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Annual Report
On Exploration Retention Leases 67-70

for the period 6 December 1990 to 7 December 1991

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SUMMARY

A review of past exploration activities and geological studies has indicated that standard methods of step-out drilling and surface geology, geophysics and geochemistry are unlikely to lead the way to structurally controlled ore bodies within major fold geometries. An agreement between Plenty River Mining Co NL and Normandy-Poseidon has opened the possibility of a regional approach and an EM deep probing for major ore accumulations. A regional airborne EM survey of the whole Jervois area comprised in the EL's 6993, 6994 and ERL's 67-70 will be followed up in 1991-1992 by an EM ground survey. The whole area has been gridded for this purpose and a detailed soil and bed-rock geochemical survey.
INTRODUCTION

Exploration by Plenty River Mining Co and other tenement holders of exploration and mining leases within the Jervois area have established the presence of a number of stratabound ore deposits of copper, lead, zinc and silver within a largely chemically sedimentary sequence of very specific lithology: the so-called Mine Sequence. Notwithstanding the confinement of one or more Lode Horizons within this Sequence the development of ore reserves in the Jervois area has been hampered by significant pinch and swell structures of the ore bodies, requiring drilling at closely spaced intervals (less than 25 metres). The pinch and swell structures of the ore bodies are largely tectonic in nature and depend on the ductility of the ore material being most pronounced with galena rich ore bodies, slightly less for sphalerite and having less effects on chalcopyrite-rich zones. This structural control is superimposed on a primary variation in stratiform ore content of the Mine Sequence. The latter is geophysically characterized by magnetic anomalies due to the presence of magnetite. The magnetic anomalies have helped to delineate the regional structure of the Jervois area. On the basis of outcrop geology of the Mine Sequence and their subsurface continuation based on magnetic interpretation a structural model has been developed which bears close resemblance to the geology of the Willyama Block of Broken Hill (NSW).

The sequence of deformational events is nearly identical for Jervois and Broken Hill. The oldest event: D_1 created recumbent and overturned nappes at Broken Hill and low angle thrust folds at Jervois. The schistosity belonging to D_1 is generally parallel to S_0, except in fold hinges where S_0 is transposed into S_1. A difference between Jervois and Broken Hill is the degree of metamorphism during D_1. The grade was very low at Jervois and has led to hydration of igneous minerals with extensive sericitization and chloritization. During D_1 at Broken Hill the metamorphic grade was already progressing leading up to the main metamorphic event: M_2 during D_2.

The major D_2 deformation caused isoclinical folding both at Jervois and Broken Hill, with a dominant S_2 foliation. S_2 is generally parallel to bedding (S_0) and S_1 (where this is present). Pro-grade regional metamorphism (M_2) is associated with this deformation phase. This M_2
metamorphic phase was followed or accompanied by high heat flow creating the knotted schists at Jervois and skarn-type ore assemblages at both places. The timing of the thermal overprint is slightly later than D2 at Jervois, but can hardly be distinguished from M2 at Broken Hill. Both D2 and M2 affected the stratiform mineralization at Jervois and Broken Hill and resulted in attenuated ore bodies on fold flanks but thickened ore bodies in fold hinges. The most important ore bodies at Broken Hill are located in an antiformal structure, which is - because of overturning during D1 - a syncline. The Pb + Zn ore bodies at Jervois are all located in small parasitic fold hinges, and lack the continuity given by the major antiformal structure at Broken Hill.

The Broken Hill ore bodies are near the main fold closure, whereas the present ore bodies at Jervois are estimated to be 300 m above the projected closure of the major D2 (= F2) syncline.

The present Jervois ore bodies of Green Parrot and Reward are analogous to the Western Mineralization at Broken Hill which features a lead-zinc stringer zone extending down dip from the main antiformal ore body. Because the Broken Hill situation is that of an overturned antiform, which makes it a synclinal closure, one could expect a more important mineralization down dip from the present line of lodes at Jervois.

Further structural analogies concern the D3 deformation which produced crenulation folding both at Jervois and Broken Hill. D3 has a shear fold mechanism at Jervois and created the J structure. D3 was accompanied - both at Broken Hill and Jervois - by retrograde (M3) metamorphism. Relocation of ore material occurred at Broken Hill during D3. It is not known whether the same applied to Jervois.

