



Progress Report #14

October 9th, 2015

I am pleased to bring you up to date on the Canadian REE R&D Initiative (the Program) since our last Progress Report (#13) on Sept 11th. The Program's Steering Committee met on October 1st during which it endorsed the proposed Year 1 work plan.

You will recall that the four Technical Committees (Characterization, Physical Processing, Leaching / Separation, and Environment) convened their first meetings on Aug 25th to review specific work plans for the balance of the first Year (Oct 1st – Mar 31st). The Technical Committees continued discussions in an effort to better define specific studies and priorities, with the primary goal that 'Canada contributes 20% to the global supply of REE'. The Steering Committee endorsed the first year's work program. A copy of Program Director Janice Zinck's overview to the Steering Committee and minutes of the meeting are appended.

The following outputs are expected at the end of Year 1

- Characterization database of REE ores and deposits
- Mineralogical tool to better understand flotation/leaching performance
- Identification of ores amenable to ore sorting
- Technical reviews on REE flotation, baking/cracking, separation technologies
- Techno-economic assessments
- Literature reviews on radioactivity aspects including regulations and management, toxicity issues for REE processing, secondary sources for REE
- Expert panel assessment of leaching and separation challenges for Canadian REE companies/project
- Planning workshop for Year 2 tentatively scheduled for February 2016

The Year 1 program will be collaboratively delivered by CanmetMINING in partnership with industry where over half a million dollars in technical and service contracts will be awarded during this period. In addition, the Steering Committee has committed to developing the selection criteria for Year 2 projects in advance of the February planning workshop.

As always, I hope you find these progress reports helpful. Please feel free to contact CREEN with any suggestions you may have.

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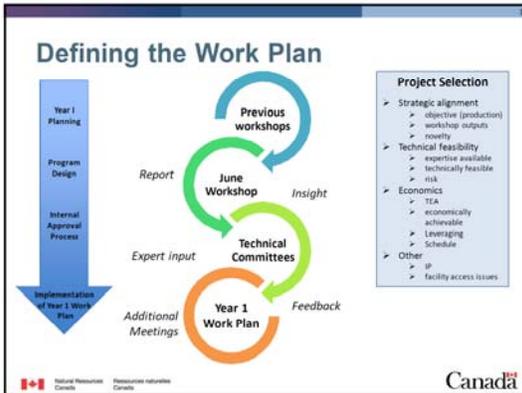
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Rare Earth Elements Year 1 Work Plan and Technical Committees

Janice Zinck
REE Steering Committee
October 1, 2015

Outline

- Work plan development
- Characterization Committee
- Physical Processing Committee
- Leaching and Separation Committee
- Environment Committee
- Year 1 outputs
- Next steps



REE

Committees			
Characterization	Physical Processing	Leaching/Separation	Environment
Canmet Technical and / Committee Chairs			
Yves Thébaud - Canmet Dionne Fragomeni - NPS	Tatjana Rogoff - Canmet Claude Sagor - COMET	Chen Xia - Canmet Nelly Verbeem - SGS	Rory Cameron - Canmet André Gauthier - Malvern
Projects			
Sample collection and preparation			
Characterization of ores and minerals	Enhanced flotation and magnetic separation	Baking/roasting and regrinding	Radioactivity
Fragmentation options to increase liberation		Reagent development and optimization	Toxicity
Linking mineral and surface properties to processing and leaching performance			
Water as a reagent/recycle			
Impurity Control (P, U, Th)			
Alternatives to conc. flotation		Revised assessment of separation technologies	
Secondary Sources			
On-site operations	Alternative leaching processes	Separation roadmap	
Single and mixed collector systems			
State of Global REE industry (technology and market analysis)			
Mapping Canadian REE expertise and facilities			
Updated REE R&D gaps analysis			

Characterization Committee

- Characterization Database (External)
 - A compilation of mineralogical and associated metallurgical data is essential to identify the knowledge gaps, define the challenges and focus our efforts for subsequent phases.
 - Phase I - an exhaustive review of available data for the top ten advanced projects from Canada and comparable global deposits.
 - Phase II- Based on gaps identified in Phase I, a detailed characterization of relevant samples following a recognized approach. This will ensure that the gathered information results in a consistent database of properties for a wide range of relevant mineral assemblages.

Characterization Committee

- Linking mineralogical variation to flotation and leaching performance (Canmet)
 - The extensive solid solutions displayed by many REE-bearing minerals induce significant variations in crystal and surface properties that can strongly influence the flotation and leaching responses of a single mineral.
 - A parallel and complementary investigation using synthetic analogues that allows tight control of the chemical and structural variables represents a valuable tool to establish links between these factors and trends in processing behaviors.
 - The objective is to complement the information obtained from the characterization of natural mineral systems, by providing a systematic approach that can be adapted to improve the level of understanding of the mechanisms that control specific flotation or leaching responses observed in actual ore materials.

