Pile Scale Models for ARD Prediction -
- Case Study on Equity Silver Mine

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The NRC Canada comprises:

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

Environmental Advances in Mining program

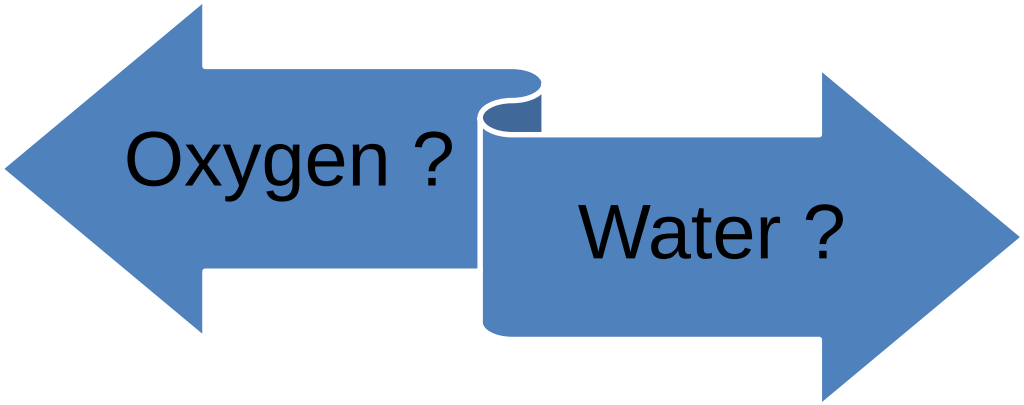
- ARD / ML Prediction and Prevention
- Mine Effluent Treatment
- Environment Friendly Extraction Processes
- Mine Closure & Reclamation
- Sensing and Monitoring

1 Objective: Fundamentals in ARD/ML

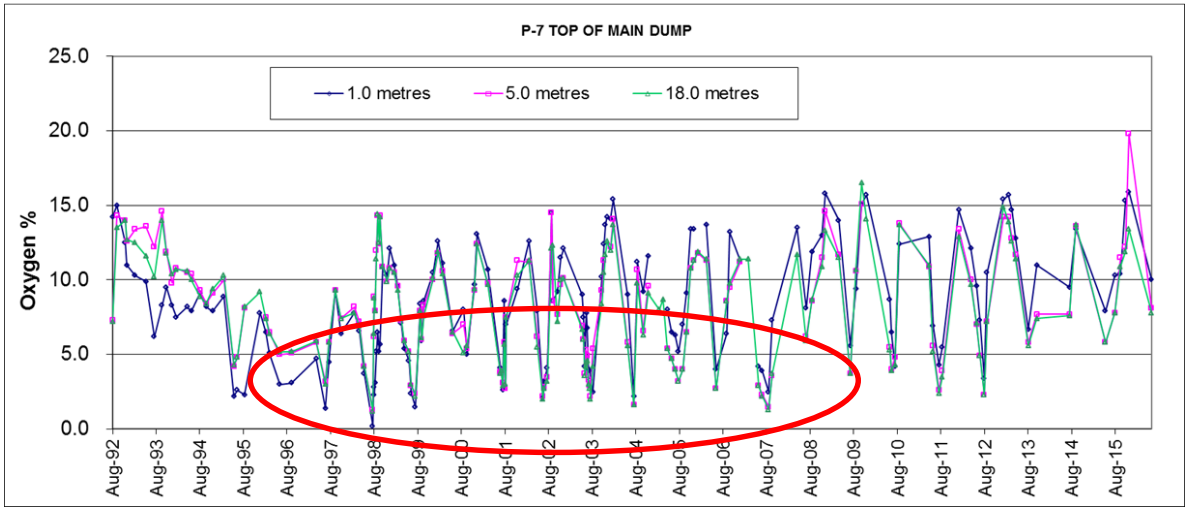
Step 1 Geochemical Reaction
Step 2 Leaching Process

Step 1: Oxidation of sulphide minerals

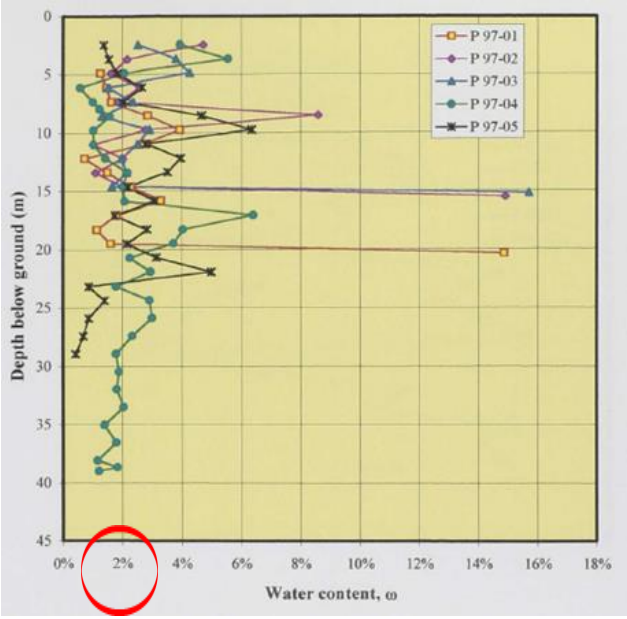
$$2FeS_2 + 7O_2 + 2H_2O \rightarrow 2Fe^{2+} + 4SO_4^{2-} + 4H^+$$



