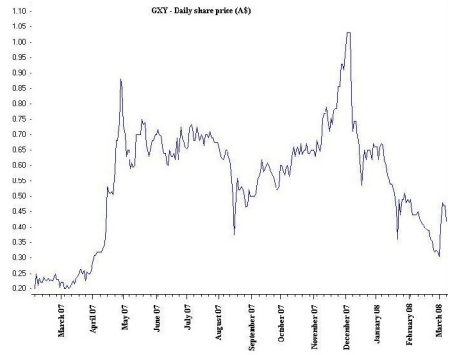
Galaxy Resources Ltd (GXY)

Recommendation: Long Term Buy ($0.44)

Participant of the ASX Group
AFSL 247100 ABN 95 092 989 083

11 November 2008



Investment Data	
Share Price	$0.44
Fully Paid Ord Shares (m)	44.66
Options (m)	9.73
Fully Diluted (m)	54.39
Current Market Cap ($'m)	23.9
Enterprise Value ($'m) (diluted)	23.5
Net Cash (Dec 2007)($'m)	0.41
52 week Low/High (cents)	20 / 115
Average daily volume (3 mths)	72,500
GXY Valuation: 80% debt	**per share**
- Mt Cattlin – lithium conc. project	**$4.34**
- Other Exploration	**$0.20**
TOTAL	**$4.54**

Directors & Officers

Craig Readhead	Chairman
Michael Fotios	Managing Director
Robert Wanless	Non Exec Director

Major Shareholders

State One Capital Group	13.5%
Directors	8.0%
Pegmont Mines	7.1%

State One Stockbroking Ltd

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Lithium anointed by the Oracle of Omaha as a growth commodity

The world's richest man and respected investor, Warren Buffet, gave a vote of confidence recently to the lithium car market. It was announced on the 29th of September that Buffet's MidAmerican Energy Holdings had bought a 10% stake in Chinese lithium battery manufacturer BYD for US$230 million.

Galaxy resources is set to capitalise on a forecast increase in demand for lithium batteries through the development of its Mt Cattlin Lithium/Tantalum Project. Preliminary results from the current BFS study indicate a 14% improvement in lithium recoveries (80% up from 70%) compared with initial assumptions. Coupled with a sharp increase in tantalum price to US$100/lb and the falling Australian dollar, the forecast NPV of the project has increased by 180% to $293 million.

Key Investment Points:

Galaxy intends developing the Mt Cattlin lithium/tantalum mine near Ravensthorpe, in the south of Western Australia.

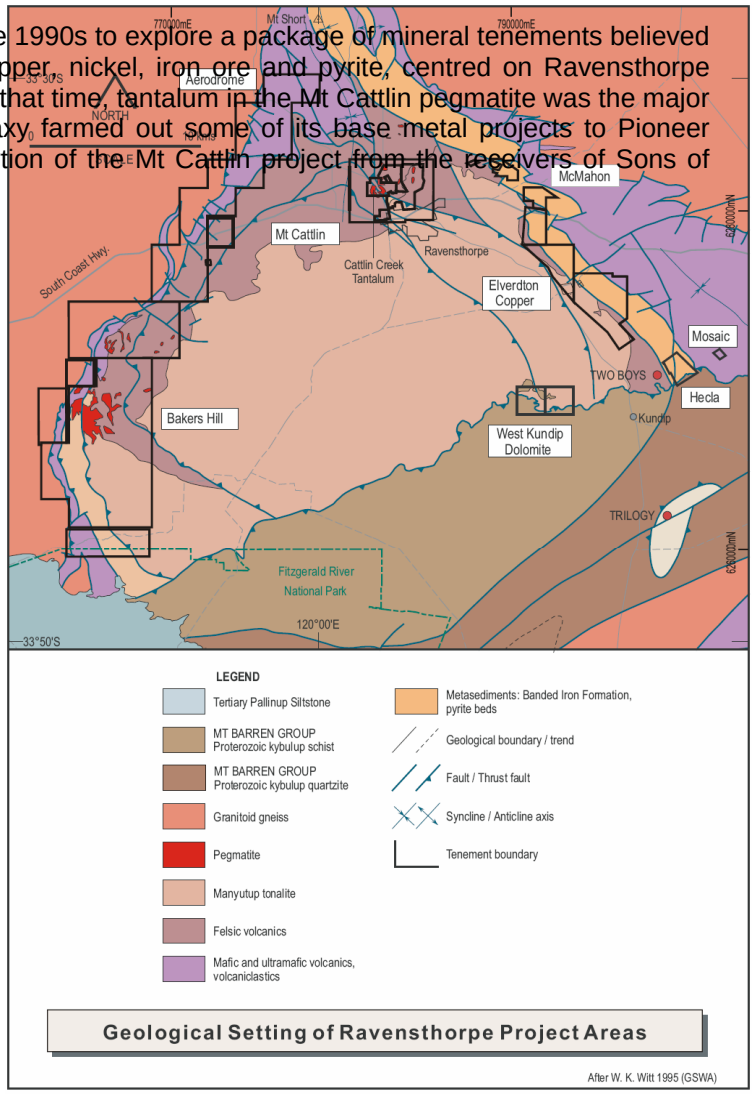
- Initial indications from the bankable feasibility study (BFS), due to be completed in March 2009, are that recoveries of the spodumene (lithium ore mineral) concentrate will be 80% compared with an initial assumption of 70%.
- A toll treatment option may allow recoveries of 85% to 90% at lower assuming lower concentrate grade, representing additional upside.
- Chinese export restrictions on rare earth elements and precious metal exports have pushed the price of tantalum up to US$100/lb, with prices expected to rise further.
- Mt Cattlin is set to annually produce over 7,000 t of lithium oxide (Li_2O) from 117,000 t of spodumene concentrate & 193,000 lbs tantalum oxide (Ta_2O_5).
- Recent expansion drilling has intersected spodumene rich pegmatite veins below the existing resource envelope and along strike. Resulting in an extension to the BFS time frame to accommodate a resource expansion, expected ~January 2009.
- Estimates of the capital expenditure for the project remain at a modest A$50 million, including working capital.
- Assuming 80% debt funding, a spodumene (lithium ore mineral) concentrate price of US$400/t, and a 10% nominal discount rate, modelling of the Mt Cattlin deposit returns a base case net present value (NPV) of approx. $293 million for the concentrate project.
- **Assuming the capital base expanded by 22% to 67.6 million shares, the Mt Cattlin concentrate project returns a NPV of $4.34 per GXY share.**
- Assumptions for lithium price in the valuation are a flat rate of US$400/t for spodumene concentrate. No forecast prices rises have been included.
- Mt Cattlin's production is projected to be 4.3% of world production in lithium carbonate equivalent terms, less than half of annual demand growth.

