Collaborative Research on Environment and Mine Waste Management at the Research Institute on Mines and the Environment (RIME)

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History

• A 30 years old partnership between Polytechnique and UQAT

• Industrial NSERC Polytechnique-UQAT Chair on Environment and Mine Wastes Management (2001 - 2012)

• Led to developments that have been integrated in best available mining practices in Quebec, Canada and elsewhere around the world

• May 2013 : UQAT and Polytechnique Montreal launched a joint research program: the Research Institute on Mines and Environment (RIME) UQAT-Polytechnique.
RIME UQAT-Polytechnique

• Objectives:
  o develop innovative environmental solutions for the entire life cycle of a mine
  o train students to become the future specialists in the field

• 5 industrial partners


• Industrial financial support of 9,45M$

• Lever to get support from NSERC, FRQNT, CFI and others
Research team

• 2 universities
• 18 professors and researchers
• 20 technicians and research professionals
• 45 MScA students, 35 PhD students and 100+ interns
• 51 graduates to date
• More than 20 different nationalities
• 3 chairs
• Over 600 publications in peer reviewed journals and conferences since 2006
Infrastructures and laboratories - Polytechnique

Permeameters · Triaxial systems · Shear boxes · Oedometers · Consolidation setups
Column tests (10-20 cm diam., 10-100 cm height) · Consumption/diffusion cells
Inclined box (2 m x 1 m x 25 cm) · Physical models
Infrastructures and laboratories - UQAT

Microscopy labs • Geophysics lab • Analytical chemistry labs • Geotechnics and hydrogeology lab
Backfill/concrete lab • XRD lab • Freezing/refrigeration chamber
Site characterization mobile lab
Field work

Advantage: proximity of mine sites; applied projects for students
Arctic Conditions
Behavior of mining wastes exposed to arctic conditions, influence of CC

Prediction of water quality
For AMD and contaminated neutral drainage (CND)

Water treatment
Biological and chemical treatment, passive or active methods

Mine site reclamation: Reclamation of mine wastes disposal areas, control of acid mine drainage (AMD) and contaminated neutral drainage (CND), cover systems, long-term performance (incl. vegetation impact and CC)

Integrated mine waste management “Designing for Closure”, backfilling, desulfurization, valorization

Waste rock inclusions
Innovative management method, improving the geotechnical stability

Waste rock piles
Characterization, development of new construction methods for waste rock piles
Experimental waste rock pile, Lac Tio Mine – Rio Tinto Fer & Titane (Qc)
Waste rock piles

(Martin, 2003)

(Aubertin et al., 2013)
Water flow in waste rock piles

(Aubertin et al., 2002; Fala et al., 2003, 2005)

(Aubertin, 2013)
Collaborative Research and Development Grants

• 4 years CRD project
• Industry: 280 k$ + 430 k$ in kind
• NSERC: 510 k$

• Many students involved (Marie-Lin Bréard Lanoix, Julien Dubuc, Adrien Dimech, Robert Wu, Bissé Poaty, Fernando Medina) and PDF (S. Broda) + research associate (Vincent Martin) + technicians (Yvan Poirier, Pierre-Alain Jacques)
Lac Tio Mine - Waste rock piles

Waste rock piles: \(\approx 100 \text{ ha} / 100 \text{ Mt}\)
Preliminary characterization

Experimental waste rock pile - Construction
Experimental waste rock pile
Experimental waste rock pile - Instrumentation

(Martin et al., 2017)
Innovative instrumentation - DTS
Field tests

FCL characterization (ML. Bréard Lanoix)

Large scale infiltration tests (J. Dubuc)
Field tests

Night shifts (summer 2017) © RIME

Installation of a plastic membrane (impermeable top-boundary)
Field tests

Large scale infiltration test
(≈ 32 m³ (53 mm) in 10 h)

Lys. 5 + 6 ≈ 58% of percolation

(Dubuc et al., 2017)
Field tests

Field saturated hydraulic conductivity \( k_h \) (cm/s)

Blank ratio \( e (-) \)

SR15  ×  SR30  △  GP  ●  DR (inner) —— KC —— KCM

+ water qualities (B. Poaty), DTS investigations (R. Wu) and numerical simulations (J. Dubuc)
Diffusion and communications

• 1 scientific committee per year
• Regular meetings (once a week or more) while in the field
• Presentations at the mine
• Conference presentations + journal papers to come
• Collaboration with other universities and experts

“Spin-off” project at another partner’s mine

Charact etrization of the Hydrogeological Properties of a Sand Layer Placed on an Experimental Waste Rock Pile

Marie-Lin Bréard Lanoix, Thomas Pabst & Michel Aubertin
Research Institute on Mines and Environment (RIME), Montréal, Qc, Canada
Department of Civil, Geological and Mining Engineering – Polytechnique Montréal, Qc, Canada

An assessment of the hydrogeological response of the flow control layer installed on the experimental waste rock pile at the lac Tio mine

Julien Dubuc, Thomas Pabst & Michel Aubertin
Polytechnique Montréal, Montréal, Québec, Canada

Controlling water infiltration in waste rock piles: Design, construction, and monitoring of a large-scale in-situ pilot test pile

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Last remarks

- The partnership between mining companies and universities is beneficial for both parties
- Results are also used by government to improve guidelines and methodologies
- The quality of the training is significantly improved by the close collaboration
- More funds can be invested with the partnership of research organization (estimated at 20-23 millions for the 7 years)
- The renewal is in progress (end in 2019); integration of a new partner in 2018 – Goldcorp Mine Éléonore
- The work is performed with other universities and organizations (e.g. TERRE-NET)