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# Hallgarten & Company

**Sector Review**

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## Lithium Sector Review: LatAm wins with its *salares*

# The Lithium Mining Scene

## Brine beats rock mining any day

- + The lithium mining sector is one where a clear dichotomy exists between brine extraction and hard rock mining. The former (with a strong bias to South America in sourcing) has a massive lead over hard rock mining due to a dramatic cost differential (hard rock being 100% more expensive in general terms).
- + The simplicity of the brine process means that the road to production for these facilities is relatively inexpensive and with little lead time. It also has almost no environmental impact (evaporation being the main component in the processing).
- + The lithium resources in the lakes of the *altiplano* are substantial, that of Rincon alone is enough to supply the planned production for 400 years, while the potash resource as currently delineated is around three times the annual production of the industry giant, Potash of Saskatchewan. The situation is similar for the other potential producers in the region.
- + The lithium demand picture appears robust and resilient in the face of global slowdown due to its relation with the cellphone, computer battery and hybrid auto subsectors. All face a slowdown in the short term but this should be transitory. The hybrid auto industry may become enormous in the next few years more than making up for maturity in the other two principal applications for lithium ion batteries.
- + There is a cartel in the potash market that is holding firm on prices. Peripheral producers cannot challenge the current price discipline (at least for a few more years).
- ✘ The pace of growth in lithium demand is clearly linked to economic activity. The current slump in global economies could crimp demand for the most important usage of lithium (in terms of quantity used per unit) in the hybrid auto industry. These were luxury items that did well in the boom times, which corresponded with high oil prices. For the near term we would see hybrids suffering with the rest of the auto industry, if not more so.
- ✘ Potash demand has weakened with the economy, but seems more to have been hit by lower grain commodity prices since that bubble (again partly driven by oil driving up corn because of its ethanol applications. We see ag commodities being one of the first areas to rebound in demand terms due to excellent fundamentals that override slower economic conditions.

### More than gold in them thar hills..

The El Dorado (Spanish for "the gilded one") legend began with the story of a South American tribal chief who covered himself with gold dust and would dive into a lake of pure mountain water. No one these days would be much inspired to leap into the murky depths of the lithium lakes in the Andean Altiplano that stretches from Argentina through Chile to Bolivia. It might however be more worth their while to explore those depths than the countless time and energy that the Spaniards expended on finding the gold dust that washed off the aforementioned chief in his ablutions.

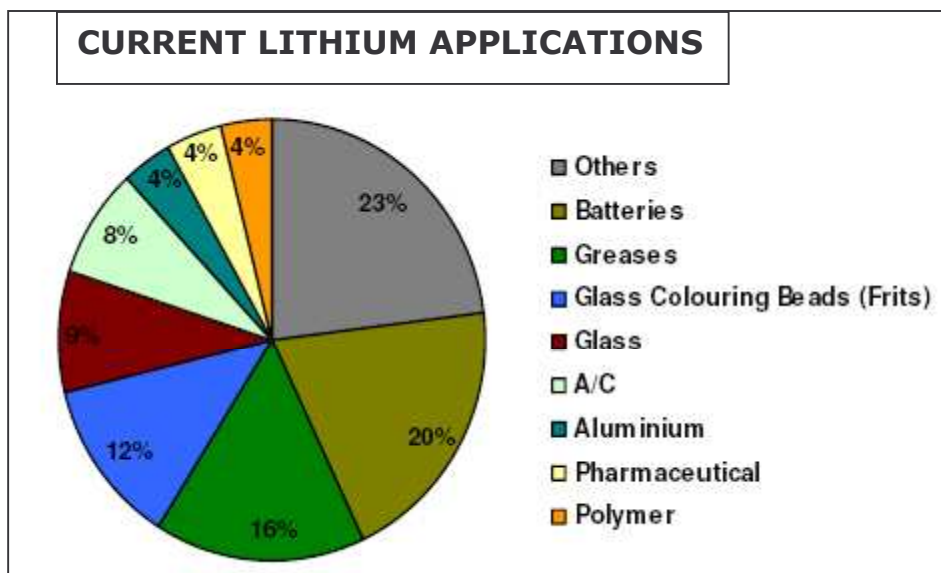
The Andean region of northern Argentina and Chile and southern Bolivia is a rich hunting ground for lithium. Never a product to inspire much enthusiasm due to its linkage in the popular imagination to psychiatric drugs, its real attraction is in applications related to battery applications (cellphone, laptop, automotive) amongst other high tech uses.

Also interesting in the LatAm lithium lakes is the associated potash deposits. In a world of high energy costs (coinciding with escalating agricultural commodity demand) potash has assumed magical properties. It is not dependent upon natural gas consumption (as urea production is) and has an expanding demand linked to farmers switching over to alternatives to the rapidly inflating price of traditional agrochemical fertilizers. In this aspect even humble guano is getting a second wind as an alternative. The latter is not available in amounts even vaguely sufficient to satisfy demand but potash resources do exist in quantities to make a meaningful difference in the supply balance in world markets. Until now this trade has been dominated by Saskatchewan producers, however Argentina is now surfacing as a major potential source of new supply.

### The Lithium Market

Lithium compounds have long been used for various applications, but the metal has moved to a new level of interest in recent times with the dynamics of firstly the cellular phone industry with its demand for lightweight batteries and more recently the massive upsurge in hybrid automobile demand and production. A long term negative for the electric powered auto niche had been the weight of batteries involved.

Demand for lithium (according to the consultants Roskill) has shown strong growth in the mid-2000s, with world consumption estimated to have increased by 4-5% p.a. since 2002 to reach a record level close to 80,000 tonnes of lithium carbonate equivalent (LCE) in 2005. The new applications for lithium have produced a surge in specialist demand with the usage of lithium in secondary batteries rising at a compound annual growth rate of 25% between 2000 and 2005. In 2005, batteries accounted for 20% of total lithium consumption, more than double the 9% share held in 2000.



