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How we look at lithium projects

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April, 2018

Brief introduction to Sprott

- Sprott: mining specialist with C$11.5bn AUM; 90% precious metals and natural resources investment
  - Early stage principal investing: C$0.5bn
  - Private equity: C$0.8bn
  - Mutual funds and alternative investments: C$1.2bn
  - Debt lending: C$0.6bn
  - Physical and gold miner ETFs: C$8.8bn
- Sprott Capital Partners: merchant banking team
  - NY, Toronto, London distribution
  - Technical base: 442 issuers reviewed in last 15M
  - C$780m of equity financings in 41 transactions in CY17

'One stop shop' for junior miners from exploration to production

38 sites visited in last 15M	
Australia	Kirkland Lake
BC	Ascot, IDM, Tudor
Botswana	MOD / Metal Tiger
Burk'a, Liberia	Avesoro
Burkina Faso	West African
California	American Pac. Borate
Chile	Lit. Power, Min. Cobre
DRC	Tiger, Alphamin
Finland	Aurion
Ghana	Cardinal
Ireland	Group 11
Nevada	Jerritt Can., Contact, Fiore
Ontario	Pure Gold
Quebec	Alexandria, Cartier, Integra
Quebec	Champion, Crit. Elements
Quebec	Metanor, Bonterra, Osisko
Turkey	Eldorado, Liberty, Mariana
Utah	Liberty
Utah	Nulegacy
West Australia	Artemis, De Grey, Novo

Brines, clays, hard rock and conversion

- Brines
  - Lithium already exists in solution, evaporated to 2-6%, ‘precipitated’ to carbonate or hydroxide
  - Predominantly located in Argentina and Chile with subsidiary US resources
  - Typically very large resources, with low opex, long lead time to production
- Hard rock
  - Lithium contained in spodumene (8.1% Li_2O), petalite (4.9% Li_2O), lepidolite (~4% Li_2O)
  - Simple floatation to concentrate, sold as ~4-6% concentrate to converters
  - Typically small- to medium resources, low lead-time to production
- Clays
  - Lithium in a variety of solid-state forms, liberated either via atmospheric acid leach or roasting
  - Predominantly located in USA and Mexico
  - Typically very large resources, with high opex, intermediate lead time to production
- Conversion
  - Hydrometallurgical process, less conventional than simple floatation
  - Predominantly undertaken in China, limited western precedent
  - Both ‘conventional’ and non-conventional processes proposed

Macro considerations from capital markets perspective

✓ Demand: increasing rapidly (~3,000% increase

– 100% EVs needs ~3,000% supply increase vs. 2,000% for Co, 500% for graphite

✓ Supply: increasing slowly

X Reserves: no shortage

– Over 100 years, longer than any other EV commodity

- Considerations from capital markets

Consideration	*Brine*	*Hard-rock*	*Clay*
– *Speed* to production to access current high prices	X	✓	X
– *Size* where 'strategic' (large) assets attract M&A interest	✓	X	✓
– *Risk* where new technologies have higher risk than existing	~	✓	X
– *Opex* lower = better	✓	X	X
– *Capex* lower = better	X	✓	X

Lower opex for brines is key structural advantage; hard-rock offers quick wins

Subtleties to each subset of resource

- Key project evaluation parameters
  - **Hard-rock:** strip, dilution, and recovery determined by dyke width and geometry; con-grade / mica and iron content determined by ore and host rock mineralogy
  - **Brine**: reagent consumption and impurities (Mg, SO_4, Ca, B), resource-to-reserve conversion, on-salar evaporation pond space, regulatory environment, permitting
  - **Clay**: proximity to sulphuric acid, ability to atmospheric leach and acid consumption, strip ratio
- Technology is not your friend!
  - **Hard-rock** mines like Nemaska lift NPV via conversion to carbonate / hydroxide, but lift cost and risk; others like Critical Elements, Galaxy, and Neometals sell concentrate
  - **Brine** projects require bespoke plant but can reliably produce lithium carbonate
  - **Clay** has never been used as a large-scale source of lithium
- Costs can be compared, 'hidden cost' of hard rock operations, brines have higher margins
  - Hard-rock: US$325/t con cost = ~US$4,700/t LCE, but US$900/t con price = ~US$10,000/t LCE* = 'hidden cost'
  - Brine: costs of ~US$3,500/t LCE vs. contract prices US$10-15,000/t, and spot prices >$15,000/t

