Grange Securities

19 May 2004

GME Resources Limited (GME.ASX)

Recommendation: .... SPEC. BUY

Share Price: .... A$0.12

Price target: .... A$0.74

Avg. mthly turnover: 4.3M

Price range low/high: .... A$0.01-A$0.17

Shares on issue: 180.6M

Options: 0.0M

Diluted MCap: .... A$21.7M

GME has acquired a 100% interest in NiWest Limited and full ownership of a large nickel-cobalt laterite resource in the Eastern Goldfields of Western Australia in close proximity to the Murrun Murrin JV plant.

The 123Mt resource contains a high grade component of 38.4Mt at 1.3% Ni and 0.08% Co for 0.5Mt Ni and 35,000t of Co metal insitu.

GME plan to commence infill drilling in July 2004 on the high grade resources to upgrade the inferred resource to a measured or probable reserve category.

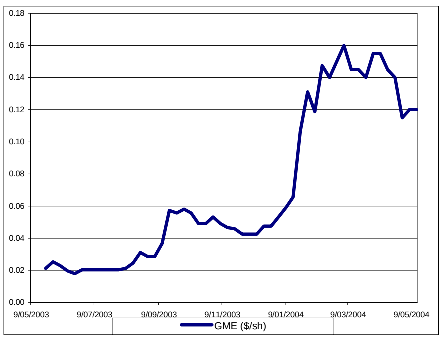
As a result of the Murrin Murrin JV's willingness to access high grades over 1.3% Ni, as seen by transitional material sourced from a recent deal with WMC Leinster nickel operations, we estimate that the component of the GME resource above 1.3% will equate to approximately A$134M in revenue to GME in the short term or A$0.74 per share.

The Murrin Murrin JV partners, Minara Resoures and Glencore Interntational would yield substantial long term benefits of a full acquisition of the GME laterite resources. We estimate a present value of A$573M for the high grade resource only if processed through the Murrin Murrin plant from 2009 onwards.

GME also holds gold and base metal exploration tenure in the Leonora and Laverton region of WA.

We recommend GME as a SPECULATIVE BUY based on the potential revenue derived from a 1.8% high grade feed as a realistic short term value to GME of A$134M or A$0.74 per share. Our value range expands to A$271M or A$1.50 per share for the value upside of a sale of the resource to the Murrin Murrin JV partners, Minara and Glencore.

Figure 1. Share price chart weekly



Sources: DFS IRESS.

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Table of contents

Background

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Partially dil. MCap:.... A$21.7M

GME Resources was floated in 1980 with a focus on mineral exploration. During 1996 the Company rejuvenated its portfolio through the acquisition of a number of new projects with a focus on the Leonora/Laverton region of Western Australia with both lateritic nickel and gold exploration targets.

In early 2000 the formation of NiWest Limited took place through the merger of the Company's lateritic nickel assets with those of Western Metals to provide a critical mass for a stand alone project development or a strategic alternative with the nearby Murrin Murrin nickel laterite plant which was in its early stages of production.

NiWest Limited emerged with over 120Mt of inferred and indicated laterite resources which included a high grade component of 38.4Mt at 1.28% Ni.

The appointment of receiver to the Western Metals group resulted in the sale of Western Metals holding in NiWest to GME for A$2.7M after exercising a pre-emptive right from the highest bidder, Minara Resources.

Board

Major shareholders:
Retirewise Capital 22.6%
Troika Securities 9.4 %
Peter Sullivan 6.2%
Retford Resources 5.6%
James Sullivan 5.1%
Geomett Pty Ltd 2.2%
Donald Sullivan 2.0%
ANZ Nominees 1.5%
Clodene 1.4%
M.R. & M.Sullivan 1.2%

Michael Perrott – Non-Executive Chairman: Mr Perrott has been involved in industries associated with construction, contracting, mining and land development since 1969. Mr Perrott is a non-executive director of Portman Limited.

Peter Sullivan – Managing Director: Mr Sullivan is an engineer and has been involved in the development of resource companies and projects for more than 15 years. Mr Sullivan has considerable experience in the management and strategic development of resource companies. He is currently the Managing Director of Resolute Mining.

Geoffrey Motteram – Non-Executive Director: Mr Motteram is a metallurgical engineer with over 25 years experience in the development of projects in the Australian resources industry. He has extensive experience in gold and base metals having been involved with WMC's Kwinana Nickel Refinery and Kalgoorlie Nickel Smelter. Mr Motteram was involved in the formation of Anaconda Nickel Limited in 1994 and controlled the technical development of the Murrin Murrin Joint Venture until the end of 1997. He is a former director of Anaconda Nickel (now Minara Resources).

