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Dept of M | A.O. | C.O. | E.O. | D.S.M.E
Received Answered 24 DEC 1982
DEPT. OF MINES
REF. No. 10,861/82

# FOLEY ZONE EXPLORATION

## 1980 - 1982

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DECEMBER, 1982

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## INTRODUCTION

This report summarizes work carried out in the exploration of Foley Zone at Cleveland Tin Mine during 1982. Foley Zone lies within the Cleveland Tin Limited Mining Lease (M.L. 27M/71), however, under an agreement with the Department of Mines, expenditure incurred in the exploration of Foley Zone will be in lieu of exploration activity carried out in the exploration licence E.L. 34/82.

## 1a. HISTORY OF DISCOVERY (1974-1980)

Although not documented a project initiated by K.G. Palmer between 1974 and 1978 aimed to establish a metal zoning pattern within and encompassing the main tin lode horizons. The metal content of veins in broad terms was thought to mimic and reflect some of the basic metal variations in the tin lode they surrounded. From this work a central high temperature zone characterized by the presence of wolframite, bismuthinite and molybdenite was inferred to be surrounded by an outer low temperature zone defined by the appearance of galena and sphalerite. During 1978 mining development on 17 B-South Drive and the 20-22 Level Decline had also exposed molybdenite and wolframite bearing quartz veins above the inferred zone. Two holes were motivated in November, 1978 (K.G. Palmer, Ref. 1) to test this high temperature zone but drilling was delayed due to the lack of suitable sites. In February, 1980, the "discovery hole", C.1485 the first of the proposed holes, intersected increasingly mineralized quartz vein stockwork and altered quartz porphyry.

## 1b. EARLY EXPLORATION (1980-Mid. 1981)

Folowing hole C.1485 two holes (C.1501 and C.1570) were drilled on Hall's sections some 120m north and south of C.1485. Only very weak mineralization was detected.

In November, 1980, the 24-26 Level Decline intersected weak stockwork and heavily altered quartz porphyry. Two holes (C.1608 and C.1611) were collared on Gd section near to the newly exposed quartz porphyry in the decline. Large

quartz stockwork zones were encountered but no porphyry. A vertical hole on 25 Level (C.1615) intersected moderate stockwork and porphyry 80m below the collar. Two holes (C.1627 and C.1634) were drilled on the northern side of the porphyry on Ga section. Patchy stockwork and traces of quartz porphyry in the form of thin veins were observed. One hole (C.1633) further north on J section deviated enormously and intersected altered porphyry at the very deep level of 450m below sea level.

Given the limited amount of porphyry intersections a body steeply dipping and cross-cutting the stratigraphy, was suggested.

In July, 1981, a new grid based on the orientation of Battery Reference Plane was established. Hole C.1637 was attempted across the width of the intrusive intersecting minor quartz porphyry, dense stockwork and alteration where they had been projected to lie. It became apparent that the new inferred strike and dip direction of the porphyry was valid. Shortly after, hole C.1642 was drilled some distance up-dip from C.1637. Low grade mineralization was intersected at its projected position. The new Foley Grid was maintained and no further drilling on Hall's sections was to be attempted.

## 2a. SYSTEMATIC DRILLING FROM JULY, 1981

In July, 1981, a proposal (E.V. Dronseika, Ref.2) based on an urgency to define the zone was motivated. A platform just above 26 Level was required. 370m of horizontal development with sky-raises at 8 drill section spaced at 40m intervals was recommended. A fan of 4 holes per section with each section generating a total of 900m per section. 7200m of drilling was to be anticipated. No holes, however, could be drilled during that year due to site unavailability.

In December, 1981, this proposal was modified and drilling commenced in January, 1982. The number of holes was reduced to 13 and totalling only 3150m. Most of these holes were completed according to plan and form the basis of the overall definition of Foley Zone.

In July, 1982, a re-assessment of drilling priority was undertaken. A dense pattern of drill holes aimed at investigating possible high grade mineralization footwall to the porphyry above 28 Level was motivated. This program involved drilling 14 holes totalling 2030m. Since January, 1981, 3336m of drilling has been completed in a systematic campaign to evaluate Foley Zone.

