GEOPEKO LIMITED

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GEOLOGICAL REVIEW - DOLPHIN OREBODY

OCTOBER, 1976

by

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KING ISLAND OCTOBER, 1976.

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INTRODUCTION

The Dolphin Mine has been in operation since June 1973 and mine openings have been developed to the -178m R.L. Stoping areas have been extended into the Wedge Area at the -130m R.L. and above and into the Central and Pit Areas at the -150m R.L.

The C lens oreblocking program has continued eastward at 40 metre intervals to 220 280 E and 3.2 million tonnes of ore is Proved above the -200m R.L. B lens definition is continuing at 20 metre intervals.

The structure to the south of the Central Area has been modified to conform with the geology exposed at the -150m R.L. and two further significant faults have been located in the Pit Area.

This report reviews the progress since the preceding review report (Danielson, October 1975) in so far as it affects the geology and makes recommendations for the continuation of the oreblocking program.

SUMMARY

The underground oreblocking program is continuing and to date 89 holes have been completed for 6890 metres. Of this figure, 25 holes totalling 900 metres were used in B lens definition and the remainder in C lens oreblocking. Drilling approved for the present year is 1930 metres of which 62 metres has been completed.

The present underground drilling program has proved 3,223,200 tonnes at 1.10% WO_3. The total Proven and Probable ore resource of Dolphin is 5,614,200 tonnes at 1.07% WO_3. A further 1,000,000 tonnes is classified as Possible.

There has been an increase of approximately 130,000 tonnes of C lens Proven ore since the September 1975 calculation. This increase was due to continued oreblocking on sections 220 000 E, 220 020 E and 220 040 E and an expansion in ore outlines in the Central Area at the -150m R.L.

B lens definition at 20 metre intervals is in its preliminary stages and the lack of continuity in the mineralisation is apparent. An ore resource of 700,000 tonnes at 0.79% WO_3 is classified as Probable. Of this resource approximately 203,000 tonnes at 0.68% WO_3 is located above the -50m R.L.

Future oreblocking programs for C lens will require drill drives to 220 360 E at -150m R.L. and to 220 400 E at -250m R.L. At the -150m R.L. approximately 175 metres of development is proposed within the Upper Metavolcanic Unit. If the present 40 metre cuddy spacing is maintained approximately 3750 metres (44 holes) will be required. This metreage is exclusive of the drilling budgetted for this year.

The structure south of the Central Area has been partially resolved. It is now clear that the Central Area is bounded to the south by only one fault, the Central Fault and that an apparent displacement of 25 metres south block down previously attributed to the Sliver Fault is explained by a rapid steepening in dip. The 'Q' Fault is purely interpretation at this stage and may be liable to alteration as more evidence becomes available.

The existence of the 'P' Fault in the Pit Area, which was interpreted from the 20 metre spaced C lens drilling between 220 000 E and 220 040 E has been confirmed by mine openings at the -158m R.L. Another major fault, named the Swan Fault which has similar movement to the 'P' Fault and strikes subparallel was intersected in the Pit Area at the -150m R.L. south of the area defined by oreblocking.

The underground oreblocking program has proved C lens ore east of 220 000 E to the -200m R.L. It is considered that on the 40 metre cuddy spacings presently in use the geological correlation of the ore horizons between 220 040 E and 220 200 E is not adequate for accurate correlation between sections in the Central and Pit Areas. Mine openings so far have confirmed that area is strongly faulted and structurally complex in addition to the problem in correlating ore outlines in Lower C lens where the contact is a grade % WO_3 boundary.

The Wedge Fault has been shown at the -130m R.L. to be a zone of barren sheared biotite hornfels up to 6 metres wide rather than a single plane as exposed at the -98m and -75m R.L.'s.

Geophysical investigations have indicated that the Grassy River Fault may be 150 metres east of its present indicated position. Even if this is so it is not expected to result in a significant increase to the ore resource.

The computer section have developed a technique whereby grade control grab sample assays can be combined with diamond drill hole assays in the estimation of mining block grades.

Total production ex Dolphin Mine from the commencement of mining operations to September 28th 1976, is 346,800 tonnes at 0.92% WO_3.

CONCLUSIONS

1. In the Central and Pit Areas the 40 metre spacing presently in use to oreblock C lens is considered inadequate between 220 040 E and 220 200 E for accurate definition of ore outlines and structural features. Mining considerations prevent the closing up of the oreblocking program as the main decline would be required as a principal drilling site. Final definition of the areas will be by mine openings as the production stopes develop.

2. The requirement for more drilling east of 220 160 E to provide sufficient grade data for resource - reserve estimation may not be necessary if the technique of combining grab sample assays and diamond drill core assays is successful.

3. The irregular nature of the B lens mineralisation will necessitate the continuation of the close spaced (20 metre) drilling program to provide adequate definition for mining purposes.

4. The basic structure of the Dolphin mine series is that of an anticlinal nose plunging southeast at 30^{o} cut by three major faults - the Central, Wedge and 'Q' Faults. The Central and Wedge Faults have been well defined by mine openings and diamond drilling but the 'Q' Fault is largely interpretative at present. Two lesser faults - the Swan and 'P' Faults also occur in the Pit Area.

5. The C lens oreblocking program now proposed is advantageous in that it can provide adequate information in the Wedge Area at the -250m R.L. before the main decline development reaches that level and the necessity to drill from within the orebody at 220 360 E is removed.

