Trace	nil
169' 5"	-	172' 3"	Trace	nil
172' 3"	-	175'	Trace	nil
175'	-	180'	Trace	nil
180'	-	185'	nil	nil
185'	-	190'	nil	nil
190'	-	192' 6"	nil	nil
192' 6"	-	200'	nil	nil
200'	-	210'	0.3	nil
210'	-	220'	0.3	nil
220'	-	230'	0.3	nil
230'	-	235'	0.3	nil
235'	-	240'	Trace	nil
240'	-	245'	0.4	nil
245'	-	250'	0.5	nil
250'	-	255'	0.6	nil
255'	-	260'	0.7	nil
260'	-	265'	0.5	nil
265'	-	270'	0.3	nil
270'	-	275'	0.3	nil
275'	-	280'	0.3	nil
280'	-	285'	0.4	nil
285'	-	290'	0.5	nil
290'	-	293' 10"	0.4	nil
293' 10"	-	297' 4"	0.4	nil

COSMOPOLITAN HOWLEY MINE

DIAMOND DRILL HOLE NO. 6

LOCATION: 230' west-north-west of No. 1 Open Cut.
BEARINGS: 121° (Magnetic) DEPRESSION: 50°
DRILLING COMMENCED: 19th August, 1963. DRILLING FINISHED: 25th
DRILLER: S. Berger. FINAL DEPTH: 393' 7" September, 1963

<u>Drill Run</u>		<u>Core Recovery.</u>
<u>From</u>	<u>To</u>	
0'	12'	11"
12'	17'	2' 4"
17'	26'	2"
26'	31'	2"
31'	36'	4' 0"
36'	44'	7"
44'	53'	6"
53'	61'	1' 0"
61'	65' 6"	8"
65' 6"	71'	1' 11"
71'	72'	1' 0"
72'	79'	7' 0"
79'	84'	5' 0"

100% recovery hereafter except for the run between
261' 1" and 273' which recovered 6' 4".

<u>Footage</u>	<u>Core Description</u>
0' - 36'	Hard graphitic shale with patchy red staining and minor hematite. Rock is highly contorted and slightly cavernous.
36' - 71' 4"	Zone of poor recovery. Quartz and graphitic shale recovered in about equal proportions. Most of the section drilled in graphitic shale which has largely been ground during drilling.
71' 4"- 72'	Hard, hornfelsic, graphitic shale - no fissility - cut by quartz veins which show evidence of later fracturing and shearing. Change to BXM.
72' - 74'	Hard, non-fissile, graphitic shale, somewhat contorted and fractured. Bleaching occurs along many of the fracture planes.
74' - 76'	Graphitic shale, fractured and brecciated. Much of the fracturing is controlled by fissility. The fracture planes are bleached, less intensive alteration has left the rock a light brown.
76' - 78' 6"	Graphitic shale, slightly fissile.
78' 6"- 79' 6"	Gossanous graphitic shale with silica box-works.
79' 6"- 80' 9"	Grey, amphibolitic rock. The amphibole is light brown in colour - cummingtonite?
80' 9"- 81'	Vein quartz.
81' - 81' 9"	Sheared graphitic shale, bleached along fracture planes.

DIAMOND DRILL HOLE NO. 6 (continued)

<u>Footage</u>	<u>Core Description</u>
81' 9" - 85' 3"	Carbonaceous schist, composed of massive, black, micro-crystalline groundmass and scattered, but visible amphibole needles, - cummingtonite?
85' 3" - 86'	Gossanous amphibolitic schist.
86' - 94'	Fine-grained amphibolitic schist. Light coloured amphibole tends to be concentrated in bands.
94' - 98' 3"	Massive vein quartz with a few fragments of amphibolitic schist.
98' 3" - 107'	Light grey (dark grey with white specks) fine-grained schist. The rock is strongly banded into bands of differing composition, some of which are distinctly quartzitic. The last foot is somewhat gossanous and cavernous. This material is very similar to that mined in No. 7 open cut.
107' - 117' 9"	Gossanous, cavernous, graphitic shale. The shale is slightly hornfelsed and fractured conchoidally, though it is slightly fissile in places. Fracture planes are commonly stained yellow.
117' 9"- 176'	Dark grey, graphitic shale, poorly fissile. Fractures in the rock are seldom controlled by cleavage. The fracture surfaces are bleached white and often enclose small tabular bodies of pyrite. Only occasionally does pyrite form thicker blebs. The pyrite comprises 2% of rock.
176' - 178'	Broken-up graphitic shale, bleached along shear planes. Massive and disseminated pyrite some of which appears to have been affected by the shearing. 10% pyrite.
178' - 179' 9"	Finely granular kaolinised graphitic shale with the appearance of ash-grey greywacke. This rock contains disseminated 1 mm grains of pyrite as well as blebby pyrite. 10% pyrite.
179' 9"- 186' 6"	Kaolinised sandstone and sandy graphitic shale. The prevalence of kaolin makes mineral identification difficult. The rock, is, in places, much like a sandstone, elsewhere unconsolidated matrix may predominate.
186' 6"- 187' 7"	Friable, earth-like, red-brown material, probably representing sheared and oxidised chlorite schist.
187' 7"- 195'	Chlorite schist, rather friable, bleached and stained. In places the rock contains numerous flesh coloured andalusite crystals and often seams of megascopically visible graphite crystals. Some of the fractures contain a lining of a soapy green mineral which is probably talc. No sulphides observed.
195' - 201' 6"	Spotted chlorite-mica-quartz schist with an overall green colour. The spots are centred by a shiny, black mineral. Pyrite occurs occasionally as small patches of granular pyrite. Some thin veins of chalcocite which are brightly stained on the surface are present. Sulphides 2%.