Growth in the use of lithium secondary batteries has been driven by the rapid expansion in the portable consumer electronics sector. By 2005, nearly all mobile phones and over 90% of laptop computers incorporated lithium-based secondary batteries due to their higher energy density and lighter weight than nickel-cadmium and nickel-metal hydride products. Global Strategic Analysts predict that the market for lithium ion (Li-ion) batteries is likely grow at a compounded annual growth rate of over 32% to 2010.

We would note that the real surge in hybrid demand didn't really begin until 2005. The automobile manufacturers that are now using Lithium-ion batteries include Ford with its the Escape 4WD and the Mercury Mariner while General Motors has the Sierra and Saturn and Honda has the Accord. Citroen

announced at the 2007 Frankfurt Motor Show that all Citroen cars would be hybrid diesel-electric powered by 2012.

Lithium-ion batteries remain the only currently viable solution with the cost of hydrogen infrastructure currently prohibitive for hydrogen fuel or hydrogen fuel cell technology. This will inevitably change but already the spread of hybrid vehicles is being hampered by rampant and high purchase costs (which make the hybrids thus far as upper-middle class conscience toy).

The response of the battery manufacturers (which is largely driven by the Japanese at the technology front) has been to get new battery technologies near market ready to “cut hydrogen off at the pass”. A critical mass of usage make sit difficult for alternative technologies to gain a foothold, particularly when it would need a massive new “filling station” infrastructure to implement the hydrogen alternative. Amongst the new lithium products evolving is a Lithium Polymer (that allows the battery to be molded like putty, particularly into very thin shapes) and Lithium Ceramic anodes, which would provide higher energy density/greater number of recharges.

One interesting feature of the supply side of the market is its opaqueness. Some refer to it as an oligopoly. As the chart below (sourced from Rincon Lithium) shows there are some quite dramatic variances in output statistics by industry experts and insiders. Misinformation seems to be standard practice.

	Admiralty Estimate	Japanese Corporate Estimate	Industrial Minerals Estimate	Roskill Report 2006	SQM 2006 Estimate Annual Report
Hombre Muerto FMC	12-15,000	16,000	17,500	12,168	
Attacama / Silver Peak, Chemetall	10-15,000	23,000	30,000		
Attacama SQM <sup>3</sup>	25-28,000	28,000	27,800	44,140	
Rincón Admiralty <sup>2</sup>	17,000	17,000	17,000		
Other	10,000 CITIC <sup>1</sup> China			14,600	
Total FMC+SQM+ Chemetall (Andes Brines)	57-68,000	67,000	75,300	70,908	83,800 <sup>4</sup>
Admiralty production as a percentage of total Brines	29.8%- 25%	25.4%	22.6%	23.9%	20.3%

Demand from the battery market and higher production costs spurred a recovery in lithium carbonate prices from 2003, with a quickening in the pace through 2006. Tight supply was reflected in a 20% rise in Chilean lithium carbonate prices in 2005. SQM saw a 40% rise in prices between the first quarter of 2005, and the same period of 2006.

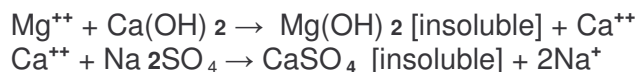
Pricing for 99% (or lower) lithium carbonate has been around US\$6,000 per tonne in recent times but escalates rapidly upon further refinement. The previously mentioned **Four 9** (99.99%) grade achieves over US\$13,000 per tonne. Lithium hydroxide fetches US\$10,500 per tonne while lithium chloride is priced around US\$8,500.

The current market purchase price of lithium carbonate has exceeded US\$6,600 per tonne making for attractive margins. However, due to the relatively small number of deposits exploitable in size, there has

been limited scope for new parties to step into this situation and take advantage of the higher prices. However many of the *salares*-based lithium projects being contemplated in the Argentine *altiplano* have the potential to become meaningful contributors to global lithium supplies. Balancing this lithium production increase are markets that are anticipated to grow solidly owing in part to the expanded uptake for lithium batteries utilized in "greenhouse gas friendly" hybrid motor vehicles and other major applications in the glass and ceramics industries.

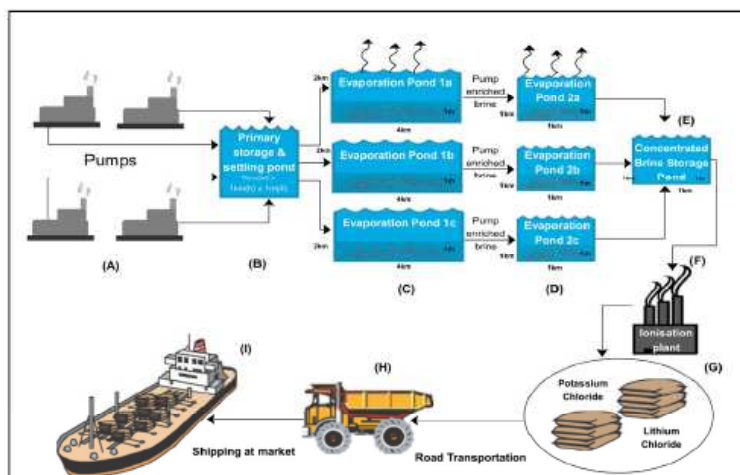
### The processing of output from *salares*

All mining is a chemical process to some degree. The production of lithium and its by-products are more chemical than most mining processes. Firstly the brines are evaporated in lined evaporating ponds. The evaporation rate at high level *salares* can be around 3,000mm per annum (this depends most upon the number of cloudless days per annum at any given site). Then the output from the salar requires the selective precipitation of calcium and magnesium cations (positively charged ions) that interfere in the recovery of lithium of sufficient quality. These cations are precipitated in a two step pre-treatment process:



These pre-treatments require the input of lime. This is a key ingredient and the supply of this input is one of the most onerous conditions of the process. To produce 15,000 tpa of LiCl will require approximately 84,000 tpa of sodium sulphate.