1.0 Introduction

Galaxy Resources Limited was formed in the late 1990s to explore a package of mineral tenements believed to be prospective for tantalum, spodumene, copper, nickel, iron ore and pyrite, centred on Ravensthorpe near the southern coast of Western Australia. At that time, tantalum in the Mt Cattlin pegmatite was the major focus of the Company. Early this decade, Galaxy farmed out some of its base metal projects to Pioneer Nickel and in 2006 it purchased the central portion of the Mt Cattlin project from the receivers of Sons of Gwalia.

In December 2006, Galaxy raised $3.0 million through an over-subscribed IPO sponsored by State One, issuing 15 million shares at $0.20 per share. It listed on the ASX on 6th February 2007.

Since listing, Galaxy has focussed its efforts almost exclusively on the targets in the Ravensthorpe area, specifically on advancing the Mt Cattlin lithium / tantalum project.



Mt Cattlin Resource:

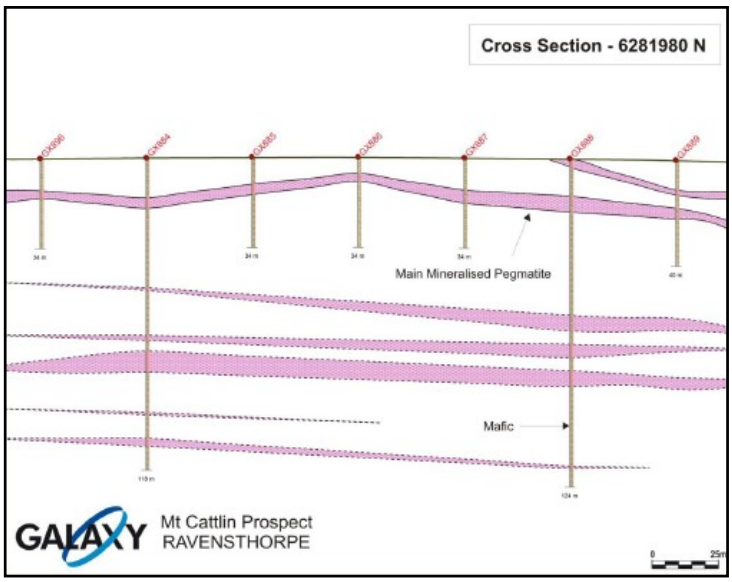
In December 2007, the Company issued a resource statement on Mt Cattlin, based on a total of 712 holes drilled in a number of drilling campaigns:

- A global total measured, indicated and inferred mineral resource of: 24.8 million tonnes at 8.2% spodumene or 0.56% Li_2O and 120 ppm Ta_20_5, for a contained resource of 2.03 million tonnes of spodumene and 6.62 million lbs of Ta_20_5.
- Using a 0.4% Li_2O (i.e. 5.9% Spodumene) cut-off, the resource is calculated at: 12.3 million tonnes at 14.7% spodumene or 1.0% Li_2O and 135 ppm Ta_20_5, for a contained resource of 1.8 million tonnes of spodumene and 3.8 million lbs of Ta_20_5.

The calculated lesser resource was approximately five times the 2.4 mt tantalite-dominated resource which had been calculated prior to GXY's listing.

On going resource expansion:

As anticipated, recent RC drilling has expanded the resource potential via thick pegmatite intersections outside the resource envelope along strike and at depth. These intersections are a significant addition to the geological model as it now appears the surface mineralisation is part of a stacked pegmatite array rather and a discrete mineral occurrence. As the balance of assay results are received, they will be included in a resource expansion that is expected to be announced in January 2009. Associated revisions to mining and milling rates are expected to be completed by March 2009.



Recently announced assay values outside resource envelope.

Hole ID	From	Interval	Li_2O%	Spodumene %
GX836	19	11	1.08%	15.9%
GX849	70	14	1.70%	25.0%
GX850	53	10	1.77%	26%

*measured resource grade is 1.00% Li_2O

Pre-Feasibility and Bankable Feasibility Study Progress

After a Pre-Feasibility Study on the Mt Cattlin project was completed with encouraging results in late December 2007, in January 2008 the Galaxy board decided to commence a Bankable Feasibility Study (BFS).

Key project appointments for the BFS have been made, including;

Resource Modelling	-	Hellman and Schofield
Pit Modelling	-	Orelogy
Concentrator Pant Design	-	Como Engineers
Metallurgical Test Work	-	Nagrom & Co
Lithium Carbonate Plant	-	Outotec

It is expected that completion of the BFS by March 2009 will permit funding to be secured in time for the commencement of mine development by mid 2009, and of production by late 2009, while full production will be achieved by mid 2010.

The delay in scheduled BFS completion from September 2008 to March 2009 is due to additional considerations from an anticipated increase in resource. Such as, increased mining and milling rates, cut off grades and mine scheduling.

2.0 Mt Cattlin Project Summary

2.1 Ore body and Mining

The leases containing the Mt Cattlin ore body are immediately to the northwest of Ravensthorpe, some 450 km southeast of Perth. Galaxy holds an option to purchase all of the land on which the ore-body sits, apart from a small portion which is Vacant Crown Land (was previously freehold which means there are no native title issues). Galaxy expects to exercise the purchase option concurrently with a decision to mine, expected March-April 2009. The majority of the proposed mining area falls within a granted Mining Lease in respect of the key parts of the project. The Ravensthorpe North area however falls under a Mining Lease Application, which is expected to be granted in November 2008. Although a Mining Lease has been granted, the project still needs a satisfactory Notice of Intent to Mine, assuming a satisfactory BFS.

