

# Proof of Principle: How Genomics Can Innovate Mining Environmental Management

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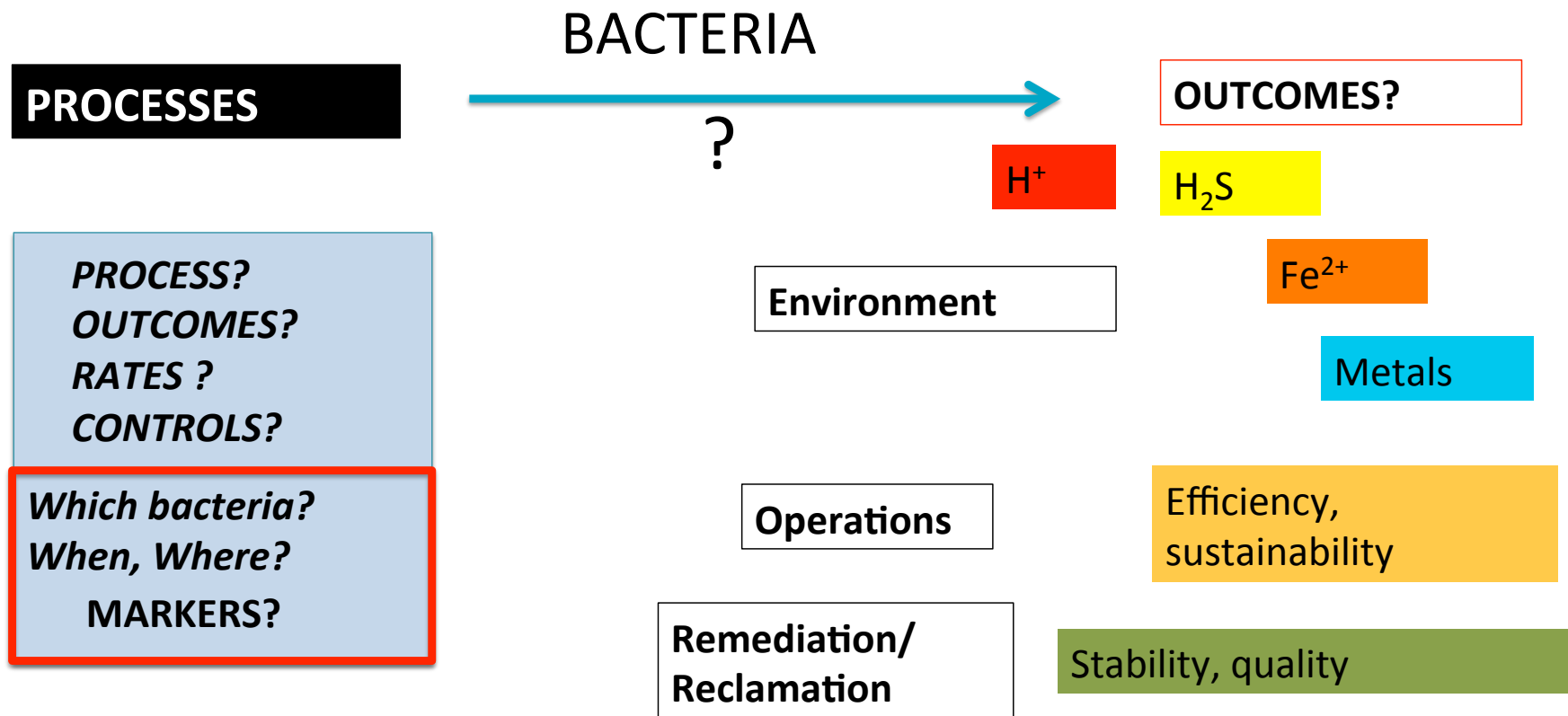
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# Mining contexts: **MICROBIAL BLACK BOXES**