Nickel-Cobalt tenure

Background

The incorporation of Western Metals and GME nickel laterite assets occurred in late 2000 with the formation of NiWest Limited. At the time of going into liquidation Western Metals were the manager of the NiWest tenements and held 62.4% with GME holding 37.6%.

The appointment of receiver to the Western Metals group resulted in the sale of Western Metals holding in NiWest. GME held pre-emptive rights to the portion of NiWest which they did not own and exercised its right on 31 March 2004 to pre-empt the highest bidder of the asset, Minara Resources (previously Anaconda Nickel). GME paid a matching amount of A$2.7M for Western Metals 62% equity from Minara's offer of A$4.4M for a 100% interest in NiWest.

The combined assets of the Company are:

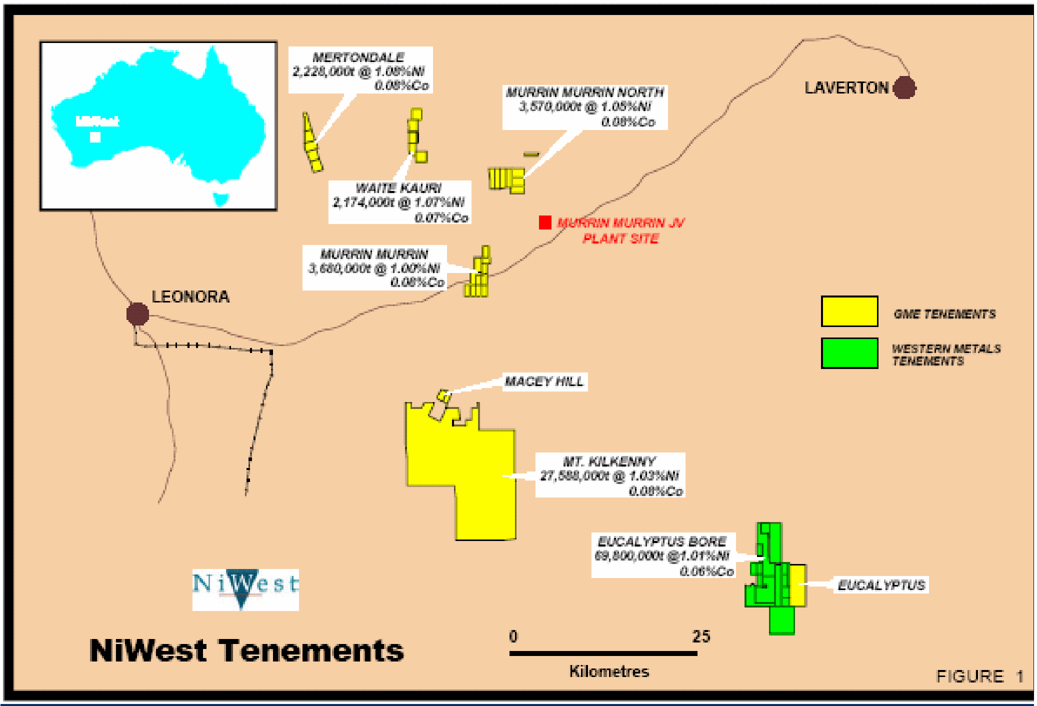
- Mt Kilkenny, Eucalyptus Bore, Waite Kauri, Mertondale, Murrin Murrin North, Murrin Murrin, Macey Hill.

Location

The majority of the NiWest resources are located within a 50km radius of the Murrin Murrin nickel-cobalt plant

The assets are located in the Eastern Goldfields region of Western Australia between Leonora and Laverton. The majority of the NiWest resources are located within a 50km radius of the Murrin Murrin nickel-cobalt plant which has a rated capacity of 3.75Mtpa. The NiWest tenement locations and project resources are shown in the figure below.

Figure 2. NiWest tenement location plan and project nickel-cobalt resources



Source: GME Resources Ltd

Nickel-Cobalt resources

The resource hosts 1.3Mt of nickel metal and 77,000t of Cobalt metal insitu.

The global resources for NiWest currently total 123.1Mt at 1.00% Ni and 0.06% Co at a 0.70% nickel cut off. The resource hosts 1.3Mt of nickel metal and 77,000t of Cobalt metal insitu. A total of 90% of the resource occurs within the Eucalyptus Bore and Mt Kilkenny tenements.