### The Lithium Extraction Process



- b. Salt removed
- c. Magnesium removed
- d. Sodium sulphate removed
- e. Potash removed
- f. Lithium Chloride produced, then LiCO<sub>3</sub>, LiOH

The brine passes through a series of evaporation ponds (phases B, C & D above). These are all of one metre in depth. Then the potash is extracted at the concentrated brine phase (E). Finally the ionization plant (at phase F) creates the finished chemicals for bagging and then export.

In some brine lakes magnesium (at phase C) can be produced as a by-product. However in some cases this byproduct is of no economic value.

### Lithium – Andean nations seize the competitive advantage

The mid-Andean region is a hot spot for lithium/potassium brine lakes, called *salares* by the locals. The lithium industry at the global level was dominated by the US until the 1980s with hard rock mining from

spodumene, mainly in North Carolina. This industry was made extinct over a short period by the better economics offered by the Chilean and then the Argentine brine lake deposits. The map below shows the intense concentration of activity in the Andean region.

The Puna plateau, covers a portion of Argentina, Chile and Bolivia. It is at an elevation of around 4,000m and contains the largest concentration of economic evaporate deposits in the world. The evaporate deposits are formed by intense evaporation under hot dry air in a closed basin. The brine, under the crust formed on the surface of the salt lakes, contains high concentrations of sodium, lithium, potassium, magnesium and boron (the major element of borax).



The biggest players are the sometime investor darling Soquimich (which trades as an ADR under the symbol SQM) and the German company, Chemetall, which used to be paired with the ill-fated Metallgesellschaft. Meanwhile in Argentine, the US agrochemical major FMC controls the only major mine (thus far) in the country while Rincon is looking to move into commercial production shortly (it currently has a test production facility).

Company	Holding company	Location	Current production
Comibol	Bolivian government, Bolivia	Salar de Uyuni	Pilot plant construction begins May 2008
Minera del Altiplano SA	FMC Lithium, USA	Salar de Hombre Muerto	17,500 tpa lithium carbonate
Rincon Lithium Ltd	Admiralty Resources, Australia	Salar de Rincon	8 tpm lithium carbonate, 10 tpm potash (pilot)
Sdad Chilena de Litio	Chemetall, Germany	Salar de Atacama	30,000 tpa lithium carbonate
SQM SA	SQM SA, Chile	Salar de Atacama	42,000 tpa lithium carbonate

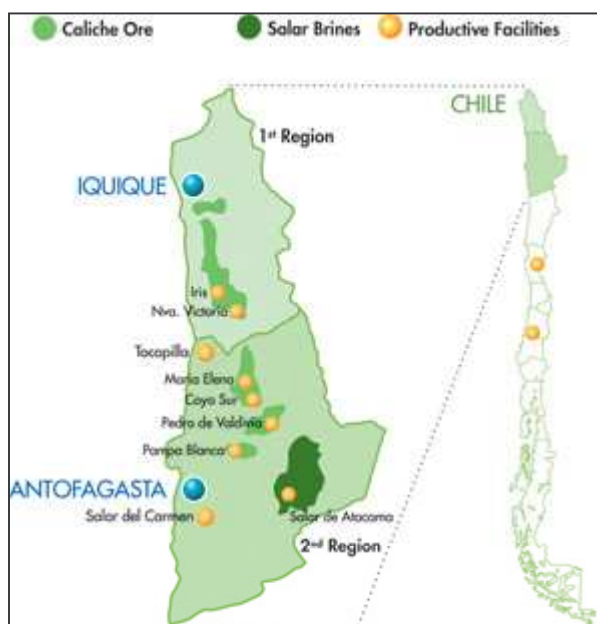
Over the border in Bolivia, Comibol, the State mining franchise is trying to move into the lithium space. Recent negative publicity has surrounded the Bolivian moves. Like all we hear from the media on that subject we take it with more than a grain of salt.

### The Brine Giant - Soquimich (SQM)

This company (officially Sociedad Quimica y Minera de Chile S.A.) has been around as an ADR since at least the early 1990s. It has had various phases of investor enthusiasm depending on the fickle tendencies of the international emerging markets crowd. In 2008 it caught something of a second wind. It was able to cast aside some of the negative vibes surrounding the Chilean energy crisis and forge to new highs. While the processing of lithium and potash requires some energy, it is important to remember that evaporation is the most important component and the Atacama Salt Desert (located between the first and second region of Chile), where SQM has nine plants, is one of the driest places on the planet and nature drives the SQM production process (as it does to a lesser extent at Rincon).

SQM's Salar de Atacama is the world's largest lithium brine mine and a significant potash producer is located on the Atacama. SQM has exclusive access to the Atacama reserves that include the biggest iodine and nitrate reserves in the world and the highest lithium and potassium concentrations currently recorded. SQM has the mining and exploration rights of over 2.5 million hectares of these deposits, accounting for almost 75% of current mineral economic deposits in Chile. It was control of these assets that prompted the War of the Pacific in the late 1800s that resulted in Chile seizing these territories from Bolivia and Peru.

The chemical resources in SQM's mining areas (shown at the right) have leached down from the high Andes, originating in the areas where Rincon (and FMC) have their resources. SQM's *caliche* (iodine and nitrate deposits) and *salar* brine reserves provide the minerals that feed its three main lines of business: specialty plant nutrition, iodine, and lithium.



The last 12 months proved to be a bonanza year for SQM, though a glance at the stock price chart (on the following page) makes one think that the investment community doesn't think it can pull off a repeat of its eight consecutive years of higher revenues and profits. In late February the company announced its FY08 results with earnings of US\$501.4mn (US\$1.91 per ADR), an increase of 179% over the 2007 figure of US\$180 mn (US\$0.68 per ADR). Operating income reached US\$632.2 million (an operating margin of 35.6%), 144% higher than the US\$259.5 million (21.9% operating margin) recorded in FY07. Revenues for 2008 totaled US\$1,774.1mn (representing growth of 49.4% over the US\$1,187.5mn reported in FY07).