Look into Monitoring Data:



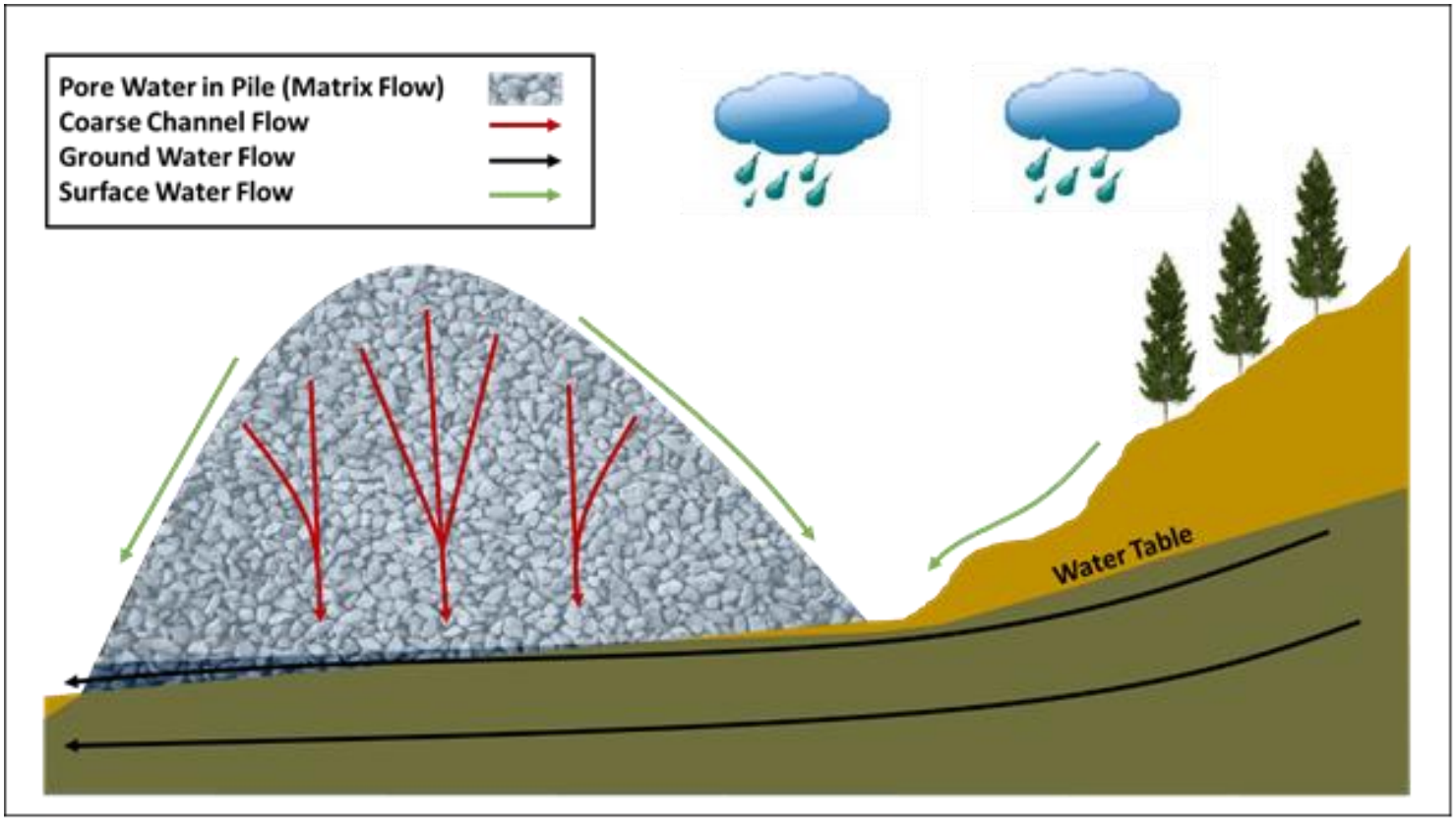
Oxygen Concentration Profile



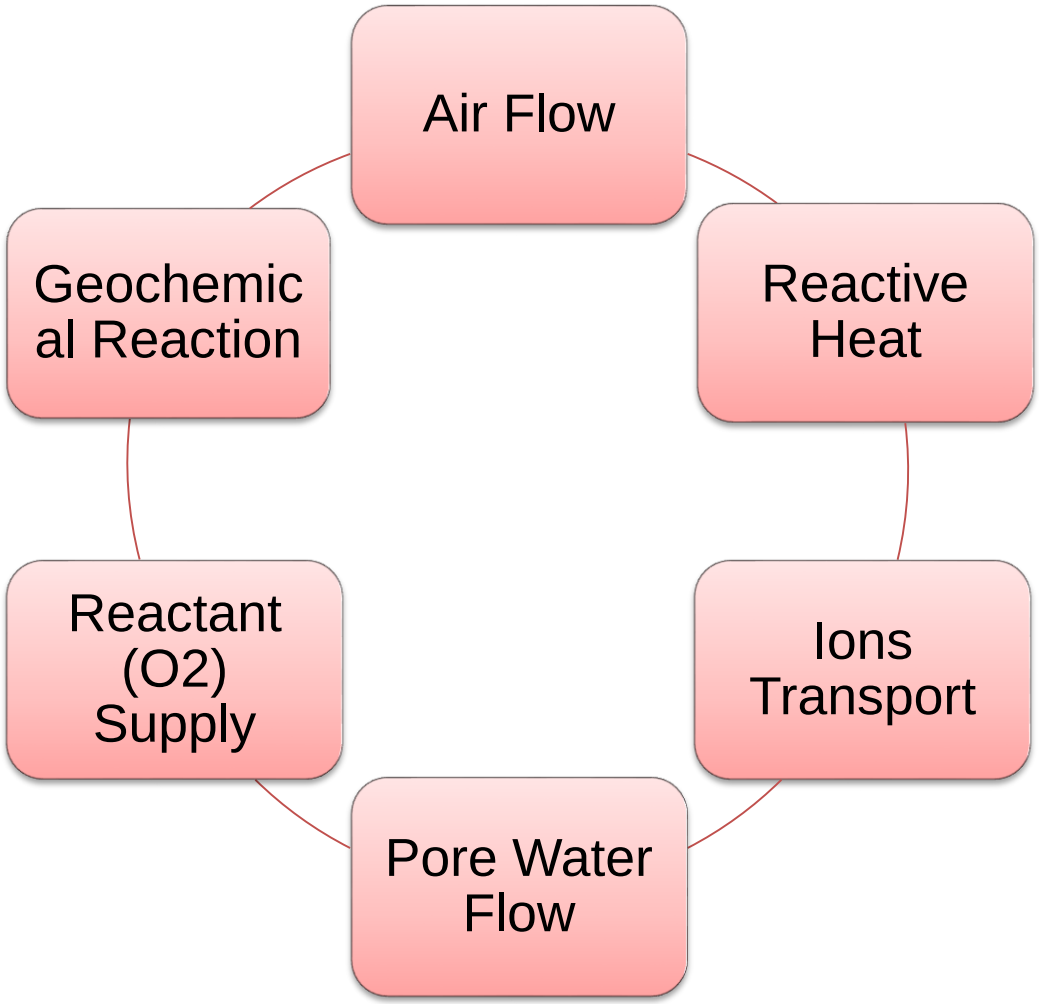
Moisture Content Profile*