The resource inventory is summarised in the following table are at a 0.70% nickel cut-off.

A total of 90% of the resource occurs within the Eucalyptus Bore and Mt Kilkenny tenements.

Figure 3. NiWest nickel-cobalt resources by project areas at 0.70% Ni cut-off

Project	Category	Tonnes (m)	Grade Ni	Grade Co	Insitu Value at Spot (A$/t)	Insitu Value at 15 yr average (A$/t)
Mertondale	Inferred	3.0	0.98%	0.08%	200	149
Murrin Murrin North	Inferred	7.3	0.97%	0.08%	199	148
Murrin Murrin Hepi	Inferred	5.3	1.04%	0.08%	209	156
Mount Kilkenny	Inferred	29.8	1.00%	0.05%	182	138
Waite Kauri	Measured	1.3	1.05%	0.05%	190	144
Waite Kauri	Inferred	1.1	0.97%	0.06%	185	139
Macey Hill	Inferred	0.3	1.26%	0.12%	270	200
Duck Hill	Inferred	3.9	0.96%	0.12%	226	165
Eucalyptus Bore	Indicated	54.9	1.01%	0.06%	191	144
Eucalyptus Bore	Inferred	14.9	1.00%	0.06%	189	143
Laverton Downs	Inferred	1.2	0.92%	0.07%	185	138
Total Inferred		**66.9**	**0.99%**	**0.06%**	**188**	**142**
Total Indicated		**54.9**	**1.01%**	**0.06%**	**191**	**144**
Total Measured		**1.3**	**1.05%**	**0.05%**	**190**	**144**
Combined Total		**123.1**	**1.00%**	**0.06%**	**189**	**143**

Price assumptions at spot: Ni - US$5.00/lb, Co - US$24.00/lb, 1AUD:0.75USD

Price assumptions at 16 year average: Ni - US$3.67/lb, Co - US$14/lb, 1AUD:0.6964USD

Source: GME Resources, Grange

As a comparison the table below lists the resources at a 1.0% nickel cut-off which gives a combined total of 38.4Mt at 1.28% Ni and 0.09% Co for 0.5Mt of nickel metal and 35,000t of cobalt metal.

Figure 4. NiWest nickel-cobalt resourcs by project areas at 1.00% Ni cut-off

The GME resources represent approximately 90% of the total resources which lie outside of the Murrin Murrin JV held tenure.

Project	Category	Tonnes (Mt)	Grade Ni	Grade Co	Insitu value at spot (A$/t)	Insitu value at 15yr average (A$/t)
Mertondale	Inferred	1.2	1.24%	0.08%	275	180
Murrin Murrin North	Inferred	2.7	1.26%	0.11%	300	195
Murrin Murrin Hepi	Inferred	2.6	1.26%	0.10%	293	191
Mount Kilkeny	Inferred	12	1.28%	0.07%	275	180
Waite Kauri	Inferred	1.3	1.33%	0.14%	333	217
Macey Hill	Inferred	0.3	1.40%	0.15%	353	229
Duck Hill	Inferred	1.5	1.27%	0.30%	436	281
Eucalyptus Bore	Inferred	16.9	1.28%	0.09%	289	189
Combined Total		**38.4**	**1.28%**	**0.09%**	**289**	**189**

Price assumptions at spot: Ni - US$5.00/lb, Co - US$24.00/lb, 1AUD:0.75USD

Price assumptions at 16 year average: Ni - US$3.67/lb, Co - US$14/lb, 1AUD:0.6964USD

Source: GME Resources, Grange

The GME resources represent approximately 90% of the total resources which lie outside of the Murrin Murrin JV held tenure in a 70km radius of the Murrin Murrin plant.

Geology of NiWest projects

A review of the geology of nickel laterites, formation, classification and processing routes has been included in Appendix A.

Western Metals as managers of NiWest estimated that 50% of the reported nickel and cobalt resources occur within smectites (ferruginous and goethite), with siliceous limonite and saprolite material each comprising 25% of the remainder of the resources.

Standard wet screen beneficiation tests have yielded 38% increases in nickel grades from a high silica low nickel siliceous goethite ore fraction.

Eucalyptus bore

The Eucalyptus bore project is located 45km south east of the Murrin Murrin plant. The project has the highest proportion of high grade resources.

The Eucalyptus bore project is located 45km south east of the Murrin Murrin mine site. The project contains the highest proportion of high grade resources (16.9Mt at 1.28% Ni & 0.09% Co) which is mainly at an indicated and inferred category with the majority of resource drill holes spaced at 200m by 100m.

