Separation Rapids Lithium Project: After 25 years its time has finally come!

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Avalon Advanced Materials: Corporate Info

› Toronto-based, operating in Canada since 1995
› Listed: TSX (AVL), OTCQB (AVLNF), Frankfurt (OU5)
› Market Cap: CAD$50m (389.5m S/O, 462m fully-diluted) with over 20,000 shareholders worldwide
› Working Capital: CAD $3.5 million

2021 Sustainability Report

Sustainability: committed to environmentally and socially responsible mineral resource development
› Avalon’s 10th annual GRI compliant Sustainability Report released November 2021 - addresses GRI framework, UN 17 SDGs and MAC’s TSM
› Received an excellent Sustainalytics ESG risk rating licence following audit Avalon’s business practices and policies to attract interest from new ESG investors

Aligns Avalon’s operating philosophy with its cleantech customers and reduces social licence risk
Critical Minerals for Clean Technology

Project Pipeline

Nechalacho
- Rare Earths
- Be-Li-Nb-Ta-Zr

Lilypad
- Cesium-Tantalum-Lithium

Separation Rapids
- Lithium
- Cs-Rb-Ta-Feldspars

Cargill
- Phosphate

Warren Township
- Anorthosite

East Kemptville
- Tin-Indium
  - Cu-Zn
The Challenges Ahead

› Production of Critical Minerals is more like an *advanced manufacturing* business where it is about recognizing the market opportunity & designing an appropriate or innovative extraction process to make a product that will meet the needs of the end-users.

› Mining Regulations need to adapt to fundamental differences from traditional mining as it is not simply about tons and grade. Production rates are defined by market size not resource size and should be designed to be scalable as demand grows.

› Therefore bulk sampling and process testwork at an early stage are critical to establishing the business opportunity and securing offtake commitments.

› This is why mine wastes offer such an interesting opportunity, the mining is already done!
Recent developments in Ontario relevant to Separation Rapids

› Ontario recently announced its first-ever Critical Minerals Strategy to support a made-in-Ontario electric vehicle supply chain:

  • Attracting EV and battery manufacturers to establish plants in Ontario which resulted in Stellantis and LGES recently announcing plans to establish such facilities in Ontario
  • Supporting establishing the mid-stream processing capacity to produce the required lithium battery materials
  • Investing in innovation, research and development
  • Improving the regulatory framework to encourage more international investment in mineral development in Ontario
  • Building new economic development opportunities for Indigenous partners and remote First Nation communities/

› The recent Federal government budget also announced new funding support for establishing critical minerals supply chains
The Critical Minerals Opportunity for Canadian First Nations

- Many opportunities exist to develop new resources for critical minerals in northern Canada that occur in northern regions offering impoverished First Nations new economic development opportunities.
- Can be developed at a small scale involving minimal environmental impacts and requiring relatively small initial capital investments compared to a typical new mine.
- Indigenous business can participate directly in implementing environmentally and socially responsible cleantech materials development in northern Canada.
- Additional opportunities for creating new downstream value-added clean technology businesses in the supply chain including lithium battery materials.

Rare earths and other critical minerals are essential for effective wind turbine motors and solar panel technology.
Separation Rapids is located close to transportation and power infrastructure.
There are two main lithium ore minerals in the Separation Rapids LCT pegmatite: petalite & lepidolite.

Petalite is the predominant lithium mineral, with lepidolite occurring in distinct subzones comprising 20% of the resource.

- **Petalite** ($\text{Li Al Si}_4\text{O}_{10}$) contains 4.5% $\text{Li}_2\text{O}$ with no impurities.
- **Lepidolite** ($\text{K(Li,Al,Rb)}_2(\text{Al,Si})_4\text{O}_{10}(\text{F,OH})_2$) is a lithium mica containing other elements including cesium.