* Saretzky, G.T., Hydrological Characterization of a sulphide waste rock dump, Master thesis of University of Saskatchewan, 1998

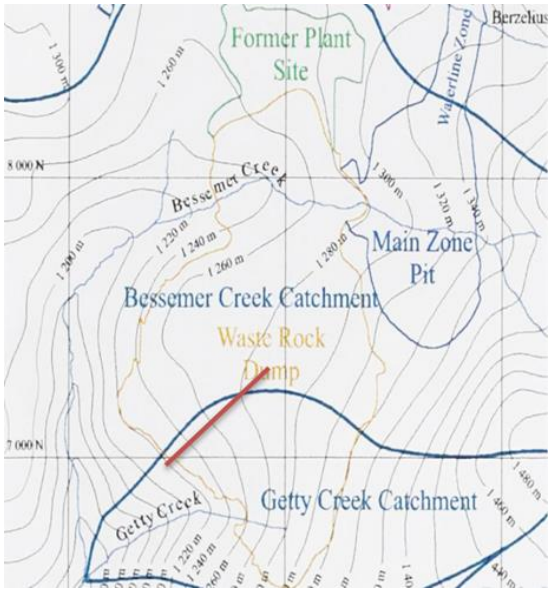
Step 2: Drainage Leaching - Water Flow Type