# Microbial impacts diverse & unconstrained



# Genomics provides tools to constrain microbial activity

## Genomics: DNA based characterization

**genome:** complete set of DNA

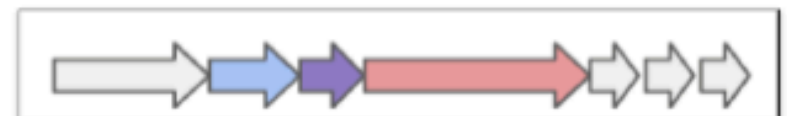
within a single cell of an organism

**Genomics** is the science of interpreting, understanding and harnessing the **DNA code (genome)** of organisms

Genomes are like the instruction manuals for organisms. If we can read them we know:

- What the organism can do
- What the organism needs in order to grow
- What it will respond negatively to

**metagenomics:** multiple genomes of an entire community



Genes confer specific functions: they can be predicted from DNA sequences

# Metagenomics & Mining

NOVEL MICROBIALLY INTEGRATED KNOWLEDGE BASE →

**Opportunities to access & therefore derisk & harness bacterially driven processes**

relevant monitoring

proactive management

novel bio-based strategies

(bioleaching, bioremediation)

**INFORMED CLOSURE PLANNING**



# MINE WASTEWATER SOLUTIONS (MWS) project - in year 1



The Mining Association of Canada | L'association minière du Canada

## Genome Canada LSARP project



# The Problem: knowledge gaps in sulfur biogeochemistry of mining wastewaters



**Thiosalts:  $S_nO_x^{2-}$**   
Sulfur oxyanions generated during milling of ores

**Acidity, toxicity**

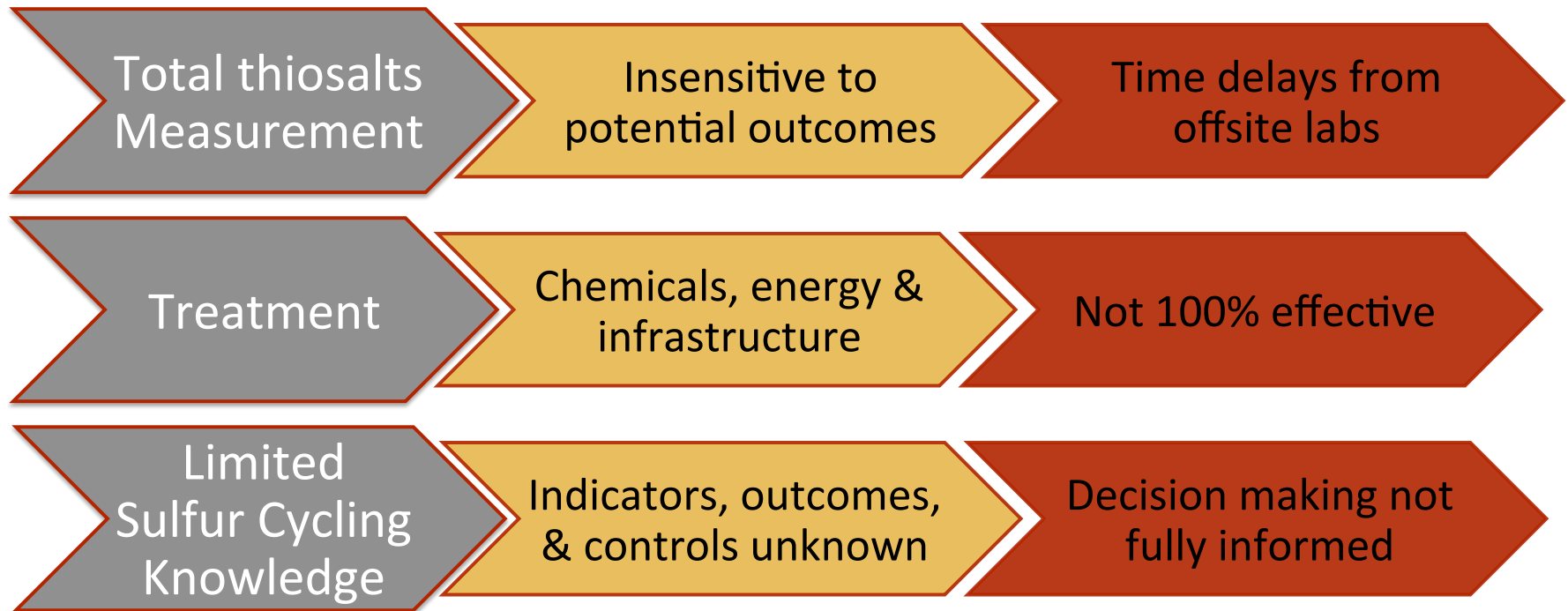
**Penalties, shutdowns,  
↓ license to operate**