In any case, the originally stratiform ore bodies were severely affected by deformation, in particular the lead-zinc ore bodies, as sphalerite and galena behave more plastically than pyrite and other oxides (including silicates). The small difference in plasticity between pyrite+chalcopyrite in quartz-magnetite-garnet rocks is the reason for - still - stratiform nature of copper ores at Jervois and Broken Hill.
A petrofabric study of quartz from quartzites has confirmed the ductility controlled ore accumulations at Jervojs. Principal extension direction is nearly vertical, as is the main $S_2$ schistosity. The vertical extension direction explains the scarcity of ore on the fold limbs, but holds promise for ore accumulation in $F_2$ hinge zones where the relative strain is less.

The ductility contrast between magnetite-garnet rocks and pyrite-chalcopyrite ores on one hand and the lead-zinc-silver sulphides on the other explain why drilling of strong (bull's eye) magnetite anomalies have failed to improve the ore reserves of lead and zinc, and only appeared to be due to massive magnetite pods.

The ductile segregation of lead and zinc ore bodies in parasitic fold hinges has created a situation where the onset or attenuation of a sulphide pod is difficult to predict. The sphere of influence of an ore pod hardly exceeds the drilling spacing. The amount of ore intersections, their correlation and grid density appeared insufficient to apply kriging statistics. Ore reserves calculations were based on the inverse-distance method where the sphere of influences drops to zero values over 30 metres. Mining practice has corroborated those ore calculation practices.
REVIEW OF PREVIOUS EXPLORATION RESULTS

The copper and lead deposits at Jervois were discovered in 1929 by T.T. Hanlon and Mudge on a droving trip. Hanlon's Reward (Jervois Range) Limited was founded in 1930 to work the deposits and three shafts about 30 metres deep were sunk on each of Reward, Marshall and Green Parrot prospects and the Bellbird and Killeen prospects were investigated. Work was abandoned due to the depression and to adverse metal prices in the early thirties. The field lay idle until 1948, when several leases were worked on tribute. Mr. K. Johannsen progressively acquired the leases. With production mainly from Bellbird, he sold ore to Mount Isa. Production from 1948 to 1958 was 2,840 tons of ore averaging 15% copper. He then erected a copper leaching plant capable of producing one ton of copper sulphate per day from 7 tons of ore. This plant did not perform satisfactorily.

From 1961 to 1965, New Consolidated Gold Fields (Australasia) Pty Ltd undertook the first modern exploration program. The program was directed towards proving up mineable copper reserves. It involved regional and detailed prospect mapping, geochemistry, B.M.R. magnetic and Turam surveys in 1962. The diamond drill holes totalling 1,901 metres were drilled in this period, 5 at Bellbird Extended, 2 at Green Parrot and 1 at each of Reward and Marshall. The program was terminated because it had failed to find ore reserves of the required tonnage and grade. Ore reserves for Reward, Green Parrot and Bellbird were estimated to total 2.4 million tonnes at 2% Cu to a depth of 95 metres.

Apart from some small scale mining of the oxidized zone by Mr. K. Johannsen, further exploration was not undertaken until Petrocarb Mineral Exploration (S.A.) Pty Ltd acquired certain key leases in 1969-70. Until 1972 intensive diamond drilling and lesser percussion drilling took place to test the known mineralised positions. About 110 holes were drilled including some 55 diamond core holes and 22 percussion holes on the Reward, Marshall and Green Parrot prospects. A smaller number of diamond and percussion holes were drilled at Green Parrot Scheelite (JG54-58), Bellbird North or Pioneer H (PH1-2, PHB22-23), Bellbird Scheelite (PE2-7, PE1-4), Crystallisation Plant Scheelite (XP1-4),
Pioneer A (PA1) and Pioneer B Scheelite (PB1-4), Cox's West (PE1), Mineral Lease 613H (Rockface PF1-5) and at Jericho. Costeanning of scheelite prospects also took place in 1972.

In late 1970 McPhar Geophysics carried out a detailed dipole - dipole I.P. survey of the Reward-Green Parrot mineralised zone and the Bellbird zone together with orientation VHEM and vertical fluxgate magnetometer surveys.

