BILLITON AUSTRALIA
THE METALS DIVISION OF THE
SHELL COMPANY OF AUSTRALIA LIMITED

EXPLORATION LICENCE 4873 SPRING HILL WEST
ANNUAL REPORT FOR THE PERIOD ENDING 7TH NOVEMBER 1989

AUTHOR: C.R. MACKAY REPORT NO.: 08.4851

OPEN FILE

DISTRIBUTION:
1. NT Department of Mines & Energy - Darwin
2. Ross Mining NL - Cairns
3. Billiton - Melbourne
4. Billiton - Cairns
5. Billiton - Darwin
**SUMMARY**

Exploration Licence 4873, Spring Hill was granted to Territory Resources NL on the 5th October, 1987 for a period of three (3) years. Ross Mining NL purchased Exploration Licence 4873 from Territory Resources in September 1988. A Joint Venture (Spring Hill Joint Venture) over the tenement between Ross Mining NL and The Shell Company of Australia Limited commenced on the 1st of October 1988. Shell is manager and operator of the Joint Venture.

Exploration Licence 4873, Spring Hill West is located some 27 kilometres north-northwest of Pine Creek.

The geology of the tenement area consists of moderately folded Early Proterozoic Finnis River Group (Burrell Creek Formation) and South Alligator Group (Gerowie Tuff, Mt Bonnie Formation) sediments and volcanics.

Several megascopic antiforms and synforms with moderate to strong axial planar cleavage occur in the area, the Spring Hill anticline being the dominant structure.

The major Pine Creek Shear Zone passes through the region and several old gold, tin and silver-lead mines occur along this structure. The main mining activity in the area occurred at the Spring Hill West gold mine where some 22,000 ounces of gold has been extracted in the past.

Work to date has consisted of stream sediment sampling, reconnaissance mapping/rock chipping sampling and aeromagnetic coverage.

No economically mineralised targets have been outlined to date, however several highly gold anomalous stream sediment catchment areas have been delineated which drain from MCN's and MLN's held by the Spring Hill Joint Venture partners on the main Spring Hill ridge.
CONTENTS

1.0  INTRODUCTION
2.0  LOCATION AND ACCESS
3.0  REGIONAL SETTING
4.0  STRATIGRAPHY
5.0  STRUCTURE
6.0  MINERALISATION
7.0  WORK COMPLETED
   7.1  STREAM SEDIMENT SAMPLING
   7.2  RECONNAISSANCE MAPPING/ROCKCHIP SAMPLING
   7.3  AEROMAGNETICS
8.0  CONCLUSIONS
9.0  EXPENDITURE STATEMENT

REFERENCES
LIST OF FIGURES

FIGURE NO.  TITLE

1.  EL 4873 LOCATION AND TENEMENT STATUS
2.  EL 4873 GEOLOGY AND STRUCTURE
3.  EL 4873 BCL GOLD STREAM SEDIMENT SAMPLE RESULTS
4.  EL 4873 Cu, Pb, Zn STREAM SEDIMENT SAMPLE RESULTS
5.  EL 4873 Ag, As STREAM SEDIMENT SAMPLE RESULTS
6.  EL 4873 RECONNAISSANCE MAPPING/BOCKCHIP SAMPLING
7.  EL 4873 AEROMAGNETIC CONTOURS
1.0 Introduction

Exploration Licence 4873, Spring Hill West was granted to Territory Resources NL on the 5th October, 1987 for a period of three (3) years. Ross Mining NL purchased Exploration Licence 4873 from Territory Resources in September 1988. A Joint Venture (Spring Hill Joint Venture) over the tenement commenced between Ross Mining and The Shell Company of Australia Limited on the 1st of October 1988. Shell is manager and operator of the Joint Venture.

This report details the work completed and results gained by Billiton Australia, The Metals Division of The Shell Company of Australia Limited, on behalf of the Spring Hill Joint Venture, during the year ended 7th of November 1989.

The licence area presently consists of two (2) sub-blocks or approximately 6.5 km².

The bulk of work completed in Exploration Licence 4873 has occurred on MCH's and MLN's in the northeast corner of the tenement. Work on these tenements is subject to a separate annual report due at the N.T. Department of Mines & Energy on the 31st December, 1989, and therefore no mention of this work is included in this report (See Figure 1).

2.0 Location & Access

Exploration Licence 4873 lies some 27 kilometres north-northwest of Pine Creek (See Figure 1).

Access to the tenement is from the Stuart Highway via Spring Hill Road or via the Mt Wells - Pine Creek Road. A gravel track from the Spring Hill Road to small scattered alluvial gold plants on the western side of Spring Hill provides access to the southern portion of Exploration Licence 4873. Another graded track from the Mt Wells - Pine Creek Road to the old Spring Hill gold workings provides access to the northern area of the licence area.