They can each be concentrated to make saleable products:

- Petalite can be used both as an industrial mineral for high strength glass and as a high purity feed to make battery grade lithium hydroxide or carbonate.
- Lepidolite concentrates are being used increasingly for production of battery grade lithium carbonate.

Tantalum minerals are also recoverable along with Rubidium-rich K-feldspars as an industrial mineral by-product.
Regional trend of lithium pegmatites, where exploration commenced in summer 2018 on new claims acquired in 2017 and several new targets developed.

All claims, leases and the aggregate permit are 100% owned by Avalon.
The Lithium Battery Materials Supply Chains Opportunity in Northwestern Ontario

- NWO hosts lithium pegmatites of various sizes and mineralogy. To start production the next step is to establish the mid-stream processing capacity to process concentrates to produce the battery materials.

- Thunder Bay is ideally located with excellent transportation infrastructure to serve both provincial and international markets with numerous industrial sites available for a refinery.

- The refinery in T-Bay will be a separate business that can accept concentrates from any producer in NWO.

- Ontario government now committed to supporting the establishment of EV and battery manufacturing capacity along with the critical materials supply chains as a new Industrial Strategy for Ontario.

Lakehead University in T-Bay has a respected Earth Sciences Program and plans to increase relevant Critical Minerals & Materials Engineering research.
On April 4 Avalon announced it had signed a binding LOI with the Mumbai, India based Essar Group to collaborate on establishing the lithium battery materials supply chain in northwestern Ontario.

Essar will become a co-owner of Avalon Lithium Inc, a new AVL subsidiary established as the business entity that will own the lithium refinery.

Essar will provide funding to support the next steps including final feasibility studies and site preparation work at both Separation Rapids and the industrial site for the refinery in Thunder Bay once it is secured.

Avalon now has considerable off-take interest in the lithium hydroxide product from emerging battery manufacturers both in Ontario, the U.S. and in Europe, who may also be willing investing partners in the refinery.

There is also local Indigenous business interest in investing in the refinery and potential for government funding support as part of the new national critical minerals strategy.
Separation Rapids Lithium Project
2016 PEA Model Highlights ($CAD)

- Assumes open pit mining at 950,000 tpy with concentrator at site to recover petalite and Refinery in Kenora or Thunder Bay to make LiOH
- Minimum 10-15 year life lithium, 20 years for feldspars
- 14,600 tpy lithium hydroxide and 100,000 tpy feldspars
- Prices: US$11,000/tonne LiOH and US$170/tonne feldspars
- Current lithium hydroxide prices exceed US$20,000/tonne
- Average lithium hydroxide production cost: US$4900/tonne
- F/X US$1.00 = CAD$1.30
- IRR: 19% pre-tax, 16% after-tax, now 42.1% pre-tax, 34.7% after-tax
- NPV (8% Discount rate): $343 million pre-tax, $228 million after-tax
- NPV now: $1.74 billion pre-tax, $1.16 billion after-tax
- CAPEX: $514 million (now $900 million incl. $600 million for refinery)

Note the PEA is preliminary, includes inferred mineral resources considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as mineral reserves. There is no certainty that the preliminary economic assessment will be realized.
**Lithium is not just a battery material: also critical for high strength glass-ceramic products**

- Lithium additions create thermal shock resistance in: Stovetops, Corningware® Cookware, Fireplace Shields
- Now being used in many new high strength glass products, such as Corning’s Gorilla Glass (display screens and automotive) and high strength flexible glass
- Glass-ceramic products are also being used in advanced aerospace and defense technologies (hermetic seals)
- **Petalite, as a very high purity lithium aluminum silicate mineral, is the ideal form of lithium addition to the batch**
  - Petalite is a very rare mineral and Separation Rapids is the only potential large supply source in North America
- Lithium additions can also strengthen traditional container glass formulations to extend the life of the container

Petalite is used in many high-strength glass applications, such as electronic screens.
Separation Rapids Next Steps: Moving toward Phase 1 Production Facility