Brines more likely to be 'strategic' given longer life and higher margin

Chemistry is critical

- Chemistry is critical
  - Brines ranked by Li grade, Mg and SO_4
  - Lower impurities = lower opex
- Quantitative rank of brine quality
  - Atacama / Sal de Vida are quality
  - 3Q and Maricunga rank highly, but Ca creates complexity
  - Pastos has lower grade but vanilla chemistry and large size
- Top ranked independent juniors
  - Neo Lithium (NLC CN, C$170m)
  - Millennial Lithium (ML TV, C$197m)
  - Lithium Power (LPI AU, A$64m)

Salar rankings by brine chemistry

			ppm	Ratios		Rank			
Company	Project	Loc'n	Li	Mg/Li	SO_4/Li	Li	Mg/	SO_4/	Score
Neo Lithium[2]	3Q	ARG	716	2.0	0.5	11	12	15	38
SQM/Albermarle[1]	Atacama	CHL	1,500	6.4	11	15	7	13	35
Galaxy[9]	Sal de Vida	ARG	810	2.2	12	12	11	12	35
Lithium Power[7]	Maricunga	CHL	1,163	6.5	0.8	13	6	14	33
Zhabuye L.[4]	Zhabuye	CHN	1,258	0.0	54	14	15	3	32
FMC[1]	Hombre Muer.	ARG	620	1.4	14	7	13	11	31
Orocobre[1]	Olaroz	ARG	690	2.4	25	9	9	7	25
Lithium Americ.[6]	Cauchari	ARG	698	2.4	28	10	10	5	25
Millennial L.[11]	Pastos Gr.	ARG	445	6.3	18.2	5	8	10	23
Albermarle[1]	Silver Peak	USA	230	1.3	31	2	14	4	20
Lithium X[10]	Sal de LA	ARG	456	10.9	19	6	4	9	19
Comibol[5]	Uyuni	BOL	424	18.6	24	4	3	8	15
Rincon Lithium[1]	Rincon	ARG	393	9.2	26	3	5	6	14
Western Min. Gr[1]	East Taijinair	CHN	640	21.5	221	8	2	2	12
CITIC Guoan[1]	West Taijinair	CHN	210	32.8	713	1	1	1	3

(1) Lithium Americas 2012 43-101 FS, (2) Neo Lithium weighted average from drilling, (3) Orocobre 43-101 2013, citing Rincon study, Pavlovic and Fowler, 2004, (4) NeoLithium 43101 2016, data from China pers. comm, (5) NeoLithium 43101 2016, data from Roskil 2009, (6) 2017 43101 FS, (7) 3Q17 JORC, (8) 2011 FS, SO4 not reported, taken from 2011 LAC FS, (9) DFS 2016 and minority ratios from presentation, (10) Li and K from 2016 LiX resource, Mg from 2011 Rodinia Lithium PEA, colour denotes shared salar, (11) Grade from drilling ranges, Mg / SO4 from first drill hole

Many other factors to 'watch out for' in brine plays

- Infrastructure: impacts opex
- Evaporation grade: impacts location of plant on/off salar, size of plant, capex
- Topography: on salar ponds cheaper
- Location: Evaporate rate sets pond size
- Permitting: Chile vs. Argentina
- Porosity: Drives resource and reserve
- Resource to reserve conversion