## **Lack of practical tools to mitigate risk**

**CMIC** has identified **thiosalts** as a **priority research need** for the mining sector.  
CMIC: Canadian Mining Innovation Council

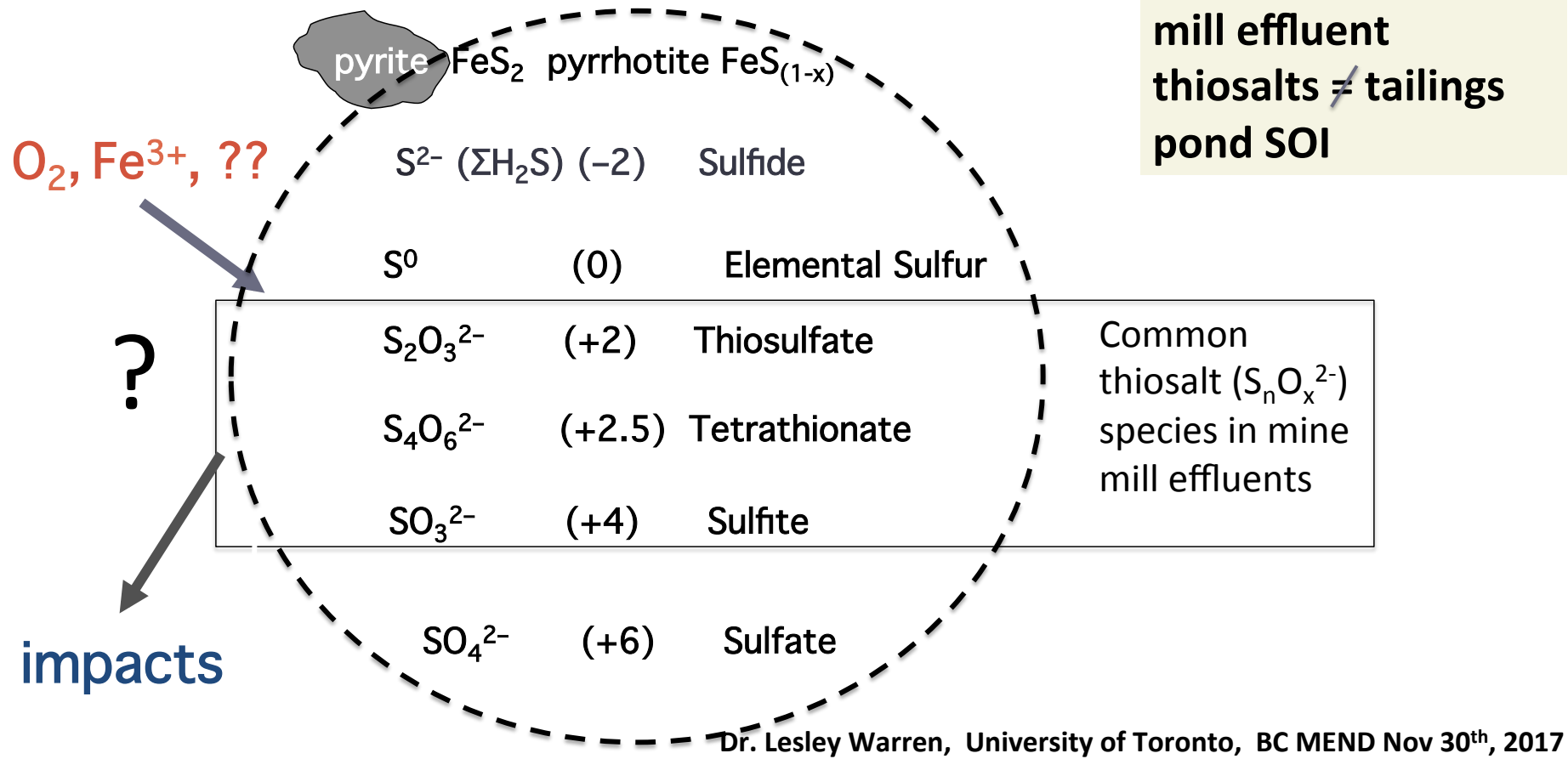
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# The Current Practice & Limitations





