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SARACEN MINERALS N.L.
TIMBARRA MINES N.L.
R.T. GARDINER AND ASSOCIATES

EXPLORATION LICENCE 5146 - "LIMESTONE CREEK"

(1:250 000 Sheet SF 53-12 Tobermory)

Report for the 12 months 29 January 1987 to 28 January 1988

Saracen Minerals N.L. (Operator)
Brisbane
February 1988

R.J. Virtue

ABSTRACT

Exploration Licence 5146, "Limestone Creek" was examined with the aim of detecting possible platinum-group element mineralization similar to that detected in BMR Hay River 11A. The prospect can be compared with platinum-group element mineralization in the basal black shales of the Zechstein Deposit in Poland.

No drilling was carried out in this area due to difficult access but drilling was carried out in nearby Exploration Licences 5145, 5147 and 5149.

Results from the analysis of the drill cuttings for Pt, Pd and Au were all below the limits of detection.

Possible explanations for the low results are; erosion or non-deposition of mineralized horizon and underlying rocks, geochemical and environmental differences, absence of favourable post depositional environments.

Further exploration is recommended, especially in the untested area of Exploration Licence 5146. Drilling should be carried out by a rig suitable for sandy environments.

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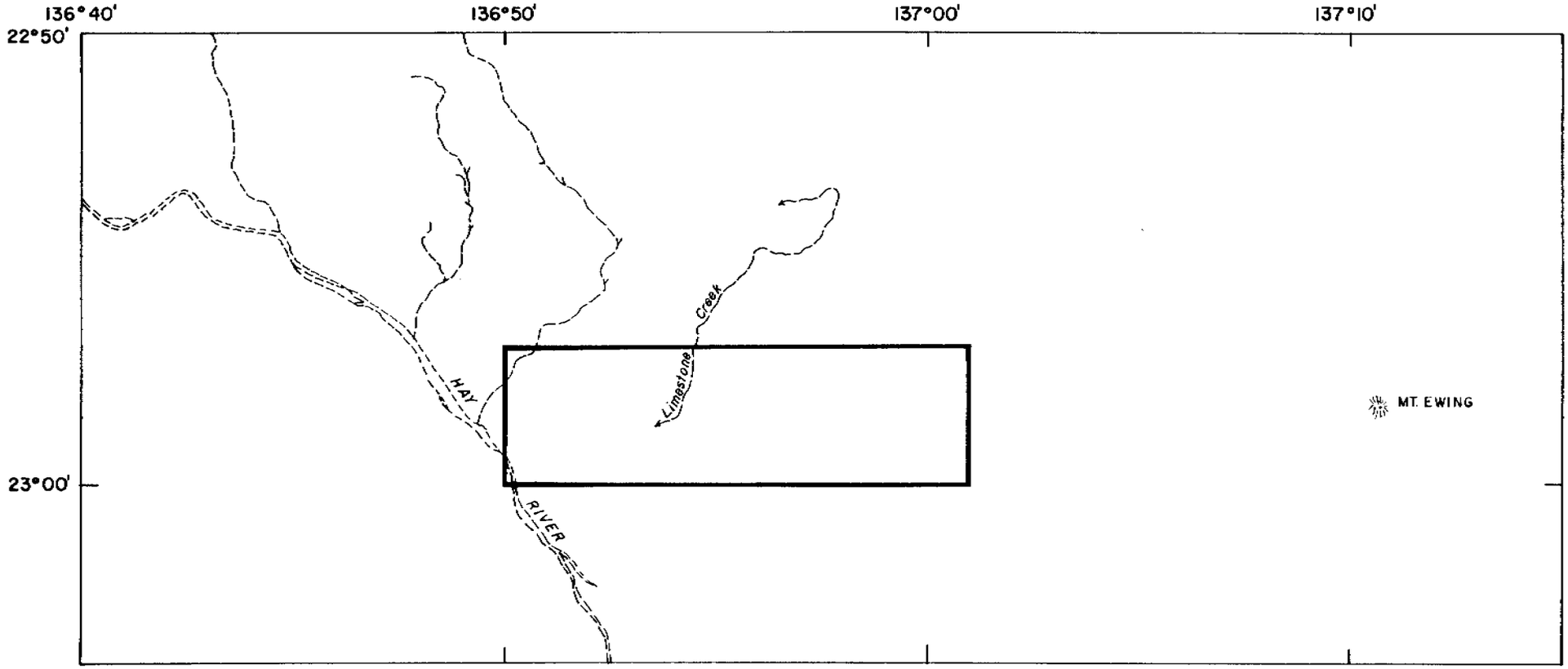
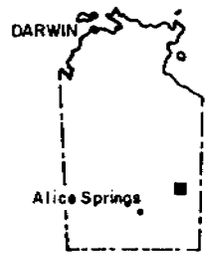
1. INTRODUCTION