6. The grade of Upper C lens ore mined at the -130m R.L. undercut was 12% below the resource estimate and production grades have decreased further in the mining of the first and second lift. This feature may not be simply due to dilution and an overestimation of the resource grade but may reflect on the precision of the individual assays, whether a bias is being introduced due to sample size in the production grade assays or the validity of the method of employing the assays.

RECOMMENDATIONS

No specific development be considered to provide sites for B lens oreblocking. Oreblocking should be continued at 20 metre intervals from development headings and C lens hangingwall mining stopes as sites become available.

No hangingwall development proceed at the -250m R.L. until the level is adequately defined by diamond drilling.

The proposed diamond drilling program from cuddy sites at the -150m R.L. be carried out so as completion will coincide with the main decline reaching the -250m R.L.

If it becomes apparent, as mining operations are continued into the Wedge Area, that grade information derived from the oreblocking program combined with the mine grade control assay values is insufficient to allow the Computer Section to predict ore resource grades with a high degree of confidence, then additional drilling should be done in doubtful areas to supplement the assay information already available.

ACTION SHEET

GEOLOGY REVIEW

Main Decline

The main decline has now advanced to the -178m R.L.

In the period under review the decline advanced 310 metres in banded footwall hornfels, which was weakly mineralised at times (sub ore grade) and basal quartzites. Ground conditions in the banded hornfels were generally good but deteriorated in the quartzites where steel sets were required over the entire 40 metre length of decline in this rock type. Steel sets were also required as support in the Wedge Fault Zone between the -143m and -148m R.L. The decline passed through a fault, interpreted as the Central Fault, at the -160m R.L. with no associated bad ground.

There has been no 'cover' diamond drilling ahead of development.

For the past year the major part of the decline development has been at R.L.'s below that defined by either the oreblocking program or surface diamond drilling and a similar situation will exist for the next 100 metres of development. Rock types are expected to continue in unmineralised footwall hornfels with probably a short intersection of basal quartzites about the -182m R.L.

B lens

There has been no B lens development in the period under review.

Total ore production (development ore) remains at 7156 tonnes at 0.41% WO_3.

C lens Pit Area

(i) -75m R.L.

No further work here.

(ii) Footwall access ramp (J 16)

This ramp development from the main footwall decline at -103m R.L. has progressed 120 metres to the -122m R.L. and is planned to the -145m R.L. Rock types, as expected, have been quartzite, through the No.3 Fault into the footwall contact of Lower C lens where 3490 tonnes at 0.59% WO_3 was mined. The ramp is now continuing in unmineralised banded footwall beds and is expected to remain so to the -140m R.L. where it will re-enter the C lens sequence.

Ground conditions have been good. Surface ddh D 191 was intersected at the -120m R.L. making minor water.

(iii) -150m R.L.

Stoping operations commenced in May 1976, access being gained via the C Central Area.

Upper C lens was developed by one stope (C 16) and ore mined was 7615 tonnes at 1.64% WO_3 (resource grade 1.58% WO_3) before the ore terminated against a major fault, named the Swan Fault striking northwest and dipping southwest at 45°. The fault has an interpreted vertical component of movement of 10 metres south block down. The fault was located to the south of the area defined by the oreblocking program.

Lower C lens has been developed in several stopes on a ramp system to the -160m R.L. to the west of a major rib pillar. Ore mined has been 10368 tonnes at 0.58% WO_3 (resource grade 1.05% WO_3). This low grade was anticipated near section 220 040 E and is expected to improve as stopes extend eastwards toward 220 080 E.

The C 10 stope in Lower C lens intersected the 'P' Fault as expected at the -158m R.L.

Ore horizons have been flat dipping (approximately 15°) as expected.

C lens Central Area

(i) -75m R.L.

No further work here.

(ii) Footwall Access Ramp (N 15)

This ramp was originally developed from the Wedge Area undercut at the -130m R.L. to the -145m R.L. junction with the Pit Area i.e. the Central Fault and has been connected to the main decline at the -138m R.L.

The Wedge Fault was exposed along a strike length of 40 metres and at the -135m R.L. the No.3 Fault was clearly seen to truncate against it. Ground conditions necessitated steel sets in some of the fault zone but were otherwise good.

Production, which was all Lower C lens was 10573 tonnes at 0.76% WO_3 (resource grade 0.84% WO_3).

Surface ddh D 197 was intersected making minor water.

(iii) -150m R.L.

An undercut has been developed with access gained from the main decline. Production, which was all Lower C lens, was 21313 tonnes at 0.81% WO_3 (resource grade 0.84% WO_3).

C Central Lower C lens was originally defined at this level by D 120/5 and D 120/7 but the extrapolation of this ore eastward toward the Wedge Fault was in doubt due to the conflicting results of D 160/3 and surface hole D 184 (unsurveyed). D 160/3 indicated the Lower C lens footwall contact

to be at -135m R.L. while D 184 (anticipated position 20 metres updip) indicated the footwall contact at -160m R.L. The conflict was resolved by mine openings which showed rapid changes in dip from 20° to 90° within the width of the C 68 stope and ore outlines were shown to continue eastward to the Wedge Fault at this level.

The C 64 stope passed through the Central Fault to connect the Central and Pit Areas with no poor associated ground conditions.

