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SHELL COMPANY OF AUSTRALIA LTD
C.R.A. EXPLORATION PTY. LTD.

MOINA JOINT VENTURE
R.L. 8810

1991 Annual Status Report

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1.0 INTRODUCTION

This report summarizes the current financial and marketing position held by the joint venture in regard to the economic exploitation of the multi-mineral resource at Moina within Retention Licence 8810. It is by no means an exhaustive evaluation but serves to bring the joint venture more up to date in terms of options available.

2.0 LOCATION & ACCESS

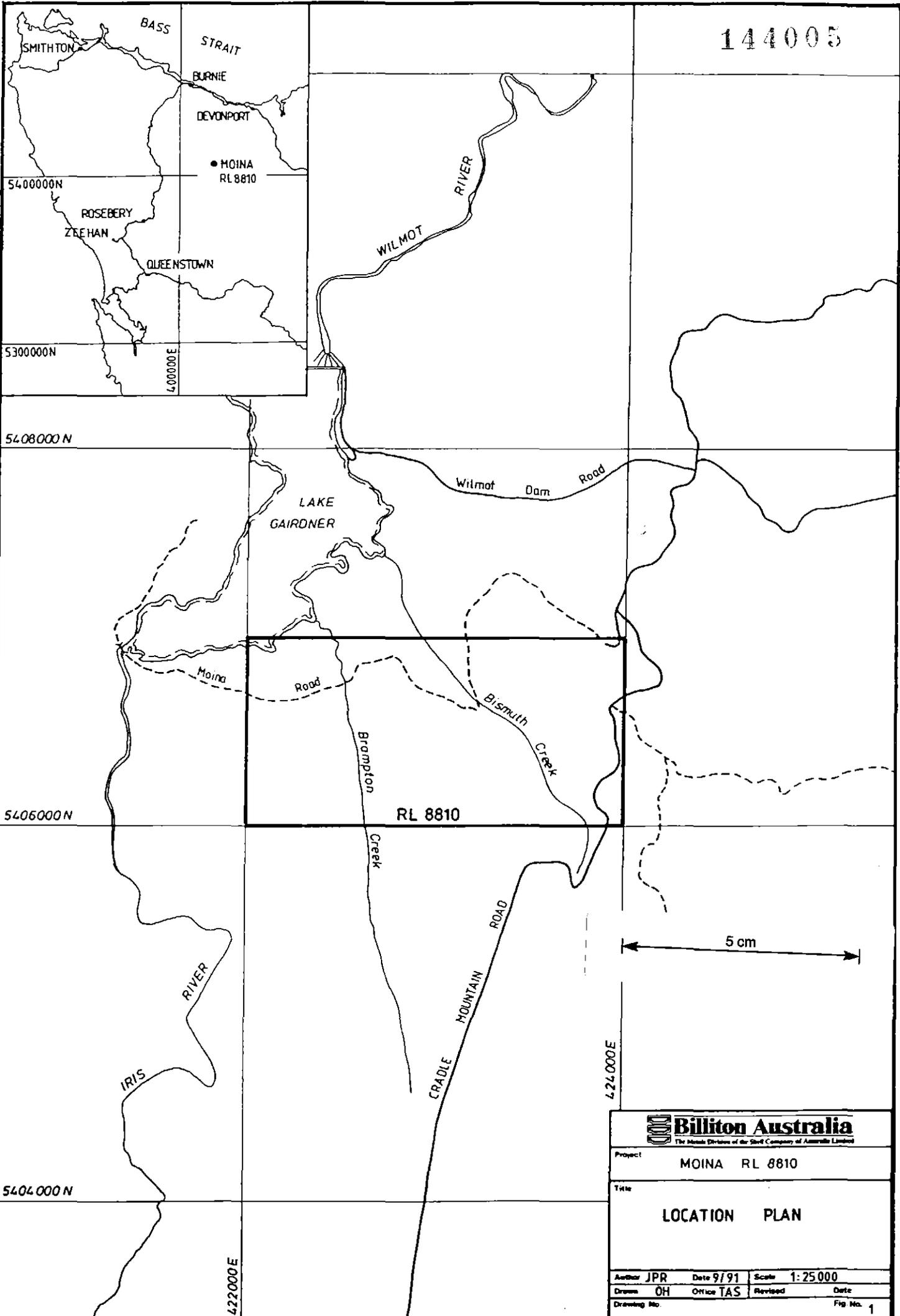
The Moina licence is located 40kms south west of Devonport in the north west of Tasmania (Figure 1). Access to the lease is via the sealed Cradle Mountain Road and thence by farm tracks to the abandoned townsite of Moina.