The ore-body is a flat-lying pegmatite sheet averaging 10 to 12 metres in thickness, with a maximum depth of 80 metres. The life-of-mine waste to ore ratio is estimated at 3:1. The ore minerals are spodumene (containing lithium), tantalite and some tin. Waste minerals are quartz, feldspar, blue metal and mica, from which we have assumed no revenues.

The Current Global Ore Resource is calculated as:

Category	Tonnes	Ta_20_5 ppm	Li_2O %	Spodumene %
Measured	**2,028,715**	**182**	**0.62**	**9.19**
Indicated	**10,141,524**	**114**	**0.7**	**10.23**
Inferred	**12,602,066**	**113**	**0.43**	**6.32**
Total	**24,772,306**	**119**	**0.55**	**8.15**

The *current* global resource is therefore 2.03 million tonnes spodumene and 6.62 million lbs Ta_20_5.

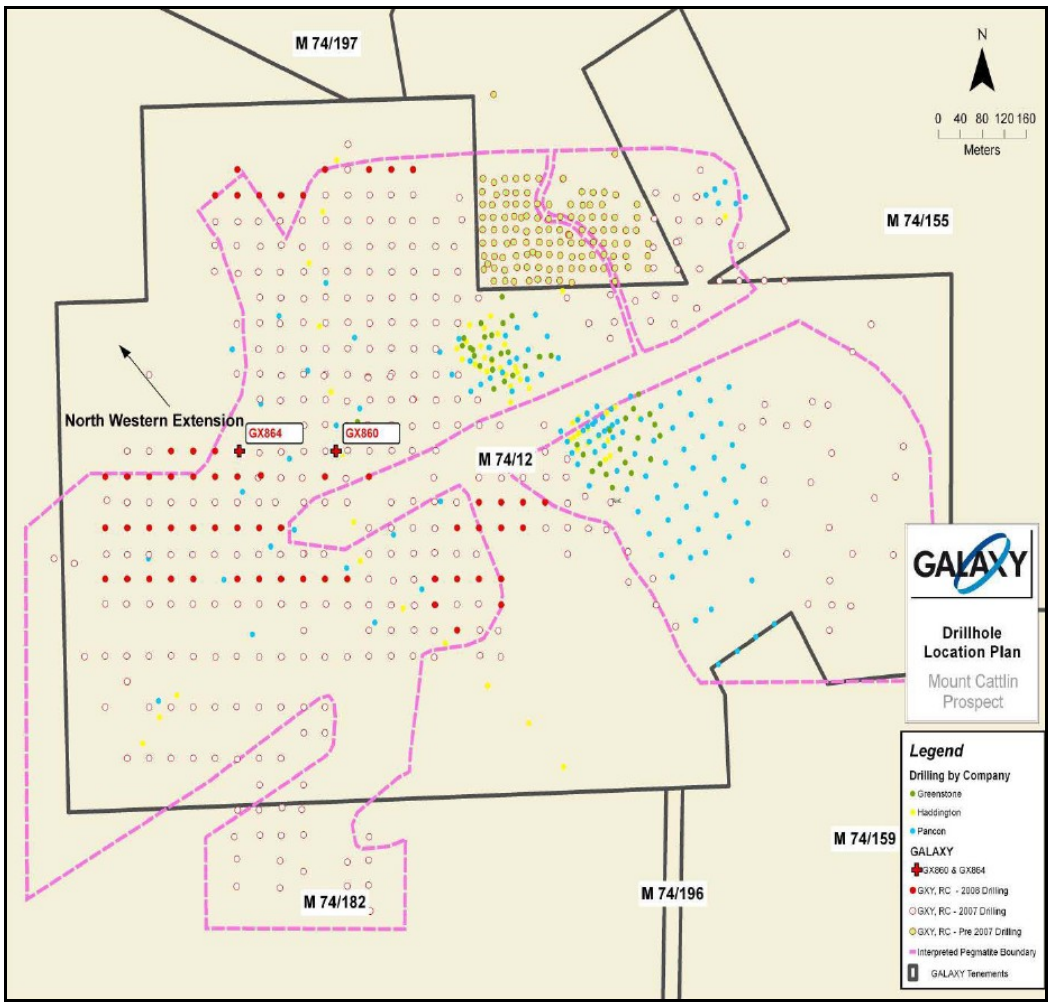
The Cut Ore Resource is calculated as:

Within the global resource, a higher grade resource of 1.81 million tonnes spodumene and 3.80 million lbs Ta_20_5 has been delineated using a 0.4% Li_2O cut-off:

Category	Tonnes	Ta_20_5 ppm	Li_2O %	Spodumene %
Measured	**1,090,066**	**177**	**1.07**	**15.67**
Indicated	**6,417,133**	**125**	**1.02**	**15.00**
Inferred	**4,797,911**	**140**	**0.96**	**14.12**
Total	**12,305,110**	**135**	**1.00**	**14.72**

An updated resource announcement is expected to be announced in January 2009.

Current estimates assume 1.0Mtpa of ore will be delivered to the ROM stockpile, this will possibly be increased depending on final resource/reserve figures.



2.2 Processing

Processing of 1.0 mtpa of ore will involve:

1. Crushing and screening of ROM ore to ~12 mm.
2. Heavy media separation (HMS) at SG 2.9 (spodumene has an SG of 3.2).
3. Grinding, classification and wet magnetic separation of the HMS sinks (spodumene primary concentrate containing tantalite minerals).
4. Gravity concentration (spirals and wet tables) of tantalite minerals.
5. Contract dressing and packaging of tantalite concentrates.
6. Drying, packaging and storage of spodumene product.

A deeper investigation into lithium processing as part of the BFS has found that improved recoveries of spodumene (80%, up from 70%) are achievable and higher still (85% to 90%) if the 6.0% Li_2O cut off does not need to be met (6.0% is the industry standard for spodumene concentrate.). As would be the case if a concentrate product was initially toll treated offshore to produce lithium carbonate, prior to the construction of a lithium carbonate facility on site.