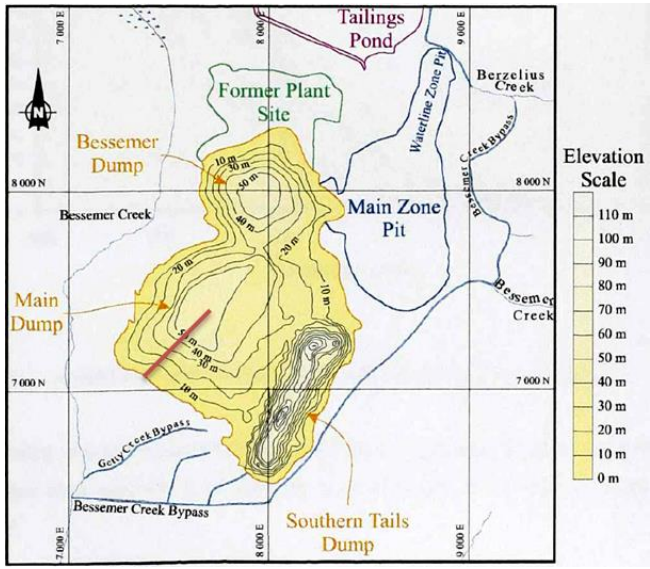


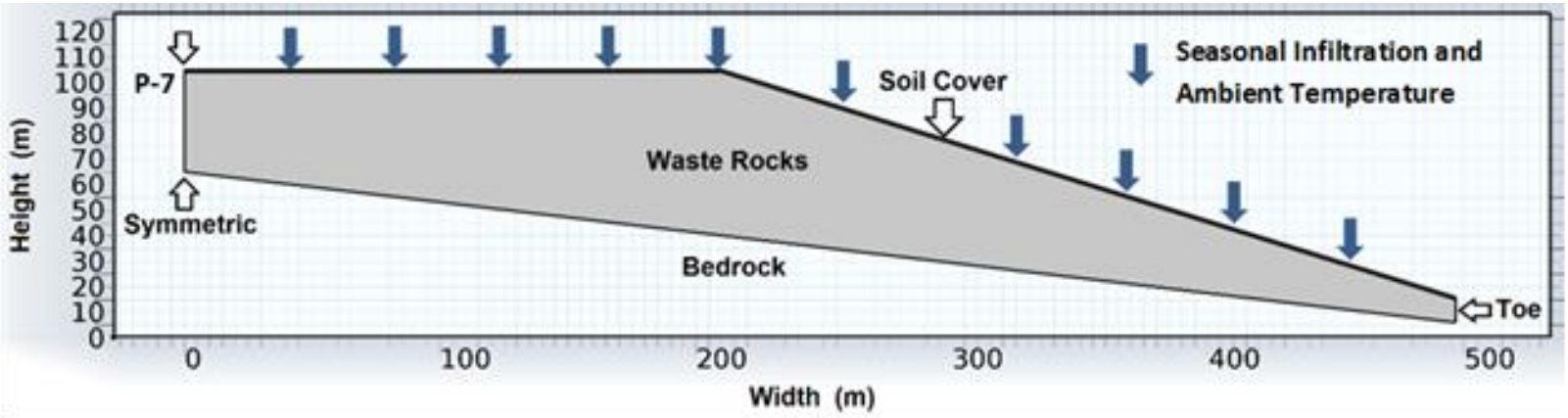
2 Modeling ARD Reaction



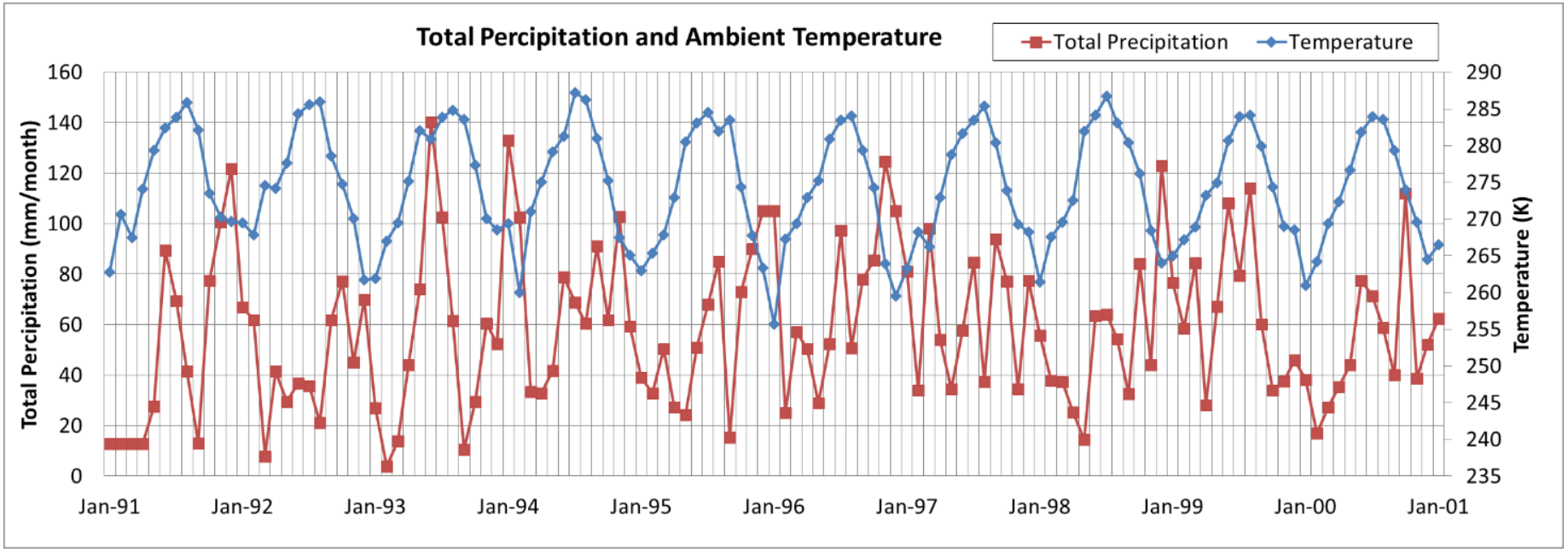
3 Case Study on Equity Silver Mine



