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GMIAC Workshop – December 2018

# Green Mining Innovation: *Mid-point assessment*

Janice Zinck





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## CanmetMINING Research Plan 2016-2021

### Green Mining Initiative

ENHANCED PRODUCTIVITY  
ENERGY EFFICIENCY  
WASTE MANAGEMENT  
WATER MANAGEMENT

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## Energy Efficiency

Develop technologies to reduce energy consumption in mining and milling

## Enhanced Productivity

Develop novel and innovative new mining technologies to increase productivity and decrease risk of adoption

## Waste Management

Develop best practices for waste management into the design of new and existing mines

## Water Management

Develop technologies to reduce risks to the aquatic environment and use sound science to inform regulations

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## Climate Change

Tools and best practices to adapt water and water management practices in a changing climate

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# Achievements



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# Capital and Operating Cost Reduction



- Flowsheet – beneficiation
  - \$35M decrease in capex
  - \$3.5M/a decrease opex
- Purification process
  - Elimination of unit operation
- Novel tunnel furnace reduces capex, opex, and downtime

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# Reduced Risk



- Through demonstration and piloting
  - REE beneficiation pilot plant
  - Field trials for reclamation using organic waste cover
  - Vacuum membrane distillation pilot plant
  - SDTC project for 12-18 month field demonstration (2019)

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# Decreased consumption



- Water recycle using electrodialysis to 95%
- Several ore sorting studies to reduce gangue to mill
- Novel rock sizer prototype to improve mill feed
- Coarse particle ( $P_{80}$  of 265  $\mu\text{m}$ ) flotation increased Cu recovery by 3%, energy reduced by 40% for an REE ore
- High pulse voltage (HPV) to reduce comminution energy, consortium established

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# Sound science for regulatory development



- Working directly with ECCC to provide the science to fill regulatory gaps for REE - (La, Nd, Ce, Y)
- NORM and U/Th management options for REE
- Environmental studies to understand the potential release of hexavalent chromium during mining, milling and smelting
- Selenium ecotoxicity for MMER/MDMER

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# Novel methods



- Method for environmental hazard classification of metals
- Analytical methods for Se species
- Toolbox of dust sampling methods (lichen, rain catchers, passive air samplers and 24-hr high volume air samplers)
- Rapid removal method and resuspension toxicity method for contaminated sediments
- Sediment core resuspension test
- Toxicity sensors
- Method to track REE reactions in real-time

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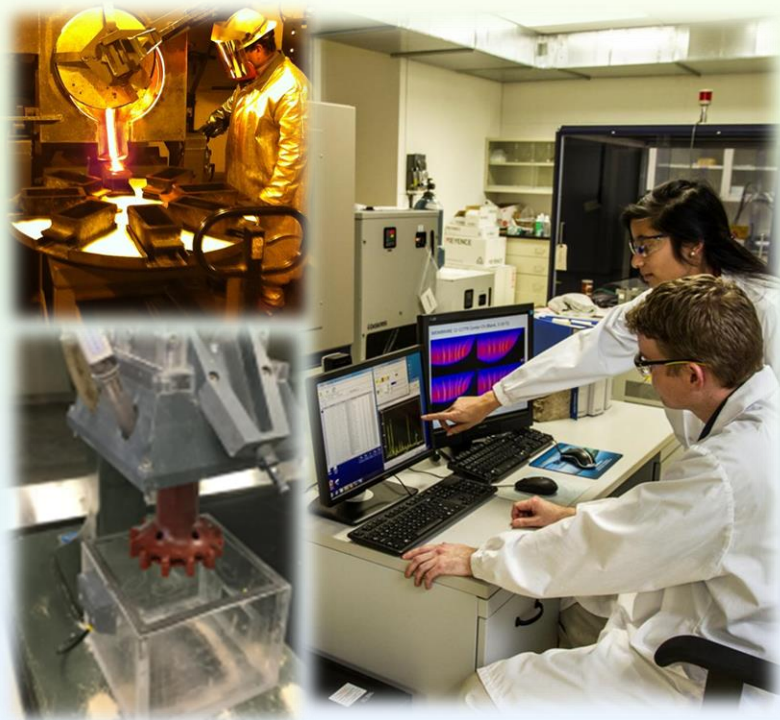


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# New patented technologies



- Several new patented technologies
  - Two patents for the use of ceramic membranes
  - Novel 3D rock sizer
  - Two patents for smelting technologies for ferrochrome
  - Direct oxalic precipitation (DOP) for REE (two patents)
  - Tunnel furnace for baking/roasting
  - Combined leaching / attrition mill