	LAC	LPI	GXY	NLC	ML
Plant capital intensity					
LCE plant capex (US$m)	121.5	77.4	63.0	52.2	66.3
Indirects (US$m)	13.5	11.0	13.7	14.4	10.7
Contingency (US$m)	20.3	16.4	7.6	13.0	13.3
Total (US$m)	155.3	104.8	84.3	79.6	90.3
Production (ktpa)	25.0	20	25	35	25
Reagents p=pond pl=plant	p + pl	pl only	p + pl	p + pl	pl only?
Plant cap intensity (US$/t pa)	6,210	5,241	3,372	2,274	3,612
Pond capital intensity					
Pond + wells capex (US$m)	143.9	159.7	89.0	178.4	168.6
Indirects (US$m)	16.0	22.6	19.3	49.1	27.3
Contingency (US$m)	24.0	33.9	10.8	44.6	33.7
Total (US$m)	183.9	216.3	119.1	272.1	229.6
Pond area (ha)	1200	760	1200	1004	1250
Pond capex (US$000/ha)	153	285	99	271	184

	LAC	LPI	GXY	NLC	ML
Reagent consumption					
Lime (t:t LCE)	2.7	~0.4	-	0.1	4.3
Soda ash ($NaCO_3$, t:t LCE)	1.7	2.1	-	1.8	1.8
Glauberite ($NaSO_4$, t:t LCE)	0.0	~0.4	-	6.4	0.0
Hydrochloric (HCl, t:t LCE)	0.3	~0.1	-		0.2
Total opex (US$000/t LCE)	2,412	2,981	3,369	2,908	3,218
Portion of this as reagent (%)	41%	30%	53%	56%	47%
Reagent cost (US$/t LCE)	991	896	-	1628	1502
Blended reagent price (US$/t)	211	302	-	197	238
Resource and reserve conversion					
Resource (000t LCE)	11.8	2.2	7.2	2.1	3.0
Grade (mg/L)	585	1157	753	714	452
Reserve (000t LCE)	1.5	0.8	1.1	1.5	~0.7
Grade (mg/L)	698	-	700	639	452
Mg:Li (x)	2.4	6.6	2.2	2.0	6.3
Reserve conversion (%)	15%	38%	16%	64%	24%

Leading independent brine plays

- Neo Lithium (NLC CN, C$170m): 3Q, 2Mt LCE @ 716ppm
  - Low opex of due to low Mg and SO_4, high-quality brine
  - December 2017 PEA showed a US$1.2 billion $NPV_{8\%}$, 28% IRR
  - Reserves could double with deep drilling, pilot plant 3Q18, FS 1Q19
- Millennial Lithium (ML TV, C$197m): Pastos Grandes, 3Mt @ 445ppm
  - Maiden drilling to 3Mt LCE resource and PEA in 14 months
  - 1Q18 PEA showed US$824m $NPV_{8\%}$, 23% IRR
  - New licences to the South to extend mine life
- Lithium Power (LPI AU, A$64m): Maricunga, 2.2Mt LCE @ 1163ppm
  - Highest grade brine, low impurities
  - 4Q17 PEA showed a US$731m $NPV_{8\%}$, 20% IRR
  - Maricunga is strategic, ongoing bid process on salar

Key evaluation metrics

- KPIs can be seen from first hole
- Width and orientation critical
  - Narrow / vertical mean strip constrains size
  - Narrow dykes have finer crystals, risk of lower recovery
  - Narrow dykes have high wall rock dilution which adds iron impurities
- Location
  - Low cost electricity for conversion
  - Logistics to China for con. sales