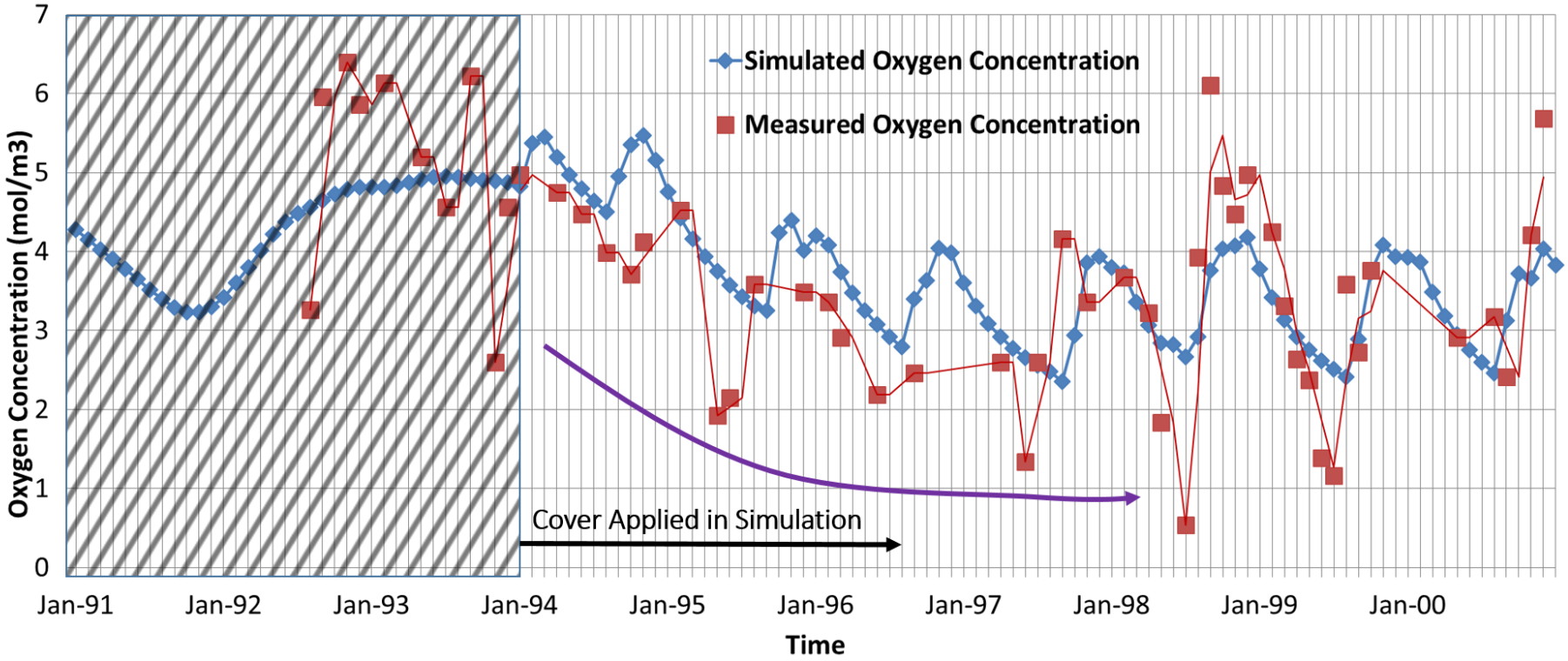




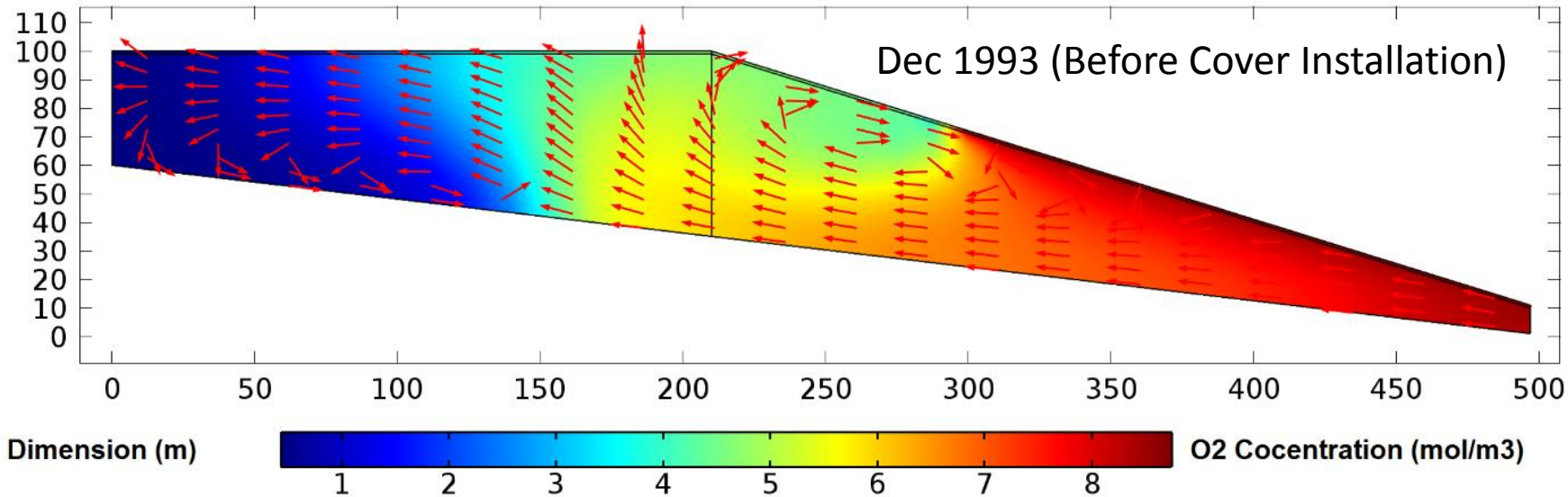
Total Precipitation and Ambient Temperature From Jan 91 to Jan 01