A skewed diamond drill hole D 150/2 drilled from N 15 terminated at the -150.2m R.L. in the Central Area due to heavy inflow of water into the hole measured at 40 gallons per minute. The position of the hole is approximately 20 metres southeast of the present mine openings and is estimated at 5 metres distant from the expected position of surface ddh D 199 (unsurveyed). No major faults or aquifers are anticipated in the area and it is possible D 150/2 is siphoning off water being channelled into the mine via D 199.

C lens Wedge Area

(i) above -75m R.L.

Mining operations concluded in October 1975 having completed the third lift above the -75m R.L. with backs at -60m R.L.

In the period under review 2319 tonnes were mined to give a total production from this area of 65277 tonnes at 1.04% WO_3 (resource grade 1.10% WO_3).

(ii) -98m R.L.

No further work here.

(iii) -116m to -130m R.L.

Stoping operations have continued in this area and the third lift above the -130m R.L. undercut has recently commenced taking the backs to a maximum elevation of -116 metres R.L. The first and second lifts in the vicinity of the main decline have not yet been fully completed.

A summary of production to date is set out with resource grades in parentheses.

	Upper C lens		Lower C lens	
	Tonnes	Grade % WO_3	Tonnes	Grade % WO_3
-130m Undercut	41950	1.20 (1.36)	31464	0.69 (0.72)
First lift	26152	1.03 (1.20)	16946	0.60 (0.69)
Second lift	14907	1.03 (1.20)	8057	0.65 (0.69)
Third lift	2015	0.61 (1.20)		

Resource grades for the -130m R.L. undercut were calculated from diamond drilling. The Upper C lens was 12% below resource grade and Lower C lens 4% below. Resource grades for the subsequent lifts were reduced to the grades derived at the undercut (arithmetic average grab sample assays) as it was considered that they were a more accurate representation of the grade of ore present. However grades on subsequent lifts have been below this grade particularly in Upper C lens probably due to dilution. Ore mined in the third lift is mineralised pyroxene garnet hornfels and should not be compared to the resource grade.

Ore outlines have been much as anticipated. Some variations occurred in the outline of Lower C lens south of W 82 stope in the second lift (-119m to -122m R.L.) where mineralised skarns graded into barren marble although this trend had been predicted from diamond drilling on section 220 160 E. On the third lift it is unlikely that Lower C lens will support a viable mining operation south of W 82.

The Wedge Fault has been intersected in numerous stopes and has usually been shown to be a zone of sheared barren biotite hornfels. Two probe holes D 190/1 and D 200/16 through the fault zone showed the biotite hornfels zone to be up to 6 metres wide. However in the N 15 development (W 26 stope) which passed through the Wedge Fault into the Central Area, the zone was shown to consist of brecciated garnet hornfels - mostly sub ore grade.

A previously unsuspected wedge of barren biotite hornfels approximately 15 metres wide at its widest part plunging west at 15^{o} - 20^{o} occurred in the southeast corner of the Wedge Area adjacent to the Wedge Fault Zone. The base of this unit became apparent in the backs of the first lift but caused no interruption to mining. However on the second lift an ore loss of approximately 4000 tonnes was incurred. The plunge of this unit coupled with the dip of the ore horizons is such that it will have a decreasing effect on the third lift and should have no effect on the fourth lift.

(iv) -150m R.L.

Geology in the access to the hangingwall drill drive has been as expected. Ore production (development ore) has been 5348 tonnes at 0.78% WO_3.

Quartzite development

Mine openings developed in quartzites have been the footwall decline and the openings associated with the pumping scheme at the -150m to -160m R.L.

In all instances the quartzites are very strongly jointed with abundant pyrite on joint surfaces and are noticeably more water bearing than the Mine Series rocks.

Ground conditions have varied from good to very poor and it is observed that stability problems are greatest near the stratigraphic contact with the Mine Series and near major faults but improve north of the No.3 Fault and west of the Wedge Fault.

DISCUSSION OF RESULTS

Structure

Stoping operations have now been extended into the three main areas of the Dolphin Orebody, namely the Wedge Area at the -130m R.L. and above and the Pit and Central Areas at the -150m R.L. Mine openings have continued to confirm the general strike and dip of strata in the main areas and have clarified some of the fault interpretation.

Initial diamond drilling on sections 220 000 E and 220 040 E had shown an anomalous 20 metre change in relative level of the C lens ore horizons south of the Central Fault and a short program of 6 holes totalling 538 metres, which involved the establishment of intermediate section 220 020 E was drilled in March 1976 to resolve the situation. A fault, known as 'P' Fault was interpreted striking 330° I.S.G. and dipping steeply south with relative movement 10 metres south block down has been confirmed by its intersection in C 10 stope at the -158m R.L. in the Pit Area. Five of the six holes in this drilling program made ore intersections which have increased the Proven ore resource by approximately 110,000 tonnes.

Also in the Pit Area another major fault, named the Swan Fault was intersected in the C 16 stope south of the area covered by the oreblocking program. The fault strikes subparallel to the 'P' Fault, approximately 30 metres to the northeast at the -150m R.L. and has similar relative movement but has a shallow (45°) dip to the south. The Swan Fault is interpreted as steepening with decreasing R.L. and connecting with a fault intersected in the main decline near the 220 080 E drill cuddy (dwg. No. KG2-121).