The following is the report on the exploration activities carried out under EXPLORATION LICENCE 5146 during the first 12 month period 29 January 1987 to 28 January 1988.

EXPLORATION LICENCE 5146 was granted to Saracen Minerals N.L. (45 shares), Timbarra Mines N.L. (45 shares), and Rhys Thomas Gardiner (10 shares) on 29 January 1987 for a period of 6 years.

Exploration was carried out by Saracen Minerals N.L. with the aim of detecting a "Zechstein Type" (Kucha, 1982) platinum deposit in the lower black shale horizons of the Hay River Formation, and its equivalents, in the Georgina Basin.





SARACEN MINERALS N.L.

NORTHERN TERRITORY

EL 5146 - LIMESTONE CREEK

LOCATION MAP

SCALE

5 0 5 10 Km.

DRAWN : January, 1988

A4 1154

2. LOCATION ACCESS AND TENURE

2.1 Location

EXPLORATION LICENCE 5146 consists of 33 blocks and lies between 22° 57' and 23° 00' South, and 136° 50' and 137° 01' East, approximately 320 km ENE of Alice Springs. The maximum dimensions are 19 km E-W and 5.5 km N-S, with a total area of 10,659 km.

2.2 Access

Access to the area from the Plenty Highway is by graded track to Tarlton Downs, then along abandoned tracks to the N-W corner of the area. Access with the area is difficult even for four-wheel-drive vehicles due to large sand drifts. The Plenty Highway runs from the Stuart Highway 70 km North of Alice Springs, to Urandangi in Queensland. Tarlton Downs has a small landing strip, suitable for emergency use only.

2.3 Tenure

Exploration Licence 5146 was granted to Saracen Minerals N.L. (45 shares), Timbarra Mines N.L. (45 shares) an Rhys Thomas Gardiner (10 shares) on 29 January 1987, for a period of six (6) years. The minimum expenditure required for the first year was $12,000.00.

Exploration Licence 5146 is defined as follows on 1:250 000 Mining Tenure Southern Mineral Field Map 72, Tobermory:

72/4	68/31 to 68/40 inclusive
	69/31 to 69/40 inclusive
	70/31 to 70/40 inclusive
72/5	68/11
	69/11
	70/11

3. GEOLOGY

3.1 Regional Geology

Exploration Licences 5145, 5146, 5147 and 5149 lie on the south western margin of the Georgina Basin.

The basement rocks in the area are the amphibolite and granulite facies metamorphic rocks, and granite and gabbroic intrusive rocks of the Arunta Orogenic Domain.

The basement is overlain by the sediments of the Upper Proterozoic to Devonain Georgina Basin. The Upper Proterozoic section is dominated by arkosic sandstones, conglomerates and siltstones with some glacigene sediments.

The Cambrian section consists of a series of unconformable carbonate rich sediments, including limestones, dolostones, black shales, siltstones and minor arenite beds. Similar units were deposited in the Upper Cambrian to Lower Ordovician.

These units are unconformably overlain by Ordovician sediments with limestones at the base giving way to sandstones at the top. The Ordovician sediments are unconformably overlain by Devonian sandstones which mark the top of the Georgina Basin sequence.

The Georgina Basin sediments are unconformably overlain by various Mesozoic sandstone units including those of the Eromanga Basin. (Shergold 1985, Freeman and Woyzbun 1986).