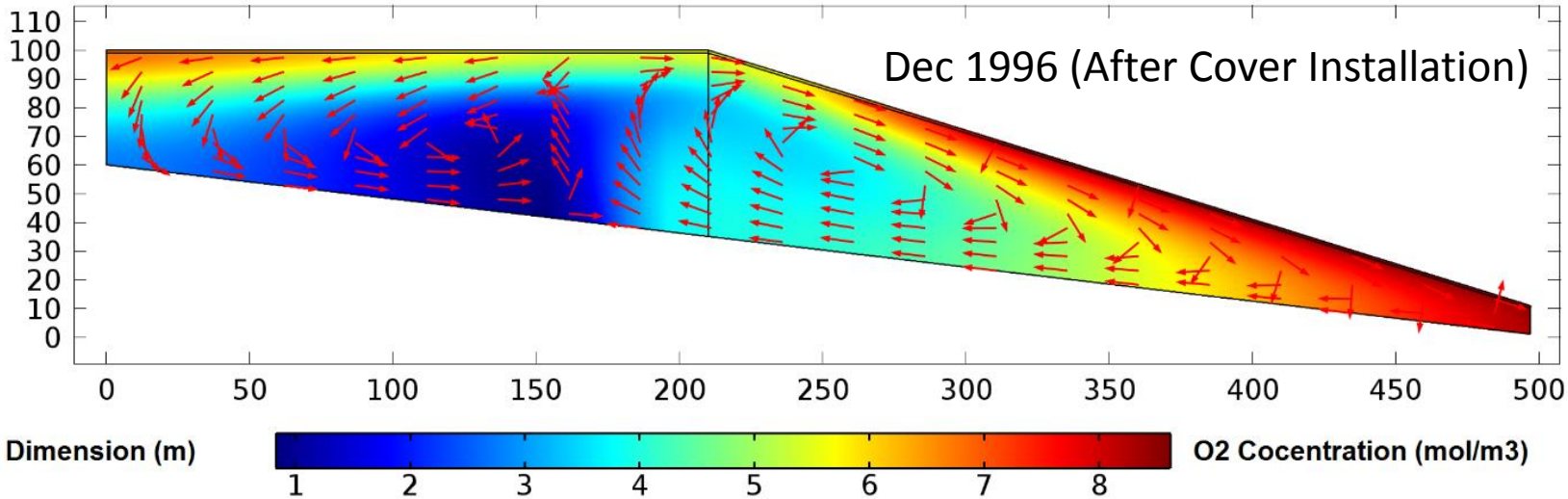


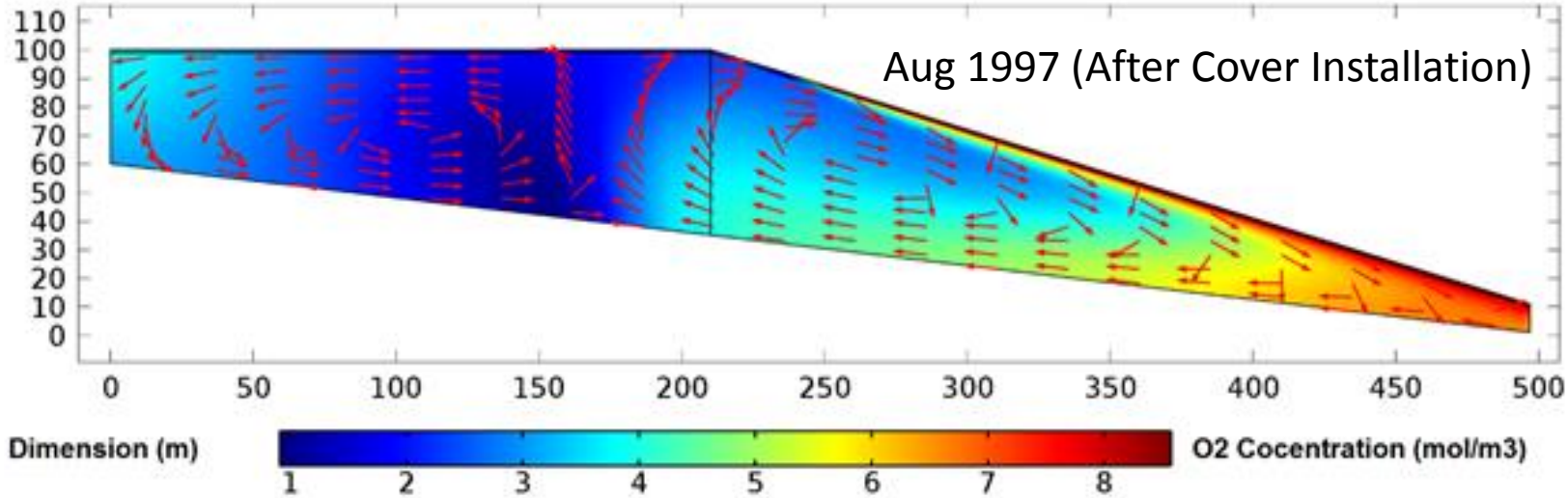
Measured and Simulated O2 concentration