Sediment Hosted Lithium – the unconventional hydrocarbon of the new energy economy?

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Unconventional Hydrocarbons

**Conventional**
- High permeability
- Fracking: minimal
- Principal evaluations:
  - Trap
  - Seal
  - Source
  - Reservoir
  - Migration
  - Timing
- Primary risk: geologic
- Access: vertical wells

**Unconventional**
- Ultra tight rock
- Fracking: large, hydraulic
- Principal evaluations:
  - Kerogen content
  - Maturity
  - Clay content
  - Pressure
  - Bulk volume
  - Hydrocarbon
- Primary risk: economic
- Access: horizontal wells
Significant impacts

- Yet in 2009 the US passed Russia as the world’s largest producer of gas; domestic gas price falling.
- By 2013 LNG terminals converted to export LNG & coal fired power stations switching to gas.
- US became the world’s largest crude oil producer in 2018; expected to be a net energy exporter by 2020.
- Making US industry more competitive with additional geopolitical implications.

Sources: US EIA Annual Energy Outlook 2019 and other reports
US industry growth factors

- Geology
- Technology
- Infrastructure
Worldwide Li demand increasing at CAGR ~17% (UBS).

100% of growing US Li-ion supply chain demand is satisfied by imported Li chemicals and finished products.

One small US operation (brine).

“the US produces 1% of global lithium supply and only 7% of the refined lithium chemical supply while China produces 51%” (Simon Moores, Benchmark Mineral Intelligence 2019).

Chronic import reliance recognized by Federal agencies:

- US Department of the Interior report June 2018 includes Lithium as critical to economic and national security.
- Bipartisan Bill ‘American Minerals Security Act’ introduced May 2019 to secure mineral resources and reduce reliance on foreign sources.
Growing US demand

- US Li-ion battery factories planned or under construction will require ~66 ktpa Li carbonate.
- Demand from US car industry expected to grow further.

Sources: various company public releases
• Current supply from pegmatite and brine sources.
• Sediments a potential new source of large amounts of Li.
• Identified by USGS in 1970’s.
• Lithium is hosted within or adsorbed onto clay minerals.
• No commercial production yet, but adequate scale for long mine lives (>16Mt of contained LCE in US alone).
• Proposed process routes leach or calcine-leach lithium and other elements.
• Pilot plant in Mexico has produced battery grade carbonate for 2 years (Bacanora Lithium plc, AIM:BCN).
• Second pilot plant shortly to commence operation in Nevada (Lithium Americas TSXV:LAC).
Outcropping lithium rich sediments at McDermitt. Images: Jindalee
Existing projects

- Published sediment hosted lithium resources in US host >16Mt contained LCE.
- Long mine-life development options.
Feasibility studies show sediment hosted Li projects can be long life, highly competitive sources of battery chemicals.

**SEDIMENT HOSTED LITHIUM OPEX FROM RECENT STUDIES**

- LAC: US$4088 no by-products
- BCN: US$3910 incl. by-products
- LAC: US$2570 incl. by-products
- INR: US$1796 incl. by-products

*Sources: Canaccord 30/10/2018 and various company reports*
Four holes drilled September 2018 intersected significant thicknesses of flat lying Lithium mineralization.

Open in all directions and at depth.

JRL’s ASX announcement 8 November 2018: “More wide intercepts from McDermitt Lithium Project”.
McDermitt Exploration Target*

*Note that the potential quantity and grade of the Exploration Target is conceptual in nature, there has been insufficient exploration to estimate a Mineral Resource and it is uncertain if further exploration will result in the estimation of a Mineral Resource.

- Continuity of mineralised zones supports Exploration Target Range of 160-780Mt @ 1300-1600 ppm Li².

<table>
<thead>
<tr>
<th>Cut Off (ppm Li)</th>
<th>Lower (Mt)</th>
<th>Upper (Mt)</th>
<th>Grade Range (ppm Li)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>160</td>
<td>780</td>
<td>1300-1600</td>
</tr>
<tr>
<td>1500</td>
<td>40</td>
<td>210</td>
<td>1800-2200</td>
</tr>
<tr>
<td>2000</td>
<td>20</td>
<td>80</td>
<td>2100-2600</td>
</tr>
</tbody>
</table>

- Imminent follow up drilling to support resource estimation.
- Mid-range of Exploration Target would contain ~2.5Mt LCE.
- Metallurgical tests show up to 97% of Li can be leached using conventional means in 2 hours³.

² JRL’s ASX announcement 20 November 2018: “Lithium Exploration Target at McDermitt”.

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Conclusions

- US heavily reliant on Li imports, 100% of growing Li-ion demand satisfied by imported material.

- One US producer.

- A domestic supply option is available:
  - Geology - huge amount of contained Li (10’s Mt LCE).
  - Infrastructure – chemical industry, transport,..........
  - Technology – conventional extraction processes – future improvements?
  - *Bonus* - no currency or political risk for US consumers (e.g. Tesla), plus tariff advantage.

- No technological constraint, but lack of an operating example and perceived high CAPEX are key hurdles. Two pilot plants and current domestic energy security focus mean these hurdles will likely be overcome in the near future.

- Jindalee is well placed with a large, 100% owned ground position over this key deposit style.

- Not a question of if, but when will the US have its ‘unconventional’ Li moment?
Competent Persons Statements:
The information in this presentation that relates to Exploration Results is based on information compiled by Mr Pip Darvall. Mr Darvall is an employee of the Company and a Member of the Australasian Institute of Mining and Metallurgy and the Australian Institute of Geoscientists, and has sufficient experience relevant to the style of mineralisation and type of deposit under consideration and to the activities undertaken, to qualify as a Competent Person as defined in the 2012 Edition of the ‘Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves’ (JORC Code). Mr Darvall consents to the inclusion in this presentation of the matters based on the information in the form and context in which it appears.

The information in this Report that relates to the Exploration Target for the McDermitt deposit is based on information compiled by Mr. Arnold van der Heyden, who is a Member and Chartered Professional (Geology) of the Australian Institute of Mining and Metallurgy and a Director of H&S Consultants Pty Ltd. Mr. van der Heyden has sufficient experience relevant to the style of mineralisation and type of deposit under consideration and to the activity being undertaken to qualify as a Competent Person as defined in the 2012 Edition of the ‘Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves’ (JORC Code). Mr. van der Heyden consents to the inclusion in this report of the matters based on the information in the form and context in which it appears.
Appendix 1 - Processing Routes

- Brine:
  - ‘Mine’
  - ‘Crush’
  - Leach
  - Purify

- Sediments:
  - Mine
  - Crush
  - Concentrate
  - Calcine
  - Leach

- Lithium sulphate solution:
  - Purify
  - LiCO₃
  - LiOH

- CAPEX figures for brine and sediment projects include the co-located processing plants producing the chemical outputs.
- Processing plants (and their costs) are typically not incorporated into pegmatite projects.

Sources: Various company presentations and studies.
Oil price war 2014, continued innovation allowed shale industry to remain competitive and OPEC capitulated in 2016.