3.0 Regional Setting

The Spring Hill area lies in the southern part of the Pine Creek Geosyncline. The geosyncline contains Early Proterozoic metasedimentary rocks resting on a gneissic and granitic Archean basement. The metasediment represent a preserved basinal sequence up to 14 kilometres thick (Needham et al., 1980), comprising of a possible original thickness of up to 20 km (Ferguson, 1980), which at 1870-1899 Ma was folded and metamorphosed mostly to greenschist facies, and in places to amphibolite facies. The geosynclinal sequence is intruded by transitional igneous
rocks; including pre-tectonic dolerite sills and syn- to post-tectonic granitoid plutons and dolerite lopoliths and dykes (Stuart-Smith et al., 1987). Largely undeformed platform covers of Middle Proterozoic, Late Proterozoic, Cambro-Ordovician and Mesozoic strata (mainly sandstone and minor volcanics and carbonate rocks) rest on these with marked unconformity (Stuart-Smith et al., 1987).

4.0 STRATIGRAPHY

The geology within Exploration Licence 4873 comprises of three (3) different Early Proterozoic rock units, namely:

1) Gerowie Tuff
2) Mt Bonnie Formation
3) Burrell Creek Formation (See Figure 2)

The Gerowie Tuff of the South Alligator Group is the oldest exposed unit in the licence area, covering the far northeast corner. The unit is comprised of a sequence of interbedded siltstone, phyllite, argillite, tuff and minor chert. A silicified mudstone/tuff is the most common lithology found in Exploration Licence 4873. These mudstone/tuff beds sometimes contain chert nodules.

The Gerowie Tuff is conformably overlain by the Mt Bonnie Formation (the upper most member of the South Alligator Group). The Mt Bonnie Formation covers most of the northeast and southwestern portions of the licence area. Lithologies within the unit consist of mainly highly interbedded shales, siltstones, and greywackes with some minor tuffaceous chert and banded iron formation.

Unconformably overlying the Mt Bonnie Formation is the Burrell Creek Formation of the Finniss River Group. The Burrell Creek consists of interbedded shale, slate, phyllite, siltstone and greywacke, and is found in the central portion of the exploration licence. Outcrops of the Burrell Creek Formation commonly form topographic lows and are covered by alluvium and colluvium.

5.0 STRUCTURE

Two major phases of folding can be recognised in the Early Proterozoic sediments of the region, both pre-dating granitoid intrusions.

The older (F₁ folds) are tight to isoclinal, and have north to north west trending axes. A major anticlinal fold of this generation (The Spring Hill Anticline) represents the dominant structure in the licence area. The westerly dipping axis of the Spring Hill Anticline passes through the
centre of the licence area and can be traced along some 10 kilometres of strike (See Figure 2). The fold plunges at varying degrees to the south. The folding is a composite of parallel and similar folding in competent sandstone/greywacke and pelitic units, respectively; a penetrative slaty to phyllitic cleavage is present in pelitic rocks and a less-prominent spaced fracture cleavage in sandstone. Both cleavages are the axial plane surfaces to the F_1 folds and are either near vertical or dip to the south west (Stuart-Smith, et al., 1987).

The second phase and younger (F_2 folds) in the region are widely spaced open types. They are not obvious in outcrop owing to their openness and spacing of several kilometres. They trend east and may be associated with poorly developed mesoscopic similar-trending kink or crenulation cleavages (Stuart-Smith, et al., 1987).

The north-north westerly trending Pine Creek Shear Zone passes to the north east of the licence area. Evidence of faulting and shearing throughout the tenement area commonly along axial plane cleavages are thought to be related to this structure.

6.0 MINERALISATION

Exploration Licence 4873 encompasses MCN’s and MLN’s covering workings of the old Spring Hill Gold Mine. The Spring Hill mine was one of the largest mines in the region in the last century, and has been worked intermittently ever since. Total recorded mine production is estimated at some 22,000 ounces of gold. The gold is associated with pyrite, galena, and other sulphides in quartz veins, forming three major lodes between 0.4m and 1.5m wide and up to 180m long (Taubie, 1966). The lodes trend 170°, dip steeply to the east (75-90°), and lie in shear zones transgressing the hinge of a south-plunging anticline of Mt Bonnie Formation. Most of the ore has come from the oxidised zone where the gold is free and enriched, and is associated with kaolin, limonite and quartz.

Other lesser workings on MCN’s encompassed by the licence area include the old Hong Kong, New Era, and Pay Me Well Mines on the western side of Spring Hill. These mines produced only limited high grade ore from a number of shallow shafts and small pits. Gold is associated with pyrite in narrow sheeted quartz veins ranging from a few millimetres to one half metre in width.

