Developing the Supply Chain for the Clean Economy in Canada

Lithium, Tin & Rare Earths

May 2020
Don Bubar
President & CEO
Safe Harbour Statement

Forward looking information

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Who is Avalon Advanced Materials?

› Toronto-based, operating in Canada since 1995
› Focused on critical minerals and cleantech materials with near term production potential
› Listed: TSX (AVL), OTCQB (AVLNF), Frankfurt (OU5)
› Market Cap: CAD$15m ((341m S/O, 374m fully-diluted) ) with over 20,000 shareholders worldwide

Sustainability: committed to environmentally and socially responsible mineral resource development

› Avalon’s 8th annual GRI compliant Sustainability Report released November 2019 - addresses GRI framework, UN 17SDGs and MAC’s TSM
› Aligns Avalon’s operating philosophy with its cleantech customers and reduces social licence risk
Avalon’s Vision and Mission

Establish a diversified clean technology materials business, built on strong environmental and social performance.

Create shareholder value and long term growth through sustainable development of our critical minerals (lithium, cesium, tantalum and rare earths) assets.

Focus on opportunities to generate near term revenue and growth
Avalon’s Sustainable Resource Development Strategy

- Focus on materials that enable clean technology
- Design the operation to minimize environmental impacts and plan for productive use of the land post closure
- Minimize GHG emissions and water impacts
- Focus on process efficiency, minimizing waste and maximizing productive use of the resource
- Engage in dialogue early and often with local Indigenous communities to listen to their concerns and identify opportunities for partnerships, job creation and training
- Apply a staged development approach, starting at a modest scale, to minimize project footprint and potential risks to environment, while also reducing investment risk
- Focus on near-term revenue with growth potential
Avalon’s Strategy for Growth and Value Creation

**Staged development**: Create a platform for growth with a demonstration scale production facility to prove process and introduce products to cleantech customers for approval

› Achieve initial production and positive cash flow at a small scale with scalability to increase production as product demand grows

**Product design**: Work with our customers to create quality products to serve their needs at attractive prices

› Target cleantech and high tech growth industries, such as aerospace, where energy efficiency and “light-weighting” are key drivers on demand

**Innovative metallurgy**: Design an efficient process flowsheet and new technology to produce the best quality products at the lowest cost, while minimizing waste

› Utilize new ore sorting technology to increase efficiency and lower costs & innovate new hydromet processes for lithium battery materials
Critical Minerals for Clean Technology

Project Pipeline
Cleantech materials, such as *lithium and rare earths*, are not basic commodities!

- They are highly refined chemical products with demanding specifications designed to meet the needs of end-users.
- Define the market to be served and design an appropriate mineral recovery and extraction process to develop new resources.

**Clean Energy**
- i.e. solar panels, wind turbine motors, electric vehicle engines, LED lights, energy storage

**Aerospace & Defense**
- i.e. jet engines, space shuttles, missile detection & guidance

**Energy Efficiency**
- i.e. rechargeable batteries, electric motors, GPS systems

**Modern Electronics**
- i.e. circuit boards, hard drives, screen displays, high strength glass

**Medicine**
- i.e. MRI & x-ray, radiation therapy, vision improvements, medications
Since 2010, Avalon has been known primarily as a Rare Earths equity in the US

Rare Earths see price spike and major media publicity because of China imposing export quotas

Price jumps in reaction to news on rare earths in context of US/China trade war
Separation Rapids Lithium
A rare LCT type of pegmatite deposit enriched in the lithium minerals petalite and lepidolite

Large, high quality resource amenable to open pit mining, discovered in 1996
› PFS initially completed in 1999 on model to produce petalite for glass and ceramics, model updated in 2018 as a PEA
› Secure Tenure under Lease: 100% owned
› 6,000 acres of exploration lands
› Road access, proximity to clean hydro-power allow low carbon intensity
› Strong community support: will diversify local economy and create jobs
› No acid mine drainage or toxic heavy metals in the deposit

Discovery outcrop after clearing for mapping in 1998
First Nations Relationships:
Separation Rapids Lithium Project

- 2013: Renewed MOU with Wabaseemoong Independent Nations (WIN) first signed in 1999
- Committed to maximizing business & partnership opportunities for WIN during operations and post closure
- WIN leadership are supportive of the Project
- Community members continue to have active involvement

Original MOU signing in 1999
Separation Rapids is located close to transportation and power infrastructure.
Lithium Minerals at Separation Rapids

- 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** (Li Al Si$_4$O$_{10}$) typically contains 4.5% Li$_2$O with very low impurities.
- **Lepidolite** (K(Li,Al,Rb)$_2$(Al,Si)$_4$O$_{10}$(F,OH)$_2$) is a lithium mica containing other elements.
- 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.
Lithium is not just a battery material: also critical for high strength glass-ceramic products