Mt Kilkenny

The Mt Kilkenny project is located 30km south of the Murrin Murrin mine site. The project contains the second largest high grade resource (12Mt at 1.28% ni & 0.07% Co) which is at an inferred category with the resource drill holes spaced at 400m by 100m.

Waite Kauri

The Waite Kauri project is located 20km north west of the Murrin Murrin mine site.

The high grade portion of the prospect is located on a hill and contains siliceous limonite and saprolite material which is upgradeable to a run of mine feed of 1.8% nickel from 1.3% nickel ore. Waite Kauri contains a measured resource drilled to a 50m by 50m pattern.

Future exploration focus

GME plan to upgrade all high grade resources into a measured resource or probable reserve category. Drilling is planned to commence in July 2004 subject to drill rig availability and continue on a campaign basis. A total of 4200m and 2100m is planned for infill RC drilling at Eucalyptus Bore and Mt Kilkenny with a further 2000m of infill drilling designated for other higher grade ore zones outside these areas.

Metallurgical test work will also be undertaken to help define economic project parameters with bulk sampling to be conducted at Mt Kilkenny, Eucalyptus and Waite Kauri.

Ni-Co development options

Options for the development of the NiWest nickel-cobalt ores are as either a stand alone operation or providing ore to the Murrin Murrin plant.

Stand alone operation

A scoping study, metallurgical test work program and hydrological studies were completed on the NiWest nickel-cobalt resources which confirmed the viability of a stand alone operation.

The scoping study was completed by Kvaerner E&C Australia in June 2000 and indicated that although a stand alone plant would be viable, an expanded resource base enabling the mining of higher grade feed would significantly improve the project economics.

The metallurgical testing programme showed nickel and cobalt recoveries in excess of 96% nickel and 94% cobalt.

The metallurgical test work was carried out on a number of composite samples based on the entire resource base, using saline process water sourced from site. The metallurgical testing programme showed nickel and cobalt recoveries in excess of 96% nickel and 94% cobalt in 60 minutes.

The plant options investigated included a high pressure acid leach (HPAL) 20,000t, 30,000t and 40,000tpa scenarios to produce LME grade metal on site. Alternatively production of an intermediate product was investigated for further refinement in another location or Company facility. This approach is favoured to introduce partners seeking a concentrated nickel-cobalt product for refineries with excess capacity but limited feed stocks. Potential partners include major nickel producers, Chinese and Russians refineries and the Murrin Murrin project.

Strategically located resources to Murrin Murrin operations

The nearby Murrin Murrin operation is aiming to be at a design capacity of 40,000t-45,000tpa by 30 June 2004. The recently restructured reserves for the Murrin Murrin operation, as a result of the exclusion of those reserves west of Lake Carey that have a high chloride content, has resulted in an overall decrease in the reserve tonnes from 296Mt at 0.99%Ni in 30 June 2002 to 145Mt at 1.07%Ni in 30 June 2003. The current mine plan for Murrin Murrin is for 1.30% Ni and 0.085% Co feed for five years (as of 30 June 2003) and a trailing head grade to 1.15% Ni from 1.3% incrementally over the following 10 years.

The Murrin Murrin plant is currently operating below its design capacity of 3.75Mtpa with a debottlenecking programme and capital upgrade programme to deliver annualised throughput of 4Mtpa to achieve a 40,000t to 45,000tpa nickel production.

Minara Resources has also announced that a feasibility into a 5th autoclave which would add an additional 10,000tpa of production is being investigated with a conclusion anticipated in December 2004.

Over the long term any additional high grade ore source (greater than or equal to 1.30% Ni) acquired by the Murrin Murrin Joint Venture (Minara 60%, Glencore International 40%) will have positive implications for the life of mine financial model.

Other exploration

The Linden project is located 5km south of the Red October mine and hosts a resource of 55,000oz at an average grade of 7.15g/t Au.

In the Leonora-Laverton region of Western Australia GME also has gold exploration tenure. The Linden tenements cover a total area of 479ha near the southern margin of Lake Carey where GME has calculated a resource of 240,000t at 7.15g/t Au. The Linden resource is located 5km to the south of the Red October mine.

Also in the Leonora area GME has the Abednego West Joint Venture with Placer which covers a 32 square kilometre area 40km east of Leonora. Placer have completed their expenditure requirements and now hold an 80% interest with the Sonex Prospect producing the most encouraging results with one hole reporting 8m at 3.3g/t and 5m at 15.1g/t gold.