Hard-rock peer comparison

Asset	Rose	Pil'goora	Mt Catlin	Mt Marion	Pil'goora	Earl Grey	Whab'chi
Commodity	Li-Ta	Li-Ta	Li-Ta	Li	Li	Li	Li
Country	Canada	Australia	Australia	Australia	Australia	Australia	Canada
Stage	DFS	Const'n	Prod'n	Prod'n	Const'n	PEA	Const'n
Company	Critical Elements	Pilbara Minerals	Galaxy Res	Neometals	Altura Mining	Kidman Res	Nemaska Lithium
Ownership	100%	100%	100%	13.8%	100%	50%	100%
Ticker	CRE.TV	PLS.AX	GXY.AX	NMT.AX	AJM.AX	KDR.AX	NMX.TO
Market cap	C$173m	A$1452m	A$1255m	A$182m	A$682m	A$664m	C$554m
Debt - cash	-C$5m	-A$89m	-A$40m	-A$42m	A$31m	-A$6m	-C$67m
EV	US$132m	US$1054m	US$939m	US$786m	US$552m	US$1017m	US$384m
Resource (Mt)	35	156	16	78	48	189	44
Resource (% Li_2O)	1.03%	1.25%	1.08%	1.37%	1.00%	1.50%	1.46%
Reserve tonnes (Mt)	27	80	10	12	34	47†	20
Reserve (% Li_2O)	0.85%	1.27%	1.04%	1.34%	1.04%	1.40%	1.53%
Recovery (%)	89%	78%	54%	77%*	83%	60%	84%
Recoverable LCE (kt)**	403	1574	111	246	584	781	507
Con grade (% Li_20)	5.2%	6.0%	5.7%	5.1%	6.0%	5.9%	6.0%
Recoverable grade (%)	0.76%	0.99%	0.56%	1.03%	0.86%	0.84%	1.3%
Avg con prod'n (ktpa)	199	314	190	400	220	288	216

**average of 3 2009 samples † PEA prod'n target, not JORC reserves **80% converter recovery*

Comparing costs to brines is critical

- 'Typical' hard rock costs: 1.5% Li_2O, 7:1 strip, 60% recovery
  - Mining US$2.50/t, crush-grind-float US$12.50/t, G&A US$3.50/t = US$240/t 6% con
  - 2.47x conversion to LCE, ~80% converter recovery = **US$2,021/t LCE equivalent**
  - Galaxy 4Q17: US$325/t opex, 5.75% opex = ~US$2,850/t LCE site cost
- The 'hidden' cost: transport and conversion…still excludes converter margin
  - Transport ~US$90/t concentrate = $790/t LCE
  - Adding converter cost ~US$2,000/t LCE = **~US$4,800/t LCE** (GXY 4Q18 ~US$5,640/t)
- Actual prices paid demonstrate real 'cost'
  - Galaxy achieved US$868/t in 4Q17 for 5.75% concentrate grade = ~US$10,000/t LCE
  - **'Lost revenue' of >US$5,000/t LCE** on top of site opex of ~US$2,000/t LCE

Hard-rock total LCE 'cost' >US$7,000, ~double that of a brine

To convert or not to convert

- Detractors suggest insufficient conversion capacity in China
  - Low risk: Chinese quite well known for adding factory capacity
- Third party conversion comes at high cost
  - Own-conversion such as proposed by Nemaska / Kidman to tackle this
- Improves NPV, but expands initial capex considerably
  - Other players such as Critical Elements scrapped conversion at outset to lower capex
- Conversion technical risk is real
  - 'Existing' Chinese methods aren't necessarily appropriate, or available
  - New methods such as proposed by Nemaska been commercially tested

Conversion improves economics, but risk and capex too

Potential new source of lithium

- Low-cost processing to ‘PLS’ in some clays
  - Cypress / Global Geoscience have sulphuric-soluble lithium at atmospheric pressure
  - Enables simple leach to produce lithium in solution
  - Low sulphuric acid (200-400kg/t) when compared to eg laterite leach
  - Total cost **to PLS** ~US$4,500/t LCE for 1.2% Li grade
  - Then has same brine ‘back end’ costs, eg Mg/Ca/B removal reagents, evaporators etc
- Other clays require roasting
  - This puts the lithium in solution
  - Roaster has higher capex and technical risk than heap or vat leach
  - Then requires deleterious removal and lithium precipitation

Just because it hasn’t been done before doesn’t mean it can’t be done!

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