List of completed holes is a follows: (1982 drilling)

| | | | |
|---|---|---|---|
| C.1713 - 373m | C.1800 - 263m | C.1824 - 117m | C.1842 - 128m |
| C.1730 - 172m | C.1803 - 134m | C.1826 - 171m | C.1852 - 137m |
| C.1741 - 200m | C.1809 - 112m | C.1832 - 141m | C.1860 - 129m |
| C.1754 - 232m | C.1811 - 139m | C.1833 - 146m | C.1865 - 99m |
| C.1786 - 323m | C.1822 - 17m | C.1840 - 134m | C.1869 - 169m |

## 2b. COSTS FOR 1982 DRILLING PROGRAM

A breakdown of costs is given below for period 18/11/81 to 16/11/82:

| | |
|---|---|
| Salaries | - 33,632 |
| Survey | - 533 |
| Sampling | - 22,068 |
| Assaying | - 31,972 |
| Petrology | - 1,652 |
| Drilling | -211,313 |
| Draughting | - 1,180 |
| Groundwater Investigation & Control | - 7,619 |
| TOTAL: | $309,969 |

## 3. GEOLOGY

Foley Zone is composed of an altered quartz - feldspar porphyry intrusive plug or dyke surrounded by a mineralized quartz vein stockwork.

### 3a. LOCATION

The zone occurs deep in the central footwall portion of the mine sequence. The porphyry is virtually confined to the Crescent Spur Mica Sandstone unit which is immediately footwall to Hall's Formation. Henry's lode position appears to terminate the porphyry in the east. Limited drilling to the west indicates the porphyry to either terminate within the mica sandstone or plunge very steeply towards the Ultrabasic Sequence contact further to the west. The top of the porphyry is inferred to be at approximately sea level and the deepest drill hole intersection to date (C.1633) has located it to a depth of at least 600m below sea level. The quartz vein stockwork surrounding the porphyry extends and peters out into the Ultramafic Sequence to the west and into Hall's Formation to the east. Isolated veins attributed to Foley Zone have been located as far as 15 - 16 B-South Decline and this would probably represent the top of the system approximately 180m above sea level.

### 3b. QUARTZ-PORPHYRY INTRUSIVE

The original mineralogy of the porphyry is not clear due to the heavy topaz, quartz, sericite, carbonate, tourmaline and clay alteration. Relict textures and limited petrographic

work have indicated the rock to have contained euhedral quartz (up to 1 cm in diameter) and probably K-feldspar phenocrysts (up to 2 cms lengths) in a fine grained quartz - feldspar groundmass. In some specimens a phyllosilicate which may have been biotite originally, occurs in accessory quantity as partially destroyed grains in the groundmass. In hand specimen quartz phenocrysts are generally visible and the rock looks similar to porphyry outcropping at Mt. Bischoff. The heavily topazized zones contain visible cassiterite together with pyrite.

3c. QUARTZ - VEIN STOCKWORK

From cross-cutting relationships, vein overprinting and vein displacements a list of tentative vein types in paragenetic sequence is given below starting with the oldest veins:

1. Fine carbonate bleaching with thin irregular quartz veins. (Approx. 1mm thick.)
2. Fine quartz veins. (Approx. 2mm thick.)
3. Quartz - very minor wolframite veins.
4. Grey sericite - quartz veins.
5. Grey sericite - quartz - carbonate - minor wolframite veins.
6. Quartz - minor wolframite - molybdenite - bismuth - flourite veins.
7. Quartz - major wolframite - minor molybdenite - minor bismuth - fluorite veins.
8. Quartz - carbonate (siderite) - minor wolframite - minor pyrite - minor chalcopyrite veins.

9. Quartz - topaz - pyrite - arsenopyrite - chalcopyrite - carbonate - flourite - tourmaline - cassiterite veins.
10. Arsenop yrite - pyrite veins.
11. Purple and green flourite veins.