Amongst other tenure GME also has the Murrin Murrin group of tenements where the Murrin Murrin JV has the nickel-cobalt rights and GME retains the right to any precious metals or other base metals discovered on the tenements, including nickel sulphides. Minara pays GME a fee of A$100,000pa. In addition it will pay A$0.20 per tonne on all nickel laterite ore that is mined and treated. Minara has outlined 21.4Mt at 1.05% Ni and 0.07% Co at a 0.8% Ni cut off grade.

Regional projects which the Company holds are interests at Ilgarari for copper in the Bangemall Basin north of Meekatharra where an inferred resource of 255,000t at 3.3% copper has been defined.

Valuation

Methodology

The methodology we have used in valuing the GME high grade nickel-cobalt resource is based on:

1. a plant head grade differential; by replacing our estimate of Murrin Murrin JV production from 2009 onwards at the current cessation of that projects anticipated high grade ore with the GME high grade ore (30.7Mt at 1.28% Ni and 0.09%Co using a 80% resource to reserve conversion). This method values the head grade differential.
2. the full value for the high grade ore if it was processed through the Murrin Murrin JV plant at a production rate of 4Mtpa and cash costs of US$2.40/lb.

Assumptions

Metal prices used are 16 year average prices for nickel of US$3.67/lb and cobalt of US$14.0/lb. The 16 year average exchange rate is 1AUD:0.6964USD.

We have assumed in our Murrin Murrin JV project value an 85% metal recovery and ongoing cash costs at the top end of the recently released target range of US$2.40/lb.

We have not included an expansion of the Murrin Murrin JV plant to a nominal 5Mtpa throughput and 50,000-55,000tpa of nickel metal production or the subsequent effects of increased production to Murrin Murrin’s current stated higher grade 5 year reserve outlook.

Our values are free of capital requirements as they assume processing through an existing plant.

Grange valuation and comment

Our analysis is reliant on the inclusion or sale of the GME resources to the Murrin Murrin JV plant. The close proximity of the GME resources to the plant provide obvious synergies to the ore being processed through the plant in terms of value to the Murrin Murrin JV partners. Processing of similar ores through the Murrin Murrin plant utilises the metallurgical knowledge gained over the past 5 years.

We see our valuation range based on valuation method 1 as being the base case value for a sale of GME’s High grade ore to the Murrin Murrin JV, and method 2 as being the full value to the Murrin Murrin JV of these high grade resources and therefore the value upside an acquisition or sale of the GME assets would provide to Minara and Glencore shareholders.

Our preferred present value as our base case is A$153M increasing to A$312M in June 2009 when we assume processing of the ore would commence. Our full preferred present value is A$573M increasing to A$1206M in June 2009. The equity share of these values to Minara shareholders is A$0.74 and A$1.57 per share respectively representing a compelling upside for its shareholders.

Figure 5. Valuation matrix of the GME high grade resource utilising the Murrin plant

	Jun-04 (A$m)	Jun-07 (A$m)	Jun-09 (A$m)
Method 1 - head grade difference	153	239	312
Method 2 - processed value	573	763	1206

Assumptions: 16 year average prices - Ni US$3.67/lb, Co - US$14.0/lb and 1AUD:0.6964USD
First ore processed in 2009

Source: Grange estimates

Early processing of ores with greater than 1.3% average grade

High grade feed greater than 1.3%Ni would be highly valued by the Murrin Murrin JV as shown by the recent agreement to process 0.6mt of oxide sulphide nickel ores from WMC which average 2.5-3.0% nickel.

The high grade laterite portion of the GME ore we assume to be 4.0Mt at 1.8%Ni (excluding cobalt) which includes 1.3Mt at 1.8%Ni from upgrading of the Waite Kauri ore. Early sale of this material assuming a revenue return to GME of 50% of the grade difference of the ore which it is displacing from the Murrin Murrin reserves (at spot prices – US$5.00/lb and 85% recovery) totals A$134M or A$0.74 per GME share.

GME are to commence drill testing of the high grade ore in early July to prove resources to reserves. In the short term we anticipate resource upgrades will provide at least short term revenue opportunities for GME.

We recommend GME as a SPECULATIVE BUY based on the revenue derived from a 1.8% high grade feed as the **realisable short term value to GME of A$134M or A$0.74 per share. Our value range expands to A$271M or A$1.50 per share** for the value upside of a sale of the resource to the Murrin Murrin JV partners, Minara and Glencore.