Mine openings in the Central Area at the -150m R.L., particularly the C 68 stope have shown rapid changes in dip from 20° to 90° over short distances (less than 6 metres). This feature together with information derived from skewed drill holes D 150/1, 2 and 3 has led to a reinterpretation of the structure to the south of the Central Area. The original interpretation (Danielson,1975) was that the area was bounded to the south by two faults, the Central and Sliver Faults, giving a combined relative movement of 70 metres south block down but it is now apparent that approximately 25 metres of this movement can be attributed to the change in dip and the area is bounded by only one Fault; the Central Fault (see dwg. No. KG2-127).

The Central Fault has been tentatively extrapolated eastward to cut section 220 200 E as shown in dwg. No. KG2-128. A fault does cross the main decline near 220 200 E in the appropriate position. The Central Fault crossing section 220 200 E as proposed may also explain the warping down to the south in the pyroxene garnet hornfels at this position and also the anomalous C lens geology between D 200/1 and D 200/11. In D 200/1 C lens is shown to be almost all massive garnet hornfels typical of Upper C lens and the 20 metre drill hole intersection averaged 2.38% WO_3 whereas in D 200/11 the C lens intersection of 28 metres is mostly Lower C lens averaging 0.51% WO_3.

The 'Q' Fault which was the other major fault interpreted in this area (Danielson, 1975) remains as originally proposed. No mine openings have yet been placed to intersect this fault but the -150m R.L. hangingwall drill drive should intersect it near 220 200 E early in 1977-78.

Numerous mining stopes have terminated in and several development headings including the main decline have passed through the Wedge Fault Zone which has been shown usually to be a zone of barren sheared biotite hornfels up to 6 metres wide.

The No.3 and Northern Boundary Faults remain as previously reported.

The position of the Grassy River Fault as shown on all Dolphin Mine geological level plans is derived by a combination of extrapolating southwards from the position indicated by aerial photos in the Bold Head - Powerhouse areas and a diamond drill hole D 215, 150 metres north of the Northern Boundary Fault. This hole showed Upper Metavolcanics to a depth of -268m R.L. abutting an area known to be quartzites. However a recent magnetic survey has indicated that the fault may be a further 150m eastward in the mine area. If this were so it is unlikely that it would have the effect of adding significantly to the ore resource as the C lens horizons would be expected to bottom in the granite basement or be removed by the unconformable Upper Metavolcanic unit before reaching the revised fault position.

In general confidence is high in the correlation of stratigraphy, structural features and C lens ore outlines between sections with the following exceptions:

1. The rapid increase in the thickness of ore horizons in the Central Area east of 220 040 E.
2. The structure south of the Central and Wedge Faults about 220 150 E - 220 200 E where the 'Q' Fault is interpreted.

Point 1 above was reported previously (Danielson, 1974 and —, 1975) and closer spaced definition by diamond drilling was recommended between 220 000 E and 220 160 E.

Point 2 was also reported previously (Danielson, 1975) and further drilling may be recommended here in 1977-78 if the geology exposed in the development of the -150m R.L. hangingwall drill drive does not clarify the structure beyond any doubt.

B lens definition continued on sections 220 140 E and 220 180 E. Drill sections at 20 metre intervals have now been established between 220 120 E and 220 240 E but this area is not completely oreblocked and additional drilling will be required as more suitable sites become available.

Stratigraphy

The continuation of the oreblocking program and the development of mine openings have so far confirmed the stratigraphy detailed by previous workers. e.g. (Danielson, 1976).

All stratigraphic units including Upper Metavolcanics and basal Quartzites have now been intersected in mine openings.

The granite basement has not been intersected in either mine openings or the oreblocking program.

Ore Resource

In the period under review the C lens total Proven + Probable resource has been reduced from 5,709,400 tonnes at 1.10%WO_3 to 5,614,200 tonnes at 1.07%WO_3. This represents a reduction in tonnage of 95,200 tonnes and in grade of 0.03%WO_3.

During this period ore mined has been 175,900 tonnes at 0.91% WO_3 and a further 53,000 tonnes has been written off the resource as being locked in pillars.

Therefore the revised calculation represents an overall increase in resource tonnage of 133,700 tonnes over the previous calculation.

Principal tonnage increases have been:

(a) Approximately 110,000 tonnes due to continued oreblocking on sections 220 000 E, 220 020 E and 220 040 E.

(b) Approximately 30,000 tonnes due to increase in ore outline area as shown from mine openings in the Central Area at -150m R.L.

The overall increase in resource has been achieved despite a reduction of approximately 17,000 tonnes in the Wedge Area due to the barren Wedge Fault Zone and a biotite hornfels wedge adjacent to it at the -119m R.L.

The decrease in total Proven and Probable resource grade from 1.10% WO_3 to 1.07% WO_3 is due mainly to the use of grades derived from mining in the -130m R.L. undercut rather than grades derived from diamond drilling. In the earlier calculation (30.9.75) diamond drilling grades for Upper and Lower C lens at the -125m R.L. Wedge Area were 1.36% and 0.72% WO_3 respectively. The grade of ore mined in the -130m R.L. undercut for Upper and Lower C lens was 1.20% and 0.69% WO_3 respectively (arithmetic averages of grab sample assays). As minimal dilution was incurred in the mining of the undercut it was considered that the mining grades were more representative of the true grade at the -125m R.L. and were consequently used in the ore resource calculation.

The B lens ore resource has been ammended from 688,000 tonnes at 0.83% WO_3 (30.9.75) to 700,000 tonnes at 0.79% WO_3 (28.9.76) due to continued oreblocking at 220 140 E and 220 180 E. The ore resource remains classified as 'probable' however the tonnage defined between 220 120 E and 220 240 E on 20 metre spaced drill sections i.e. 293,000 tonnes at 0.59% WO_3 can be regarded with a higher degree of confidence.