Mass balance yield results in a concentrate production of 117,000 tpa from a 1.0 mtpa head feed. Recovery of tantalite to final shipping concentrate is estimated at 65%, at a grade of 25% Ta_20_5 for 193,000 pounds of contained Ta_20_5 annually.

At calculated resource grades the spodumene will provide about 82% of concentrate revenue, with the balance from tantalite.

If a lithium carbonate stage is added to the project, then it is expected to incorporate similar roasting and leaching methods to those which have been successfully used since the 1940s. Galaxy expects that the lithium carbonate stage of the process will convert +80% of the input lithium to the much higher value material. An added advantage of adding this step is that the first stage processing to a concentrate does not need to be as onerous as when striving to attain 6.0% Li_2O. A concentrate grade of less than 6.0% can be achieved with higher conversion rates (recoveries) to concentrate but with no offsetting losses in the lithium carbonate stage. Resultant lithium carbonate production should be 21,000-22,000 tpa, with an project revenue in excess of $160m.

With upgrading to lithium carbonate, the tantalite contribution to total revenue would fall to only 6.5%. Galaxy will also be looking for income from by-product tin and road aggregate, which has not been included in our workings.

2.3 Product Specification

The typical specification on the primary spodumene concentrate from Mt Cattlin is expected to be as follows:

Li_2O		6.000%
Fe_2O_3		1.450%
Na_2O		0.450%
K_2O		1.190%
P_2O_5		0.035%
MnO		0.156%
Al2O3		25.500%
LOI		0.810%
Tyler 50 #	(300 micron)	100% passing
Tyler 200 #	(75 micron)	100% retained

2.4 Capital Costs

The capital cost estimate used in our modelling of the Mt Cattlin project is A$50 million comprising:

Process plant, tailings and infrastructure	A$34 million
Mining Pre-strip and other	A$6 million
Working Capital	A$10 million

The above numbers are as calculated by Galaxy's consultants in the PFS. A revision is expected as part of the BFS but is not available at this stage, although no material changes are expected.

If Mt Cattlin proceeds to the lithium carbonate stage, it is expected that the estimated $60m capital requirement would be debt funded on the back of revenues from lithium concentrate production.

2.5 Operating Costs

Concentrate Stage

Galaxy's pre-feasibility study generated the following estimate of costs for production to concentrate stage and include trucking the 180 km to Esperance wharf for export. No further guidance on costs has been given at this stage, although no material changes are expected:

	$m pa	A$/tonne	A$/t cons.
Mining	**$11.7**	**$11.65**	**$99.84**
Power	**$5.4**	**$5.44**	**$46.63**
Consumables	**$2.9**	**$2.93**	**$25.14**
Contract Services	**$7.9**	**$7.89**	**$67.60**
Labour	**$4.1**	**$4.09**	**$35.02**
G & A	**$0.9**	**$0.94**	**$8.03**
Total Cash Costs	**$32.9**	**$32.93**	**$282.27**

Lithium Carbonate Stage

Available data as provided by Galaxy suggests that taking the concentrate to the lithium carbonate stage will involve additional operating cash costs of approximately A$325 per tonne of lithium concentrate or about A$34m pa. Capital recovery costs will increase the costs to about A$40m. Note however that there would be a significant saving in road transport costs.

2.6 Marketing

Galaxy's discussions with potential customers for spodumene and tantalum concentrates indicate that current contract prices are:

- US$400 - US$500 per tonne for spodumene concentrate, grading 6% Li_2O;
- US$85 - US$100 per pound of contained Ta_20_5 for tantalite concentrate; and
- US$6,500 – US$7,000 per tonne for lithium carbonate.

The evidence suggests that there is a ready market for all three products, most especially the lithium carbonate, provided specifications meet market demands.

2.7 Tantalum

The Mt Cattlin mine will produce 315 tpa of tantalite (Ta_2O_5) concentrate grading 25% tantalite. This is projected to have a value of $15 million per annum at current prices. Contained tantalite will be 193,000 lbs, which is expected to be 3% of world demand in 2010. As this is less than annual demand growth of 4% per annum, market entry for Galaxy's tantalite is not expected to be problematic.

The tantalum market is now in recovery mode after a period of overstocking early this decade was followed by excessive sales out of the US. We understand that since mid 2006 Talison Minerals has kept its 1.0 million lb per annum Greenbushes tantalite mine, which is an underground operation, on care and maintenance pending a further improvement in the market.

3.0 Galaxy's Cash Needs - Pre-Commissioning of Mt Cattlin

As at 30 June 2008, Galaxy had cash reserves of $1.9 million.

Galaxy's cash demands to the completion of the BFS (i.e. the period prior to the securing of funding for Mt Cattlin) are estimated as follows:

Mt Cattlin	- Bankable Feasibility Study & EIS	$ 0.75 m
	- Drill-out of Resource	$ 0.50 m
Elverdton JV expenditure		$ 0.50 m
Exploration drilling other projects		$ 0.50 m
Corporate Overheads		$ 0.50 m
Land Purchase		$ 0.42 m
Contingencies		$ 0.33 m
TOTAL		$ 3.50 m