DIAMOND DRILL HOLE No. 6 ^{3.} (continued)

<u>Footage</u>	<u>Core Description</u>
201' 6" - 212'	Biotite schist containing brick red crystalloblasts of andalusite and coarse tetragonal casts filled with black powdery material - (?) Mn Oxides. No sulphides.
212' - 217'	Knotted chlorite schist with black poikiloblastic mineral in knots.
217' - 220' 6"	Chloritite - a mass of intergrown, unorientated chlorite grains. Individual chlorite grains approximately 1 mm in diameter.
220' 6" - 221' 3"	Quartzite.
221' 3" - 226' 4"	Intermixed, thickly bedded quartzite and chloritic schist. Some of the schist contains a few quartzite fragments.
226' 4" - 237'	Fine-grained biotite schist containing small blotches of disseminated pyrite. The rock is composed of rather diffuse bands of material of varying silica content, becoming, in places, a quartzite. There are also some small blebs of vein quartz. Pyrite 5%.
237' - 251'	Chloritic schist, sheared and altered in places to produce a more variegated rock. The most common secondary mineral is a grass-green platy mineral which is probably a chloritoid or a serpentine mineral. The rock contains small, ribbon-like quartz veins and occasional quartz boudins. Graphite can be identified in shear planes. Pyrite occurs both as disseminated grains and in blebs - 5% of rock.
251' - 261' 3"	Graphite-chlorite schist with minor (?) cumingtonite. The composition of the rock varies greatly and interbedding and veined by quartz and coarse pyrite. Some of the quartz has been broken into boudins. 2% sulphides.
261' 3" - 277' 6"	Massive vein quartz with occluded fragments of slickensides graphitic shale. Pyrite forms blebs and thin coatings along fracture planes. 2% sulphides.
277' 6" - 288' 3"	Intermixed graphitic schist and massive vein quartz. Sulphides, both pyrite and arsenopyrite, occur in coarse, and sometimes bedded segregations. The graphitic material is often very friable. 5% sulphides.
288' 3" - 290' 3"	Dense chloritite, rich in disseminated sulphides - pyrite and arsenopyrite in roughly equal amounts. 20% sulphides.
290' 3" - 292' 6"	Vein quartz, somewhat sheared, with white coatings along fracture planes. A few pyrite seams - 2%.
292' 6" - 294'	Dark green, dense, chloritite with thin quartz veins. Disseminated arsenopyrite and minor pyrite comprise 40% of the rock.
294' - 300' 4"	Blocky vein quartz containing some intensely sheared graphite-biotite schist occlusions.
300' 4" - 304'	Rock composed largely of arsenopyrite crystals set in a fine black matrix. Some quartz and pyrite blebs. 90% sulphides.

4.
DIAMOND DRILL HOLE NO. 6 (continued)

<u>Footage.</u>	<u>Core Description.</u>
304' - 306'	Chloritite with quartz veins and blebs of pyrite and arsenopyrite. 15% sulphides.
306' - 308' 6"	Sheared, blocky vein quartz with a few graphitic shale horizons.
308' 6"- 310'	Arsenopyrite and pyrite crystals in fine black groundmass. The ratio between the sulphides is about 2 arsenopyrite : 1 pyrite. 90% sulphides.
310' - 315'	Rock composed of coarse grained (2-3 mm), dark grey-green, brittle but sectile silicate-(chloritoid?). A similar, but red-brown mineral (margarite ?) appears near fracture planes. Disseminated pyrite with lesser amounts of arsenopyrite comprise 8% of the rock.
315' - 322'	Massive vein quartz with occlusions of unfissile chloritite rich in arsenopyrite.
322' - 329' 6"	Dark grey-green chloritic schist with disseminated sulphides and some massive vein quartz. Associated with the vein quartz are blebs of massive pyrite. The sulphide content of the rock is 25%, made up by equal portions of pyrite and arsenopyrite.
329' 6"- 333'	Vein quartz with some irregular masses of granular pyrite and minor arsenopyrite; sulphide grains have a brick-red coating. 15% sulphides.
333' - 337'	Graphitic shale with blebs of finely granular pyrite and quartz veins. The shale contains large (up to 10 mm) porphyroblasts of a radiating, green fibrous mineral - some of which has been replaced by pyrite. 10% sulphides.
337' - 341'	Soft, crumbly moderately fissile, graphitic shale. Pyrite in a few scattered blebs associated with some thin stringers of vein quartz. 5% sulphides.
341' - 344' 8"	Dark, hornfelsic schist, mineralised by a boxwork of pyrite blebs. The rock contains contorted quartz veins. Pyrite blebs and minor arsenopyrite comprise 25% of the rock.
344' 8"-347' 3"	Massive vein quartz with pyrite and chloritic coatings along shears. 2% sulphides.
347' 3"-361' 8"	Dark green mass of inter-grown chlorite containing abundant boudins and irregularly shaped masses of rose-quartz sandstone. Individual boudins are often well rounded and mantled by micaceous material. Large blebs of pyrite are closely associated with the boudins. Pyrite may also be disseminated in bands within the rock. Minor arsenopyrite occurs disseminated throughout the rock. 10% sulphides.
361' 8"- 367'	Vein quartz with occasional blebs of pyrite. 5% sulphides.
367' - 393" 7"	Green chloritic schist with large subhedral arsenopyrite crystals and minor pyrite. 2% sulphides.