3.0 LAND TENURE

Retention Licence RL 8810 of two square kilometres was granted to the Shell Company of Australia Limited and CRA Exploration Pty Ltd on the 21st October 1988 for a period of three years, renewable every 12 months. The licence is due to expire on 21st October 1991 and application has been made to renew the licence.

Within the licence area, approximately 0.6km² is Private Land, the remainder being Crown Land. No other land access restrictions are current.

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5 cm

Billiton Australia
The Metals Division of the Shell Company of Australia Limited

Project **MOINA RL 8810**

Title **LOCATION PLAN**

Author JPR	Date 9/91	Scale 1:25000
Drawn OH	Office TAS	Revised
Drawing No.		Fig. No. 1

4.0 GEOLOGICAL SETTING

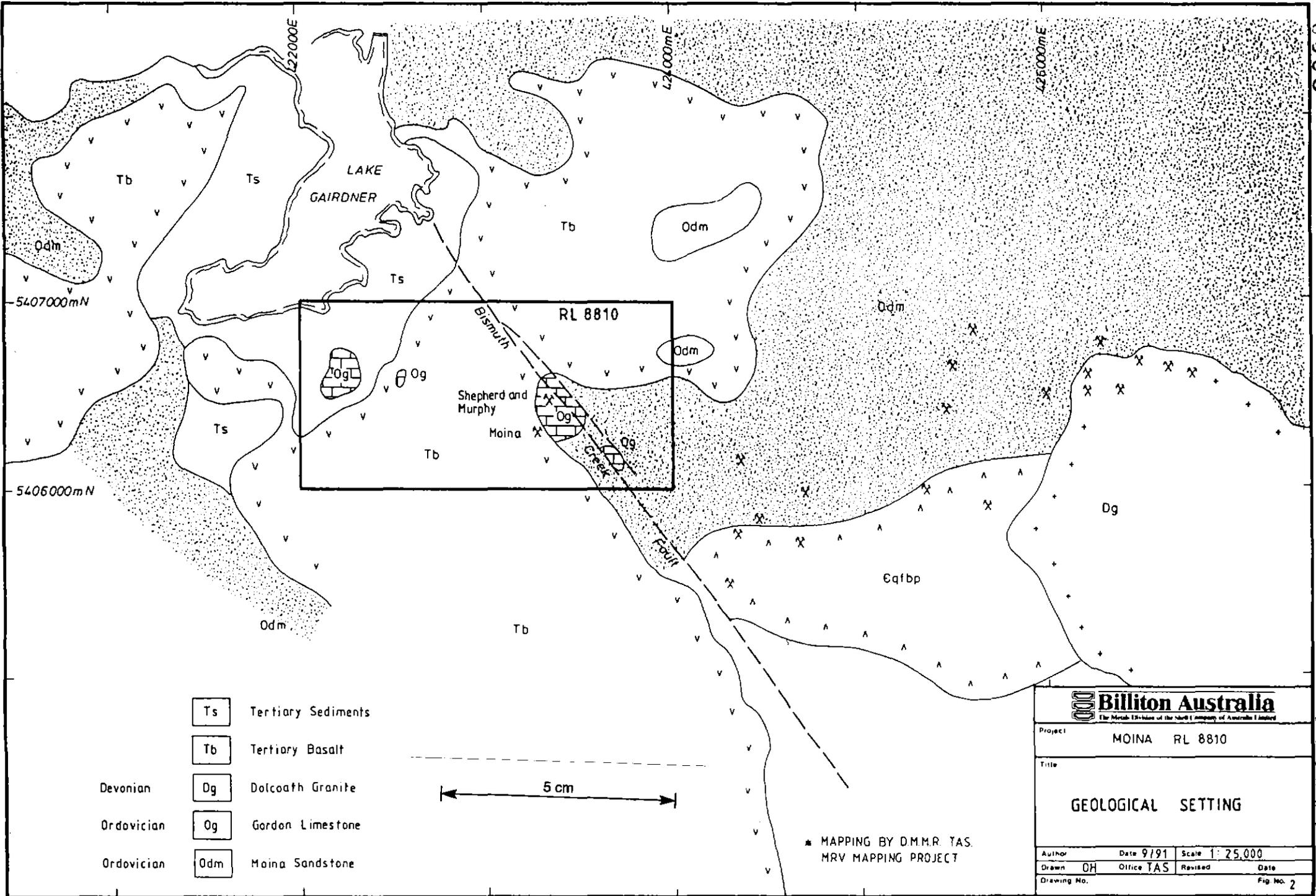
The Moina skarn deposit occurs as a replacement of flat lying Ordovician Gordon Limestone which conformably overlies quartz sandstone and siltstone (Moina Sandstone). Mineralization is associated with the Devonian granite (Dolcoath Granite) but is spatially distinct, typically being separated from the granite by several hundred metres of Moina Sandstone (Figure 2, 3). The most intense mineralization occurs in a folded and fractured zone associated with a major northwest-southeast trending fault known as the Bismuth Creek Fault.