It should be noted that of the B lens resource approximately 203,000 tonnes at 0.68% WO_3 is defined above the -50m R.L.

A comparison study of production grades between subsequent lifts from various sources and resource grades has shown the emergence of a problem which at present is only clearly evident in the Wedge Area.

Total production from Upper C lens at the -130m R.L. undercut was 41,950 tonnes at 1.20% WO_3 (arithmetic average of grab sample assays) which could be compared with a resource grade of 1.36% WO_3. At the time it was considered that the resource grade may have been overestimated due to the weighting effect of the high (+2.5% WO_3) assays which under normal procedures are truncated at 4% WO_3. However subsequent lifts above the undercut have given production figures of

1st lift 26152 tonnes @ 1.03% WO_3
2nd lift 14907 tonnes @ 1.03% WO_3

The problem is in the significant reduction in grade above the undercut for which there is no apparent geological explanation. The first lift is now almost fully complete and the second lift approximately 80% so.

There can be no doubt that some dilution has occurred in mining the first and second lift due to the development of longitudinal stopes along ore / waste contacts and the unintentional extraction of fill, although the fill is not assayed and should not reflect in the average of grab sample assays. It seems unlikely that the waste rock and fill dilution could depress the grade sufficiently and significant dilution has not been evident from the tonnes mined.

At the same time there can be no doubt that high grade ore does exist. In the mining of the undercut between periods 5 - 7, 1975-76 inclusive Upper C lens production was 24,688 tonnes at 1.25% WO_3 but at no time in the mining of the first and second lift has such high grade production (according to grab sample assays) been sustained for any significant time, even up to one periods duration .

Doubt then exists as to the validity of the assays used in the calculation of ore resource and production grades.

The ore resource grade is calculated from diamond drill grades which undergo a rigorous 1 in 10 check assay program involving two outside laboratories in addition to K.I.S. A statistical study should now be undertaken to determine whether other estimators other than the arithmetic mean (in use at present) should be used to estimate the mean grade.

K.I.S. should be encouraged to thoroughly examine the technique of grade control assaying to determine whether there is any bias introduced by the size distribution of rocks sampled to determine production grades and to check the precision of assaying by introducing a comprehensive check assay program.

DIAMOND DRILLING 1976-77

The underground oreblocking program has continued and a total of 89 holes for 6890 metres have been completed since oreblocking commenced in December 1973.

The K.I.S. M5 machine has been used in 5 holes totalling 164 metres to provide additional structural and ore outline definition. This machine is not employed in the oreblocking program.

The diamond drilling program for 1976-77 is as follows:

	Budgetted program		Actual to date
A.D.D.	1. C lens oreblocking	1050m	-
	2. Skew drilling on 40m spaced sections.	250m	-
	3. B lens surface	100m	-
	4. B lens oreblocking on 20m spaced sections.	280m	-
		1680m	
K.I.S.	5. M5 / M10 drilling	250m	62m
		1930	62m
	Cost	$84,780	$2000 approx.

The C lens oreblocking program (item 1 above) is presently under review although the total metres of drilling is expected to remain unchanged.

The program submitted for approval at the April 1976 Technical meeting proposed drilling on three sections; 220 240 E, 220 280 E and 220 320 E from cuddy positions outside of the hangingwall Upper Metavolcanic unit due to the uncertainty of ground conditions within this unit. However an attempt is now planned to develop within this unit to provide drilling positions better sited for the continuation of the oreblocking program. Additional development of approximately 80 metres is

proposed for the -150m R.L. but this is compensated by an equivalent reduction in development to drill sites at the proposed -250m R.L. Drilling from the revised sites at the -150m R.L. will involve an increase in total metreage from this R.L. but is likewise compensated by a decrease in metreage at the -250m R.L.

It is now proposed to drill sections 220 280 E and 220 320 E this year from the -150m R.L.

The revised program (allowing drill sites within the hangingwall Upper Metavolcanic unit) is:

Section	No. of holes	Metres
220 280 E	5	490
220 320 E	5	560
		1050

The K.I.S. Mine Planning department are at present examining the feasibility of developing the western part of the -150m R.L. hangingwall drill drive later this year via the C Pit stoping areas. This development is advantageous while access is still available through the Central and Pit areas at the -150m R.L. and it will also complete a ventilation circuit with the C Pit footwall ramp (J 16). Should this development proceed it is likely that drill sites will be provided at 220 040 E and 220 080 E. Drilling on these sections was not originally planned until 1977-78. Information to be derived from drilling on these sections will not affect mine planning in the short - medium term and does not have the priority of drilling east of section 220 240 E however, if sites become available some drilling may be funded from item 2 of the approved program or additional funds may be requested. Planned drilling is 235 metres and 190 metres respectively.

At the present time a total of approximately 200 metres of B lens oreblocking drilling, in addition to that already scheduled under item 4 of the program, is available to be drilled on several sections from a variety of mine openings including the stoping areas. The cost of this drilling could be borne under item 5 of the approved program. However as standard procedures exclude the use of the M 5 machine for oreblocking purposes due to small core size and limited hole length, this drilling will need to await the acquisition of an M 10 machine by K.I.S. or the letting of a contract to a drilling contractor. As B lens drilling is and will continue to be of an intermittent nature due to the availability of suitable mine openings it is preferable that this drilling be done by ourselves and K.I.S. must be encouraged to obtain an M 10 machine.