ASSAY RESULTS

COSMOPOLITAN HOWLEY -DIAMOND DRILL HOLE NO. 6

<u>DEPTH</u>		<u>GOLD</u>	<u>SILVER</u>
<u>From</u>	<u>To</u>	<u>DWTS PER TON</u>	<u>DWTS PER TON</u>
0'	- 12'	Trace	N11
12'	- 26'	Trace	N11
26'	- 39'	Trace	N11
39'	- 53'	Trace	N11
53'	- 65'	Trace	N11
65'	- 80'	Trace	N11
80'	- 96'	N11	N11
96'	- 100'	N11	N11
100'	- 110'	N11	N11
110'	- 120'	Trace	N11
120'	- 130'	Trace	N11
130'	- 140'	Trace	N11
140'	- 150'	Trace	N11
150'	- 160'	N11	N11
160'	- 170'	N11	N11
170'	- 175'	N11	N11
175'	- 180'	N11	N11
180'	- 185'	N11	N11
185'	- 188' 4"	N11	N11
188' 4"	- 194'	Trace	N11
194'	- 204'	Trace	N11
204'	- 214'	N11	N11
214'	- 220'	N11	N11
220'	- 230'	N11	N11
230'	- 240'	1.0	N11
240'	- 247'	2.1	N11
247'	- 250'	1.0	N11
250'	- 255'	1.1	N11
255'	- 261' 6"	2.0	N11
261' 6"	- 270'	0.4	N11
270'	- 280'	0.6	N11
280'	- 290'	1.2	N11
290'	- 300'	0.6	N11
300'	- 308' 6"	0.4	N11
308' 6"	- 315'	0.7	N11
315'	- 325'	0.8	N11
325'	- 330'	0.7	N11
330'	- 334'	3.2	N11
334'	- 339'	1.5	N11
339'	- 344'	1.6	N11
344'	- 349'	6.6	N11
349'	- 354'	2.5	N11
354'	- 361' 7"	5.0	N11
361' 7"	- 369'	0.7	N11
369'	- 375'	0.4	N11
375'	- 385'	0.6	N11
385'	- 393' 7"	Trace	N11

COSMOPOLITAN HOWLEY MINE

DIAMOND DRILL HOLE NO. 7A

LOCATION: 145 feet west of Open Cut No. 1.

BEARING : 104° DEPRESSION: 50°

DRILLING STARTED: 16th October, 1963. DRILLING FINISHED: 26th November, 1963.

FINAL DEPTH: 268 feet. DRILLER: D. Daniels.

<u>DRILL RUN.</u>			<u>CORE DESCRIPTION.</u>
<u>From</u>	<u>To.</u>	<u>Recovered.</u>	
0'	19' 6"	2' 10"	0'-110' Soft graphitic shale of low fissility. Cavities are common in the core recovered and large cavities, many feet across, were encountered from 60' onwards. It is difficult to ascertain the nature of the cavities, but they appear to be caused by the solution of carbonate veins in the shale.
19' 6"	37' 6"	10' 3"	
37' 6"	39' 8"	2'	
39' 8"	45' 6"	4' 5"	
45' 6"	49'	10"	
49'	57' 9"	8'	
57' 9"	66'	10"	
66'	74'	2'	
74'	110'	1' 8"	
110'	120'	2' 9"	110'-130' Graphitic shale of poor fissility containing some veins of rather granular quartz.
120'	134'	1' 3"	130'-145' Finely cellular gossan with some granular quartz.
134'	145'	1'	
145'	155'	1"	145'-175' Only small quartz fragments recovered.
155'	165'	3"	
165'	175'	3"	
175'	182'	1' 7"	Moderately fissile graphitic shale with some shearing along cleavage planes. Some thin veins and blebs of pyrite. Pyrite 1%.
182'	185'	1' 9"	182'-205' 3" Interbedded graphitic shale and amphibole - graphite schist. Some of the schist contains pinhead-sized rosettes of chlorite. The amphibole is very light coloured, probably cummingtonite, and barely discernible with the naked eye. It imparts a higher gloss and more rounded fracture surface to the rock, which otherwise is still rich in very fine-grained graphite. Some bleached clay material imparts an ash-grey colour to some of the beds. A few of the beds are rich in disseminated pyrite.
185'	190' 6"	6"	
190' 6"	204' 9"	9"	
204' 9"	205' 3"	4"	
205' 3"	215'	1' 7"	Pyritic sludge. The last 3" contains ground quartz fragments with inclusions of chloritic graphitic schist.
215'	220'	10"	Worn fragments of massive pyrite and quartz. The quartz is of two types - vein quartz, which tends to be massive; and a porcellanous white quartz intimately associated with the massive pyrite. The massive quartz contains some small specks of pyrite, but is separate from the massive pyrite. The massive pyrite is veined by hematite.
220'	224' 6"	1' 11"	Vein quartz with a few small pyrite blebs.