Interestingly the company also announced YoY earnings growth of 170% for 4Q08, reporting quarterly net income of US\$120.3 mn (US\$0.46 per ADR) compared to the 2007 figure of US\$44.6 mn (US\$0.17 per ADR). Revenues totaled US\$397.9 million, an increase of approximately 29.9% with respect to 4Q07, when revenues amounted to US\$306.2 million. In theory the last quarter of 2008 should have been buffeted by the economic headwinds and revenues should have slumped. Investors are over-anticipating here as the company benefits from a lower Chilean peso since the global slump deepened and lower

energy prices, particularly oil. It must be remembered that Chile is highly dependent upon imported oil and gas supplies. The company did see slightly lower lithium demand in Q4 though and an easing of prices from levels seen in 2007.



### The Argentine Salares

There are around 50 *salares* located within the Antofallos-Pocitos volcanic rift valley in the high Andean plain. On the Argentine side of the border there are a couple of currently producing deposits:

- FMC Corp.'s Fenix brine complex located on Salares Hombre Muerto in Argentina contains high uniform concentrations of lithium with low levels of other contaminants and is the fifth largest lithium producer in the world
- Rio Tinto's Tincalayu complex also located on Salares Hombre Muerto in Argentina and is South America's largest borate mining operation. Interestingly this asset was not included in the sale of Rio Tinto's potash assets in Argentina to Vale that closed in February 2009.

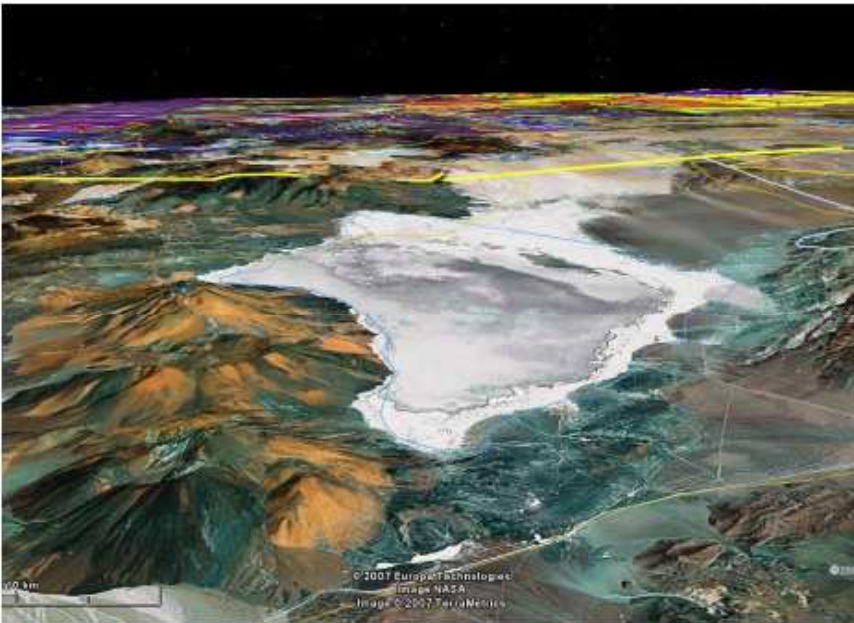
### The Lithium Pioneer in Argentina – FMC

The US-listed agrochemicals company, FMC is a major global player in lithium and operates in Argentina via its subsidiary, Minera del Altiplano S.A.. Its prime "mine" is El Salar del Hombre Muerto located in the Andean province of Catamarca, in the far northwest of the province in the department of Antofagasta de la Sierra, some 700 kilometers from the provincial capital.

The photo on the following page shows the FMC resource/mine in all its Martian splendour. There are only three regions in the world with deposits similar to those in Antofagasta de la Sierra, that of FMC being the most significant.

The useful life of this "mine" is estimated at around 40 years. It produces lithium chloride and lithium carbonate, of which 100% goes to export markets. The product goes to its markets by rail to Antofagasta in Chile and then by ship to the US.

The lithium carbonate plant of FMC began production in the third quarter of 1997 and the lithium chloride plant, at Güemes in Salta, started up in January of 1998.



### The Nearly-Theres and the Wannabes

We shall discuss here the up-and-coming players in the Argentine lithium/potash space. These are Rincon Lithium (now owned by Sentient, a hedge fund), Orocobre (traded on the ASX) and Latin American Minerals (traded on the TSX-V).

The map at the right shows the relative close proximity of these deposits to each other, largely in the far northern Argentine province of Jujuy. This is an extremely mining friendly jurisdiction, as Silver Standard (SSRI) has often attested. Some are located more to the south in Salta province (also mining friendly).

### Rincon Lithium

We shall concentrate more on this asset, even though it is currently not investable, for what holds true for Rincon also pertains to several of the other up and comers in the LatAm lithium space. They face the same “chemical” challenges and the resources largely vary only in size



and accessibility.

The project is situated at 3,700 metres above sea level (very near to the Chilean border). The tenements cover an area in excess of 250 square kilometers. The Rincon Salar asset is a lithium, potassium, magnesium-rich brine resource located in the province of Salta. It is a hyper-saline lake fed by three subterranean rivers percolating into the *salar* through volcanic rocks. The ponded evaporate deposit is estimated to contain:

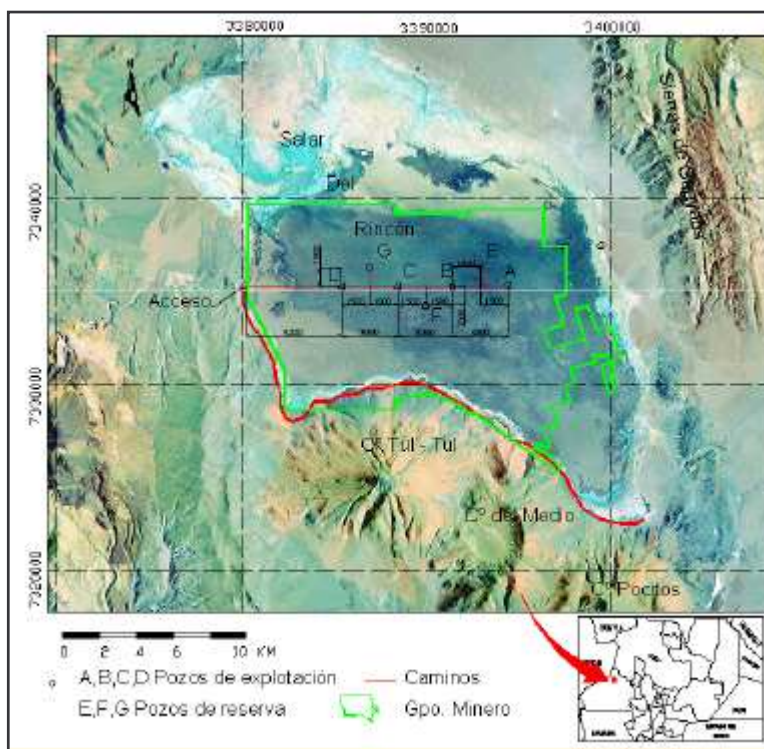
- 7.4 million tonnes of lithium carbonate (LiCO<sub>3</sub>) equivalent
- 51 million tonnes of potassium chloride (KCl)

The key resources that can be produced from exploiting these deposits are lithium carbonate, lithium chloride and lithium hydroxide, potassium chloride (muriate of potash), sodium sulphate and magnesium.

This asset was the subject of an extensive research report by us in mid-2008 when it was scheduled to be spun-off from the Australian-listed miner Admiralty Resources (ADY.ax). The tenements had been acquired by Admiralty in February 2001. The plan in mid-2008 was to distribute shares in the Rincon Lithium subsidiary to existing shareholders and this transaction was expected to take place in the third quarter of 2008. This plan was well-regarded by us (hence our coverage) but came to grief due to the feckless financing by the company executives of their own purchases of shares in ADY through a second tier brokerage firm in Australia that hit the rock in the financial crisis. This necessitated a rapid sale of the asset to clear debts and Rincon was sold to a Cayman Island-based entity controlled by the Sentient hedge fund group. The price of around AUD\$35mn (USD\$27mn) was a howling bargain but such was the state of Admiralty's finances that the company could think of no better solution than divestment.

A study commissioned by Admiralty on the extraction methods for processing the brine has shown that pumping rates of as high as 375,000 litres per hour can be achieved by the production wells with no noticeable effect on the water level of the Salar. The capital expenditure program for the development of the Rincon Salar has been established at US\$105m. Major supplies of raw materials are located close by to produce calcium hydroxide and sodium carbonate needed for the separation processes.

It would appear in light of the JORC resource estimate that Rincon Salar could also be considered a world-class resource with components of lithium, potassium, sodium and magnesium. The satellite photo at the left shows the salar. The Chilean border is just outside the photo to the left.



Admiralty initially constructed five hectares of lined evaporation ponds (two layers of 100 micron PVC) to feed the pilot plant, where some steam evaporation is undertaken to speed what would otherwise be an entirely solar process in the full version of the evaporation process (with five square kilometers of ponds in that iteration).

As a result of very favorable evaporation conditions during the (Southern) 2007/8 summer and an improved production process the site showed consistently high recoveries of lithium. In the company's view the mass balance results were outstanding in terms of minimal loss of lithium as the brine moves through the production process. The pilot plant had already (in 2008) produced 12 tonnes of lithium carbonate (97% purity) using the new production process and chemical inputs that originate from Rincon's vertically integrated supply model. The lithium carbonate so far produced will be further purified when the next stage of pilot plant (due to be complete by November 2008) will produce 30 tonnes per month of 99.0+% Li<sub>2</sub>CO<sub>3</sub>. This additional equipment, when installed will generate other by-products such as sodium hydroxide. Battery standard lithium carbonate is 99.99% purity (known as **Four 9's** in the industry).

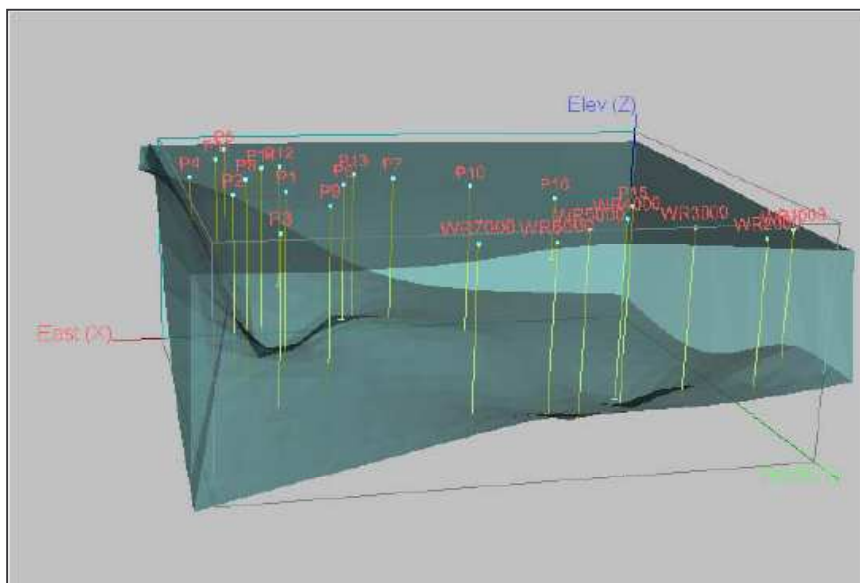
**(1) Lithium Reserves**, expressed as Li metal, after 75% recovery:

	Low	Expected	High	Uncertainty of the estimate
	kilo tonnes			
Proved Reserves	746	911±53	1,098	±10%
Probable Reserves	288	492±72	762	±25%
Total reserves	1,035	1,403±126	1,861	±15%

**(2) Potash Reserves**, expressed as KCl, after 70% recovery:

	Low	Expected	High	Uncertainty of the estimate
	mega tonnes			
Proved Reserves	27.1	33.0±1.9	39.5	±10%
Probable Reserves	10.5	17.8±2.6	27.4	±24%
Total reserves	37.5	50.8±4.5	67.0	±15%

Production of Potash will commence when the necessary equipment is installed to bring it up to 99.75% purity. The focus to date has been on lithium carbonate production but potash will commence soon. Originally the company had plans to commence potash production before lithium. At that time the planned output was 40,000 tpa of potash. In 2005, it even signed a heads of agreement with Reochem PLC for the sale of all the production on an end-user and agency basis.



The company has acquired an R-C drill that is being sent to Argentina to expand drilling work with a view to increasing the resource size. At the left is the geo-hydrological 3D model of the lake.

### Orocobre (ORE.ax)

This is an Australian listed company which originally (as its name indicates had a copper/gold focus in Argentina). It has now shifted direction (while retaining the original metals asset) towards the easier pickings of the lithium market. Its Olaroz Lithium Project consists of 118 square kilometres of tenements over a *salar* located in Jujuy Province. Olaroz is located just to the north of Rincon and has a similar geological model. Although smaller in area, the company claims it has higher indicative lithium grades.

The location has good infrastructure with access by sealed road and nearby high voltage electricity, gas pipelines and rail. Orocobre has rights to 100% interest in these properties by way of a purchase contract.

Indicative lithium grades based on sampling by government agencies is relatively high at 0.09% and this compares favorably with other possible brine sources of lithium.

Orocobre has used Minnelex Pty Ltd, as its independent geological consultant. Their initial work suggests the exploration target is potentially in excess of 325,000 tonnes of contained lithium (i.e. greater than 1.7mn tonnes of lithium carbonate) based on 10% porosity. Orocobre feels that it is geologically reasonable to assume that the Rincon geological model will have similarities at Olaroz. If Olaroz has as high an effective porosity as Rincon, Minnelex considers the exploration target could be 3 to 4 times the size. Likewise there is also potential for other products such as potash and borates. Recent work by Orocobre indicates average grades of 700 ppm Li and 1.3% K at Olaroz. We regard Orocobre as a **Speculative Long** at the current time.



### Latin American Minerals (LAT.v)

This Toronto Venture Exchange-listed explorer has an Argentine focus and a handful of projects. Recently, it too decided to move into the lithium space (dare we call it the lithosphere?). LAT's territory covers 93,000 ha on the Puna Plateau, of northwestern Argentina, in proximity to all the other Argentine

players covered in this note. It wholly owns 83,424 ha, including: the Arizaro (60,314 ha), Incahuasi (7,168 ha), Pocitos (14,381 ha) and Cauchari (1,561 ha). Additionally, LAT has the right to purchase 100% interest in a second property located on the Cauchari salt lake covering 9,033 ha.

The Arizaro salt lake is located in the center of the project area and is the third largest salt lake in the world covering 1,600km<sup>2</sup>. LAT has two properties covering approximately one third of this poorly explored but highly anomalous salt lake. LAT's other properties cover significant portions of the Pocitos, Incahuasi and Cauchari salt lakes. Several highly anomalous hot springs near the salt lakes contributes hypersaline brines to the lakes increasing the already anomalous brine concentrations of the lakes.

In 2008 LAT started a regional reconnaissance-sampling program covering its Salares properties and other strategic areas in the region. The program consisted of sampling the crust on the various salt lakes and excavating 1-2m deep holes through the salt crust to sample the brine below. A total of 93 samples of the salt crust and 113 samples of the brine were collected during the sampling program. In January 2009 the company appointed the specialized lithium consulting group, TRU, to advise on the next moves in moving the lithium assets forward for LAT.



On the basis of this prospect alone we would rate LAT as a Speculative Long, however the highly interesting nature of its other prospects (including gold in Paraguay) we prefer to rate this stock as a **Long** in our model portfolio. We have a research report in process on this company that should be appearing shortly.

### Sodium sulphate - the vital ingredient – grab your positions

As we noted earlier, extraction of lithium carbonate is a process of chemical reactions with sodium sulphate being a key input in this process. To deal with this need, in September 2007, Admiralty announced that it had purchased the Rio Grande *salar*, approximately 250 kms distant from the Rincon asset, as a means of securing its future supplies of sodium sulphate, a vital input in lithium processing. The purchase price was not revealed but the company claimed that it represented less than the first year's savings to Rincon.

The key here to note is the level of the savings. Essentially all the producers will need to have access to sodium sulphate or risk being made less economic than Rincon (and others with access to this product).

The Salar del Río Grande purchase is critical in that it gives Rincon a resource capable of supplying all the requirements for its production of lithium for the foreseeable future (more than 40 years). Via this purchase Rincon has grabbed a strategic hold on a unique asset with more applications than just mining. The *salar* represents the most significant resource of sodium sulphate in Argentina and one of the most significant resources in South America. The Salar del Río Grande has yielded almost all of the domestic production of this commodity over the last 25 years.

At the time of the deal we speculated that the purchase also provided an interesting possibility to sell excess sodium sulphate to the detergent industry in Argentina and Brazil. Detergent grade sodium sulphate currently sells for \$130-\$140 per tonne. Rincon was working on the feasibility of processing and selling 20,000-40,000 tonnes per annum of extracted and processed sodium sulphate in the domestic market. However, it might very well have a market much closer to its mine/lake if the other lithium lake owners are forced to deal with Rincon to obtain sodium sulphate for their processing needs.