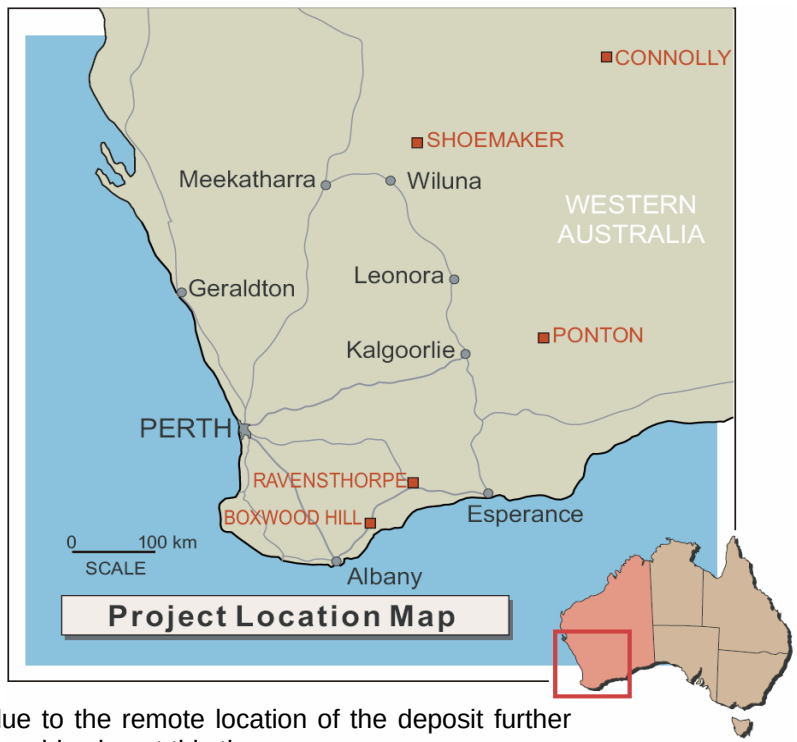
Galaxy announced on 18th Feb 2008 that it had secured commitments from directors and ex-directors of the company, the holders of unlisted in-the money options, for their early exercise. The funds to be raised under these arrangements in the period from March to September 2008 will be just above $2.0m.

On the 26th of June 2008 Galaxy announced that it had raised a total of $2.25million through the issue of 5 million fully paid ordinary shares at 45cents per to institutional investors and high net worth individuals. Galaxy is now adequately funded through to the completion of the Mt Cattlin BFS.

4.0 Galaxy's Exploration Projects

Galaxy's exploration projects include:

- Two wholly-owned impact structures in the north of Western Australia – **Shoemaker & Connolly**, which are believed to be prospective for iron ore and base metals;
- The wholly-owned **McMahon pyrite** and **West Kundip manganese/dolomite** projects both located near Ravensthorpe. McMahon has potential as a source of sulphuric acid for the nearby BHP Billiton nickel plant, as well as numerous other consumers in WA; and
- The wholly-owned **Ponton Rare Earths** Project located 535 km east of Kalgoorlie;
- A number of **copper and nickel** tenements near Ravensthorpe, held 25% by GXY after having been farmed out to Pioneer Nickel.



On the 22nd of August, Galaxy announced ground magnetic results from the Shoemaker deposit which in association with rock chip results confirmed the presence of a significant iron endowment. However, due to the remote location of the deposit further exploratory work is considered unlikely to add value at this time.

5.0 Summary

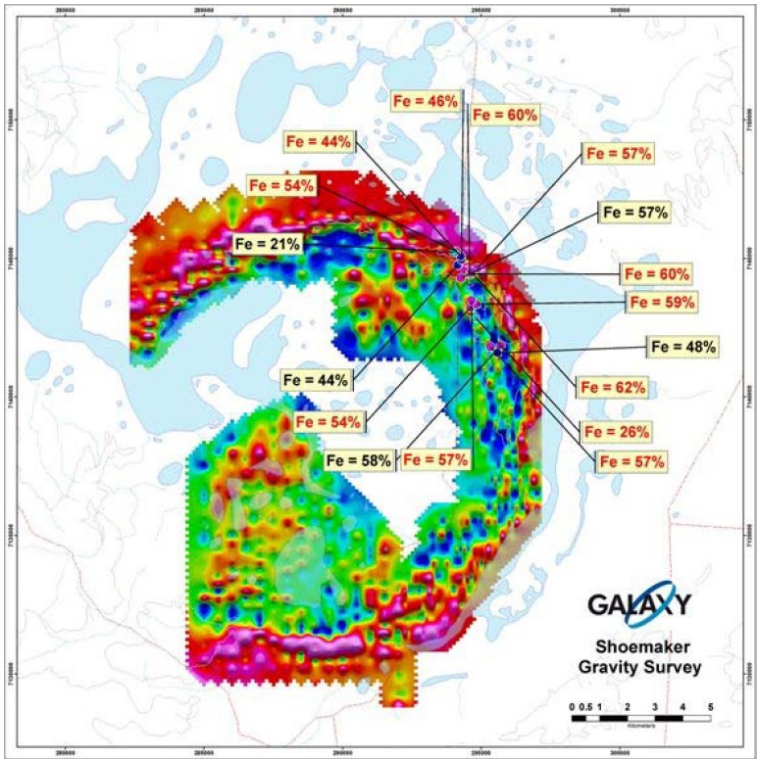
Galaxy Resources is currently the only pure lithium exposure company in the Australian stock market, and the only one with an Australian operation.

Whilst the entry of electric cars into the market has been talked about for decades, environmental concerns and oil prices have heightened demand.

Contemporaneously, advances in battery technology have improved the marketability of electric and hybrid vehicles.

There has been a steady increase in activity in the Lithium battery sector over the last 12 months;

On the 29th of September it was announced that Warren Buffet's MidAmerican Energy Holdings had bought a 10% stake in Chinese lithium battery manufacturer BYD for US$230 million.



Rock chip sampling and magnetic survey results over the Shoemaker deposit.

On the 10th of October Exxon mobile announced that it was commencing construction of a lithium ion battery separator plant in South Korea at a cost of US$325 million. The plant will initially produce separator film, a key component of the lithium batteries used to power hybrid cars as well as laptops and mobile phones.

On the 16th of October LG Chem (Korea's biggest chemicals firm) posted a 43% profit in driven a 81% rise in operating profit from it's electronic materials division which makes next generation lithium ion batteries for hybrid cars.

The sum of which is a greater confidence in growing lithium demand and price. The Mt Cattlin Project shows robust fundamentals at current lithium prices and represents exposure through Galaxy Resources to one of the few bright lights remaining in the commodities sector.

6.0 Financial Model

Mt Cattlin Lithium / Tantalum Project – Profit & Cash Flow Forecast

(NPV calculation with 80% project debt - to Concentrate Stage only. Our preliminary estimates suggest potential for considerable additional value to be derived by further processing to lithium carbonate.)