2.

DIAMOND DRILL HOLE No. 7A (continued)

<u>DRILL RUN</u>		<u>CORE DESCRIPTION</u>	
<u>From</u>	<u>To.</u>	<u>Recovered.</u>	
224' 6"	230'	2' 6"	Sheared graphitic chlorite schist with some small, mainly concordant pyrite veins. The shearing is parallel to the core.
230'	235'	3"	Chlorite schist with some small specks and veins of pyrite.
235'	240'	2"	Chlorite schist with some contorted quartz veins, a few isolated quartz boudins and an occasional small bleb of pyrite, - definitely foot wall material.
240'	250'	3"	
250'	255'	1' 5"	
255'	260'	1' 2"	
260'	268'	2' 10"	

ASSAY RESULTS.COSMOPOLITAN HOWLEY - DIAMOND DRILL HOLE NO. 7A

<u>DEPTH</u>	<u>GOLD: DWTS PER TON</u>
<u>CORE:</u>	
74' - 110'	0.2
110' - 120'	0.3
120' - 127'	Trace
127' - 134'	0.3
134' - 145'	Trace
145' - 175'	11.6 N.B. Only 7" of core recovered.
175' - 182'	1.7
182' - 190'	1.1
190' - 205' 3"	2.0
205' 3" - 215' 3"	2.2
215' - 220'	1.8
220' - 224' 5"	7.7 1' 11" of core recovered.
224' 5" - 230'	4.2 2' 6" of core recovered.
230' - 240'	0.5
240' - 250'	0.6
250' - 260'	0.3
260' - 268'	Trace

SLUDGE:

210' - 220'	0.8
220' - 224' 5"	0.6
224' 5" - 235'	1.1
235' - 240'	1.1
240' - 245'	0.7
245' - 250'	0.8

COSMOPOLITAN HOWLEY MINE.

DIAMOND DRILL HOLE NO. 8.

LOCATION : 440 feet south-east of the eastern extremity of
open cut No. 5.

BEARING : 120°

DEPRESSION: 50°

DRILLING STARTED: 2nd October, 1963 DRILLING FINISHED: 15th

DRILLER: S. Berger. FINAL DEPTH: 245' November, 1963,

DRILL RUN

CORE DESCRIPTION.

<u>From</u>	<u>To</u>	<u>Recovered</u>	
0'	6'	1'1"	0'-23' Red-brown sludge
6'	8'	1'4"	
8'	19'	2'0"	
19'	21'	1'2"	
21'	27'7"	2'0"	23'-52' Yellow and light brown
27'7"	35'7"	1'10"	sludge with isolated, highly
35'7"	40'	4'5"	weathered, rock fragments.
40'	51'9"	4'2"	
51'9"	58'8"	7'	52'-75' Fragments of highly weath-
58'8"	63'	1'7"	ered rock which appears to have
63'	72'	6'2"	been an amphibolite with some small
72'	77'6"	3'9"	porphyroblasts, now sericitised.
77'6"	85'	2'2"	75'-85' Small fragments of highly
			weathered rock, which was probably
			a phyllite. Some graphite recog-
			nisable along shear planes.
			85'-119' Micaceous argillite, weath-
			ered with red staining.
85'	90'	1'	
90'	95'	3'3"	
95'	99'	3'5"	
99'	103'	2'3"	
103'	104'	1'	
104'	117'4"	3'7"	
117'4"	131'1"	2'6"	119'-140' Zone of poor recovery.
131'1"	136'9"	2'10"	The material recovered is mainly
136'9"	138'	1'3"	quartz fragments with subordinate
138'	140'	1'8"	fragments of micaceous argillite.
			The quartz is fractured, and
			cavernous in places. Biotite,
			hematite and finely euhedral quartz
			crystals fill the openings.
140'	144'	3'4"	140'-143' Brecciated, fine-grained
			siliceous rock which has a resem-
			blance to chert but is coarser
			grained and somewhat clayey.
144'	145'6"	1'6"	143'-148' Brecciated and consider-
145'6"	147'	1'6"	ably altered micaceous argillite.
147'	148'1"	1'1"	The rock is highly oxidised with
			hematite encrustations along
			fracture planes.
148'1"	153'4"	5'3"	148'-245' Light green to purple-
153'4"	156'10"	3'6"	brown micaceous argillite. On
156'10"	162'	5'2"	weathering the rock becomes reddish
162'	165'6"	3'6"	brown.
165'6"	168'	2'6"	
168'	168'6"	6"	
168'6"	170'	1'2"	
170'	171'	6"	
171'	172'	1'	
172'	182'3"	9'8"	
182'3"	188'9"	1'9"	
188'9"	192'	3'3"	
192'	196'7"	3'4"	
196'7"	199'3"	2'8"	
199'3"	202'	2'9"	
202'	204'5"	2'5"	