Physical Processing

- Review of participating industry processing-related data (Canmet)
 - Establish relationship between mineralogy and processing data
 - Update physical processing work plan
- Feed ore sample characterization and process mineralogy (External)
- Pre-concentration and radioactive element removal using ore sorting
 - Review of ore geology to evaluate the potential for ore sorting (External)

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Physical Processing

- Focus on REE flotation
 - Options to improve flotation performance
 - Literature review (External)
 - Revise flotation work plan
 - Preliminary studies to increase liberation
 - Investigation of microwave pulp conditioning (Canmet)
 - SelfFrag and microwave assisted mineral liberation studies (Canmet)
 - Techno-economic analysis (External)

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Leaching and Separation

- Initial studies
 - Gaps analysis on baking and cracking (External)
 - Review of separation technologies (External)
 - TEA of separation technologies (External)
 - Review current PEA, PFS, FS documents (Canmet)
- Expert panel
 - Review flow sheets for advanced projects
 - Proposed projects: Avalon, Commerce, GéoMégA, Magris/St Honore, Matamec, Orbite, Pele Mountain, Quest, Innovation Metals, Search, Canada Rare Earth Corp.
 - 5 experts identified and selected by technical committee (include one academic, one Canmet)

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Leaching and Separation

- Other studies (to be further defined)
 - Modelling of REE SX
 - U/Th/Ce removal before separation
 - Canmet initial work
 - Reagent recycling (NaOH, HCl, H₂SO₄...)
 - Optimization of conventional REE SX
 - Impurity control
 - Canmet

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Environment Committee

- Three areas of focus
 - Radioactivity – especially regulation and policy aspects, management of NORM
 - Literature review (External)
 - Toxicity - REE processing including reagents, effluents and stack emissions, health issues and best/worst practices in global REE processing, lessons learned
 - Literature review (External)
 - Secondary Sources – to accelerate production. Including tailings, ash, red mud, etc.
 - Canmet led
 - Literature survey (External)

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Year 1 Outputs

- Characterization database
- Mineralogical tool to better understand flotation/leaching performance from mineralogy
- Identification of ores amenable to ore sorting
- Technical reviews on REE flotation, baking/cracking, separation technologies
- Techno-economic assessments
- Literature reviews on radioactivity aspects including regulations and management, toxicity issues for REE processing, secondary sources for REE
- Expert panel assessment of leaching and separation challenges for Canadian REE companies/projects

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Next Steps

- Approval of work plan
- Canmet to initiate contracting
- Bi-weekly updates
- Planning workshop for Year 2 work plan
 - February 2016
- Technical workshop
 - April 2016

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Annex

Rules of Engagement
Contracting/IP
REE Logic Model

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Rules of Engagement

Objective

- The objective of the program will be to deliver timely, relevant and applicable research and development to advance the Canadian REE and chromite sectors.

Program Approach

- Industry (exporation and mining companies, refiners and manufacturers, and industry associations) will lead the research and development direction for the programs through their contributions on the steering committees and NRCan will deliver the programs as per its mandate.
- To accelerate innovation and program outcomes expertise will be leveraged both within NRCan and within the private and academic sectors.

Governance and Decision Making

- Direction for the overall technical program will be set by the REE Steering Committee
- Two steering committees will be created: one for REE and another for chromite and the steering committees will have two co-chairs: NRCan and industry.
- The manner in which the Steering committees will function will be outlined in the Terms of Reference. Members will act in the best interests of the program and its objectives, and potential for conflict of interest is to be minimized and mitigated.
- Project level decisions will be made by NRCan in association with the appointed technical committees and guidance as needed.
- NRCan research will be guided by industry stakeholders but will be at the direction of Canmet/MNNG senior management.

Communication

- The Minister and his delegates are the spokespersons for the REE and chromite programs.
- Communication of governance, program direction and technical results will be transparent.

Sharing of Information and program results

- Program results will be shared collectively with the Canadian REE sector.
- All intellectual property directly derived for the program funding will rest with the Crown but will be accessible for deployment and commercialization by program participants.

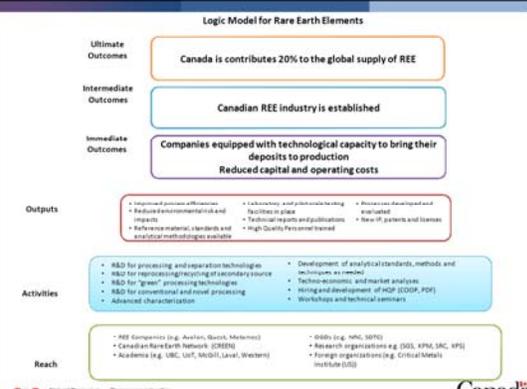
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Delivery within Government Context

- Intellectual Property
 - Companies/inventors retain ownership of existing IP
 - New IP generated by federal funding to be owned by CROWN
 - Goal to deploy and commercialize
 - Licensing arrangements – case by case
- R&D contracts
 - Competitive process
 - Small contracts (<\$25k) and larger contracts – project dependant
 - Preapproved suppliers
 - IP clause in all contracts
 - Dedicated resource in procurement
 - No unsolicited proposals (Y1)

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Logic Model for Rare Earth Elements



Ultimate Outcomes

- Canada contributes 20% to the global supply of REE

Intermediate Outcomes

- Canadian REE industry is established

Immediate Outcomes

- Companies equipped with technological capacity to bring their deposits to production
- Reduced capital and operating costs

Outputs

- Regional process efficiencies
- Reduced environmental risk and impacts
- Performance metrics, standards and analytical methodologies available
- Technology and process know-how
- Facilities in place
- Technical reports and publications
- High quality personnel trained
- Processes developed and evaluated
- New IP, patents and licenses

Activities

- R&D for processing and separation technologies
- R&D for reprocessing/recycling of secondary source
- R&D for "green" processing technologies
- R&D for conventional and novel processing
- Advanced characterization
- Development of analytical standards, methods and techniques as needed
- Techno-economic and market analysis
- Writing and development of HOP (COOP, PDF)
- Workshops and technical seminars

Reach

- REE Companies (e.g. Avxian, Quest, Metchem)
- Canadian Rare Earth Network (CREEN)
- Academia (e.g. UBC, UofT, McGill, Laval, Western)
- 000s (e.g. NRC, SPTC)
- Research organizations (e.g. IGS, KPM, SNC, SPT)
- Foreign organizations (e.g. Critical Metals Institute (CMI))

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