A high level of veining is not apparent in the porphyry yet the extreme level of alteration observed within the intrusive can be attributed to various vein phases detailed above. Veins 4 and 5 have caused extensive greisenization, veins 3, 6 and 7 extensive silicification, vein 8 carbonate alteration and vein 9 extensive topazization.

Vein size is variable but only rarely exceeds 40 cm and then only at some distance from the porphyry. Over 50% of vein material is generally less than 20mm thick. Vein density generally increases towards the porphyry. Re-calculated grades of mineralized veins are generally highly variable containing between 1% and 15% $WO_3$ by weight.

3d. MINERALIZATION

Minerals of economic significance within the zone are wolframite, molybdenite, bismuthinite and native bismuth, cassiterite, flourite, chalcopyrite. Their spatial location within the system is distinct being related to specific vein phases and the abundance of that vein phase within the system. Molybdenite, bismuthinite, native bismuth and flourite occur as an outer shell in the stockwork zone. Strong wolframite mineralization occurs inside this and cassiterite - chalcopyrite mineralization is confined to the central zone within the quartz porphyry. As different mineralizing vein phases are

temporaly distinct, overlapping of zones has been noted.

Foley Zone cuts across narrow low tin grade Henry's lode in the eastern part of the main mineralized zone. Despite the low observed vein density within the lode, grades are still considerable. Close inspection reveals fine wolframite and molybdenite in a metasomatized lode matrix of green, brown and khaki biotite, flourite, sellaite, quartz and carbonate. The implication is that veins have reacted with the lode rather than crystalize out as a specific vein.

3e. ACADEMIC WORK - DR. T. KWAK AND P. JACKSON

Dr. Teunis Kwak, Lecturer in Geology at LaTrobe University in Victoria has made regular visits to the mine. His primary interest is skarn mineralization although most of his work has centred around the quartz-porphyry intrusion within Foley Zone and to a lesser extent the stockwork surrounding it. Dr. Kwak's association with the mine staff commenced in early 1981 and although no formal paper or submission on Foley Zone has been generated by him, he has been responsible for recognizing the extent of topaz alteration in the porphyry and was the first to identify beryl. He has also been responsible for assisting in generating a conceptual understanding of the tin lode lenses at the mine.

Peter Jackson a student under the direct supervision of Dr. Kwak recently completed an Honours Thesis (Ref. 3) a part of which detailed progressive hydrothermal alteration of Henry's lode lens adjacent to the quartz porphyry and similar alteration in Lower Hall's B Lens. According to

Jackson the original amphibole and chlorite skarn has been progressively altered to biotite, tourmaline, sulphides, fluorite and carbonate with a consequent redistribution of cassiterite away from the alteration. Where this alteration occurs in Lower Hall's B Lens it is not directly related to the Foley Zone porphyry, and another deeper and further north source is implied.

## 4. ASSAY RESULTS AND RESOURCE POTENTIAL

A full set of 1:500 scale working sections and plans is attached with this report.

In most cases the entire length of drill hole was split and assayed at 2.5m length intervals. Assays are for total tin, soluble tin, copper, tungstic oxide, molybdenum sulphide and bismuth. A 0.2% $WO_3$ cut-off was applied to significantly mineralized intersections and a large zone surrounding the porphyry was defined. A 0.4% $WO_3$ cut-off was also applied to intersections that carried higher grades. A small zone on the footwall (southern) side of the porphyry was also defined.

At present there is insufficient drilling to generate a meaningful ore reserve statement. However, the limited drilling that has been completed gives us an idea of what potential exists.

Using a 0.2% $WO_3$ cut-off, significant mineralization exists from 5040E section in the east to 4920E section in the west. This gives us an overall strike length of 120m. A mean width across the system of both stockwork and porphyry would be about 75m.

Drilling to date has generally defined significant mineralization above R.L. 850m to R.L. 1000m (sea level). Using a specific gravity of 2.8 there is potential for 3.5 to 4 million tonnes above 850m R.L. One hole C.1633 intersected mineralization down to R.L. 400m which suggests potential exists for a body of size between 10 and 20 million tonnes. Bulk grades within the entire system have only been around 0.3% $WO_3$.