The term argillite has been used here for the want of a better term. The rock is highly micaceous, individual mica plates are just discernible with the naked eye, but the other components are generally not visible. The rock, however, is not foliated, and has no parting.

Banding, which is well developed and occurs on all scales, tends to be gradational. A 1/2.

DIAMOND DRILL HOLE NO. 8. (continued)

<u>DRILL RUN</u>			<u>CORE DESCRIPTION.</u>
<u>From.</u>	<u>To.</u>	<u>Recovered.</u>	
204' 5"	210'	4' 1"	striking feature of the banding is the parallelism and extreme lateral consistency of even the finest bands. Over short distances banding may even appear to be rhythmic and individual sections may simulate varying.
210'	214'	3' 9"	
214'	216' 4"	8"	
216' 4"	219' 9"	3' 5"	
219' 9"	221' 10"	2' 1"	
221' 10"	223' 5"	1' 7"	
223' 5"	226' 8"	3' 3"	
226' 8"	228' 2"	1' 4"	
228' 2"	229' 2"	1'	
229' 2"	237'	1' 9"	
237'	245'	1' 6"	

The composition of the bands ranges from the more common green micaceous material to highly siliceous and its biotite - rich variants. The siliceous members may approximate a chalcedonous quartzite in appearance.

The rock may be finely speckled, in places, by blastic aggregates of platy minerals and probably amphibole.

Siliceous members are commonly fractured and contain drusy cavities. Fracture fillings may be hematite, biotite or granular quartz crystals.

Flaky hematite crystals are common, but they only compose a few per cent of the rock as a whole and no bands composed entirely of hematite were seen. In view of the fact that no other source for the gossanous outcrop could be found, it is likely that it was this hematite in conjunction with iron derived from the breakdown of the mafic minerals which gave rise to the outcrop. There is no pyrite in the sequence.

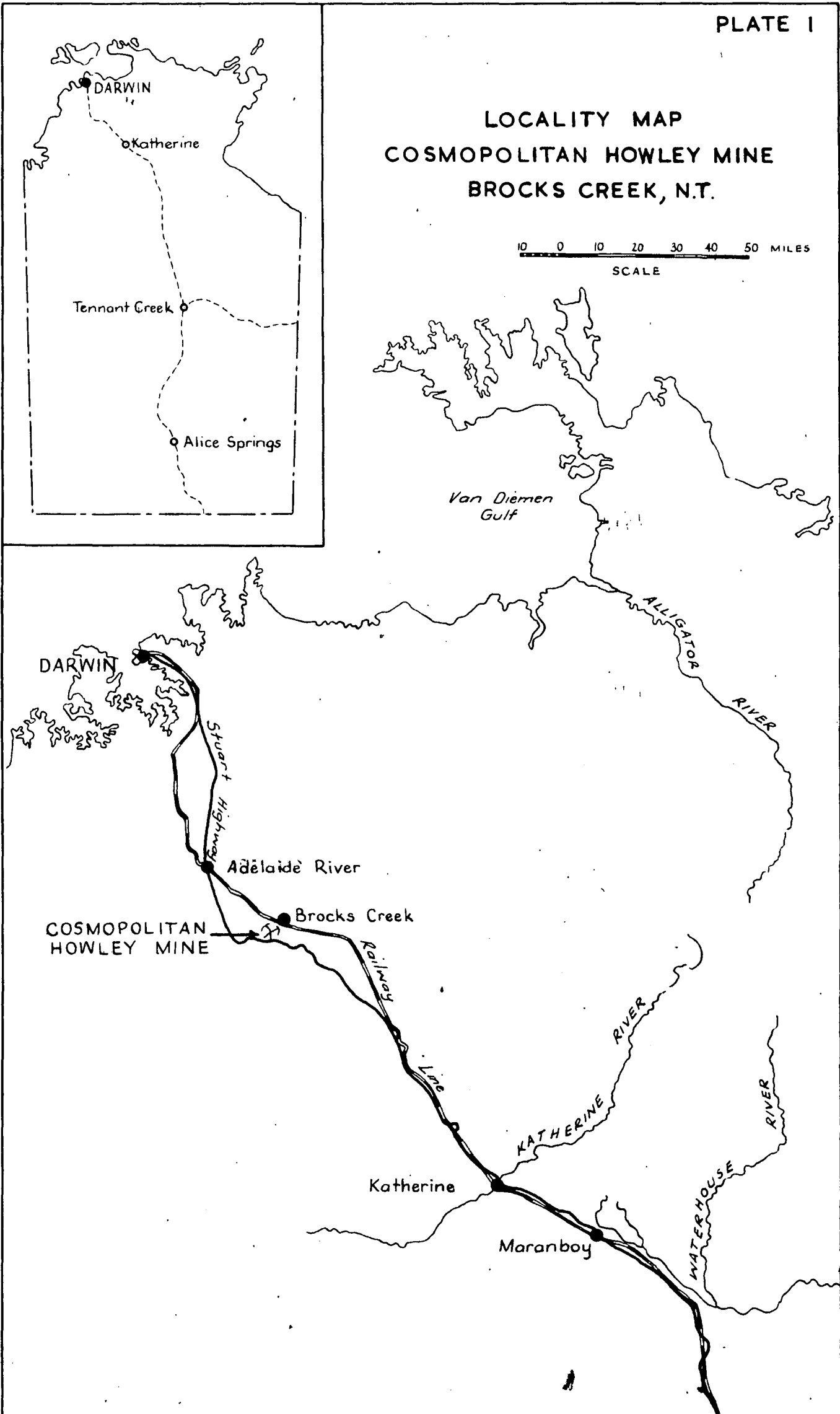
A quartz vein occurs between 177' and 188' 6". Argillite has flowed into a tension joint on the edge of the quartz.