at 17 m depth of P-7 point



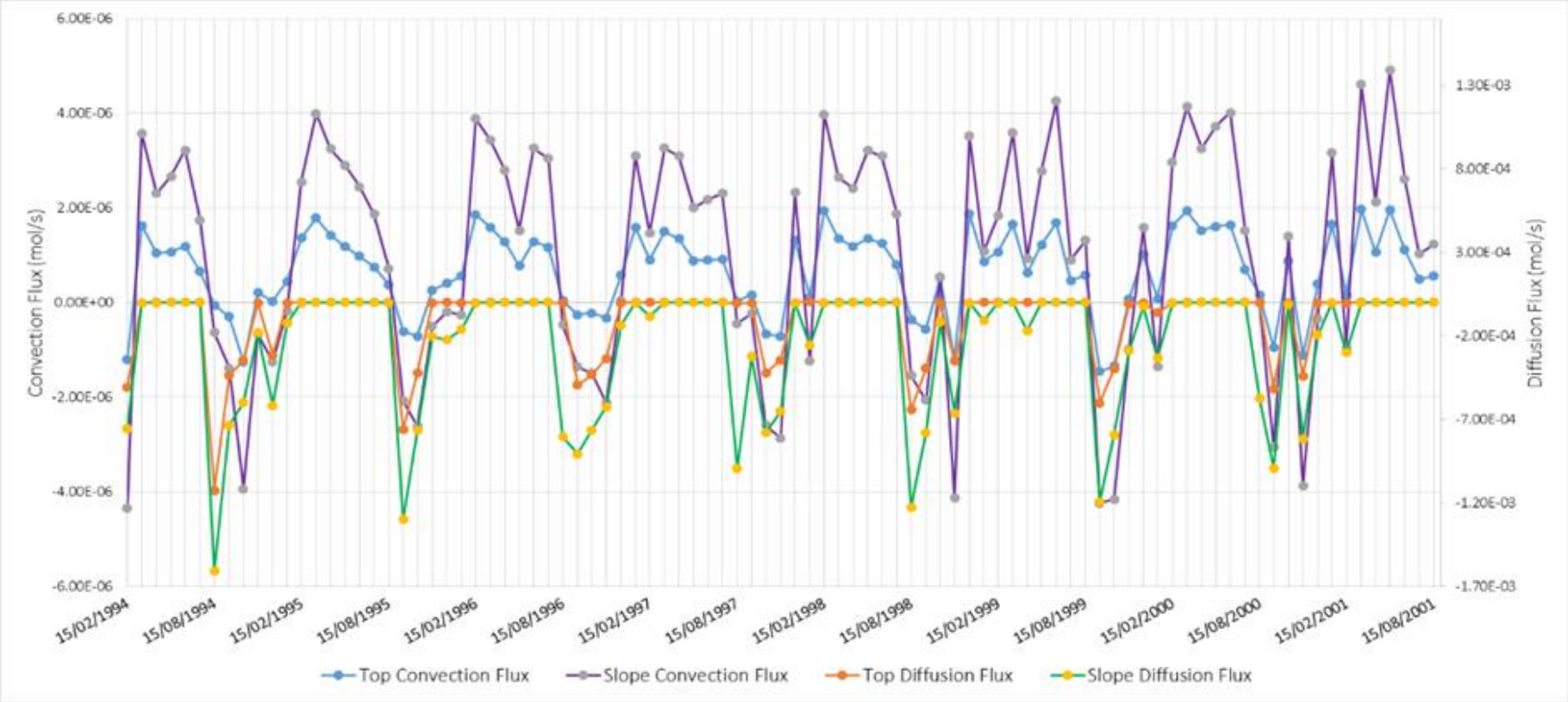
Oxygen Concentration and Air Flow Direction