This purchase was driven by the economic considerations related to the large distance alternative sources of sodium sulphate are from the Rincon site. Moreover, there is a globally tight supply situation for the mineral and it would cost approximately US\$160 per tonne to buy sodium sulphate on the open market for the fractional crystallisation process to produce lithium chloride and lithium carbonate. By buying the deposit and using the gas supply located at the plant site, Rincon will be able to produce sodium sulphate for less than US\$40 per tonne. Rincon will require 110,000 tonnes of sodium sulphate to produce 10,000 tonnes of lithium carbonate, 3,000 tonnes of lithium chloride and 4,000 tonnes of lithium hydroxide per annum. Procuring its own source should provide cost savings of US\$15 million p.a. lowering the projected operational expenditure in 2009/10 to USD\$35million (shaving 30% off the costs).

The *salar* represents an 18.5 million tonne deposit of Na<sub>2</sub>SO<sub>4</sub> and contains approximately 18.5 million cubic meters of mineable material. The *salar* covers a surface of about 110 km and hosts a 56 square km central zone enriched with sodium sulphate. The area purchased by Admiralty covers 74 square km equivalent to two thirds of the *salar's* surface. They include the richest zones of mineralisation. The Salar del Río Grande is an evaporitic deposit in the Argentine Puna with measured, probable and inferred resources of about 3.8 million tonnes of recoverable anhydrous sodium sulphate

The table below extracted from the JORC report completed by Dr Carlos Sorentino shows the *salar* has measured, indicated and inferred resources of around 3.8 million tonnes of recoverable anhydrous sodium sulphate:

<b>Resource Classification</b>	<b>Average grade, anhydrous Na<sub>2</sub>SO<sub>4</sub></b>	<b>Mineralised volume, thousand m<sup>3</sup></b>	<b>Mineral mass, Kt</b>
<i>Measured resources</i>	20.4%	4,119	842
<i>Probable resources</i>	22.2%	3,762	835
<i>Inferred resources</i>	19.7%	10,620	2,092
<b>Total</b>	<b>20.4%</b>	<b>18,501</b>	<b>3,769</b>

In addition, there are a number of groundwater bodies within the *salar* that could contribute an additional 670,000 tonnes of mineral from brines containing an average of 11.8% Na<sub>2</sub>SO<sub>4</sub>.

### Potash – Pricing trends

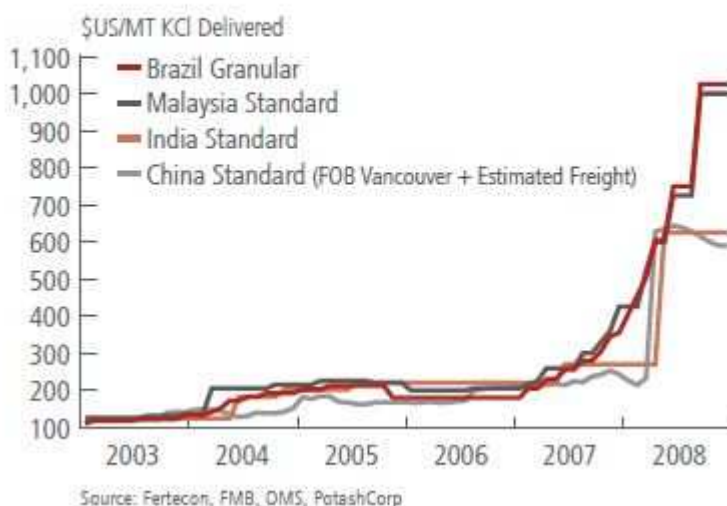
The past 18 months year have seen a wild ride in sentiment towards potash. Ironically, prices for potash have shown a bigger jump than many of the agricultural products that use potash as a fertilizer. A report by Resource Investor (and some broker upgrades) in March 2008, set off a chain reaction in the price of major stocks in the sector propelling the industry leader Potash of Saskatchewan to a market cap of over

\$75bn. The article noted that bullish sentiment originated when both Belarusian Potash Co., a Belarus-based potash supplier, and Indian Potash Ltd. agreed to a contract potash price of C\$625 per metric tonne, a strong jump up from the previous price of C\$270 per tonne (compared to prices of averaging only C\$170 in 2001).

Pricing for all fertilizers had been boosted by factors including rising demand for ethanol, made from corn. We would note that potash is a different play to the base metal imperative of recent times. Essentially potash is being dragged up by the grain price/demand surge mixed with soaring natural gas prices, which militate against urea production from natgas. While debate still rages over the sustainability of base metal prices (though we have few doubts) there is almost a general consensus that the boom in agro demand is not only here to stay but could significantly worsen the supply/demand imbalance.

### POTASH PRICES REFLECT TIGHT GLOBAL SUPPLY/DEMAND

Withstood Slowing Economy Better Than Other Nutrients



While the chart above looks frightening enough to those who need to purchase the product, the demand picture (see next page) looks robust and at least according to PotashCorp will continue romping along despite the temporary respite in grain prices of late.

A metals analyst at a leading Canadian bank noted in mid-2008 that potash prices at the Port of Vancouver had jumped from US\$504 per tonne to \$525 per tonne in April and in the bank's opinion were likely to reach an average of more than US\$800 by late 2008. This however did not come to pass. The bank also noted that potash prices of \$1,000 per tonne were affordable for most farmers, in light of soaring grain prices. In their estimates at corn prices of US\$7 per bushel (and having touched over US\$8 in mid-June), potash prices at US\$1,000 would only account for 3.6% of revenue (assuming normal crop yields of 140 bushels per acre and 35 kg of potash applied per acre). While farmers may gripe about rising fertilizer inputs, this low percentage contribution to input inflation is clearly not the major culprit.

The bigger factor though in the potash dynamic is the China (and India) possibilities. In a meeting recently with Potash One (KCL.to) they stated to us that they felt that China was using 8 mn tonnes per annum of potash but they really needed to be using around 20 mn tpa.