- **2020-21 work**: Continued process optimization work and secured permit to recover 5,000 tonne bulk sample which was collected in March, 2021
  - Determined that Thunder Bay is ideally situated to locate battery materials refinery

- **2022**: $10-15 million program planned to begin small scale DMS processing of bulk sample to produce petalite product samples for glass-ceramics
  - Secure off-take agreements and arrange project financing to expand production
  - Complete Feasibility Study-level cost estimates, project engineering and pilot plant work to optimize lithium battery materials process flowsheet & costs for the refinery and confirm the location for the refinery on a vacant industrial site in Thunder Bay
  - Complete environmental assessments and project permitting
  - Continue exploration to define additional petalite resources on NW part of property

- **2023-4**: Begin small scale commercial operations with sales of petalite and mineral by-products while new battery materials refinery is constructed

- **2025-6**: Begin battery materials production
Avalon’s 100% owned Lilypad Project hosts a significant resource of the rare cesium mineral pollucite along with tantalum and lithium and recently re-activated the Project in June, 2021

What is Cesium and why is it important?

- Mainly used to create a low viscosity fluid for drilling deep oil wells called cesium formate

- With advances in technology, cesium is in growing demand because of its potential in many high-tech applications

- Atomic clocks & GPS, Specialty glasses, Ion-propulsion motors, High-density alkaline batteries, *to name a few*

- Production from traditional sources is in decline and there is a global supply shortage at present

- Cesium products now selling for up to $US 5,000/kg
Lilypad Pollucite Dyke

- 340,000 tonnes @ 2.294% Cs$_2$O and 0.037% Ta$_2$O$_5$ (plus lithium) delineated in 2001-2003 drilling programs*
- Cesium grades increase with depth, open at 300m below surface
- “Western extension” new, undrilled zone of dykes 200m to southwest with two grab samples containing 4.62% and 2.11% Cs$_2$O
- Strong cesium lithogeochemical anomalies in surrounding volcanic outcrops

*Cautionary note: the resources described above are considered historic under NI43-101 guidelines and have not been verified by a QP and therefore should not be relied upon.
East Kemptville Tin–Indium Site Location and Regional Infrastructure

- On paved highway
- Grid power on site
- Yarmouth (55 km) & other communities within commuting distance
- Ample water
- Skilled labour available locally
- Strong local community support (TREPA, AFN)

Power lines
- 69kV
- 138kV

East Kemptville location, 270 km west of Halifax
Metals Most Impacted by New Technology:  
*Tin is No. 1!*

Tin now in very short supply and trading at record high prices over US$30,000/t

Source: MIT / Rio Tinto, March, 2018

CRITICAL MATERIALS FOR A SUSTAINABLE FUTURE
Tin in new technologies

• Electronics materials
  • Solders on circuit boards Smartphones
• Electric Vehicles
  • Power electronics
  • Wiring and connections
  • Charging stations
  • Lithium battery anode technologies
• Solar Energy Systems
  • Solar ribbon
  • Junction boxes and connections
  • Perovskite solar cells
• 5G Communications
• Tin Selenide for heat harvesting
• Hydrogen production
• Carbon capture catalysts
East Kemptville Tin Mine History

- Deposit discovered in 1976 by Shell Canada, later purchased by Rio Algom in 1982. Original mineable reserve was 55.3mt @ 0.164% tin
- Mined roughly 25mt from 1985-92 and has been the only primary tin mine in North America. Also produced some by-product copper, zinc & silver
- Closed prematurely in 1992 due to poor tin recoveries and drop in tin prices
- Significant mineral resources left both in ground and in large surface stockpiles of low grade ore
- 10,000 tpd mill removed and pits flooded
- Operated only as a closed mine site since 1992 to treat acid mine drainage
Avalon’s East Kemptville Project History