Five skarn types have been recognized, the main skarn being a fluorite-magnetite-vesuvianite-cassiterite-scheelite variety termed wriggilite. The skarn mineralization contains up to 25%F, 0.6%Sn, 0.5%W, 0.2%Be, 27.5%Zn, 4.5ppmAu.

5.0 PREVIOUS WORK

The area has been extensively prospected and a number of small mines have been developed. The Department of Mines, Mt. Lyell Mining and Railway Company, Comalco and Shell have drilled a total of 48 holes into the area. The holes were aimed at locating and delineating the extent of skarns (notably the Shepherd and Murphy Wriggillite).

The Shepherd and Murphy deposit was originally mined for tin/tungsten associated with a sheeted system of quartz-



- Ts Tertiary Sediments
- Tb Tertiary Basalt
- Devonian Dg Dolcoath Granite
- Ordovician Og Gordon Limestone
- Ordovician Odm Moina Sandstone

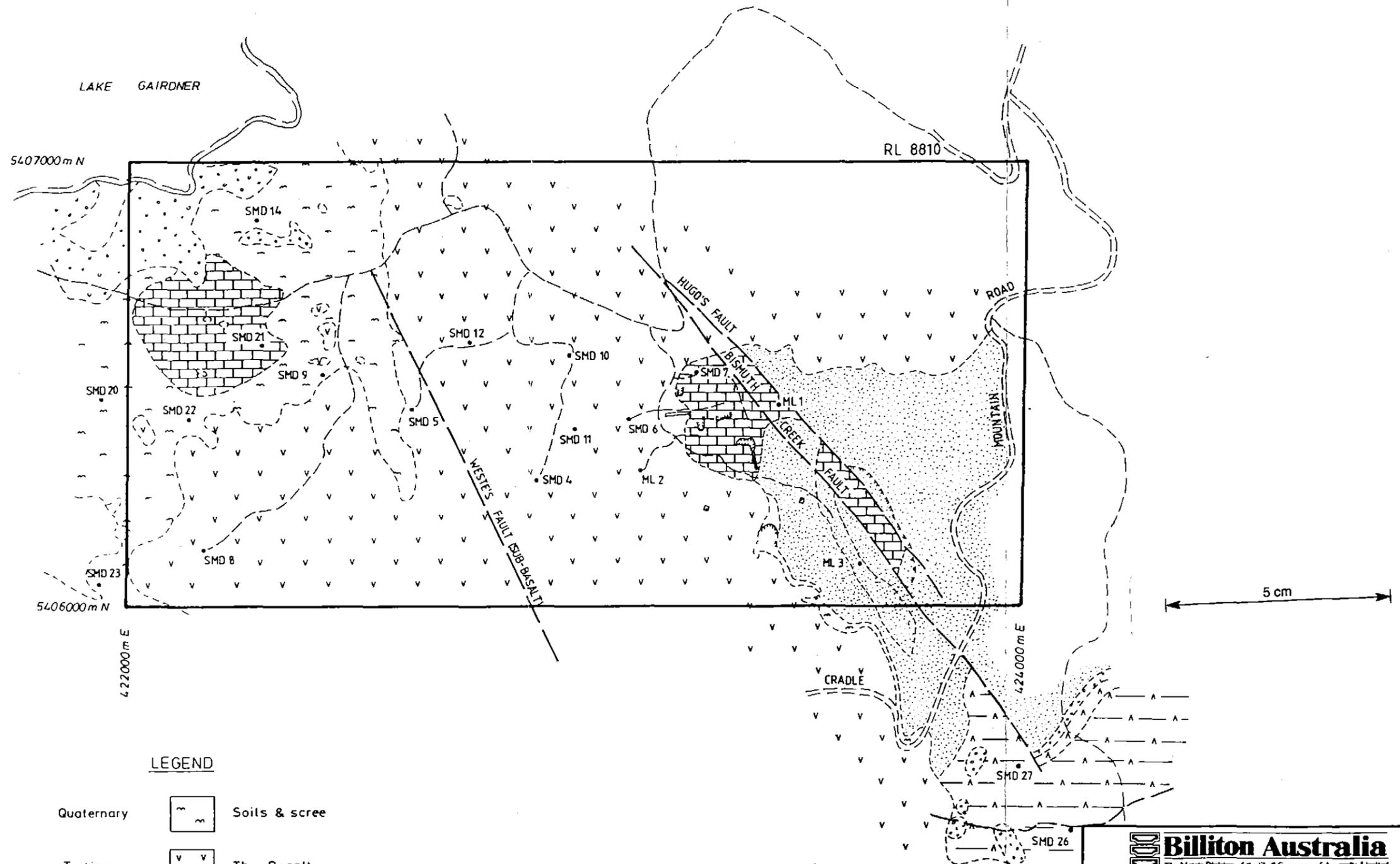
5 cm

* MAPPING BY D.M.R. T.A.S.
MRV MAPPING PROJECT

Billiton Australia <small>The Metals Division of the Shell Company of Australia Limited</small>		
Project MOINA RL 8810		
Title GEOLOGICAL SETTING		
Author	Date 9/91	Scale 1:25,000
Drawn OH	Office T.A.S.	Revised
Drawing No.		Date
		Fig. No. 2

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LEGEND

- Quaternary ~ ~ Soils & scree
- Tertiary v v Tb Basalt
- Ordovician □ □ θg Gordon Limestone
- . . . θm Moina Sandstone
- - - Bond Range Porphyry

(Mapping after Comalco)

Billiton Australia <small>The Metals Division of the Shell Company of Australia Limited</small>			
Project		MOINA RL 8810	
Title LOCAL GEOLOGICAL SETTING			
Author	Date 9/91	Scale	1:10,000