ENGINEERING GEOLOGY

Engineering geology studies are directed to two main areas; diamond drilling and mine openings.

Diamond drilling

All diamond drill core obtained in the oreblocking program is logged for its engineering parameters. Core is arbitrarily divided into zones of apparently similar structural properties and examined for

- Core loss, cavities etc
- Number of joints per metre
- Angle of joint and bedding planes to core axis
- Type of joint infilling material
- Fault, breccia or leached zones
- Amount of broken core from which the Rock Quality Designator is calculated

Drillers records are examined for any irregularities such as water loss or inflow, drilling rates, cavities etc.

All this information is plotted at 1:500 scale on a series of drill sections known as Engineering Geology Sections. Also recorded is whether the hole was cemented or left open on completion, the size of the hole, whether any casing remains in the hole and whether or not the hole was surveyed.

The purpose of this logging and recording procedure is to enable Mine Planners to avoid or know when to expect areas of apparent bad ground. Some limited success was achieved in predicting ground conditions in Mine Series rocks ahead of the main decline between the -75 and -130m R.L. where several probe holes were drilled ahead of the development and it has also been possible to extrapolate major joints and shears into areas where their presence has later been confirmed by mine openings.

Mine openings

Engineering geology studies underground are directed principally towards the maintenance of pillar stability.

As a continuing program all pillars exposed during mining are photographed and mapped before being obscured by fill. The mapping is plotted on a transparency and overlaid on the photo. Photos of the same pillar on subsequent lifts are fitted together to form a column photo mosaic with the mapping overlaid and geologic features which may effect the pillar stability are recorded in the mapping. This information is filed in the Rock Mechanics Pillar History Ledger.

Visual inspections of the pillars are made at periodic intervals and significant geological features e.g. faults, major joints, which may require attention from the mining department to preserve pillar stability are noted in the Pillar Action Book.

Significant points to emerge from the pillar mapping.

(a) Jointing is the major factor affecting pillar stability in the Upper C lens whereas bedding is more important in the marble marker and Lower C lens.

(b) Rapid local variations in strike and dip are not uncommon.

(c) Two major joint directions occur -290° and 040°.

(d) The NW trending joint set predominates and joints dip steeply (+70°) both NE and SW.

(e) The SE trending joint set has generally flatter dips (40° - 65°) and usually to the NW.

(f) Joints trending NW are usually the more continuous, usually up to 8 metres in length and have been measured up to 50 metres in horizontal direction. It may be assumed they have a similar vertical extent.

(g) Joint surfaces are relatively smooth.

(h) Joints are usually tight and where infilled rarely exceed 1 centimetre in width. Petrographic and X ray diffraction analysis has shown that joint infillings are commonly composed of

60% comminuted garnet
15% white carbonate
15% limonitised amphibole - mica material
10% garnet ground to 'flour' size, occasional scheelite grains

(i) Biotite hornfels beds within the marble marker and Lower C lens often contain abundant montmorillonite which causes significant fretting.

(j) Thin (< 1 metre) biotite hornfels beds of limited extent occasionally occur within the Upper C lens. These beds are usually heavily shattered.

COMPUTER

All diamond drill hole information from the oreblocking program is encoded for computerisation in the telex tape form and forwarded to Sydney Office together with mine grade control assay values for ore mined.

The computer group have now prepared block grade estimates for;

Wedge Block from -130m R.L. to -85m R.L.
Central Block from -150m R.L. to -139m R.L.

A technique has been developed whereby grade control grab sample assays can be combined with diamond drill hole assays in the estimation of mining block grades. It is hoped that this advance will eliminate or reduce the necessity for additional drilling to supplement the assay information already available as was thought (Danielson, 1975) may have been necessary.

A comparison study of the estimated and actual block grades in the Wedge Area is in progress.

FUTURE OREBLOCKING PROGRAMS

On completion of drilling planned for the current year two oreblocking programs remain to be implemented.

1. To complete the oreblocking of C lens south and east to the Grassy River Fault.

   A version of this program presented in the previous review report (Danielson, 1975) involved drill sites at the -150m R.L. and -250m R.L. and by continuing the program at 40 metre spacing a drilling metreage of 4800 metres (58 holes) was estimated. It was noted that while the program would serve the purpose of oreblocking it was undesirable in two main respects.

   a. Drilling on the 220 360 E section would need to take place from within C lens as a result of the elimination of the -200m R.L. drill drive due to mining considerations.
   b. Because drilling from the -150m R.L. hangingwall drive would not adequately define the Wedge Area hangingwall geology at the -250m R.L. the initial phase of the oreblocking program at the -250m R.L. would be to drill a horizontal fan of 6 holes totalling approximately 1100 metres to broadly define the geology on the level before any hangingwall development could proceed.

   However a much more desirable program is now envisaged in which the major part of the drilling is carried out from the -150mR.L. The only section to be drilled from the -250m R.L. is the 220 400 E section and that drilling remains as per the original program (Danielson, 1975).

   In the program now proposed development would proceed into the hangingwall Upper Metavolcanic unit at the -150m R.L. as shown on the attached plan (dwg. No. KG2-147). A total of 160 metres additional development is proposed at this level over and above the original program.

At the -250m R.L. (dwg. No. KG2-179) development would proceed from the main decline to the 220 400 E site via the shortest route allowing for any restrictions imposed by the pillar pattern. Approximately 140 metres development would be required; the major part of which could be in ore if desired. This represents a reduction of 330 metres of development on the original program.