Glass-Ceramics

› 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
2018 Updated PEA Highlights

› Simplified business model with initial focus on production of lithium mineral concentrates for glass and ceramics
› Production of 71,500 tpa petalite, 11,800 tpa lepidolite
› Initial CAPEX: C$77.7 million (475,000 tpa mill capacity)
› Feldspar circuit added in Year 6 (C$13.7 million CAPEX)
› 20 year operational life
› Average Annual Revenues: C$90 million
› Average Annual Costs: C$60 million
› NPV pre-tax (8% discount rate): $156 million
› IRR (pre-tax): 27.1%     IRR (post tax): 22.7%

The PEA is preliminary in nature, includes Inferred mineral resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as mineral reserves, and there is no certainty that the PEA will be realized.
## Separation Rapids Lithium Deposit
### Mineral Resources Estimate (May 22, 2018)

#### Petalite Zone (PZ)

<table>
<thead>
<tr>
<th></th>
<th>Mt</th>
<th>% Li₂O</th>
<th>% Ta₂O₅</th>
<th>% CsO</th>
<th>% Rb₂O</th>
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#### Lepidolite-Petalite Zone (LPZ)

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<th>Mt</th>
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<th>% Ta₂O₅</th>
<th>% CsO</th>
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#### Total PZ+LPZ

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<tr>
<th></th>
<th>Mt</th>
<th>% Li₂O</th>
<th>% Ta₂O₅</th>
<th>% CsO</th>
<th>% Rb₂O</th>
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<td>0.007</td>
<td>0.018</td>
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Footnotes:

1. This resource estimate is valid as of May 22, 2018.
2. CIM definitions were followed for Mineral Resources.
3. The Qualified Person for this Mineral Resource estimate is William Mercer, PhD, P.Geo. (ON).
4. The resource estimate is based on Avalon’s drilling of 74 previous holes totalling 11,644 metres drilled between 1997 and 2017 and a further four holes totalling 1,282 metres in 2018.
5. Drill data was organized in Maxwell DataShed and for estimation purposes was transferred to Geovia GEMS 6.8 software, wherein the block model was developed.
6. The geological units were modeled as outlined by drill core logs.
7. Resources were estimated by interpolating composites within a block model of 10 x 10 x 3 metre blocks oriented along the deposit strike.
8. Grade interpolation used the Ordinary Kriging method combined with variograms and search ellipses modeled for each rock unit. For PZ unit, search ellipses of 50 x 35 x 15 m and 175 x 125 x 45 m were used for Passes 1 and 2, respectively. For LPZ unit, search ellipses of 35 x 25 x 8, 75 x 50 x 15 and 115 x 75 x 25 were used for Passes 1, 2 and 3, respectively.
9. Measured material was defined as blocks interpolated using Passes 1 and 2, using composites from ≥ 24 drill holes and a distance ≤ 25 m to the nearest composite and additional blocks with excellent geological and grade continuity. Indicated material includes blocks interpolated with Pass 1 and 2 search ellipses, using ≥ 3 drill holes and a distance ≤ 35 m to the nearest composite and blocks with geological and grade continuity. Inferred material was defined as blocks interpolated with all Passes, composites from ≥ 2 drill holes and interpolated geological continuity up to 40 m below diamond drill holes.
10. Two metre composites were used and no capping was necessary.
11. The mean density of 2.65 t/m³ was used for unit 6ABC and 2.62 t/m³ for unit 6D.
12. The cut-off grade reported in this resource estimate, 0.6% Li₂O, is consistent with the previously published resource estimates by Avalon (Preliminary Economic Assessment, 2016; November 15, 2017 resource estimate).
13. Mineral resources do not have demonstrated economic viability and their value may be materially affected by environmental, permitting, legal, title, socio-political, marketing or other issues.
Separation Rapids Next Steps: Moving toward Phase 1 Production Facility

- **2019 work:** Continued process optimization work and permitting to extract up to 5,000 tonne bulk sample for pilot plant processing
- **2020:** $3-5 million program planned to prepare for construction of mine and process plant in 2020-21 to produce lithium mineral concentrates
  - Bulk sample processing to produce more lithium mineral product samples and finalize process flowsheet and plant design parameters
  - Secure off-take agreements and arrange project financing (in progress)
  - Complete FS-level cost estimates and project engineering
  - Complete environmental assessments and project permitting
- **2022:** Begin commercial operations, sales of petalite & lepidolite products
- **2023-25:** Initiate pilot plant work on lithium hydroxide battery material product for potential future production scale-up
Rare earths are found everywhere - from your smartphone to motor vehicle.
Rare Earths Markets: What has changed since 2013?