As for price trends there is a cartel in place in the industry that has been most successful in pushing the envelope over the last twelve months and getting away with it. Demand has been so firm on rising Asian food demand (despite the recent dip in grain prices from the 2008 highs) that they have been able to maintain the price gains that they put in place last year. The lack of new capacity coming on (and thus far the lack of new producers wanting to rock the boat) augurs for prices staying up. The Chinese at this point don't seem to have got their head around the new price regime and seemingly hope for a retreat. When they finally do realize they will have to pay up to increase crop yields for a demanding populace then \$600 per ton will be the firm base level.

**WORLD POTASH SHIPMENTS\***  
 Expect Strong Demand Rebound in 2010



At this level most of the underground miners (mainly solution mining) will be viable and the *salares* will be enormously profitable. We would note though that the investment required for the solution process is very high. Potash One is facing a cap spend of at least \$800mn to get into production and there is no cheap “half-measure” or staged production possible in the solution mining process.

**Risks**

The prime risk for the new batch of lithium miners may be perceived to be their exposure to Argentina. These days there is *Argentina* and *Argentina* for those in the know. Mining in the country is essentially in the hands of the provinces though the Federal government can levy taxes on exports from the sector (a subject currently causing controversy). In assessing the risk in Argentina it is important to do this on a province-by-province basis. All of the *salares* are in mining-friendly provinces.

The reality driving the pragmatism of governors in these Andean provinces is that they are “hard-scrabble” agricultural areas and dramatically poor compared to the industrial and grain belt regions of the country. Mining has not only bought skilled and unskilled jobs and infrastructure, but also royalty flows which have helped in giving these provinces better leverage with the Federal government and made them slightly less dependent upon the “charity” emanating from Buenos Aires. Thus we do not expect problems at the provincial level. Moreover the *salares* are so isolated that there are no local populations to raise environmental issues within any conceivable distance.

Might prices for the output collapse? Lithium was a hot topic in 2008. Not being a product with a spot market, it did not however attract speculative buying of the type that keeps US Congressmen awake at night fantasizing of conspiratorial hedge fund managers. The price is thus a real one driven by supply and demand. The sexy new demand is hybrid cars. This business is still in its infancy with a strong component of fringe dwellers and *Hollywoodites* leading the charge at the showrooms. However, should hybrid go mainstream then lithium at current levels will be just a distant memory. The biggest danger is likely to be from the eventual rise of hydrogen powered vehicles. This is still early days for that option.

Then there is the potash output. This is looking most healthy. As we noted fertilizer is still only a very small component in the cost of grain production. It is generally felt that higher grain prices are here to stay. We prefer to posit that they will fluctuate but at a higher level than the give-away average prices of the last 50 years. Natgas is an increasingly scarce resource and thus urea production from this source may be priced out of the fertilizer market. This leaves great scope for potash to increase its share even further. The reality for *salares* miners is that they do very well firing on only one cylinder (lithium) but if they fire on two (or more if we include the sodium sulphate potential), then the potential will be enormous to expand profits and market capitalization.

### **The Hard Rock Challenge**

The rock (well actually bentonite clay or spodumene) miners of lithium have been beating the bushes of late to get investors interested in their stories. The ones that we have encountered up close and personal include Canadian Lithium (CLQ.v), Western Lithium (WLC.v) and TNR Resources (TNR.v). Though there are others out there with hopes. Maybe it's a sign of the times but just this week, TNR, a microcap by anyone's definitions took the rather retro decision to spinout its lithium division into a standalone company. This might be the first swallow of a lithium summer (or a hard-rock one at least). The hard rock fad is expected by us to go the way of the pet rock fad.

The chief problem for the hard-rockers is that they have is large capital costs to get going (a formidable hurdle in current financial markets) and the fact that their production cost is around \$2 per lb compared to around \$1 per lb for the brine exploitation process. They trot out all sorts of arguments in favour of North America as a source of product including the old chestnut of "resource security" in the form of Evo Morales. Somehow we suspect that Evo might be sending lithium to global markets before some of the hard rock miners can do it. Argentina and Chile both have global players, as well as the juniors, in the space with no problems that we have ever heard of. When a miner like Rincon can have 400 years of mine life at half the price of the potential North American competition, it is hard to see why massive capital expenditure would go towards that area in preference to advancing the easier (and cheaper) option of the brine lakes.

### **Conclusion**

Lithium does not fit any conventional metal group. It's out on its own in the way that uranium and mineral sands tend to be. It requires an entirely different mindset to understand the implications particularly when one is looking at the brine lakes. The hard rock lithium phenomena is an easier study but why would one plump to invest in a product with double the production cost from one mode of mining than that of brine lake operators?

Lithium is not about to be superseded; indeed it looks like its consumption is holding up relatively well though the opacity of the market (and the supply) means that this is hard to judge. What one can look at are the identifiable uses of lithium and certainly the "go-go" purposes to which it can be put to use (cellphone batteries, laptop batteries and hybrid cars) are holding their own or surging ahead.

The lithium miners with *salares* as their source material are clearly ahead of the hard rock pack with a margin advantage that is, quite literally, killing for the hard rock crowd. Scare tactics evoking the bogeyman of Evo Morales will not wash as the Argentine producers have more than enough potential

Tuesday, April 28, 2009

product to leave Bolivia in the Stone Age should it choose to do so. Raising “national security” issues only starts to get some traction in our minds when the Federal government in the US starts to subsidise the hard rock miners to help them surmount their production cost disadvantage and massive upfront capital costs. Until such time they remain pie in the sky.

Meanwhile back in Argentina we suspect that some Asian end-users (Korean and Japanese.. the Chinese are spending too much effort navel-gazing these days) may make moves to JV with the smaller *salares* holders or at least fund their move to production with VPP-type arrangements. Any deals along these lines would make this **sideline** for these juniors be more than worth multiples of their market caps and move them from the “wannabe” to the “producer” column in doubletime.

## Important disclosures

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