## 5. FUTURE EXPLORATION

Further exploration within the zone could proceed in two areas.

1. Mineralization within close reach of current mining development that is above 30 Level (R.L. 890m) should be further investigated to allow for a more confident estimate as to its actual mining potential. Drilling to date has been on 40 m spaced sections which is too wide a spacing to correlate intersections confidently. Drilling between these sections that is at 20 m spacing should be attempted.

2. Hole C.1633 indicated potential for continued mineralization exists to very deep levels. A series of holes under the area which has currently been defined that is below R.L. 890m, and above hole C.1633 (R.L. 500) should also be attempted.

## 6. REFERENCES


1. Palmer, K.G. 1978 - Cleveland Mine, Geological Work Proposals. (Unpublished internal report.)

2. Dronseika, E.V. 1981 - Proposed Detailed Exploration for Foley Zone from 24 Level Platform. (Unpublished internal memorandum.)

3. Jackson, P.G. 1982 - The Mineralogy, Mineral Zonation and Hydrothermal Alteration in the Lower Hall's B Lens, Cleveland Mine, Tasmania. (Unpublished B.Sc. (Hons.) Thesis, LaTrobe University.)

66 016

## APPENDICES

1:500 Sections : 4880E - 5080E.

1:500 Plan : Interpreted Geology 28 Level showing high grade zone.

1:500 Longitude. Projection.

RL 700

RL 750m

RL 800m

RL 850m

RL 900m

RL 950m

RL 1000m

RL 1050m

RL 1100m

4850N

4900N

4950N

5000N

5050N

5100N

4850

4900

4950

5000

5050

5100

25 Level

23 Level

21 Level

17 Level

55

Projected from 4875E

Projected from 4910E

5 cm

66 024 6322

| REVISIONS | | | |
|---|---|---|---|
| DATE | DRAWN BY | DATE | DRAWN BY |
| | | | |

CLEVELAND TIN LTD 82-15892

4880E SECTION
FOLEY'S ZONE
BATTERY REF PLANE

DRAWING N°

DRAWN A.C.M. | TRACED | SCALE 1:500 | SHEET

RL 700

RL 750m

RL 800m

RL 850m

RL 900m

RL 950m

RL 1000m

RL 1050m

RL 1100m

4850N

4900N

4950N

5000N

5050N

5100N

25 Level

23 Level

21 Level

To be moved and logged

Legend

Qtz-porphyry intrusion

Mineralized Zone (0.2% WO3 Cut-off)

5 cm

66 023

6323

| REVISIONS | | | |
|---|---|---|---|
| DATE | DRAWN BY | DATE | DRAWN BY |
| | | | |

CLEVELAND TIN LTD 33-1289

DRAWING Nº

4920E SECTION

FOLEY'S ZONE

BATTERY REF PLANE

DRAWN AJM | TRACED | SCALE 1:500 | SHEET

6324

RL 700m
RL 750m
RL 800m
RL 850m
RL 900m
RL 950m
RL 1000m
RL 1050m
RL 1100m

4850N
4900N
4950N
5000N
5050N
5100N

4850
4900
4950
5000
5050
5100

Legend

- Qtz Porphyry Intrusive
- Mineralized Zone (0.2% WO3 cut-off)

2.1 km to 960E

5 cm

| REVISIONS | | | |
|---|---|---|---|
| DATE | DRAWING NO. | DATE | DRAWN BY |

CLEVELAND TIN LTD 82-1389P

4960E SECTION
FOLEY'S ZONE
BATTERY REF PLANE

DRAWING Nº

DRAWN A.M. | TRACED | SCALE 1:500 | SHEET

RECEIVED 99 022

6325

RL 700m
RL 750m
RL 800m
RL 850m
RL 900m
RL 950m
RL 1000m
RL 1050m
RL 1100m

4850N
4900N
4950N
5000N
5050N
5100N

Legend
Quartz-Feldspar Intrusive
Mineralized Zone (0.2% Sn Cut-off)