› Escalating demand for neodymium and praseodymium for use in high strength magnets - vital for electric motors in EV’s plus wind power, electronics and defense technology
› Rising prices of neodymium and praseodymium
› Limited supply sources outside China, as only Lynas Corp achieved commercial production after 2013
› US / China trade war creates new REE supply risk
› US government responds with Executive Order to provide funding to assist in creating new domestic REE supply chains with Canada’s participation
› Recent advances in process technology are creating opportunities to implement more efficient, lower cost, REE production methodologies with near term potential
Closed Mine Sites offer new Critical Minerals Opportunities

› Many historical mining operations were developed to produce one bulk commodity such as copper, but the resource contained critical minerals that were discarded as waste (as there was no market then)
› These historical wastes can now be treated as opportunities to sustainably recover critical minerals using new technologies while remediating the long term environmental liability
› Avalon is looking at implementing these new technologies, such as sensor-based ore-sorting, at a closed tin mine site in Nova Scotia.
› Other opportunities include a technology for extracting dissolved rare elements from acid mine drainage
Many closed mine sites have environmental liabilities associated with acid mine drainage. These acidic solutions can contain many elements of economic interest including:

- Rare earths, manganese, cobalt, nickel & zinc that are found in AMD from coal mine wastes
- Avalon is looking at this as an opportunity at a closed coal mine in Illinois called Will Scarlett

Avalon working with Precision Periodic, a US private company to implement a new extraction technology to recover the dissolved elements using an innovative nano-filtration method

Now planning to proceed with designing a demonstration facility to prove the process for implementation at a larger scale in the summer of 2020

Could also be used to recover arsenic from the leachates from old gold mine tailings
Metals Most Impacted by New Technology: *Tin is No. 1!*

Source: MIT / Rio Tinto, March, 2018
East Kemptville Tin: closed mine site with value in the wastes

- Operated by Rio Algom Ltd as a closed mine site since 1992, with water treatment system to manage acid mine drainage from stockpiles and tailings

- During the early years of operation, tin recoveries were less than 50% and associated metallic mineralization (copper-zinc-indium-gallium) was not recovered at all

- Therefore the stacked tailings, which are the main source of acid mine drainage, have very high contents of valuable metals that can be recovered economically using new process technologies

- Avalon’s model is to sustainably fully rehabilitate the site starting with processing low-grade stockpiles using ore-sorting technology, then re-processing the tailings and recovering dissolved metals from the acid mine drainage
East Kemptville 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)
Two Composite Views of Low Grade Ore Stockpile at East Kemptville

6 million tonnes of previously-mined tin ore now generating AMD

Can be re-processed to recover tin and remove need for perpetual water treatment
Sensor-based Ore-sorting Technology

Currently being tested by Cronimet to recover tin concentrates

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**
Cesium: another technology material supply chain now controlled by China

- Tech applications include: Atomic clocks and GPS, Catalyst in plastics, Speciality glasses, Ion-propulsion motors, High density alkaline batteries, Coatings for solar cells, Pharmaceuticals

- ~ 75% of cesium production is used to make cesium formate: a safe, high density, low viscosity fluid used in drilling deep oil wells

- 2017 price of cesium formate: US$ $55 / 25g lot

- Developed by Cabot Corp. based on resource of rare cesium mineral, pollucite at Tanco mine, MB
  - 2019: sale of the division to Sinomine

- Avalon’s 100% owned Lilypad Project hosts significant pollucite mineralization
Lilypad LCT Dyke Swarm

- Dozens of known LCT Pegmatites over a min. 10 km² area with grades of over 0.10% Ta₂O₅
- *Rubellite Dyke:* drilling yielded up 0.04% Ta₂O₅ over a 20 metre true wide and up to 0.833% Cs₂O / 22.0m Incl. 3.7% Cs₂O/2.0 m
- Numerous other undrilled dykes returned grades over 0.10% Ta₂O₅ in surface samples
- *Pollucite Dyke:* Avalon drilling in 2001-2003 delineated 340,000 tonnes @ 2.294% Cs₂O and 0.037% Ta₂O₅* to a depth of 300m (open)

*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.*
Proposed 2020 Work Program

› Baseline biogeochemical and soil surveys over known pegmatite areas (Pollucite, Rubellite Dykes)
› Biogeochemical and soil surveys over covered areas plus lithogeochemical sampling, particularly on the northern part of property, to identify new drill targets
› Bulk sampling of known occurrences, initial 50kg samples from Pollucite, Rubellite, and North Anomalies for bench scale metallurgical testwork
› Review and sampling of historic drill core at old campsite for grade confirmation and QA/QC purposes
› Rehabilitate existing exploration camp
Nechalacho Rare Earths Property
Regional Infrastructure