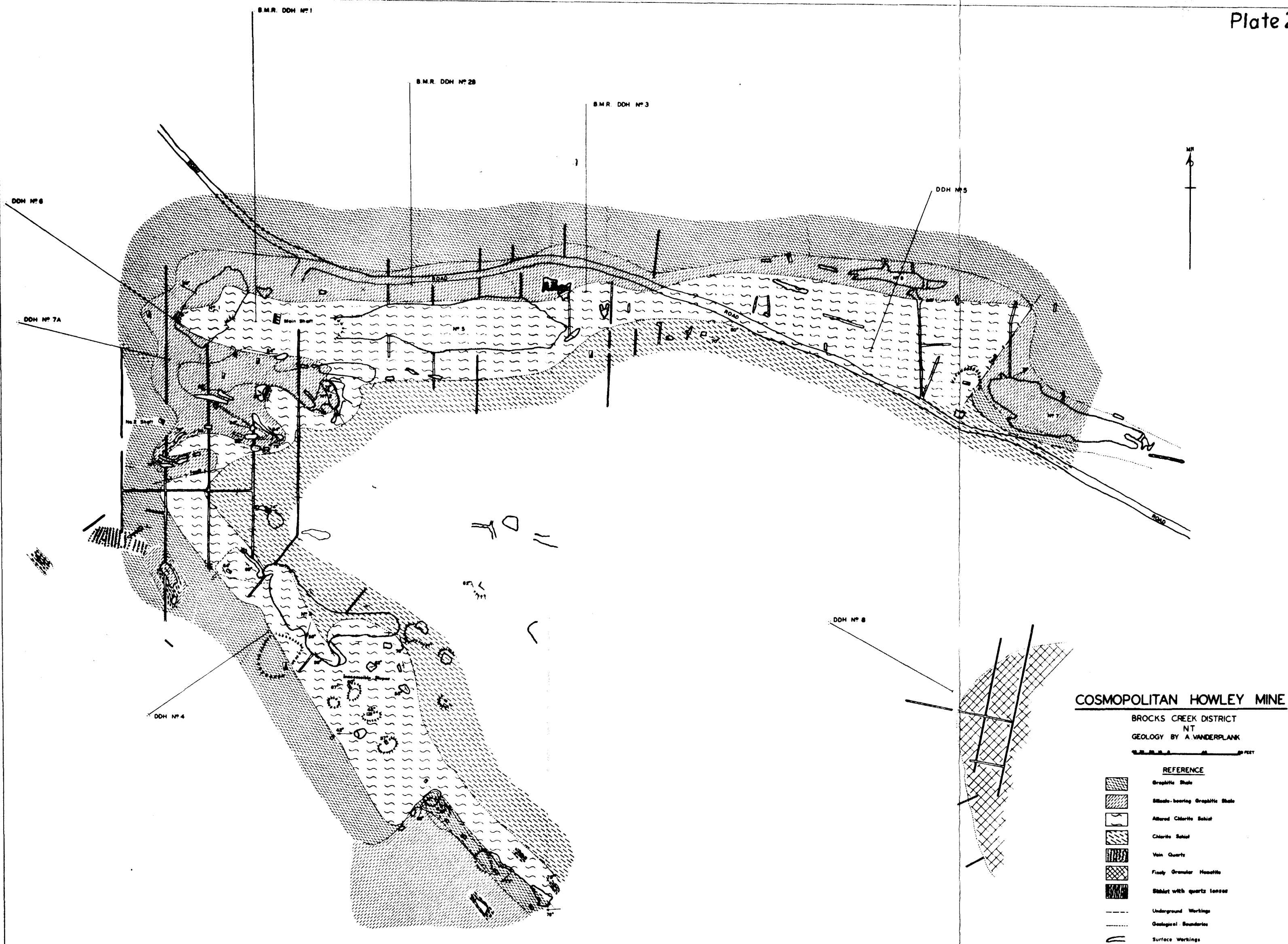
ASSAY RESULTS.