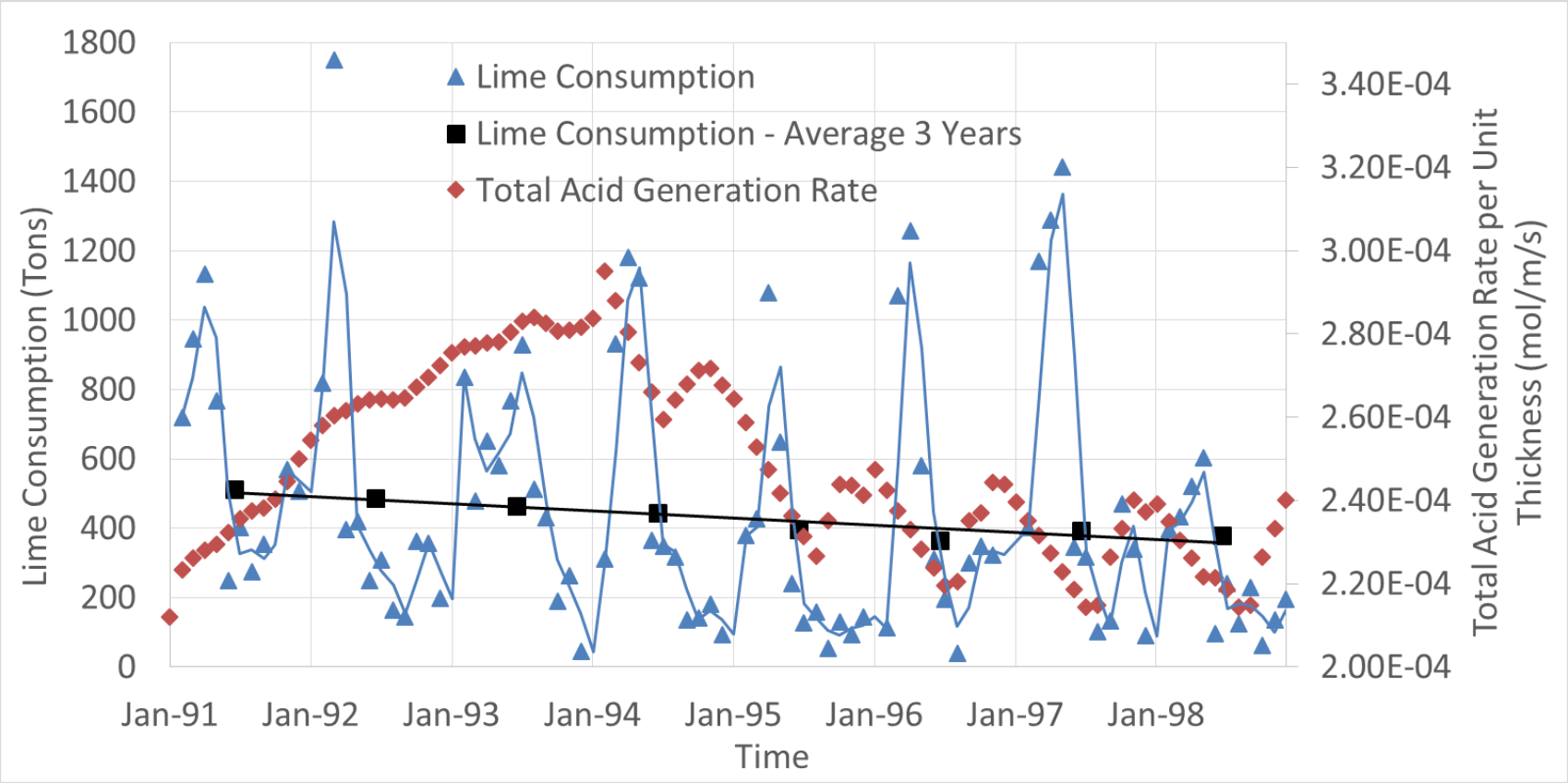

Dec 1996 (After Cover Installation)
110
100
90
80
70
60
50
40
30
20
10
0
0
50
100
150
200
250
300
350
400
450
500
Dimension (m)
1
2
3
4
5
6
7
8
O2 Cocentration (mol/m3)


Aug 1997 (After Cover Installation)
110
100
90
80
70
60
50
40
30
20
10
0
0
50
100
150
200
250
300
350
400
450
500
Dimension (m)
1
2
3
4
5
6
7
8
O2 Cocentration (mol/m3)

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?