Ore reserves for Reward, Marshall and Bellbird defined by the Petrocarb drilling were calculated at 2,295,600 tonnes at 2.5% Cu and about 50 g/t Ag (Ypma, 1983) to a maximum depth of 130 metres. In addition, a further 300,000 tonnes at 9% Pb, 3% Zn, 1.5% Cu and 170 g/t Ag were estimated for Green Parrot.

A joint venture agreement between Petrocarb Exploration N.L., Wilstone (Pty) Limited and Union Cooperation (Australia) Pty Limited was negotiated in late 1973 whereby Union would undertake exploration in the Jervois area. The program which was implemented in 1974 was directed towards the discovery of 10-15 million tonnes at 4% copper. It involved colour air photography, geological mapping at 1:10,000 and 1,1000 scale, soil and rock chip geochemistry on selected targets, a review of previous geophysical work and test surveys using a variety of methods by Scintrex and the drilling of seven core holes totalling 1,723 metres.

Four of these diamond holes (UC1, 2, 3, 4) were drilled to test the Reward-Marshall zone spread over a strike length of 650 metres to an average vertical depth of about 270 metres, and a fifth (UC7) was drilled to deepen JG 28 at Green Parrot. A further two shallower holes (UC5, UC6) yielding low copper values were drilled at Sykes Prospect. Three holes (UC1, 2 and 3) intersected significant copper grades at 1% cut-off as follows:

UC1 5.15% Cu over 1.69 metres
UC2 3.61% Cu over 2.965 metres
UC3 6.57% Cu over 2.36 metres;
          2.81% Cu over 2.55 metres; and
          2.3% Cu over 1.41 metres.
The remaining holes intersected insignificant mineralisation.

A reserve of 2,085,000 tonnes at 3% Cu, 55 g/t Ag over an average intercept width of 4.7 metres was estimated for Marshall and Reward. This was short of the objective and Goldner recommended drilling to 600 metres vertically. Union Corporation, about this time, was contemplating withdrawing from Australia and the joint venture terminated without this recommendation being implemented.

The Jervois area remained inactive between 1975 and 1980 when Plenty River Mining Company N.T. Limited negotiated a tribute agreement with Petrocarb whereby Plenty River would be assigned the leases in return for payment of a royalty on production.

A treatment plant design to treat Green Parrot lead-zinc-copper-silver ore at a rate of 125,000 t.p.a. was completed in early 1982 together with township and services at a cost of $A 15 million. The plant was successfully commissioned in April 1982 and then placed on care and maintenance in June 1982 after having produced about 500 tonnes of concentrate. Open pit mining at Green Parrot using company equipment commenced in 1982.

The company became public by the issue of shares through a prospectus dated 28th March, 1983. In this prospectus, Terence Willsteed & Associates produced ore reserve estimates based on previous drilling plus 50 shallow percussion holes (PR series) drilled in July-August 1980 for greater ore definition. These estimates to 100 metres vertical depth were as follows:

**Green Parrot**

Probable primary reserves:
210,000 tonnes at 1.47% Cu, 8.58% Pb, 2.56% Zn, 166 g/t Ag.

Possible primary ore:
50,000 tonnes at 1.55% Cu, 8.07% Pb, 2.82% Zn, 135 g/t Ag.

Oxidized mineralisation:
70,000 tonnes at 1.57% Cu, 8.14% Pb, 3.17% Zn, 179 g/t Ag.
Marshall-Reward

Probable primary reserves:
320,000 tonnes at 2.77% Cu, 0.43% Pb, 0.39% Zn, 65 g/t Ag.

Possible primary ore:
205,000 tonnes at 2.71% Cu, 0.49% Pb, 0.33% Zn, 70 g/t Ag.

Oxidized mineralisation:
180,000 tonnes.

The plant was again commissioned in August 1983 and operated on Green Parrot oxidized ore for five months, treating 25,000 tonnes, until it was placed on care and maintenance in December 1983 due to a sharp decline in metal prices and has not operated since. About 2,000 tonnes of concentrate were sold at a grade of 50.4% Pb, 5.4% Zn, 0.6% Cu, 680 g/t Au and 0.1% Bi. About 40,000 tonnes of ores were mined from the Green Parrot pit (300 metres long by 25 metres deep).

In 1980 the PR series of about 50 percussion holes (PR 1 to 57) were drilled in the Marshall-Green Parrot for ore definition and open pit planning. A large number of shallow percussion holes were drilled in the same area in 1981 for pit planning and grade control.

