EVALUATION OF THE NICKEL-CND GENERATION POTENTIAL OF THE TIO MINE WASTE ROCKS

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Outline

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- Materials and research program
- Results and discussions
  - Kinetic testing
  - Sorption studies
  - Implications for CND prediction
- Conclusions and perspectives

Background and objectives

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- Contaminated neutral drainage (CND): drainage waters with near-neutral pH which contain metal concentrations above regulated limits;
- CND production:
  - Sulfide oxidation➔ Metal/acidity generation;
  - Sufficient neutralization➔ neutral pH;
  - Metal concentrations above regulated limits.
- Possible metals in CND: As, Ni, Zn, Mo, Sn, Pb...

Background and objectives

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- Origin of the study: the Tio mine case (Rio Tinto):
  - No CND predicted with lab tests;
  - Sporadic Ni-CND conditions observed over some of the waste rock piles at the mine site after a few decades.
- Objectives of the study:
  - Improve knowledge of Ni-generating and Ni-decreasing phenomena within CND-generating waste rock piles;
  - Improve CND prediction for mine waste, particularly for Ni.

Background and objectives

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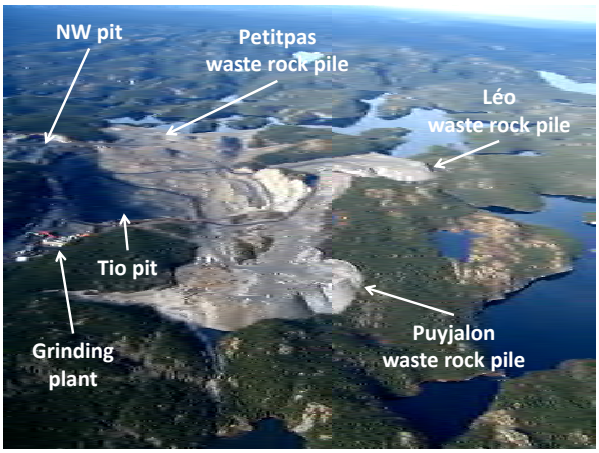
- 45 km NE of Havre-Saint-Pierre;
- Operating since 1950;
- World-class massive ilmenite ore.



Background and objectives

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- Hemo-ilmenite ore:
  - Hematite: Fe_2O_3;
  - Ilmenite: $FeTiO_3$.
- Anorthositic gangue, mainly calcic plagioclase:
  - $Na_{0.4}Ca_{0.6}Al_{1.6}Si_{2.4}O_8$ ≈ labradorite .
- Sulfide traces within the waste rocks:
  - pyrite (FeS_2) with Ni traces;
  - millerite (NiS).
- Waste rocks may contain as high as 70% residual hemo-ilmenite ore.

Background and objectives

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- Previous studies on Tio waste rocks:
  - Humidity cells (Bussière *et al.*, 2005):
    - No contamination.
  - Sulfide and gangue separation:
    - Geochemical behaviours in weathering cells:

Sulfides	**Gangue minerals**
•Generate acid; •Generate Ni.	•Neutralize acid; •Retain Ni; •Limited Ni retention potential.

Materials and research program

Materials and research program

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- Samples reflect waste rock heterogeneity :
  - Hemo-ilmenite content (between 20 and 60 %);
  - Weathering level (fresh WR and WR ≈25 years).
- Various scales of geochemical behaviour prediction:
  - Laboratory (humidity cells, 2 kg; weathering cells, 70 g);
  - Field test pads (30 m^3, ≈100 tons);
  - Waste rock pile (approx. 2 745 000 m^3).
- Batch and kinetic Ni sorption tests.

Materials and research program

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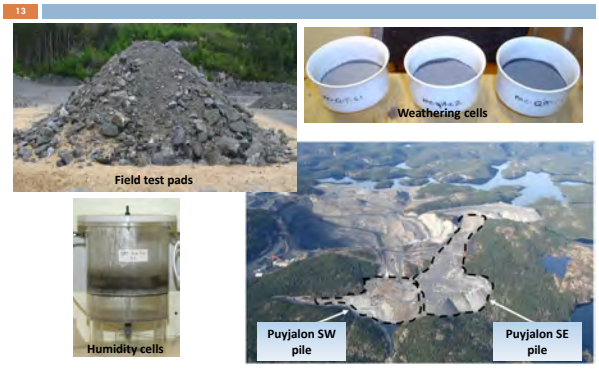

Results and discussions

- Kinetic testing
- Sorption studies
- Implications for CND prediction

Results and discussion

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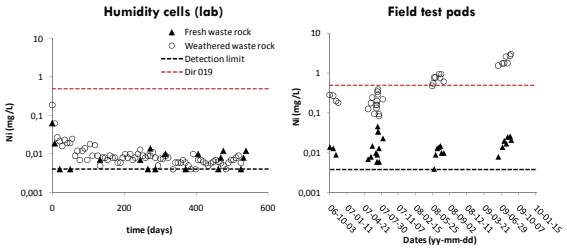
- Typical results: humidity cells (lab) vs field test pads for fresh and weathered (≈ 25 ans) waste rocks:
  - Ni level differences:



Results and discussions

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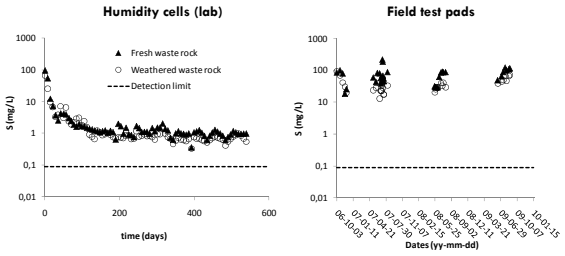
- Differences in S concentrations (from sulfide oxidation);
- Similar S production rates in fresh and weathered WR:
  - Similar sulfide oxidation rates in fresh and weathered WR:



Results and discussions

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- Waste rock weathering over ≈25 years do not decrease sulfide oxidation rates in the Tio waste rocks;
- Field observations predict CND production on weathered waste rocks (Ni>3mg/L), not on fresh waste rocks (Ni<0,1mg/L);
- Aqueous S and Ni concentrations higher on field scale tests:
  - Effect of the liquid/solid ratio, higher in lab tests, which dilutes lab-scale concentrations.
- **Lab-scale humidity cell tests inappropriate for CND prediction on waste rock.**

Results and discussions

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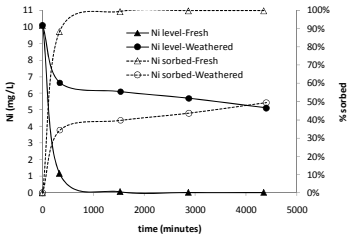
- Ni sorption phenomena in waste rocks:
  - Batch tests:
    - Fresh WR have greater sorption capacities than weathered WR



Conclusions and perspectives

Conclusions and perspectives

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- The following conclusions arise from the research program:
  - The Tio mine WR generate Ni-CND after a few years (or decades);
  - Sorption phenomena control Ni levels in drainage waters;
  - ➔ Delay before CND generation at the Tio mine;
  - ➔ Humidity cells tests inappropriate for CND prediction.
- Perspectives:
  - Column tests (lab) for CND prediction;
    - liquid/solid ratio closer to field conditions than humidity cells;
  - Sorption phenomena evaluation;
  - Development of a sorption assessment test :

Sorption capacity *vs* metal generation capacity

Many thanks!

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