Silcretes and ferricretes have developed over many units, especially the Arthur Creek Formation, probably in the Tertiary. Much of the area has been covered by Quaternary alluvial and aeolian deposits including the extensive sand sheet and dune systems of the Simpson Desert in the south.

3.2 Local Geology

The following units crop out within EL 5146 (from BMR, 1985)

AGE	UNIT	LITHOLOGY
Quaternary		Large areas of sand-sheets and dunes, alluvium, colluvium, soil
	EROMANGA BASIN	
Mesozoic		Sandstone, shale, conglomerate
	GEORGINA BASIN	
U Cambrian-L Ordovician	Tomahawk Beds	Quartz sandstone, quartz-arenaceous limestone and dolostone, glauconitic, fossiliferous and bioturbated. Thin to thick-bedded.
U Cambrian	Arrinthrunga Formation	Sandy dolostone, limestone, mudstone, domed bioherms.
M Cambrian	Marqua Formation	Silty micritic limestone, sandy limestone, mottled limestone, calcareous siltstone, sandstone

M Cambrian	Hay River Formation	Limestone and chert overlying black pyritic shale, shelly dolomite at base.
L-M Cambrian	Red Heart Dolomite	Dolomite with archaeocyaths, overlying bioturbated sandstone and arkose.
U Proterozoic	Gnallan-A-Gea Arkose	Pebbly arkose, sandstone, siltstone, shale.
	Wonnadinna Dolomite	Dolostone, arkose, siltstone, shale.
	Black Stump Arkose	Arkose, pebbly arkose, siltsone, shale.
	Yardida Tillite	Diamictite, shale, siltstone, sandstone.

ARUNTA OROGENIC DOMAIN

L Proterozoic	Teikens Granite Complex	Undivided granite (muscovite-biotite granite, minor metamorphic rock and pegmatite.)

The main units of interest are the Gnallan-A-Gea Arkose, Red Heart Dolomite, Hay River Formation and Marqua Formation.

The Gnallan-A-Gea Arkose, which underlies the Hay River formation throughout EL. 5145, consists of green-grey arkose (brown at surface) well-rounded quartz-pebble conglomerate with common granite fragments, and inter-bedded sandy siltstone.

The Red Heart Dolomite consists of a basal unit of light green grey, sandy, pyritic, dolomitic siltstone and feldspathic sandstone, overlain by a thin dolomitic sandstone and sandy dolostone. This is in turn overlain by brown and grey dolostone with abundant vughs and stylolites, manganese dendrites, pyritic, marcasite, fluorapatite and high temperature organic compounds. Quartz crystals line many of the vughs. (Walter et at, 1979; Shergold, 1985).

The Hay River Formation (Walter 1979) consists of a thin basal unit of intraclastic dolostone, pyritic dolostone, coquinite and micaceous pyritic shale with laminae and lenses of sand, overlain by a middle unit of finely interlaminated black, micaceous, silty pyritic shale, which is in turn overlain by an upper unit of interbedded fine-grained, black, pyritic fetid grainstone with pale calcareous siltstone, and black chert.

Outcrop of the Hay River Formation is generally poor, with the exception of areas containing abundant chert or silcrete. In the Marqua area the unit is generally more carbonaceous and calcareous than in the type area of BMR Hay River 11 A where the unit consists of brown black fetid shales. (Shergold, 1985; Walter et al 1979).

The Marqua Formation, which overlies the Hay River Formation, consists of two sub-units. The lower unit is mostly laminated micrite and wackestone, and grainstone interbedded with siltstone. The upper sub-unit consists of pale laminated silty micrite, wackestone and mottled carbonate (Shergold, 1985).

4. PREVIOUS EXPLORATION

As the reported occurrence of platinum in the Hay River Formation is relatively recent there has been no prior exploration for platinum group elements in the Georgina basin.

Mineral exploration within the Georgina Basin has been mostly limited to exploration for base metals in the Arrinthrunga and Marqua Formations to the north and west of Exploration Licences 5145, 5146, 5147 and 5149.

Drilling was carried out, within the area presently covered by EL 5145, by Agip Australia Pty. Ltd. under EL 3263 from 1981 to 1983 whilst exploring for uranium and base metals, using "roll front" and "Mississippi Valley" type models.