<u>DEPTH.</u>	<u>GOLD: DWTS PER TON.</u>
0' - 10'	Trace
10' - 20'	Trace
20' - 30'	Trace
30' - 40'	Trace
40' - 50'	0.2
50' - 60'	0.3
60' - 70'	Trace.
70' - 80'	Trace
80' - 90'	Trace
90' - 100'	Trace
100' - 110'	Nil
110' - 120'	Nil
120' - 130'	Nil
130' - 140'	Nil
140' - 150'	Trace
150' - 160'	Trace
160' - 170'	Trace
170' - 180'	Trace
180' - 190'	Trace
190' - 200'	Trace
200' - 210'	1.4
210' - 220'	Nil
220' - 230'	Nil
230' - 240'	Nil
240' - 245'	Nil

LOCALITY MAP
COSMOPOLITAN HOWLEY MINE
BROCKS CREEK, N.T.

10 0 10 20 30 40 50 MILES
SCALE





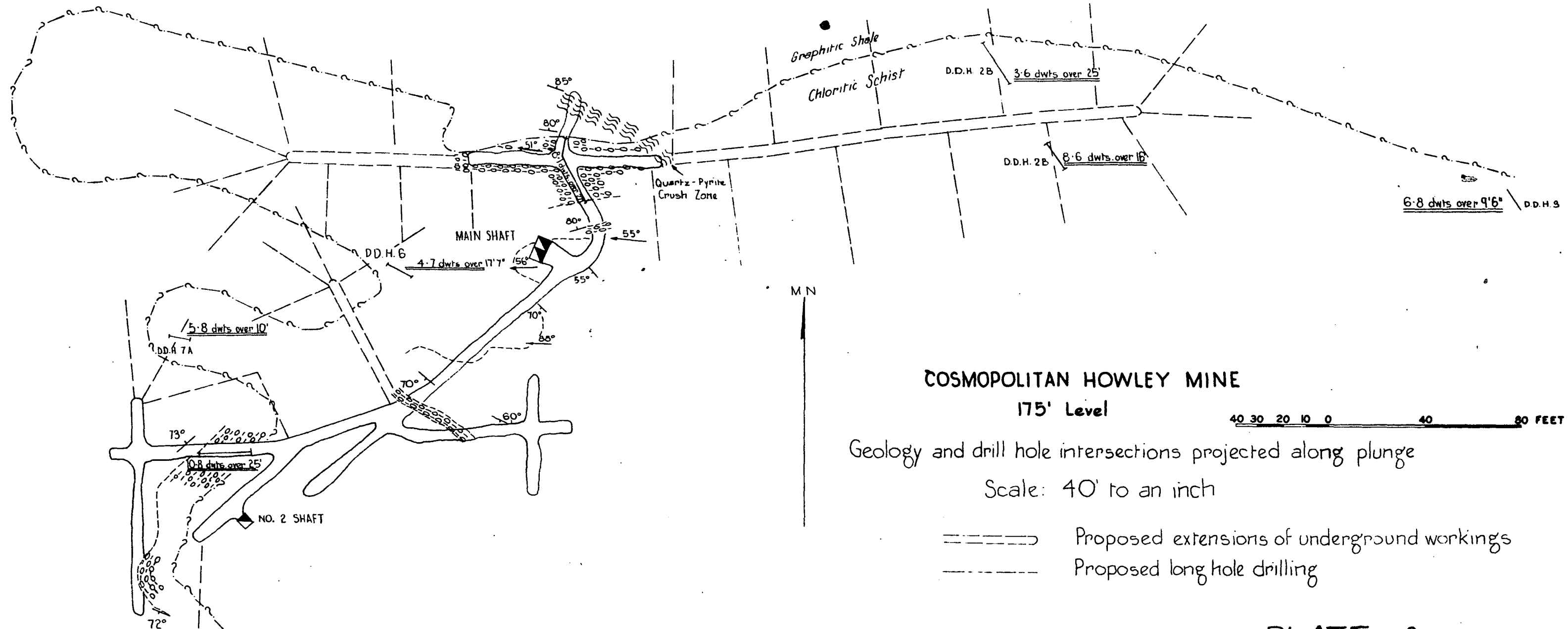
COSMOPOLITAN HOWLEY MINE

BROCKS CREEK DISTRICT
NT
GEOLOGY BY A. VANDERPLANK

0 100 FEET

REFERENCE

- Graphite Shale
- Silica-bearing Graphite Shale
- Altered Chlorite Schist
- Chlorite Schist
- Vein Quartz
- Finely Granular Monzonite
- Schist with quartz lenses
- Underground Workings
- Geological Boundaries
- Surface Workings