YE: June	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
A$/US$	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
Inflation (% pa)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Production (mtpa)	0.7	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Spodumene Grade (%)	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
Recovery (%)	80	80	80	80	80	80	80	80	80	80	80
Concentrate Grade (% Li2O)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lithium Conc. production (mtpa)	0.09	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Ta2O5 Head Grade (ppm)	135	135	135	135	135	135	135	135	135	135	135
Recovery (%)	65	65	65	65	65	65	65	65	65	65	65
Conc. Grade (% Ta2O5)	25	25	25	25	25	25	25	25	25	25	25
Tantalum Conc Production (tpa)	245	315	351	351	351	351	351	351	351	351	351
Tantalum Production (thous. lb Ta2O5 pa)	135	174	193	193	193	193	193	193	193	193	193
Spodumene Price US$/t 6% Li2O Conc	400	400	400	400	400	400	400	400	400	400	400
Tantalite Price US$/lb Ta2O5	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
Spodumene Revenue	51.1	65.7	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0
Tantalite Revenue	15.8	20.3	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Revenue	66.9	86.0	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6
Operating Costs/tonne (A$/t)	33.00	33.99	35.01	36.06	37.14	38.26	39.40	40.59	41.80	43.06	44.35
Operating Costs	23.1	30.6	35.0	36.1	37.1	38.3	39.4	40.6	41.8	43.1	44.3
Depreciation (on Capex of $50m)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Interest Charges (10% pa)	4.0	4.0	2.9	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Private Royalty	1.0										
WA State Royalty (5%)	3.3	4.3	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Pretax Profit	30.4	42.1	47.8	48.3	48.6	47.5	46.4	45.2	44.0	42.7	46.4
Income Tax @ 30%	9.1	12.6	14.4	14.5	14.6	14.3	13.9	13.6	13.2	12.8	13.9
Net Profit	**21.3**	**29.5**	**33.5**	**33.8**	**34.0**	**33.3**	**32.5**	**31.6**	**30.8**	**29.9**	**32.5**
EPS (c)	35.1	48.6	55.2	55.7	56.1	54.9	53.5	52.2	50.8	49.3	53.6
DPS (c) *	0.0	0.0	43.9	88.0	64.4	63.1	61.8	60.4	59.0	57.6	53.6
PE Ratio (x)	1.3	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.8
Dividend Yield (%)	0	0	98	196	143	140	137	134	131	128	119
Debt Repayment	0.0	10.7	14.7	14.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EBIT	26.3	45.1	53.2	53.4	39.0	38.3	37.5	36.6	35.8	34.9	32.5

NPV @ 10.0%	**$293.4m**
NPV per share	**$4.34**

(* assumed full payout of available cash from 2013, 50% payout in 2012)

7.0 Directors

Craig Readhead B Juris, Ll.B. Age: 53 (Non-executive director, Chairman)

Mr Readhead is a lawyer with 29 years experience in legal and corporate advisory services, particularly in the resources industry. In addition to being chairman and a non-executive director of Galaxy, Craig is currently chairman of Heron Resources Ltd (HRR) and non-executive director of Mount Gibson Iron Ltd (MGX), India Resources Ltd (IRL) and Frankland River Olive Company Ltd. In the past, he has also acted as chairman of Halcyon Group Ltd (now Nickelore Ltd, NIO) and Agincourt Resources Ltd (acquired by Oxiana Resources Ltd, OXR). He is also a past president of the Australian Mining and Petroleum Law Association, and is the managing partner of specialist mining and corporate law firm Pullinger Readhead Lucas.

Michael Fotios BSc (Hons, Geology) MAusIMM. Age: 45 (Managing director)

Mr Fotios specialises in Economic Geology, and has gained extensive experience from exploration through to feasibility over the last 24 years working with gold, base metals, tantalum, tin and nickel projects throughout Australia. Michael has held positions with Homestake Australia Ltd and Sons of Gwalia Ltd, and was a director and subsequently managing director of Tantalum Australia NL, now ABM Resources Ltd (ABU), from September 1999 to October 2005.

Robert Wanless. Age: 59 (Non-executive director)

Mr Wanless has 32 years experience in the mining industry as a prospector and mining investor. He began as a professional prospector and exploration supervisor e`mployed by Placer Exploration Ltd on their PNG and WA projects. More recently, Bob has been involved in a number of sales and joint venture agreements with listed companies, primarily in base metals and gold. He was formerly a founding director of Red 5 Ltd (RED, formerly Greenstone Resources NL) and manages Galaxy's exploration of its Ravensthorpe nickel, gold and tantalum projects.

APPENDIX: THE LITHIUM MARKET

1.1 Background

Lithium is the lightest of all metals with an atomic number of 3 and an atomic weight of 6.9. The soft silver grey metal is highly reactive at room temperature. As such, it never occurs as a pure element but rather in the form of stable minerals or salts. Commercial lithium production comes from two sources:

- Lithium minerals containing lithia (Li_2O), such as spodumene, petalite and lepidolite, are mined from open-cut and underground mines, with the largest producers being Australia, China, Zimbabwe and Canada.
- Lithium-rich brines from salt lakes located in the Andes of Chile and Argentina and in the Himalayas of China.

Lithium from the high altitude brines is the main source of lithium carbonate, the raw material which is used to produce lithium compounds and metal. The largest end use for these products is in the manufacture of lithium ion batteries used to power hand held electronic equipment, re-chargeable power tools and computers. Lithium from this source is also used in a wide range of applications including greases, glass, aluminium production, air-conditioning systems, alloys, catalysts, pharmaceuticals, polymers and cements.

Lithium minerals are primarily used in the glass and ceramics industries. The addition of lithia in glass manufacturing increases the melting rate. This increases production throughput and lowers the melting temperature, providing energy cost savings. For ceramics, lithia's very low coefficient of thermal expansion makes it ideal for heat-proof ovenware and ceramic cook tops to withstand the thermal shock of rapid temperature changes.

In recent years, supply of lithium carbonate from the brines operations to the chemical market has not kept up with growing demand. There have been some production shortfalls due to problems with magnesium contamination. The gap is now being filled by Chinese lithium chemical producers using spodumene as their feed source.