Other drilling in 1981-83 included 17 percussion holes (R 1 to 17) and four diamond core holes (RWD 1 to 4) at Reward in 1983; 14 percussion holes about 500 metres north of Reward near scheelite costeans yielding narrow low grade copper intersections; 24 percussion holes at HM Lode intersecting narrow low grade copper intercepts; and 11 percussion holes at Killeen Prospect. Costeaning was undertaken at Cox's (10), Killeen and HM Lode.

A program of scheelite exploration was undertaken by Plenty River in 1981/82 with extensive costeaning and shallow percussion drilling at Bellbird Scheelite, Green Parrot Airstrip, Georges Hill and Glenn. At Bellbird Scheelite there are 23 costeans and 86 shallow percussion holes. Ypma (1987) estimated a cumulative reserve from all locations at 9,000 tonnes at 0.46% WO3 to 20 metres vertically.

With the objective of discovering a large stratiform base metals ore body of the Broken Hill type, Anaconda Australia Inc. negotiated a joint
venture with Plenty River Mining in September 1983. The Anaconda program primarily centred around the flying of an INPUT electromagnetic survey in October 1983 and follow-up by reconnaissance geology and geochemistry of 26 moderate to low order EM anomalies. At the same time the Jervois Range 1:100,000 sheet magnetic data flown by the N.T. Department of Mines and Energy in 1981 was interpreted. The ground follow-up of EM anomalies did not reveal any lode horizon rocks and the geochemical results were discouraging. Anaconda withdrew from the joint venture in May 1984, about the time the parent was contemplating the ultimate shut down of activities in Australia.

Since 1982 Plenty River Mining Company has explored Exploration Licences 3301, 3202, 3203, 3204 and 3165 in the Jervois area as well as its leases. The reduced area of E.L. 3301 is still held by the company. The results of this work appear in reports by Ypma, 1983, 1984, 1985, 1986 and 1987.

The principal activities during this period have been:

* Geological mapping at 1:5,000 scale of E.L. 3301 and parts of E.L. 3202 and 3204 (including the "J" structure) in 1982-83 by students under the supervision of Dr. P.J. Ypma of Adelaide University. Emphasis in this work was on structural geology. The results are documented in a 1985 rept.

* Honours Theses by University of Adelaide students on interpretation of ground magnetic and gravity data in the Jervois mine area, and on results of fluid inclusion studies.

* A 250 metre line spacing, airborne magnetiuc and gamma ray spectrometre survey by Austirex for Plenty River Mining Company in April-May 1983 of EL 3301, the western part of EL 3202 and the northern part of EL 3204 and their interpretation by T. Whiting of the University of Adelaide (1986) as part of a PhD thesis.

* Ore reserve estimation of the Reward-Marshall-Green Parrot zones by students at the School of Mines of Delft University of
Technology in Holland under supervision of P. Ypma in 1986. This computer-based study led to the production of graphs permitting estimation of ore reserves at varying grade cut-offs.

* An ore-microscopy study of the Jervois Mine, 1987, by a student at the School of Mines of Delft University of Technology, Holland, and a study on Small Scale Mining, with special attention paid to Jervois Mine.

Some diamond drilling was completed in the period 1984 to 1987 including four holes (X84 1, 2, 3, 5) to test airborne magnetic anomalies in the Bellbird and Green Parrot South areas, which anomalies bear resemblance to those associated with Reward and Marshall. No significant mineralisation was intersected and the targetting of further magnetic anomalies was abandoned.

In 1986, accent was on testing geochemical anomalies due to high zinc in biotite. Four core holes were drilled at Pioneer (X86 1 to 4) yiedling narrow copper intercepts, one at Anaconda (X86-5) and four holes at Killeen (X86-6 to 9). One of the Killeen holes showed intersections of 16% Zn over 0.9 metres and 15.1% Zn over 1.15 metres in calc-silicate rocks.

Four core holes were drilled in 1987, three at Van Gils Prospect (X87-1 to 3) and one (X87-4) at Killeen. Results at Van Gils were not encouraging, while at Killeen, zinc values in the range 2% to 3.65% were intersected over 4.35 metres with one 0.15 metre interval at 12.5% Zn in calc-silicates. A further three diamond drill holes were later completed at Killeen in 1987 (X87-5 to 7) all of which yielded zinc/lead intersections.