5 cm

66 021 6325

CLEVELAND TIN LTD 32-1889 E

| REVISIONS | | | |
|---|---|---|---|
| DATE | DRAWN BY | DATE | DRAWN BY |
| | | | |

5000E SECTION
FOLEY'S ZONE
BATTERY REF. PLANE

DRAWING Nº

DRAWN A.C.M. | TRACED | SCALE 1:500 | SHEET

9259

RL 700m
RL 750m
RL 800m
RL 850m
RL 900m
RL 950m
RL 1000m
RL 1050m
RL 1100m

4850N
4900N
4950N
5000N
5050N
5100N

21 Level
22 Level
24 Level

55m @ 0.51% Zn Eq

Legend
Quartz-porphyry Intrusive
Mineralized Zone (0.2% Cut-off)

5 cm

66 020 6326

| REVISIONS | | | |
|---|---|---|---|
| DATE | DRAWN BY | DATE | DRAWN BY |
| | | | |

CLEVELAND TIN LTD 32-1339R

5040E SECTION
FOLEY'S ZONE
BATTERY REF. PLANE

DRAWING Nº

DRAWN A.C.M | TRACED | SCALE 1:500 | SHEET

RL 700m
RL 750m
RL 800m
RL 850m
RL 900m
RL 950m
RL 1000m
RL 1050m
RL 1100m

4850N
4900N
4950N
5000N
5050N
5100N

6327

5 cm

66 019 6327

| REVISIONS | | | |
|---|---|---|---|
| DATE | DRAWN BY | DATE | DRAWN BY |
| | | | |

CLEVELAND TIN LTD. 82-1889C

5080E SECTION
FOLEY'S ZONE
BATTERY REF. PLANE

DRAWING N°

DRAWN A.C.M. | TRACED | SCALE 1:500 | SHEET

E 4840

E 4880

E 4920

E 4960

E 5000

E 5040

E 5080

4850N

4900N

4950 N

5000 N

4840E

4880 E

4920 E

4960 E

5000E

5040 E

5080 E

C1826

C1485

C1637

C1852

C1713

C1615

C1634

C1611

C1730

C1741

C1608

C1627

C1824

C1803

C1754

4850 N

4900N

4950 N

5000 N

## LEGEND

0·2 % $WO_3$ CUT-OFF GRADE

0·4 % $WO_3$ CUT-OFF GRADE

QUARTZ PORPHYRY INTRUSIVE

HENRYS LODE

ULTRABASIC SEQUENCE CONTACT

DIAMOND - DRILL HOLE INTERSECTION ON LEVEL

5 cm

5 cm

6328

CLEVELAND TIN LTD 82-1889R

66 017

FOLEY ZONE

PLAN - 28 LEVEL
(RL 930 m)

NOV '82

DRAWING N°

MC / 500 / 1 / FOL·

DRAWN E·V·D | TRACED K·A·T | SCALE 1:500 | SHEET

4880 | 4920 | 4960 | 5000 | 5040 | 5080 | 5120 | 5160

1050 RL
1000 RL
950 RL
900 RL
850 RL
800 RL
750 RL
700 RL
650 RL
600 RL

26 Level
27 Level
28 Level
29 Level

21-22 Decline L/BAY

22 Level Workshops

24-25 L/BAY

24-26 Decline

25-26 FOLEY PLATFORM

Henry's Strat pos^n

probable limit to significant mineralization (0·2% $WO_3$ cut-off)

Ultramafic Sequence

Henry's Strat pos^n

Unit B Strat. pos^n

Legend

- Quartz - Porphyry Intrusive
- D.D.H. Intersection of Significant Mineralization (0·2% $WO_3$ Cut-off)

KEY

6259

4880 E | 4920 E | 4960 E | 5000 E | 5040 E | 5080 E | 5120 E | 5160 E

5 cm

66 018

6329

82-1889 R

| | | |
|---|---|---|
| Surveyed | | FOLEY ZONE LONGITUDINAL PROJECTION. |
| Drawn | | Drawing No. |
| Traced | K·A·T | |
| Checked | E.N.D. | |
| Scale 1:500 | Date 1 Dec '82 | Sheet |