“EXPLORING FOR LCT PEGMATITES IN CANADA AND AUSTRALIA”

Everyone’s talking about Lithium... and they should be, “It’s the next gasoline.”  
Brian Colwell

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Discussed

• granite fertility and LCT pegmatites;  
• geological setting and controls of lithium deposits;  
• explorations techniques;  
• analytical methodology including conventional laboratory analysis and non-convention non-destructive methods
Key References


"Battery storage will revolutionize the renewable energy sector by reducing the need for network investment.”

*Simon Corbell*
LCT Pegmatites represent the most highly differentiated and last to crystallize components of certain granitic melts.

- are typically derived from fertile zone of parental per-aluminous, S-type granite.
- Have a ‘granitic’ primary composition: quartz, potassium feldspar, albite and muscovite.
- May therefore have spodumene, petalite, lepidolite, leucite and pollucite. Other diagnostic minerals include beryl and tourmaline.

LCT Pegmatite – Mavis Lake Ontario

LCT Pegmatites have a Structured Internal Zonation

Deposit-scale zoning patterns in an idealised pegmatite, (after Cameron (1949), Černý (1991), Fetherston (2004))
A First-order Filter in the Search for Fertile Granite is the Geological and Temporal Context.

- Occur along large regional-scale faults in greenschist and amphibolite-facies metamorphic terranes.
- Most commonly, age is that of orogenic granites: Ca 2650, 1800 525, 350 Ma, being times of collisional orogeny and supercontinent assembly.
- The largest emplacements of fertile granites and LCT pegmatites are of Archean age.
- Hosted in mafic metavolcanics or metasedimentary rocks, near peraluminous granitic plutons.
- Geochemically unusual elemental ratios: e.g. A/CNK>1, Li/Mg>10

Zonation Around the Source Granite: The Goldilocks Zone

- Greatest enrichment of economic elements occurs concentrically around fertile parent granite.
- LCT pegmatites are known to form as far as 10km from the parental granite.
- Pioneer’s observations indicate that for lithium, the distance from the parent intrusion is commonly 1.0-4.0 km. The “Goldilocks Zone”.
- Successive zones in the most fractionated pegmatites marked by beryl, then tantalite and spodumene, and finally pollucite.
- Most LCT pegmatite bodies show some sort of structural control in host rocks.
Rare metal pegmatites occur along large regional-scale faults

World map showing the locations of LCT pegmatite deposits or districts, including smaller districts in the United States. The symbols are colour-coded by age. Giant deposits are represented by larger symbols (Bradley and McAuley 2013)

Zonation Around the Source Granite: The Goldilocks Zone

Making use of Government Data #1

LCT Pegmatite

Breaks' Fertility Index

Lithium Litho geochemistry Results

Mavis Lake

Raleigh
Glacial pavement, muskeg and pine forest. Soil is not ubiquitous. Rock chip chemistry is the norm.

Fred Breaks, ILC and Pioneer geologists and First Nation Representatives at Mavis Lake PEG003, May 2016.

Rock sampling at Mavis Lake PEG018, Ontario, Canada.
Holmquistite needles from Raleigh (Breaks)

Holmquistite, Uto, Sodemanland, Sweden. (Breaks, 2012)

Characteristic dark blue radiating crystal arrays are an important mineralogical indicator of lithium dispersion from pegmatite bodies.

*Holmquistite alteration halos in areas at Mavis Lake, in excess of 25m, are quite possibly the most extensively developed examples of its type in North America.*

Lithium Litho Geochemistry Results

Lithium Litho Geochemistry Results

Mavis Lake

Raleigh
Spodumene sheets at the Raleigh Project

Spodumene in outcrop at Peg003, Fairservice Prospect

Spodumene chevrons at Peg018, Mavis Lake. This has not ben drilled.
Not Just Geochemistry – Continuous-Reading Ground Magnetics

Mavis Lake Project: The Wet Part

Back to the Future
Pioneer Dome Revisited
Pioneer Dome

Granite Fertility (after Breaks)  LCT Pegmatite Occurrences

Data Source

Government Data: #2
The Goldilocks Zone: Pioneer Dome

Using a pXRF for Lithium Exploration: PEG008 A Blind Test Case
Pioneer Dome PEG008: Extended

Lithium Wet Chemistry vs Lithium Index

Pegmatite 8 geochemical anomaly (LITHIUM Index) now 2.7km long.

Proof is in the pudding..... Drilling Starts September 2016

Data Source

Australian Government
Geoscience Australia

Making use of Government Data: #3

Map showing the distribution of lithium in stream sediments, known lithium occurrences and the Phillips River Project

- Lithium Occurrence
- PIO’s Tenements
- Sample Site: lithium value
- Sample Site: NSA
Phillips River Stream Sediment Sampling

Aqua regia digestion

<table>
<thead>
<tr>
<th>Lithium Value</th>
<th>2mm fraction</th>
<th>75µm fraction</th>
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</thead>
<tbody>
<tr>
<td>TOS (0-10 cm)</td>
<td>40 ppm</td>
<td>88 ppm</td>
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<tr>
<td></td>
<td></td>
<td>TOS (Top outlet sediment)</td>
</tr>
</tbody>
</table>

Highest Li value recorded in Australian SS

- 88 ppm
- 40 ppm

6th highest Li value recorded in Australia

- 79 ppm
- 24 ppm

Fourth highest Li value recorded in Australian SS -2mm fraction

- 79 ppm
- 24 ppm

-75µm fraction

TOS (0-10 cm)

BOS (60-80 cm)

BOS (Bottom outlet sediment)

Making use of Government Data: #4

Mineral exploration reports (WAMEX)

Map showing lithium targets from roadside soil sampling

Map showing lithium values in roadside soil sampling

Modified PEG-4 (f(As,Sb,Sn,Nb,Ta))

values from regional road sampling (After Smith et al, 1986)
Conclusions

• The Pegmatite emplacement model is reasonably simple and seems predictable
• Government datasets make an invaluable start
• In Canada, where soils are inconsistent, rock geochemistry and minerology (holmquistite) provides a key vector
• In Western Australia, soil geochemistry seems to work. Drilling will confirm shortly!
• Modern pXRF’s show capacity for estimating lithium content by providing a lithium index

Bibliography


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