The Northern Territory Geological Survey in conjunction with the Bureau of Mineral Resources produced a second edition of the Huckitta 1:250,000 geological map as a result of work between 1972 and 1982 (Freeman 1986).
EXPLORATION STRATEGY

From the foregoing it is clear that some further shallow surveys are not going to add materially to the presently known ore reserves. Drilling and the geophysical resolution use to date was not appropriate to discover mineralization at depth greater than 100 m. The few holes which went deeper, were indeed successful in demonstrating ore continuity at depth but did not reach the major F2 hinge zone.

Plenty River Mining reached an agreement with Normandy-Poseidon in October 1991, whereby Poseidon Exploration Limited would extend their exploration of the EL's 6993 and 6994 to include the ERL's 67-70.

Exploration activities during the last year included a combined airborne magnetometer and EM survey.

Airborne magnetometer survey

About 1894 line km's were flown in 1991, for the assessment of EL 6994 with about 418 km passages over the ERL's 67-70. A report on the results of this survey has been lodged with the Mines Department as part of the Annual Report on EL 6994. The magnetometer survey was carried out with the following specifications:
- Scintrex V201 optically pumped splitbeam caesium vapour magnetometer
- 0.1 m T resolution
- 2 Hz/25 m magnetometer sampling
- 10 sec base station sample interval
- 200 m NE-SW flightline spacing and 400 m WNW-ESE flightline spacing
- 2000 m orthogonal tie line spacing
- 120 m terrain clearance of aircraft at 110 knots ground speed
- GPS satellite navigation
- colour video flight path recovery
Airborne EM Survey

The Questem EM survey was carried out simultaneously with the magnetometer survey and has been reported to the Mines Department as part of the Annual Report on EL 6994.

Flight characteristics of spacing and altitude, navigation, flight path and recovery is the same as the magnetometer survey.

The following EM specifications apply:
- Questem EM is a digital time domain electromagnetic septem mounted in a towed bird, interfaced with a PDA's 1000 data acquisition system and a transmitter operating at 75 Hz energizing the transmitter loop which encircles the whole aircraft
- 40 m EM bird terrain clearance
- 64 channels binned in 15 windows
- 1 ppm EM system resolution
- 4 Hz/13 m EM sample interval
PROGRAMME FOR 1991-1992

The airborne survey will be followed up by a ground survey in 1992.

Ground EM Survey

The ERL's 67-70 will be covered in a ground EM survey of 17 loops of 600 m (N-S) and 300 m (E-W).

Australian Metric Gridding

The ERL's 67-70 are presently being gridded for a detailed ground EM survey.

Soil geochemistry

Based on known ore occurrences and deposits the most effective soil sample grid size, sample size and grain size will be determined. It is estimated at this stage that a 500x100 m grid spacing will be used with a total of 380 samples and a follow up of 3000 m RAB drilling sampled at 5 m interval = 600 samples.

EXPENDITURE 1991-1992

The expenditure for ERL's 67-70 consists of a ground EM survey which is costed against EL's 6993 and 6994.
The gridding of ERL's 67-70 is also included in the budgets for EL 6993 and 6994.
The geochemical survey is estimated as follows:

- soil sampling 380 x $ 20.- $ 7,600
- field assistant 7 x $ 250.- $ 1,750
- RAB dried follow up 3000 m x $ 5.00 p.m. $ 15,000
- RAB sampling 600 x $ 20.- $ 12,000
- geologist + assistance 8 x $ 600 $ 4,800
Total estimated geochemistry: $ 41,150
EXPENDITURE 1990-1991

Plenty River Mining Co NL has spent in the period 6-12-1990 to 7-12-1991 the following on the Jervois Mine site: $260,000 of which $156,000 were for royalties.

Work by the geologist P. Ypma and the geological staff of Poseidon Exploration was facilitated by the presence of the Jervois infrastructure and transportation facilities. The value of these facilities for work on ERL's 67-70 is estimated at 10% of $104,000 for Jervois mine site costs $10,400 Allocation of geological consultants fees $6,000 Allocation of geological and geophysical staff time of Poseidon Exploration $16,000 Travel expenses $4,000 Total $36,400