The Agip drilling results did not indicate mineralization of economic grade, and the target units were those other than the Hay River Formation. Other previous exploration is reported in Freeman and Woyzbun (1986).

5. EXPLORATION ACTIVITIES DURING THE PERIOD

5.1 Exploration Rationale

The exploration model used during the period was based on the idea that a 1.5 ppm platinum result, reported from the stratigraphic drill hole BMR HAY RIVER 11 A (Shergold, 1985), was due to platinum group element enrichment in black shales, similar to that which has occurred in the Zechstein Shales in Poland (Kucha, 1982).

The platinum in Hay River 11 A occurs in carbonaceous mudstone and skeletal pellet wackestone. The rock is vughy, stylolitic and phosphatic with quartz crystals, manganese dendrites and pyrobitumen (Shergold 1985, Shergold & Walter 1979).

The genesis and characteristics of the Zechstein deposit are summarised by Kucha (1982) as follows:

"Au and platinum-group elements are concentrated by a process of autooxidation and desulfurization of organic matter. Platinum-group elements, acting as catalysts of the autooxidation process, are concentrated at the border between oxic-anoxic conditions, i.e. between kerogen and calcite, thucholite and calcite, black shale and white sandstone, etc. The gamma radiation accelerated and enhanced the process of autooxidation, and phosphates and borates coagulated noble metals from solution. For these two reasons the highest Au and platinum-group-element-bearing contents (Au, up 3,000 ppm; Pt, 10-370 ppm; and Pd, 10-120 but sometimes up to 1,000 ppm) are present in a layer a few centimeters thick at the bottom of the black shale (platinum-group-element-bearing shale) when this shale is overlain by phosphates, borates, and thucholite-bearing shale."

The similarities with the Hay River 11 A platinum occurrence are:

1. Platinum occurring in organic-rich black shales at the base of a sequence of black, silty pyritic shales, black pyritic fetid grainstone, wackestone and calcareous siltstone (Shergold & Walter 1979)

2. The black shales overly oxidizing dolostones and sandstones, of the Adam Shale, Red Heart Dolomite and Grant Bluff Formation (Shergold, 1985).

3. The Platinum anomaly in Hay River 11 A corresponds with an increase in phosphate content (2.15% compared with < 0.5% $P_2 O_5$ background) and base metal content (220 ppm Pb compared with < 50 ppm Pb background).

These characteristics suggest that similar platinum values may occur at the base of the Hay River Formation, and its equivalents such as the Arthur Creek Formation, for substantial distances along strike, as is the case in the the Zechstein deposits.

Since the poor outcrop of the Hay River Formation makes surface sampling unreliable, due to the narrow nature of the suspected platinum mineralization, it was decided to drill a series of shallow percussion holes, in lines running across strike, along as much of the strike length of the Hay River and Arthur Creek Formations as possible.

5.2 Preliminary Exploration

Field reconnaissance was carried out over the area to determine suitable drill sites to intersect the base of the Hay River Formation at depths of less than 60 metres. Investigation revealed that the area would be inaccessable to the drilling rigs due to numerous large sand drifts. It was decided that, as relatively major track construction would be required to gain access into EL 5146, further work would be postponed pending the results from drilling on Exploration Licences 5145, 5147 and 5149.

6. DISCUSSION OF RESULTS

6.1 Introduction

Several reasons can be offered for the absence of any platinum-group elements in the drill cuttings analysed from Exploration Licences 5145, 5146, 5147 and 5149.

These are:-

i. Failure of exploration concepts - i.e. Hay River 11A result is anomalous or erroneous, and Zechstein model does not apply in the Georgina Basin.

ii. Sedimentary sequence variations, such as non-deposition or erosion of a relevant unit.

iii. Variation in chemical conditions under which sedimentation took place i.e. oxidizing or reducing environment, phosphate and sulphide content.

iv. Variation in provenance of sediments i.e. no platinum-group elements introduced.

v. No post depositional activity to remobilize and concentrate the platinum-group elements.

6.1.1 Failure of Concept

There has been no published report to indicate that the results published by Shergold (1985) are incorrect or should be disregarded. Analysis of material from Agip drill holes indicated possible anomalous platinum-group elements values.