Drawn OH	Office TAS	Revised	Date
Drawing No.			Fig. No. 3

cassiterite-wolframite veins, contained within magnetite - fluorite and garnet-pyroxene skarn.

Comalco recognized the significance of the fluorite association and carried out a major drilling programme to outline a resource of 26 million tonnes of 18% CaF_2 , plus 0.1% Sn and 0.1% W.

A drilling programme carried out by Shell adjacent to the Bismuth Creek Fault, delineated a resource of 1 million tonnes of 8% Zn.

Reassaying of much of the drill core has indicated low grade gold values associated with the sulphide skarn in particular.

6.0 RESOURCE ESTIMATES

No new resource calculations have been attempted since the detailed work of Askins in 1979 but it is instructive to present the major results and criteria used to calculate a resource estimate.

- the resource is no more than an indicated tonnage defined on the basis of eight drill holes into the main wriggilite body.
- further infill drilling is required to obtain a measured resource.

- the resource does not include, a) the complex skarn east of Bismuth Creek beneath Hugo's Fault; b) deep intersections of wrigglite in SMD 5,9; c) sheet 2 wrigglites in SMD 17,23.

- only open pittable wrigglite (overburden ratio <2.5:1) with a cut off grade >10% CaF₂ has been included.

Within these confines, an indicated wrigglite resource of 26.5M.tonnes @ 10% CaF₂, 0.1% Sn, 0.1% W has been calculated. Askins notes that "The deposit is probably the largest single fluorite resource in Australia".

Table 1 set out below lists the drill holes used in the calculation and the range of analyses used.