Where: Whati, Behchoko, Yellowknife, Fort Resolution, Pine Point, Fort Smith, Lutsel K’e, Thor Lake (Nechalacho Mine and Concentrator), Snare Hydro Dam, Bluefish Hydro Dam, Taltson Hydro Dam, Hay River/K’atl’odeeche, Canadian National Railway, Great Slave Lake, Barge Route 220 Km, Great Slave, Slave Lake, Potential Hydro Line, Proposed National Park, Regional Infrastructure.
Mining underground drift and fill/long-hole stoping at 2,000 tpd, or 730,000 tonnes per year (tpy)

Flotation process to produce 130,000 tpy of mineral concentrate

Hydrometallurgical treatment of mineral conc by sulphuric acid bake at Pine Point to yield 55,000 tpy of REE conc and 112,000 tpy of Enriched Zirconium Conc (EZC)

Rail shipment of REE Conc to Refinery in southern U.S. (Geismar, Louisiana)

Planned initial production of 7,000 tpy separated REE oxides plus EZC (with Nb, Ta, HREE)

CAPEX:
CAD$1.575 billion (incl. refinery and sustaining capital)

Operating Costs:
CAD$265 million/ year or $362/mined tonne of ore (all inclusive)

Revenues: CAD$646 million /year or $885/ mined tonne of ore

Pre-tax IRR: 22.5%

NPV @ 10%: $1.35 billion
# Measured and Indicated Resources in the Basal Zone at Various NMR Cut-offs (August 2013)

<table>
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<tr>
<th>Basal Zone</th>
<th>Tonnes (millions)</th>
<th>% TREO</th>
<th>% HREO</th>
<th>% HREO/TREO</th>
<th>% ZrO₂</th>
<th>% Nb₂O₅</th>
<th>% Ta₂O₅</th>
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<td><strong>US$345 NMR Cut-Off (Reflects entire Basal Zone)</strong></td>
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<tr>
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Co-ownership agreement with Cheetah Resources

Avalon and Cheetah Resources Pty Ltd. signed a purchase and sale agreement in June 2019 under which Cheetah acquired ownership of the near surface T-Zone and Tardiff Zone resources for C$5 million cash and Avalon retains its 3% NSR type royalty (subject to buy-out)

• High grade, near surface neodymium-praseodymium and dysprosium resources in T-Zone and Tardiff Zones provide potential for near term, small scale development to produce Nd-Pr-rich product using low-cost ore-sorting technology

• Avalon will retain 100% ownership of Basal Zone HREE Deposit (focus of 2013 Feasibility Study)
The Nechalacho Property hosts multiple polymetallic deposits

Section 417130 looking west

South & North Tardiff Zones

T Zones (including North T)

Cheetah

Basal Zone
HREE Resource

Avalon

For illustrative purposes only. Not to scale.
Environmental and Social Responsibility at Nechalacho, Thor Lake, NWT

- Leaders in Indigenous community outreach
- The name Nechalacho was formally conveyed by the YKDFN in a ceremony held at site in 2009 in respect of the First Nations’ traditional land use
- Nechalacho REE Project Accommodation Agreements (Specific to the Basal Zone development model)
  - Signed with Deninu K’ue First Nation and NWT Métis Nation (Participation Agreement)
  - Negotiations completed with Lutsel K’e Dene
  - Continuing engagement with NSMA, Yellowknives Dene, Tli Cho, KFN
- Completed and approved Report of Environmental Assessment
- Received preliminary construction Class A Land Use Permit (April 2014) and Class B Water License (May 2014) and site preparation initiated (both renewed in 2019)

Naming ceremony attended by YKDFN Chiefs Edward Sangris and Ted Tsetta
Experienced Management Team and Board of Directors

**MANAGEMENT**

- Jim Andersen, CA, CPA  
  V.P. Finance, CFO & Corporate Secretary
- Donald S. Bubar, P.Geo.  
  President & CEO
- Cindy Hu, CA, CPA  
  Controller
- Mary Kita, BA, M.Sc.  
  Director of Communications
- David Marsh, FAusIMM (CP)  
  Senior V.P. Metallurgy & Technology Development
- Bill Mercer, Ph.D., P.Geo.  
  V.P. Exploration
- Melanie Smith, B.Sc., J.D.  
  Senior Legal Counsel
- Mark Wiseman, B.Sc., MBA  
  V.P. Sustainability

**BOARD of DIRECTORS**

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  CEO
- Alan Ferry, CFA  
  Governance/Compensation Committee Chair
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