The NRC Canada comprises:

4 integrated R&D divisions, 14 research centers focused on key industry sectors

Environmental Advances in Mining program

- ARD / ML Prediction and Prevention
- Mine Effluent Treatment
- Environment Friendly Extraction Processes
- Mine Closure & Reclamation
- Sensing and Monitoring
1 Objective: Fundamentals in ARD/ML

Step 1 Geochemical Reaction
Step 2 Leaching Process

Step 1: Oxidation of sulphide minerals

$$2FeS_2 + 7O_2 + 2H_2O \rightarrow 2Fe^{2+} + 4SO_4^{2-} + 4H^+$$
Look into Monitoring Data:

Oxygen Concentration Profile

Moisture Content Profile*

* Saretzky, G.T., Hydrological Characterization of a sulphide waste rock dump, Master thesis of University of Saskatchewan, 1998
Step 2: Drainage Leaching - Water Flow Type

Rate-Control Quotient of Mineral Dissolution from Waste Rock Dumps – Simon Liu
B.C.’s 41st Annual Mine Reclamation Symposium
2 Modeling ARD Reaction

- Air Flow
- Reactive Heat
- Ions Transport
- Pore Water Flow
- Geochemical Reaction
- Reactant (O2) Supply
3 Case Study on Equity Silver Mine
Total Precipitation and Ambient Temperature  
From Jan 91 to Jan 01
Measured and Simulated O2 concentration at 17 m depth of P-7 point

Graph showing the comparison of measured and simulated oxygen concentrations over time. The graph indicates that the measured oxygen concentration is consistently lower than the simulated concentration. A cover applied in simulation is marked on the timeline.
Oxygen Concentration and Air Flow Direction

Dec 1993 (Before Cover Installation)
Dec 1996 (After Cover Installation)

Aug 1997 (After Cover Installation)
Oxygen convection and diffusion fluxes at Top and Slope Surfaces:
Total Acid Generation Rate vs Lime Consumption (Step 2 involved):
4 Conclusions

• O2 controls the total geochemical reaction rate

• Channel flow controls the leaching of reaction products

• Cover system extends the air flow pathway in the pile

• Optimization of the pile/cover configuration by using modeling iterations leads to the reduction of total acid generation in the pile
The End

Questions?