The drilling program would be:

Section	R.L.	No. of Holes	Metres
220 000	Await results of	220 020 E	-
220 020	-150	2	145
220 040	"	4	235
220 080	"	3	190
220 120	"	4	245
220 160	"	5	370
220 200	"	4	360
220 240	"	5	410
220 280	Will be completed this year		
220 320	-150	4	435
220 360	"	8	1030
220 400	-250	5	330
		44	3750

Note: Allowing the 1050 metres of C lens drilling approved for this year the total drilling required is 4800 metres which is the same as in the original program.

The principal advantages of the new proposal over the original are:

a. Drill sites at the -150m R.L. can be made available quickly and so provide access to geological information at the -250m R.L. in the shortest possible time i.e. before main decline development reaches that level.

b. The necessity to drill from within C lens at 220 360 E is removed.

c. There would be no requirement to drill a horizontal fan of holes at the -250m R.L. to define the hangingwall at that level and the consequent delays to development incurred by this drilling is removed. Only a short probe hole ahead to the drill site at 220 400 E should now be required.

d. There is an overall saving in development to drill sites of 170 metres however most of this development would have been within the orebody about section 220 360 E.

The obvious key to the success of the revised program is the ground conditions within the Upper Metavolcanics at the -150m R.L.

2. Continue oreblocking B lens at 20 metre intervals.

This program will be continued as the mine develops and drill sites become available.

Continuation of the program at 20 metre intervals to 220 360 E would require approximately 2200 metres.

REFERENCES

Danielson, M.J., September, 1974. Geological Review-Dolphin Orebody, September, 1974.

Danielson, M.J., October, 1975. Geological Review-Dolphin Orebody, October 1974.

Danielson, M.J., 1976. King Island Scheelite Deposits in Economic Geology of Australia and Papua New Guinea Vol. 1. pp 592 - 597.

APPENDIX 1

MINE PRODUCTION SUMMARY

B lens

	7156 t @ 0.41% WO_3	
		7156 0.41

C lens Pit

Portal and main decline access	5473 t @ 0.64% WO_3	
-67m to -77m R.L.	39889 t @ 0.52% WO_3	
-110m to -120m R.L. (J 16)	3490 t @ 0.59% WO_3	
-145m to -158m R.L.	18104 t @ 1.03% WO_3	
		66956 0.67

C lens Central

-66m to -79m R.L.	25960 t @ 1.62% WO_3	
-130m to -145m R.L. (N15)	10573 t @ 0.76% WO_3	
-150m undercut and benching	21313 t @ 0.81% WO_3	
		57846 1.16

C lens Wedge

above -77m R.L.	65277 t @ 1.04% WO_3	
-100m R.L. (Q 13)	2770 t @ 0.55% WO_3	
-130m R.L. undercut and main decline	73414 t @ 0.98% WO_3	
1st lift	43098 t @ 0.85% WO_3	
2nd lift	22964 t @ 0.90% WO_3	
3rd lift	2015 t @ 0.61% WO_3	
-150m R.L. (M 14)	5348 t @ 0.78% WO_3	
		214886 0.95

Total Mine Production 346844 t @ 0.92% WO_3

APPENDIX 2

SUMMARY OF DIAMOND DRILLING RESULTS

FOR HOLES COMPLETED SINCE OCTOBER 1975

DRILLING SECTION	HOLE No.	BEARING I.S.G. (o)	INCLIN-ATION (o)	TOTAL DEPTH (o)	MINERALISATION (WO_3)	REMARKS
220 000E	D000/5	180	-45	101.2	C lens: 56 - 69m, 13m @ 0.67% 79 - 82m, 3m @ 0.54%	
220 020E	D020/1	360	-41	53.0	B lens: 14 - 17m, 3m @ 0.50%	No signif-icant C lens inter-section
	D020/2	360	-67	59.0	B lens: 11 - 13m, 2m @ 0.82%. C lens: 35 - 40m, 5m @ 0.45%	
	D020/3	180	-84	77.6	C lens: 38 - 56m, 18m @ 0.77%. 64 - 66m, 2m @ 0.48%	
	D020/4	180	-55	110.4	B lens: 14 - 16m, 2m @ 0.35%. C lens: 77 - 90m, 13m @ 0.87% 93 - 102m, 9m @ 0.96%.	

DRILLING SECTION	HOLE NO.	BEARING I.S.G. (o)	INCLIN-ATION (o)	TOTAL DEPTH (o)	MINERALISATION (WO_3)	REMARKS
220 040E	D040/4	180	-57	137.4	B lens: 42 - 44m, 2m @ 1.43% C lens: 82 - 112m, 30m @ 1.19% 114 - 118m, 4m @ 0.92%	P Fault at 113m
220 140E	D140/1	360	+90	26.2	B lens: 10 - 12m, 2m @ 0.32%	
	D140/2	180	+20	32.6		No signif-icant B lens mineral-isation
	D140/3	360	+30	51.4	B lens: 37 - 41m, 4m @ 0.77%	No.3 Fault at 51m
-	D150/1	185	-13	59.0	C lens: 0 - 8m, 8m @ 0.78% 8 - 37m, 29m @ 1.16%	Central Fault at 37m
-	D150/2	132	-16	52.0	C lens: 5 - 12m, 7m @ 1.23% 12 - 51m, 39m @ 1.80%	Signific-ant water inflow at 52m
-	D150/3	134	-23	23.5	Not available	Central Fault at 18.3m
-	D150/4	055	-44	38.5	Not available	