World nickel laterite production

Nickel laterites account for approximately 45% of world production.

Nickel laterites play an important part in the global nickel industry and currently account for around 45% of the total nickel production of about 1.25 million tonnes. About 70% of all nickel resources are contained in laterites. Production of nickel from lateritic sources as a proportion of total (sulphide plus laterite) nickel production has remained fairly constant over the last ten years, but is expected to grow with time as easily-won sulphide resources are depleted. The main barriers to more rapid growth in lateritic nickel production are the high capital cost of processing facilities, high energy requirements in the pyrometallurgical process routes, and the technical challenges of making hydrometallurgical processing more efficient.

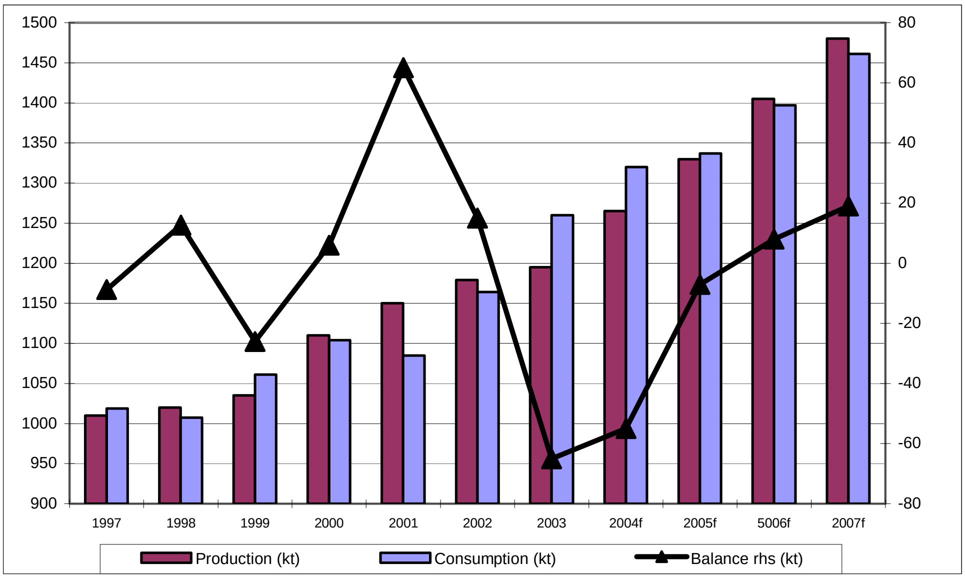
Supply and demand

The fundamentals for the nickel market are very favourable until at least 2006.

China has been the driver of nickel demand with a market share of world consumption of approximately 20%, up from 10% in 1998. As a result of supply constraints and the lack of nickel projects in the pipeline the fundamentals for the nickel market are favourable until at least 2006.

Projects such as Voisey's Bay on the east coast of Canada have been delayed since Inco's initial estimate of first production in 1999 at a rate of 122,000tpa. Current start up is now forecast for 2006 at a rate of 50,000tpa. Inco are also developing a proprietary pressure acid leach plant in New Caledonia to process nickel laterite ore from the Goro project at a rate of 55,000tpa. The Goro project has been suspended whilst a comprehensive capital cost control estimate is completed after the capital costs were estimated to rise by 30-40% above the initial US$1.45bn development cost.

Figure 6. Nickel world production, consumption and balance



Source: LME, ABARE

Nickel consumption forecasts by ABARE foresee an increase of 240,000t from 2003 to 2007 in the above chart. New projects to start up in that period includes the Goro and Voisey Bay projects and Ravensthorpe at the end of 2007. On average an additional 60,000tpa is required of nickel metal to reach estimated demand levels.

The nickel supply deficit is forecast at approximately 50,000t in 2004 and 30,000t in 2005 before levelling out in 2006.

During 2003 Chinese steel demand grew at over 30% and accounted for over 20% of the world steel consumption. Ongoing Chinese demand and an increase in the US, Europe and other Asian economies from improved economic growth will support an ongoing nickel supply deficit that is forecast at approximately 30-50,000t in 2004 and 15-30,000t in 2005 before levelling out in 2006.

Appendix A

Summary of nickel laterites [1]

Geology and formation of nickel laterite ores

Laterites are the residual products of chemical weathering of rocks at the surface of the earth. In the presence of water various original or primary minerals are unstable and dissolve or break down to form new minerals which are more stable to the environment. Well-known examples of important lateritic ore deposits are aluminous bauxite and enriched iron ore deposits, but lesser known examples include lateritic gold deposits (e.g. Boddington in Western Australia).