1.2 Lithium Supply

Lithium production from brines is highly concentrated, with currently only four significant producers operating in Chile, Argentina, the USA and China. Sociedad Quimica y Minera ("SQM") contributed about half of total global lithium production of 110,000 tpa of lithium carbonate equivalent ("LCE").

Over the next few years, brines production is expected to increase significantly with the expansion of current operations and new projects including:

1. Chemetall increasing output from its (Sociedad Chilena de Litio) SCL facility in Chile by about 8,000 tpa LCE.
2. SQM is planning to expand production by an additional 10,000 tpa LCE by the second half of 2008.
3. China's Qinghai CITIC commenced LCE production near Golmud in 2007. Initial production is at the rate of 5,000 tpa, and it is expected that this will increase over time to 20,000 tpa.
4. Admiralty Resources is commencing pilot plant trials at its Rincon project in Argentina.

Lithium minerals production in 2006 was estimated at 150,000 t (about 30,000 t LCE) with about two thirds of the production coming from Perth-based Talison's (formerly Sons of Gwalia's) Greenbushes operation. After Greenbushes, the major producers of lithium minerals are Tanco in Canada, Bikita in Zimbabwe, and a number of small spodumene mines in China.

Minerals production in 2006 was significantly higher than in previous years, in reaction to increased demand from the glass/ceramics market and sales of spodumene to the Chinese chemical producers to meet the shortfall in supply in the lithium chemicals market.

Minerals production increased further in 2007 as demand in all markets continued to rise. Most spodumene producers are at or close to capacity, with only a modest increase in supply coming from Greenbushes to service both the glass/ceramics and chemicals markets and a small increase in production expected from China. Greenbushes is reportedly considering a further expansion of its lithium activities.

1.3 Demand

Talison estimated total demand for lithium brines and minerals in 2006 to be 105,000 - 110,000 t LCE. The market has seen unprecedented growth since 2004, mainly driven by the primary and secondary lithium battery market. There has also been significant demand growth in recent years in the glass/ceramics market, particularly from China.

Continuing strong growth is forecast over the short to medium term, mainly driven by demand from the lithium battery market. There is significant market upside if lithium derivative batteries are used in electric and hybrid electric vehicles. There was encouragement on this score at the start of 2008, when the General Motors CEO came out with the statement that the future of the motor car lay with electric engines.

The outlook for the non-chemical sector of the industry is also positive despite the short term slowing of the Chinese glass/ceramics market. Growth in other regions for lithium minerals continues to be positive, not only in current markets but in the continuing development of new applications.

1.4 Lithium Market Outlook

The last couple of years have seen a significant shortfall in supply of lithium minerals and brines to the market. This has been reflected in record prices for lithium products. The shortfall in 2006 is estimated to have been 5,000–10,000 tonnes LCE – equivalent to between 4.5% and 9.0% of the total lithium market.

Lithium Minerals and Brine: Estimated World Production by Country

	2001	2002	2003	2004	2005	2007 (est)
Argentina ($LiCO_3$)	5	906	2,850	4,970	5,000	16,000
Argentina (LiCl)	4,512	4,729	4,700	6,303	6,300	
Australia (spodumene)	79,859	79,085	124,410	118,451	120,000	120,000
Brazil (concentrates)	9,084	12,046	12,100	12,100	12,100	12,000
Canada (spodumene)	22,500	22,500	22,500	22,500	22,500	22,500
Chile (carbonate)	31,320	35,242	41,667	43,971	44,000	60,000
China (carbonate)	13,000	13,000	13,500	14,000	15,000	10,000
Portugal (lepidolite)	11,571	16,325	16,000	16,000	16,000	16,000
United States (carbonate, est)	12,000	12,000	12,000	12,000	12,000	12,000
Zimbabwe (petalite, lepidolite & others)	36,103	33,172	12,131	13,710	13,000	13,000
Total ($LiCO_3$ equivalent)	**70,907**	**76,189**	**87,090**	**93,285**	**94,413**	**110,106**

Sources: Various. Note that the numbers in the above table do not tally up, because the number on each line relates to differing forms of lithium.

The estimates and forecasts suggest that world lithium carbonate production grew at an average rate of about 7.7% annually between 2001 and 2007. We suspect that the rate of growth could accelerate to 10-15 % pa or more, as the use in car batteries accelerates.

1.5 Background to Lithium

Lithium was discovered as an element in 1817 by the Swedish chemist Johan Arfwedson. It was first separated in 1854 from lithium chloride by an electrolytic process. Lithium is a silvery-white metal that is slightly harder than sodium, but softer than lead. It is the lightest of all the metals, with a specific gravity of 0.534, about half that of water.

With World War II, the special properties of lithium compounds were investigated and exploited, including in alkaline batteries in submarines. Later, greases containing lithium stearate were found to lubricate at both very high and very low temperatures. For the first time, the same grease could be used for multiple purposes over a wide range of operating conditions. With rocketry came the search for materials that could withstand the extreme temperatures of high speed travel through the atmosphere. A ceramic composition containing lithium was developed that expanded very little and resisted cracking during rapid extreme temperature change. This lithium-containing material “pyroceram” was the forerunner of modern glass-ceramic cookware that resists thermal cracking. Perhaps the most recognised application is CorningWare.

In 1953, the Atomic Energy Commission (AEC) in the United States required large amounts of lithium hydroxide from which the lithium-6 isotope was separated and reserved for use in producing hydrogen bombs. After the AEC contracts expired in 1960, the lithium industry was left with vast overcapacity and developed commercial markets in ceramics, lubrication, aluminium reduction and pharmaceuticals. Pure lithium carbonate is used in the treatment of bipolar disorder, though it has a significant side effect profile.

Lithium was first produced from zinnwaldite in Germany. This was followed by the production of spodumene from the Black Hills of South Dakota, where log-sized spodumene crystals were mined. The WW II exploration for strategic minerals resulted in the discovery of the pegmatite fields of North Carolina, where two major lithium mineral and chemical production centres developed. During the 1950s, lepidolite from Southern Rhodesia (Zimbabwe) was imported for conversion to lithium hydroxide at a Texas plant for producing the hydrogen bomb. Spodumene concentrates were and continue to be produced from the Tanco tantalite mine in Manitoba, Canada. In 1980, spodumene was discovered at the Greenbushes tantalite mine in Western Australia, with production beginning from 1984.