2010: Avalon completed Desktop Study on re-development potential
2015: Scoping Study completed on 10,000 tpd production re-start scenario.
2016: Small-scale (2,400 tpd) development concept created to utilize stockpiles to initially produce tin concentrates and integrate site remediation into business plan; gravity process flowsheet optimized.
2017: LOI signed with surface rights holder (BHP) toward agreement to acquire full site tenure and provide financial assurance to the Province.
2019: After reaching agreement, new BHP management refused to sign
East Kemptville Site Layout & Tin Resources

- **Existing Tailings Dam** with spare capacity, 18.8 M tonnes historical tailing
- **North Waste Pile:** 1.29M tonnes @ 0.089% tin
- **Low-grade Stockpile Inferred Resource:** 5.87M tonnes @ 0.112% tin*
- **In-ground Main & Baby Zone combined resources:**
  - Measured: 0.58Mt @ 0.203% tin
  - Indicated: 22.39Mt @ 0.152% tin
  - Inferred: 14.25Mt @ 0.139% tin

*The stockpile resources are considered Inferred under NI43-101 guidelines and should therefore not be relied upon.

(Resources as of May 7, 2018 for PEA
Bill Mercer (P.Geo) is QP
Historic resource prepared by previous operators, not treated by the Company as NI43-101 defined resource estimates and should not be relied upon.)
Other Critical Minerals Potential: Indium, Gallium, Germanium and Lithium

- Zinc concentrates are highly enriched in **indium** (0.25%) from which an indium product could be derived.
- Indium is in growing demand for use in solar panels, LED Lighting and LCD flat panels. Prices are increasing.
- Along with Indium, the resource contains potentially recoverable **gallium** and **germanium** apparently associated with sulphides. Germanium is very rare and in demand for optical fibres.
- The wallrocks also contain potentially recoverable **lithium** occurring in micas (polylithionite, zinnwaldite).
- Several closed tin mines in Europe (Cornwall, UK and Czech Republic) are now being evaluated as lithium opportunities.
Advances in sensor technology now allow for detection of physical properties of minerals, such as specific gravity. Minerals can be concentrated after crushing without using water or chemical reagents.
East Kemptville Small Scale Staged Re-Development Model

› Begin by processing low grade ore stockpiles and waste rock piles for tin recovery using sensor-based ore-sorting technology
  • The effectiveness of this technology to concentrate cassiterite was successfully demonstrated in 2019 by Cronimet Ag after testing a bulk sample recovered from the low-grade ore stockpile
  • Test new technologies to liberate cassiterite and reduce losses through overgrinding

› Conduct additional mineralogical studies and process testwork on bedrock samples to define efficient ways to recover lithium and indium along with copper and zinc and potentially germanium and gallium
  • At the same time, initiate systematic sampling of the stacked tailings pile to define resources and begin evaluating potential extraction techniques.

› While starting production with the stockpiles, evaluate the potential for recovering trace elements from the acid mine drainage using the Nano Beads technology
Advanced Nechalacho REE & Zirconium Project, NWT

Unique Heavy Rare Earth-rich and High grade Zirconium resource (66mt) averaging over 3.0% ZrO2 & 1.5% TREO (of which 20% of the TREO are Heavy Rare Earths) plus Nb and Ta

Bankable Feasibility Study in 2013 showed NPV of CAD$1.35B (10% disc. rate) and Pre-Tax IRR of 22.5%. China then removed the export quotas, REE prices dropped, off-take interest disappeared and the project was put on hold

Project re-activated in 2019 to consider small scale development of satellite near-surface light rare earth deposit (T-Zone) which was sold to Australian company, Cheetah Resources,

Once operations are started, development of Avalon’s original resource can also be initiated once new demand is created in NA. Growing demand for both rare earths & zirconium is creating much new interest, especially in zirconium, a critical material needed for small modular nuclear reactors and other new technologies.
Experienced Management Team and Diversified Board of Directors

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