**Thiosalts** will be linked to a larger **microbial** intermediate sulphur (SOI) compound cycle: **currently both S compounds and microbes not well constrained**



## Mining Wastewater



Microbial identities and roles in processes leading to impacts poorly constrained

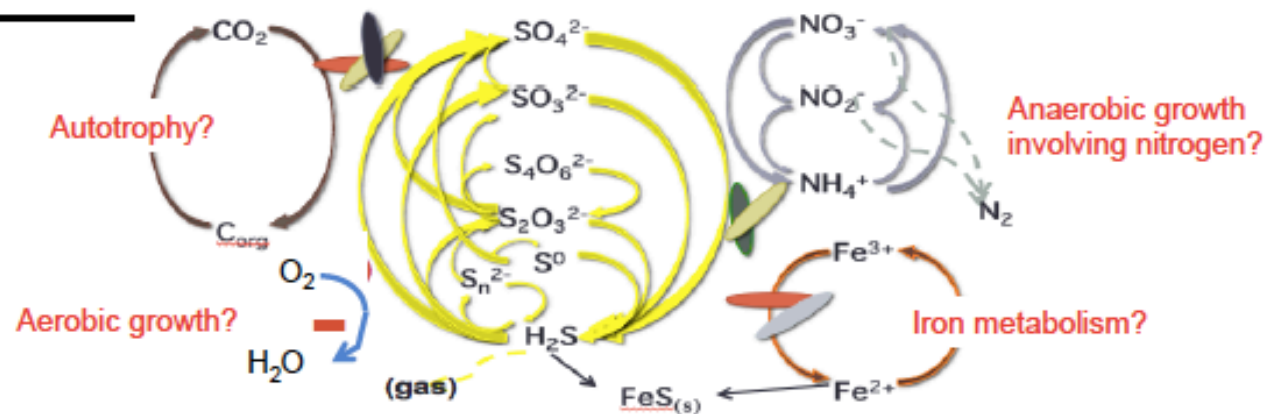


## Approach:

Cultivation-independent studies based on detection and analysis of microbial genomes

### Science inputs

Organisms present?  
Genomic capacities?  
Sulfur geochemistry?  
Seasonal and geochemical gradients?



# Objectives

**Open the wastewater microbial black box (sulfur)**



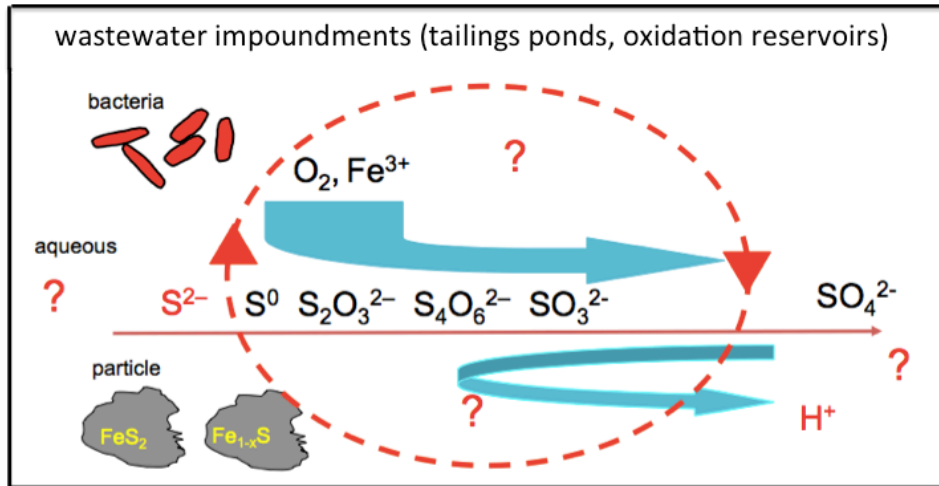
Integrated characterization of:

- (1) sulfur geochemistry,
- (2) microbial communities and
- (3) metabolic repertoires

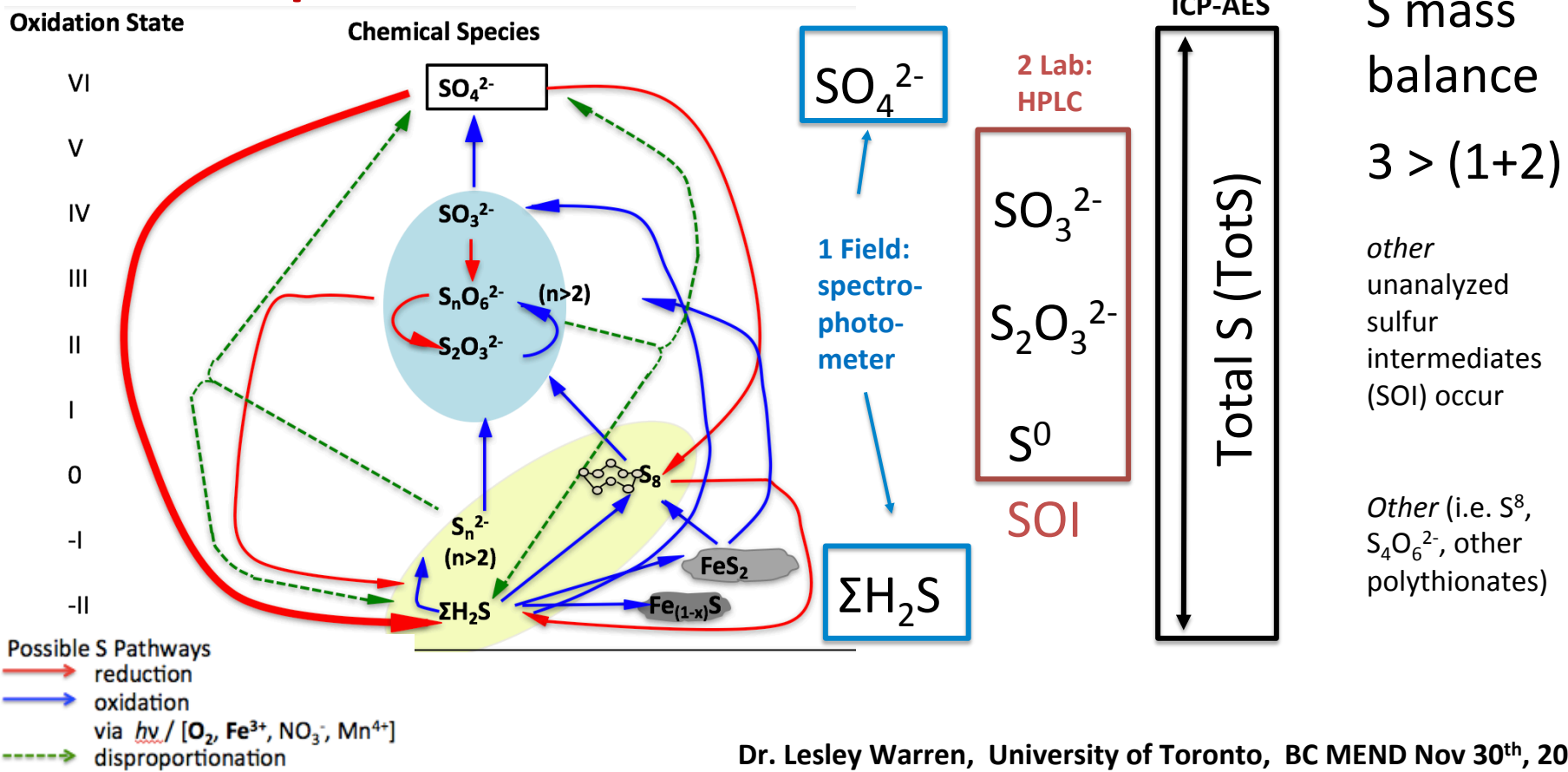
over seasonal and spatial scales



Develop **new tools** needed by the industry to better manage and treat its wastewaters

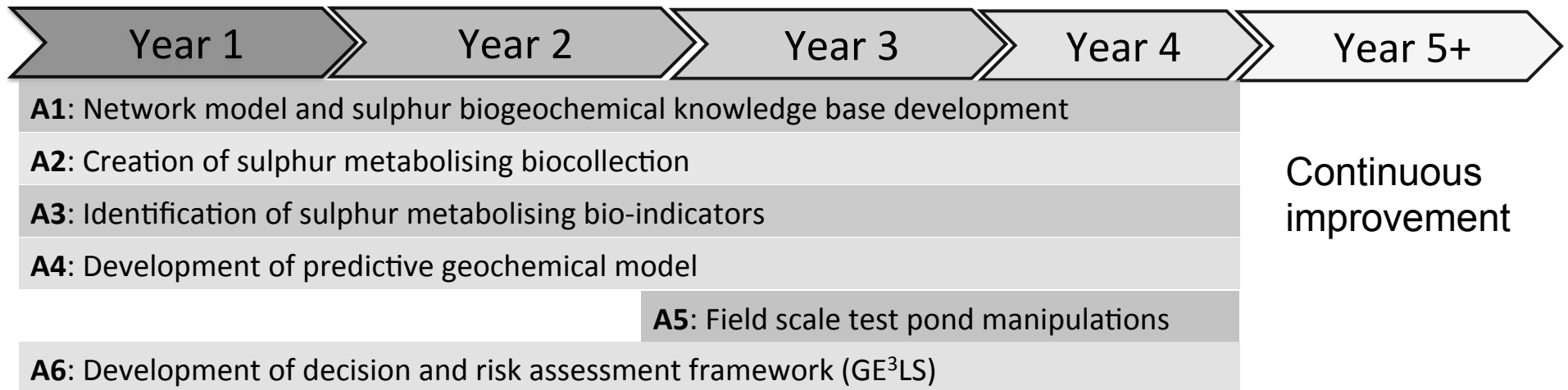


# combining detailed sulfur & microbial characterization to constrain processes and outcomes



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## Project Timeline: Activities (currently in Year 1)



## Project Deliverables

Biocollection	<ul style="list-style-type: none"><li>• Sulfur metabolising consortia adapted to a range of conditions</li></ul>
BioIndicators	<ul style="list-style-type: none"><li>• Indicators of sulfur metabolism correlated to S geochemistry</li></ul>
Geochemical Model	<ul style="list-style-type: none"><li>• Sulfur speciation in mining wastewaters</li></ul>
Decision-Making Tool	<ul style="list-style-type: none"><li>• Science informed decision &amp; risk analysis capabilities</li></ul>

## The Benefits & Impacts: improved performance

- **Increased certainty of water quality** from wastewater through discharge and downstream environment.
- **Increased credibility and reputation** (increase efficiency of consultation / regulatory review processes, public perception, shareholder perception etc.)
- **Realize process & closure planning optimization** through robust understanding of sulphur oxidation processes.
- **Improved sustainability = Social licence**
  - Relevant industry wide

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