In the southwest corner of the licence area old tin workings can be found on a series of narrow sheeted quartz/limonite veins. Limited ore taken from these workings was included with that from the Snaddens Creek Group of Mines some 4 kilometres to the south where 320 tonnes of tin concentrate was produced.

Several small alluvial gold plants work alluvium found on MCN’s within Exploration Licence 4873 in creeks draining the western side of Spring Hill. Alluvial gold has been erratically mined in the area since late last century.
The Pine Creek Shear Zone, a structure which passes to the northeast of Exploration Licence 4873 can be traced for a considerable distance to the north-west and south-east, and hosts major gold mineralisation at Pine Creek (Enterprise), Union Reefs, Woolwonga, and Goodall.

7.0 WORK COMPLETED

7.1 Stream Sediment Sampling

Some 22 BCL gold and -80# silver, lead, zinc, copper and arsenic stream sediment samples were taken throughout the licence area.

At each sample site two samples were obtained for analysis. Sediment was sieved to -8# to obtain 5 kilograms for the BCL Au sample and a 200 gram -80# fraction of sediment was obtained for AAS basemetal analysis.

BCL gold results delineated a number of highly anomalous stream catchment areas, the highest values obtained being 45.3 ppb, 26.3 ppb and 32.0 ppb Au (See Figure 3). These values highlight the prospectivity of ground held on the main Spring Hill ridge under MCN’s and MLN’s by the Spring Hill Joint Venture partners. No significantly anomalous areas away from the main Spring Hill ridge in the eastern portion of the licence area were delineated by stream sediment sampling.

Basemetal results were consistently low with only background results being obtained (See Figures 4 and 5).

7.2 Reconnaissance Mapping/Rockchip Sampling

Reconnaissance mapping and rockchip sampling to date has been concentrated in the southwestern portion of EL 4873, targeting ridges containing rocks of similar stratigraphy (Mt Bonnie Formation) as those hosting gold at Spring Hill.

Results to date have been encouraging. A rockchip taken from old tin workings in the southern part of the licence returned 0.56 g/t Au from narrow sheeted quartz/limonite veining in siltstone.

The best results obtained were taken from a 2m wide zone intense stockwork quartz veining on a ridge of greywacke in the western side of the tenement. A channel rockchip over this veining returned 10m @ 0.64 g/t Au.
7.3 Aeromagnetics

Detailed aeromagnetic data has been obtained over Exploration Licence 4873 from Aerodata Holdings. This forms part of a large multi-client survey with the following specifications:

- Line Spacing: 200m
- Sensor Height: 70m
- Tie Line Spacing: 5,000m

The results from the aeromagnetic data were relatively negative. No discrete aeromagnetic targets were delineated. Magnetic signature clearly traces the contact between rocks of the Burrell Creek Formation and those that belong to units within the South Alligator Group (i.e., Mt Bonnie Formation and Gerowie Tuff) which are marked by distinct flat aeromagnetics (See Figure 7).

8.0 CONCLUSIONS

No economically mineralised targets have been outlined to date in Exploration Licence 4873, however several highly gold anomalous stream sediment catchment areas have been delineated which drain from MCN’s and MLN’s, in the northeast of the tenement, held by the Spring Hill Joint Venture partners on the main Spring Hill ridge. Considerable follow-up of these areas, including drilling has been conducted, the results of which are subject to a separate annual report due at the NT Department of Mines & Energy on the 31st of December 1989.

A ridge of greywacke in the western most portion of the licence area from which channel rockchip results of 10m @ 0.64 g/t Au have been obtained from stockwork quartz veining shows encouraging exploration potential.
**EXPENDITURE STATEMENT**

**EXPLORATION LICENCE 4873 SPRING HILL WEST**

**5TH OCTOBER 1988 – 4TH OCTOBER 1989**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staffing - Regional Office (Including Geological Contract Staff)</td>
<td>$15,906</td>
</tr>
<tr>
<td>Support - Regional Office</td>
<td>$11,350</td>
</tr>
<tr>
<td>Tenement Costs</td>
<td>$-</td>
</tr>
<tr>
<td>Geophysical Surveys</td>
<td>$2,051</td>
</tr>
<tr>
<td>Analyses</td>
<td>$4,830</td>
</tr>
<tr>
<td>Drilling</td>
<td>$-</td>
</tr>
<tr>
<td>Aerial Photography</td>
<td>$225</td>
</tr>
<tr>
<td>Access/Gridding/Surveying</td>
<td>$2,269</td>
</tr>
<tr>
<td>Other</td>
<td>$-</td>
</tr>
<tr>
<td>Head Office Management, Administration, Technical Services</td>
<td>$3,878</td>
</tr>
<tr>
<td>Overheads</td>
<td>$4,051</td>
</tr>
<tr>
<td><strong>TOTAL EXPENDITURE</strong></td>
<td><strong>$44,560</strong></td>
</tr>
</tbody>
</table>
REFERENCES