In 1966, lithium chemical production shifted to the Silver Peak brine deposit in California. Lithium had been first identified in brines in California in 1936. In 1969, the Chilean geological survey identified unusually high concentrations of potassium and lithium at the periphery of the Salar de Atacama in northern Chile (salar = brine lakes). After confirming the high concentrations, Foote Mineral initiated a feasibility study in 1975. In 1986, the Sociedad Chilena de Litio (SCL) began producing lithium carbonate from the southern sector of the salar in 1986. Several companies attempted to develop the northern portion of the salar. Eventually, Sociedad Quimica y Minera (SQM) developed the deposit and produced a number of minerals including potassium chloride, potassium sulfate, lithium carbonate and boric acid. From being a non-producer before 1988, Chile has become the world's major supplier of lithium carbonate.

The lithium division of FMC Corporation explored the Salar del Hombre Muerto in the Altiplano of Argentina and now produces lithium chloride via a patented ionic exchange process. As a result of extensive exploration for brine deposits, prompted by lithium production development in Chile, several chemical-rich deposits were identified and explored in Argentina, Bolivia, the People's Republic of China and Tibet.

To aid its market entry, Greenbushes (which merged with Sons of Gwalia, and is now Talison Minerals after the bankruptcy of Sons of Gwalia) promoted expanded uses of spodumene in ceramics and glassware. In 1995, prompted by the high cost of transporting spodumene concentrate, Sons of Gwalia installed a 5,000 tpa plant to process part of its production to lithium carbonate, at a capital cost of $17 million. When Sons of Gwalia (SoG) was effectively frozen out of the process chain by the existing lithium carbonate producers, the lithium carbonate plant was mothballed. There have also been questions about the form or processing chosen by SoG, with suggestions that an inappropriate choice in this respect may have assisted in the operation's demise. Talison is now selling part of its spodumene production to lithium carbonate producers in China.

While some parties suggest that spodumene is not suitable as a feedstock in lithium carbonate production, this is not the case and hasn't been for many years. It was in fact the original source of lithium carbonate production, as far back as the 1940s. The question remains however, as to how amenable various sources of spodumene are to upgrading to high grade lithium carbonate. This us not always a straightforward process.

To process spodumene to lithium carbonate, spodumene concentrate is roasted at 1000 degrees C, and then subject to a sodium carbonate or sulphuric acid leach at 250 degrees C. After filtration, the remaining solution is treated with either sodium carbonate or sodium hydroxide to crystallise the lithium carbonate.

The Greenbushes operation supplies about 60% of the world demand for spodumene concentrates. The highest quality concentrate it produces has a grade of 7.5% Li_2O. In 2006, the Greenbushes operation produced 120,000 tonnes of spodumene concentrate, at grades ranging from 4.0% Li_2O) (glass grade) to 7.5% (ceramic grade) Li_2O.

Spodumene, a lithium aluminium silicate ($LiAlSi_2O_6$), is a monoclinic member of the pyroxene group. Theoretically it may contain up to 3.7% Li, but the actual lithium content ranges from 1.35% to 3.56% as a result of sodium and potassium substitution for lithium.

On the basis of spodumene containing 3.5% lithium, one tonne of spodumene translates to the following products:

Phase	% Lithium	Yield from 1 tonne of Spodumene
Spodumene	**3.50%**	
Lithium Oxide	**17.83%**	**209 kg**
Lithium Carbonate	**18.79%**	**198 kg**
Lithium Metal	**100%**	**35 kg**

One tonne of spodumene effectively translates to about 200 kg of lithium carbonate, ignoring process losses.

In glass, spodumene is used in the production of flaconage, container glass, tableware and fibreglass, lighting glass and glass ceramics. In ceramics, spodumene is used in the production of gres porcellanato tiles, sanitaryware, tableware, frits and glazes. In metallurgy, spodumene is used in the production of continuous casting powder, foundry coatings and cores.

In late 2007 the price of lithium metal imported into Japan was US$67,500 per tonne. The price of lithium carbonate at that time was near US$7,000 per tonne. The contract price for 99% lithium carbonate, based on contracts for 1 – 3 years, is currently estimated at US$6,750 per tonne. There are typically significant premiums paid for higher grade material.

1.6 Battery Technology

Lithium batteries were first proposed in the 1970s. The first commercial lithium battery was released by Sony in 1991. Lithium batteries have supplanted nickel–cadmium batteries and nickel–metal hydride batteries due to higher performance relative to weight. Early lithium batteries had a tendency to thermal runaway, and thus some laptop batteries have exploded. This tendency has had the result of limiting the size of lithium batteries. In 1996, lithium iron phosphate emerged as a promising cathode material due to its enhanced safety compared to other lithium-ion batteries.

Another important advance has been the development of lithium polymer batteries. In this design, the lithium-salt electrolyte is not held in an organic solvent as in the lithium-ion design, but in a solid polymer composite such as polyethylene oxide or polyacrylonitrile. Lithium-ion polymer batteries started appearing in consumer goods in 1996. Because of denser packaging without intercell spacing between cylindrical cells and the lack of metal casing, the energy density of lithium polymer batteries is over 20% higher than that of a classic lithium-ion battery and approximately three times better than nickel-cadmium and nickel metal hydride batteries.

Lithium batteries are the preferred technology for the development of electric and hybrid electric vehicles. Expansion of the electrical vehicle market will require a dramatic increase in the production of lithium.

The GM Volt extended-range electric vehicle is expected to be introduced to the market in 2010. This will use a large electric motor of 161 horsepower to provide all of the vehicle's motive power. The battery on full charge will provide a 60 kilometre range, after which a petrol-powered generator recharges the battery, giving a further range of 1,000 kilometres. For those first 60 kilometres, the electricity cost will be the equivalent of US$0.50 per US gallon of petrol. Significant demand can be expected for this and similar vehicles.

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