Nickel laterites are the product of lateritisation of Mg-rich or ultramafic rocks which have primary Ni contents of 0.2-0.4%. Such rocks are generally dunites, harzburgites and peridotites and to a lesser extent komatiites and layered mafic-ultramafic intrusive rocks. Lateritisation processes result in the concentration by factors of 3 to 30 times the nickel and cobalt contents of the parent rock. The processes, and the character of the resulting laterite, are controlled on regional and local scales by the dynamic interplay of factors such as climate, topography, tectonics, primary rock type and structure.

Classification of nickel laterite ores

Nickel laterites can be broadly classified into three types which signify the level of the protolith which forms the enrichment horizon. These ore types are;

Oxide

Oxide nickel laterites are the most common final products of lateritisation of ultramafic rocks. During weathering a familiar chemical trend in laterites sees magnesium decreasing upwards and iron increasing upwards through the lateritic profile due to the breakdown of olivine and/or serpentine the most unstable mineral and also most abundant mineral in ultramafics.

Nickel and cobalt behave differently to the major elements. Nearly all of the original Ni and Co in the ultramafic bedrock occurs in solid solution in olivine and olivine-derived serpentine. As these minerals break down, the released Ni and Co ions have a chemical affinity for Fe hydroxides (goethite) and are incorporated and concentrated into their structure. Contents of 1.5% Ni and 0.1% Co are seen in massive goethite developed from olivine containing 0.3% Ni and 0.02% Co. Goethite will progressively transform into hematite where nickel is unable to be accommodated in its lattice, therefore a loss of nickel occurs.

Ni and Co are also incorporated strongly into Mn oxides (asbolanes) where these are precipitated by redox reactions as veins and surface coatings on minerals and in fractures. Mn oxide minerals containing up to 12% Ni and 8.5% Co are known.

Important examples of oxide deposits as described above are Moa Bay and Pinares in Cuba, Goro and Prony in southern New Caledonia.

[1] Sources from: Giant Ore Deposits, CODES special publication

A particular variety of oxide deposit that is formed over dunite bedrock is composed of goethite and minor clay with abundant free chalcedonic silica in forms ranging from fine-grained particles to coarse veins and discontinuous lenses and masses. Examples of this silica-oxide laterite can be found in association with clay laterites developed over peridotites. Cawse and Ravensthorpe in Western Australia are examples of silica-oxide laterites.

Clay

In less severe conditions of weathering, e.g., cooler or drier climates, silica is not leached as it is in humid tropical environments, and instead combines with Fe to form a zone where the smectite clay nontronite predominates, in place of Fe oxides. Nontronite plays a similar role to goethite in fixing nickel within its lattice. Nontronite clays typically contain 1.0-1.5% Ni in mineralised laterite.

Clay-dominated nickel laterite profiles are extensively developed in Australia; e.g., Murrin Murrin, Bulong and Marlborough and also in Brazil.

Silicate

In situations where with minimal bedrock movement (faulting and uplift) and the water table is kept low in the profile, weathering over long periods can result in the development of a thick saprolite zone. Silicate laterites are characterised by an absolute enrichment or concentration of Ni in the saprolite zone which comprises altered primary minerals such as secondary serpentine, goethite and smectite clays. Much of the nickel is derived from that released by goethite forming hematite higher up in the profile. Nickel is reprecipitated within the saprolite. Average content of Ni in silicate laterites is typically 2.0-3.0%. Examples of silicate profiles are the economically important laterites of New Caledonia. Silicate laterites are also the ore source of most of the nickel currently produced from laterites.

Processing routes for nickel laterites

The three main types of processing routes for nickel laterites are designed for a specific laterite ore type. These are:

Smelting

The Pyrometallurgical smelting route is the oldest and most widely used process. The process route treats the more nickel-rich silicate fraction of the profile and produces ferro-nickel (a reduced Fe-Ni alloy which can be directly used for stainless steel production) and sulphide matte (which can join a conventional sulphide treatment route) in an electric furnace. The technology is relatively simple, well-tried and reliable, and has the advantage that the composition of the ore makes it essentially self-fluxing. The process has high Ni recoveries (90%), but there is no Co recovered when ferro-nickel is produced. The process economics are most heavily dependent on the cost of power and the successful projects (e.g. Sorowako) have their own hydroelectric power plants.