COSMOPOLITAN HOWLEY MINE 175' Level

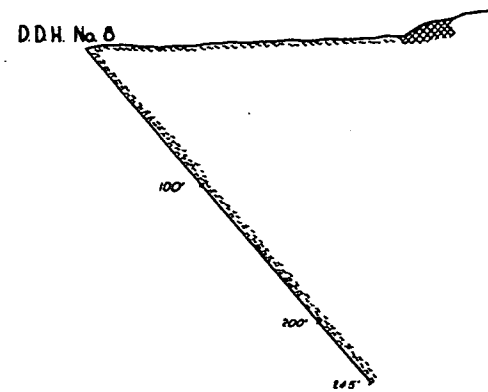
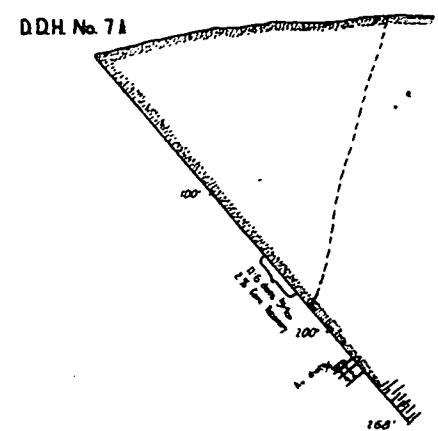
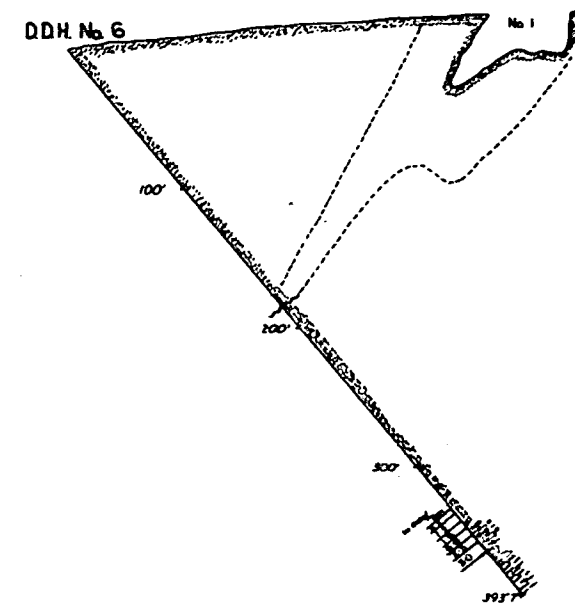
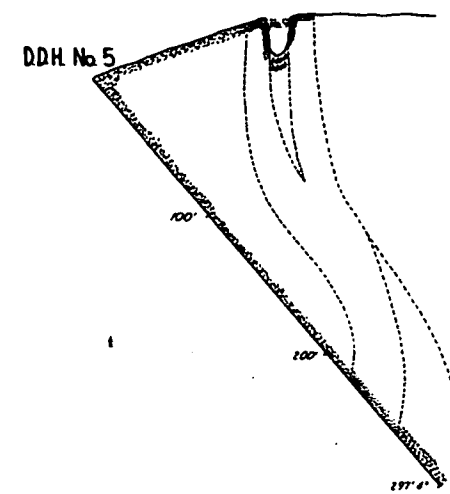
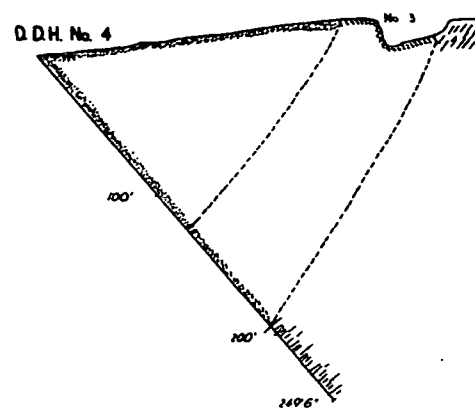
Geology and drill hole intersections projected along plunge

Scale: 40' to an inch

- Proposed extensions of underground workings
- Proposed long hole drilling

PLATE 3

To accompany Record 1965/125.



REFERENCE	
	Graphitic Shale
	Schist-bearing Graphitic Shale
	Altered Chloritic Schist
	Sheared Graphitic Shale
	Finely Granular Metasiltstone
	Chloritic Schist
	Quartz
	Schist with quartz lenses

COSMOPOLITAN HOWLEY MINE

Drill Hole Sections.



To Accompany Record 1965/125.