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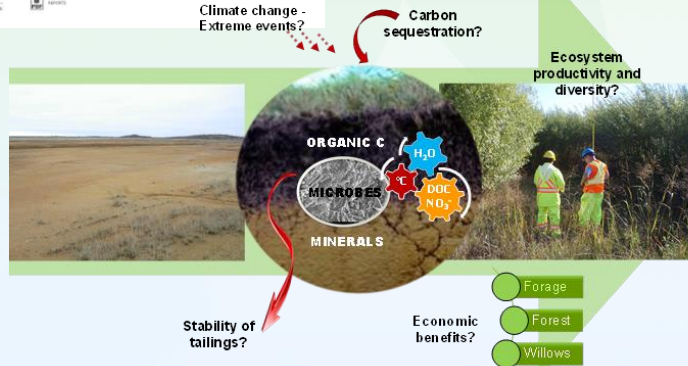
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# New knowledge

- Over 100 reports, publications and presentations
- Gaps analyses for key research areas
- Review of mill water chemistry as applied to process water recycling
- Environmental impacts of biosolids covers quantified
- Inventory of sources for secondary recovery of REEs



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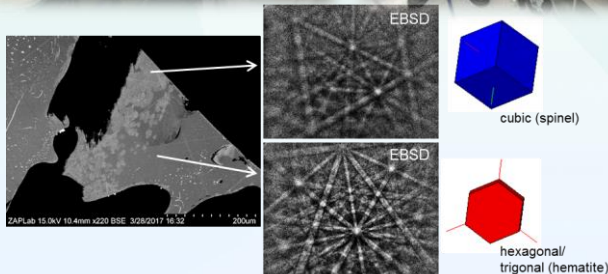


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# Novel flowsheets and processes



- Novel bioleaching process developed for pyrrhotite tailings, TEA completed
- Two integrated flowsheets developed to recover gold from historic tailings
- New process to recover REE and scandium from coal ash yielding a benign material for construction
- New process to remove/recover iron from waste as a saleable product
- Processes to treat and stabilize radioactive waste

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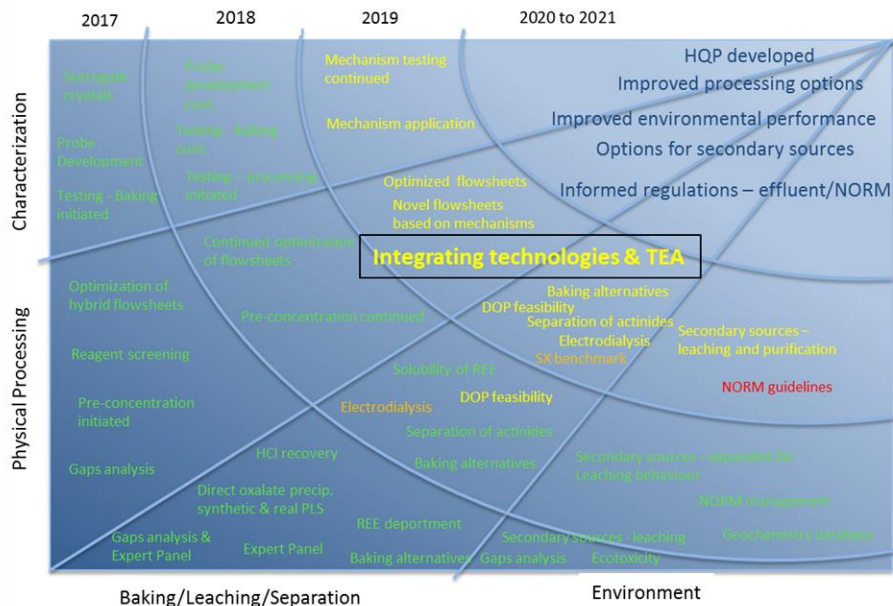
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# Project roadmaps



## Roadmap

Completed

In Progress

Planned

Delayed

New

- Project roadmaps completed for the various field of research
- REE example

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# New collaborations established



- New pan-Canadian collaborative program to develop tools, technologies, and policies to de-risk and accelerate demonstration and full-scale waste re-processing / repurposing projects.
- Others relating to microwaves, HPV, Clean Growth proposals

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# Next Steps

- Little over two years remaining
- Focus will be on piloting and demonstration
- Best practices, publications and dissemination
- Continue to strive for collaboration to achieve success



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# Discussion

## THANK YOU

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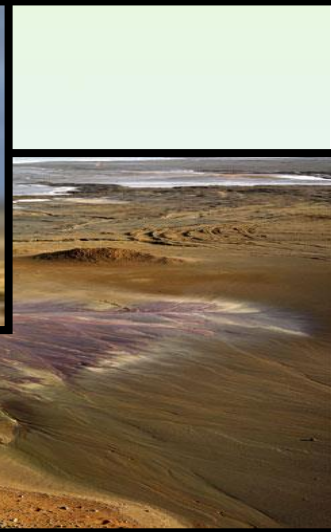
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# Leveraging and Impact

## Leverage



## Impact study of CanmetMINING projects

- Green Mining Initiative Impact Study (2015) prepared by HDR
- The study estimated the median total annual GMI benefit of \$37.3 million

## Funding leverage for greater impact

- Recent review of CanmetMINING projects found internally funded projects were leveraged 2.65 times with cost and task-shared projects leveraged 3 fold

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