TABLE 1

WEIGHTED AVERAGE ANALYSES

DIAMOND DRILL HOLES, MOINA, WITHIN "INDICATED" WRIGGLITE

Hole No	From metres	To	Interval metres	CaF ₂ %	Sn ppm	W ppm	Remarks
ML 2	43.3	50.4	7.1	17.8	ca 800	ca 400	bulked sample analysis
	50.4	61.0	10.6	11.6	ca1400	ca 150	
	61.0	82.9	21.9	19.2	ca1500	ca 800	
	43.3	82.9	39.6		1350	540	
SMD 6	22.75	83.05	60.30	17.6	1400	910	
	22.75	67.70	44.95	19.5	1540	930	
SMD 7	1.00	55.00	54.00	20.9	1450	1030	
SMD 10	38.75	88.50	49.75	17.6	1320	535	0.35 interval of rich vein excluded
	38.75	76.00	37.25	19.2	1300	500	
SMD 11	31.00	74.00	43.00	16.9	1525	1020	1.35 interval of nil core recovery excluded.
	31.00	60.70	29.70	19.4	1540	1010	
SMD 15	33.00	105.00	72.0	18.0	1470	1250	
SMD 28	29.00	90.60	61.60	20.3	1740	940	
	90.60	101.00	10.40	10.1	1110	560	
	29.00	101.00	72.00	18.8	1650	890	
SMD 29	0.00	23.25	23.25	20.8	2180	2260	

Note: All intervals except for SMD 29 are approximate true thicknesses.

In addition to the wrigglite resource, a drilling programme completed by Billiton delineated a drill indicated resource of approximately 1M.tonnes @ 8% Zn. Reassaying of this core for Au by CRAE has indicated the presence of anomalous low grade values eg:

SMD 13	16m @ 0.86g.t Au
SMD 9	8m @ 1.50g.t Au
LM 3A	3m @ 2.18g.t Au

7.0 BENEFICIATION STUDIES

No detailed work on extraction of F, Sn, W from the Moina wrigglite has been completed since the 1978-79 work of Askins. Major results and conclusions of this work were as follows:

- Amdel used a roasting process to extract fluorite from the wrigglite but the results indicated that recovery was limited to 70%. In addition, the Sn was not extracted and the high iron content caused excessive reagent usage.
- Amdel also used flotation extraction and concluded that a concentrate of 92.5% CaF_2 with a recovery of 64.9% was produced from feedstock assaying 16.5% CaF_2 . Removal of magnetite resulted in a high loss of fluorite due to its finely disseminated nature and recovery of Sn and W was of limited success due to the presence of 45% of the Sn in solid solution in garnet.

- Department of Mines evaluated the scheelite recoveries by fine grinding but results showed only a 33% recovery by tabling. Recovery of Sn was only 7% in table concentrates.
- Further work in 1979 by the Department of Mines indicated that at least 12% of the Sn and 17% of the WO_3 should be recoverable by conventional means as a by-product of fluorite flotation.

These studies have shown that the low fluorite, cassiterite and scheelite recoveries impact on the economics of the project and that new methods are required to provide better extraction.

8.0 MARKETING CONSTRAINTS

8.1 Fluorite Usage

The major use of fluorite is as a flux in the iron/steel (44% of consumption) and magnesium/alumina (22% of consumption) industries. Attempts to use other minerals have usually resulted in increased extraction costs or unwanted side effects.

Fluorite is also used in the chemical industry in the manufacture of fluorine and hydrofluoric acid.

Three grades of fluorite concentrate are produced depending upon the purity of the sample, viz

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- acid grade: $>97\% \text{CaF}_2 + <1.5\% \text{SiO}_2$
- ceramic grade: $93-95\% \text{CaF}_2 + 2.5-3.0\% \text{SiO}_2$
- metallurgical grade: $60-85\% \text{CaF}_2$ (effective)

At Moina, all metallurgical work has been carried out assuming an acid grade product for use originally at Comalco's Bell Bay alumina smelter.

8.2 Supply & Consumption

World production of fluorspar has been constant during the mid 1980's at 4.8-4.9M.tonnes although a slight increase in 1988 boosted production to 5.25M.tonnes. Major producers of fluorspar are China, U.S.S.R., Mexico and Mongolia. Australia's demonstrated resources of fluorine comprise 27 M.tonnes F contained in phosphate rock and 40,000 tonnes F as fluorite. Inferred resources comprise 6.4M.tonnes F as fluorite (Moina included as 2.3 M.tonnes F) and 60,000 tonnes F as silicite.