DRILLING SECTION	HOLE NO.	BEARING I.S.G. (o)	INCLIN-ATION (o)	TOTAL DEPTH (o)	MINERALISATION (WO_3)	REMARKS
220 180E	D180/1	360	+90	19.0	B lens: 0 - 5m, 5m @ 0.58%	
	D180/2	180	0	24.5	B lens: 1 - 10m, 9m @ 0.72%	
	D180/3	360	-90	7.0	B lens: 0 - 3m, 3m @ 0.84%	
	D180/4	360	+55	49.9	B lens: 26 - 49.9m 23.9m @ 0.70%	
	D180/5	180	+20	62.0	B lens: 26 - 32m, 6m @ 0.59%	Wedge Fault @ 24.5m
-	D190/1	192	0	37.13	C lens: 10 - 14m, 4m @ 0.80%	Wedge Fault Zone 2 - 12m
-	D200/15	310	-10	31.01	C lens: 12 - 18m, 6m @ 1.11%	
-	D200/16	288	0	33.7	C lens: 0 - 6m, 6m @ 1.53% 17 - 33.7m, 16.7m @ 0.86%	Wedge Fault Zone 6 - 19m
220 280E	D280/6	180	-45	133.8	C lens: 81 - 123, 42m @ 1.64%	

GEOPEKO LIMITED

KING ISLAND

Ore Resource Table Dolphin Orebody - 'C Lens'

(28-9-76)

	219880E	219920E	219960E	220000E	220040E	220080E	220120E	220160E	220200E	220240E	220280E	220320E	220360E	220400E	Grassy River Fault	TOTAL	CUMULATIVE TOTAL	
00 R.L.			—	10,300 2·20	5,700 1·61	6,800 1·32	15,700 1·10	—	—	—	—	—	—	—	—	38,500 1·50	38,500 1·50	00 R.L.
	237,000															237,000 0·65	237,000 0·65	
			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
-75m.R.L.			—	7,400 0·96	24,300 1·25	33,300 1·47	250,400 1·22		—	—	—	—	—	—	—	315,400 1·24	353,900 1·27	-75m.R.L.
	105,000			—	—	—		—	—	—	—	—	—	—	—	105,000 0·62	342,000 0·64	
			—	—	—	—		—	—	—	—	—	—	—	—	—	—	
-100m.R.L.			—	29,000 0·74	20,500 0·94	97,400 1·21	452,700 1·11			—	—	—	—	—	—	599,600 1·10	953,500 1·16	-100m.R.L.
	30,000			—	—	—		—		—	—	—	—	—	—	30,000 0·59	372,000 0·64	
			—	—	—	—		—		—	—	—	—	—	—	—	—	
-125m.R.L.	—	—	—	57,000 0·81	62,000 1·04	46,000 1·06	107,000 0·99	586,300 1·05			—	—	—	—	—	858,300 1·03	1,811,800 1·10	-125m.R.L.
	—	—	—	—	—	—	—				—	—	—	—	—	—	372,000 0·64	
	—	—	—	—	—	—	—				—	—	—	—	—	—	—	
-150m.R.L.	—	—	—	19,000 0·75	45,000 1·02	82,000 0·98	105,000 0·98	1,160,400					1·12	—	—	1,411,400 1·09	3,223,200 1·10	-150m.R.L.
	—	—	—	10,000 0·80	10,000 0·80	25,000 0·65	69,000 0·65	383,000					0·66	—	—	497,000 0·66	869,000 0·65	
	—	—	—	—	—	—	—	300,000								300,000	300,000	
-200m.R.L.	—	—	—	—	—	—	—	—								—	3,223,200 1·10	-200m.R.L.
below -200m.R.L.	—	—	—	—	—	—	18,000 0·55	1,504,000	—			1·24		—		1,522,000 1·23	2,391,000 1·02	below -200m.R.L.
	—	—	—	—	—	—	—	700,000								700,000	1,000,000	

C Lens Proven Ore Resource Tonnes at Grade % WO_3	3,223,200 1·10
C Lens Probable Ore Resource Tonnes at Grade % WO_3	*2,391,000 1·02*
C Lens Possible Ore Resource Tonnes	*1,000,000*

DOLPHIN OREBODY SUMMARY

PROVEN ORE RESOURCE:

C LENS ..... 3,223,200 TONNES at 1·10 % WO_3

PROBABLE ORE RESOURCE:

C LENS ..... 2,391,000 TONNES at 1·02 % WO_3
B LENS ..... 700,000 TONNES at 0·79 % WO_3

POSSIBLE ORE RESOURCE:

C LENS ..... 1,000,000 TONNES

ORE RESOURCE LOCKED IN PILLARS: ..... 75,000 TONNES

TOTAL PROVEN AND PROBABLE ORE RESOURCE 6,314,200 TONNES at 1·04 % WO_3

NOTE:

Method of grade calculation: modified polygonal method of weighted arithmetic means.

Method of tonnes calculation: truncated cone formula, using drill sections in Central Area and geological floor plans in Wedge Area.

166041

SCALE: 1:1000
COMPILED BY: M.J.D.
DRAWN BY: R.F.
CHECKED BY: M.C.R.
DATE: OCT., 1976

5 cm

93-3466