Kucha's (1982) model has not been disproved. The possible modification that re-circulating connate fluids, rather than a single pass of meteoric water, would be required to deposit the platinum would not necessarily alter the chance of platinum-group element mineralization in the area.

6.1.2 Sedimentary Sequence Variation

The Red Heart Dolomite and Adam Shale, which underlie the Hay River Formation in the type area at Hay River 11A, are absent in all areas drilled in El 5145. It is possible that if mineralization was stratigraphically controlled, then the period of non-deposition or erosion, indicated by the absence of these units, may have extended into the period during which the horizon hosting the platinum-group element mineralization was deposited at Hay River 11A. This is of great significance since the platinum anomaly occurred only a few metres from the base of the Hay River Formation.

6.1.3 Geochemical Variations

There are several geochemical differences between the Ordian section of the Hay River Formation drilled at BMR Hay River 11A and that drilled at Tobermory 14 within EL 5145.

The most notable is the difference in phosphate content and its distribution. The average phosphate content of the Ordian section in Tobermory 14 is 2.72% P_2O_5, wheras in Hay River 11A it is only 0.4% P_2O_5. Anomalous phosphate values of 2.15% and 2.60% occur in the same interval as the platinum-group element anomalies. Metal values are generally higher in Hay River 11A, and a Pb anomaly also corresponds to the Pt anomaly.

The Phosphate variations could reflect a difference depositional environment, or could directly control the concentration of remobilized platinum-group elements. If the mineralizing fluids were in closed convection cells and if several passes of these fluids were required to deposit the platinum then the thickness of phosphate units would control the concentration of platinum. If the platinum is coagulated by phospates (Kucha, 1982) then the amount of platinum concentrated in a horizon less than 1 m thick at Hay River 11A would be spread over the entire 20 m of the phosphate rich Ordian section in Tobermory 14, in which the platinum concentration would be below the limits of detection used during analysis. This is consistent with the Zechstein deposits (Kucha, 1982) in which the highest platinum-group element concentrations occur in the thinnest sections and the lowest values occur where the mineralized horizon is thickest.

In addition there are several other geochemical differences such as organic carbon content and carbonate content that indicate slightly different depositional environments in the two areas mentioned previously.

6.1.4 Provenance

It is possible that the platinum-group elements and other metals introduced into the area around Hay River 11A were not introduced to other areas. This has not been examined.

6.1.5 Post Depositional Activity

Although there is evidence for hydrothermal activity in the Hay River Formation in the areas around Hay River 11A and Tobermory 14 and in much of the Arthur Creek Formation, it is not known if the fluids had the same source or composition, i.e. connate, meteoric or magmatic. The direction and rate of flow of the fluids are also unknown. Therefore it is possible that, although hydrothermal activity occurred in many of the areas drilled, the conditions present were different to those which were responsible for the platinum-group element enrichment in the Hay River Formation at BMR Hay River 11A.

6.2 Conclusions

Platinum-group element enrichment may be present within EL's 5145, 5146, 5147 and 5149 at stratigraphic levels not yet tested.

Mineralization may require the Hay River Formatio to overly the Red Heart Dolomite. The EL 5146 area is closest, in stratigraphy, to the type area at Hay River 11A, as the Red Heart Dolomite is absent in El 5145.

6.3 Recommendations

Two alternatives are possible:-

(i) Relinquish all of the Exploration Licences on the assumption that mineralization does not occur in the areas. This is not recommended as the geochemical differences noted are based on Hay River 11A and one drillhole in EL 5145 only (Tobermory 14). No comparison can safely be made with the other areas in the absence of any other geochemical data.

(ii) Further exploration of sequences above the horizons already drilled, i.e. those above the bottom 60 m of the Hay River and Arthur Creek Formations. Any further drilling should include testing of the total thickness of the Arthur Creek and Hay River Formations and the base of the Marqua Formation.

It is also recommended that surface mapping and drilling of Exploration Licence 5146 be carried out as soon as possible.

A light weight rig suitable for sandy desert conditions should be used for any further drilling, to minimise access problems.

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