At the Speewah project (110km south of Wyndham), Elmina NL have published a resource of 4M.tonnes @ 25.5% fluorite contained in near vertical veins (1-8m width). The company plans to be producing 32,000tpa of acid grade fluorite from a 110,000tpa operation at a capital cost of \$7.5m. In early 1991, the company announced that it would proceed with the construction of a 20,000tpa aluminium fluorite plant.

Australia's consumption of fluorspar in 1987 was 13,000 tonnes, for use in both the steel and chemical industries, but this was almost a 50% decrease on previous years. Part of this reduction has been due to worldwide concern over the effect of chlorofluorocarbons (C.F.C's) on the Earth's ozone layer.

8.3 Price Forecasts

Australia does not export fluorite and prices are not quoted. However prices can be approximated from the declared value of imports and in 1987, the average price was \$107/t (US \$81). Acid grade fluorite in the same year fetched US\$100-110/t. In 1988, a strong demand scenario resulted in an upward price movement to US\$115-120/t, a trend that was expected to continue to 1989-90. However, no major shortage of fluorspar was predicted in view of the considerable additional production capacity either from new installations or from the expansion of existing facilities.

9.0 FINANCIAL ANALYSIS

9.1 Askins 1978

This analysis assumed the following parameters:

- resource 15M.tonnes @ 18% CaF₂, 0.1% WO₃, 0.1% Sn
- production 1.5mtpa
- recoveries 60% CaF₂, 50% WO₃, 30% Sn.

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- prices CaF₂ acid grade \$80/t
- WO₃ \$120/mtu
- Sn \$90/mtu
- freight \$12/t
- operating costs: mining \$2.40/t
- milling \$10/t
- o'heads \$1.50/t
- capital cost \$36m
- additional CAPEX \$2m pa
- depreciation \$3.6m pa

Askins calculations indicated that the hypothetical operation would return a cash flow of only \$0.85m pa and would not repay the capital investment. The deposit is therefore subeconomic.

9.2 Billiton 1991

A "ball park" resource analysis has been completed using the parameters of Askins 1978 model with adjustments to 1991 prices, viz

- prices CaF₂ acid grade A\$137 tonne
- WO₃ A\$ 72 mtv
- Sn A\$7500 t
- freight \$20 tonne
- operating costs: mining \$10 tonne)
- milling \$12 tonne) \$25 tonne
- o'heads \$ 3 tonne)

- capital cost \$77m
- additional CAPEX \$2mpa
- depreciation \$9.3mpa

The project has a negative net present value at any discount rate and attempts to, a) reduce CAPEX by 20%; b) reduce OPEX by 20%; c) increase recoveries by 25% failed to reverse the non-viability of the project.

10.0 CONCLUSIONS

Retention Licence RL 8810 covers the Moina wriggilite fluorite-scheelite-tin skarn where an indicated resource of 26.5 million tonnes @ 18% CaF₂, 0.1% Sn, 0.1% WO₃ has been delineated from eight drill holes. Additional skarn mineralization has been intersected but not included in this resource estimate. A drill indicated resource of approximately 1 million tonnes @ 8% Zn has also been defined.

Metallurgical studies on the wriggilite mineralization indicate poor recoveries using flotation methodologies but recent advances in pyro-metallurgy may be of benefit to the economics of the project.

The Moina deposit is a significant source of fluorite and is probably the largest indicated resource in Australia. The continued use of fluorite in the steel-alumina industries as a flux is anticipated and since Australia imports all its annual

requirements, the Moina deposit has strategic importance. Joint venture partners, CRA Exploration Pty Ltd, are currently constructing a \$100m trial plant incorporating the new HISMELT process in Western Australia. If this test is successful then CRAE would almost certainly build a steel plant and would utilize the Moina deposit as a flux source.

Whilst project economics at a first pass appear unfavourable to exploit the deposit currently, advances in extractive processes and plant construction methods may have the desired effect to increase recoveries and reduce extraction costs. These alternatives have not been examined in this study.