Caron

The Caron process is applicable to oxide laterites (“limonite”) with tolerance for some silicate laterite, but excessive silica and Mg leads to decreased Ni recoveries. The process involves drying and roasting in a reducing atmosphere, followed by low-pressure ammonia leaching. Ni and Co are recovered by solvent extraction, and further refined to product stage by calcination and reduction. Recoveries of Ni are around 80% and of Co only about 40-50%. Ore drying and reduction roasting consume considerable energy, and process economics are heavily dependent on fuel prices. Caron plants were developed before the oil crises of the 1970s, and struggled to remain viable after fuel prices rose. None have been built since then, nor is there likely to be more built in the future.

High pressure acid leach (HPAL)

The HPAL process was first used commercially in 1959 at Moa Bay (Cuba), which remained the only operating HPAL plant until the three Western Australian plants (Bulong, Cawse and Murrin Murrin) were developed in the late 1990s. The HPAL process involves leaching ore with sulphuric acid in an autoclave at about 250°C and extracting Ni and Co from the leach liquor by various methods such as sulphide precipitation using H2S, or solvent extraction and electrowinning. HPAL is used to treat predominantly the oxide fraction of the laterite and has high recoveries of both Ni and Co (over 92% in the leach stage). The process economics are largely dependent on the cost of sulphur and the conversion of the sulphur to sulphuric acid (sulphur-burning acid plants can generate much of the energy requirements for a HPAL plant). As the consumption of sulphuric acid is determined mainly by the Mg level in the ore, the latter becomes a critical factor in managing mining and blending.

The HPAL process can also be applied with high recoveries to clay laterites, but the presence of silica in the ore from both nontronite and serpentine can create slurry handling problems in the autoclave and subsequent steps; these require increased operating costs to overcome, and result in reduced efficiencies such as through-put rates in various parts of the plant. Pure oxide ores with low silica such as at Moa Bay are most efficient in the HPAL circuit.

Upgrading of ore

Beneficiation

Certain types of lateritic ores can be beneficiated before being fed to the process plant. Beneficiation is the process whereby a low-grade component of the mineralisation is separated from the rest and rejected, leaving a component with a higher grade to be treated. This is analogous to making a concentrate from a sulphide ore, but the concentration factor is much smaller for laterite ores. In the beneficiation process, some of the nickel is lost to the reject component but this is outweighed by the improved economics which result from the higher feed grade.

The practice has been applied for many years to silicate ores, where coarser boulders and fragments of hard, less-altered rock have much lower Ni content than the matrix of softer altered material in which they occur. Projects where optimisation of this type of beneficiation is integral to their economic viability include Sorowako (Indonesia) and Kopeto (New Caledonia), although the practice of screening out coarser lumps and boulders is carried out at all laterite mines. At Kopeto, a grade increase of 25% is achieved between run-of-mine ore and product finally shipped to the smelter.

Beneficiation with more effective results is possible with silica-oxide laterite. The silica component is essentially devoid of nickel and easily separated from the associated goethite by simple screening after crushing.

Clay ores are not amenable to upgrading, as Ni is uniformly distributed and there is no discrete low-nickel fraction which can be separated, except minor secondary silica in places.

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Explanatory Notes

S&P / ASX 300 Resources Statistics Bar Graph – represents the weekly movements of the 55 stocks that make up the S&P / ASX 300 Resources Index. S&P / ASX 200 Resources versus S&P / ASX 200 Weekly (Common Base) – is a relative performance chart starting at a common base of 0% and measuring performance on a weekly basis over a year. If the chart is above the 0% starting point then the S&P / ASX 200 Resources has outperformed the S&P / ASX 200 or vica versa. Commodities Advance Decline Index Weekly – monitors the direction of 10 commodities. Each week Grange Quant takes the difference between the commodities that advanced and the commodities that declined and divide the differential by the sample size of 10. If the majority of our sample is up for a week then the Index would record a positive move. If the majority of our sample is down for the week then the index would record a negative move.

Rating Classification

Buy	Expected stock return is greater than 10%
Hold	Expected stock return is between -10% to 10%
Sell	Expected stock return is in excess of -10%
Outperform	Expected stock return is in excess of the sector return
Marketperform	Expected stock return is in line with the sector return
Underperform	Expected stock return is in line with the sector return
Short Term	0 to 3 months
Medium Term	3 to 12 months
Long Term	12 months to 5 years
Speculative	High risk and/or low predictability of earnings with the stock expected to move up or down by 50% or more a year

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