

Comparative Geochemistry of Two Pit Lakes

John Crusius^{1,2}, Ph.D.

*¹Lorax Environmental
Services, Ltd.*

Roger Pieters^{2,3}, Ph.D.;

Albert Leung³;

*²UBC Dept. Earth &
Ocean Sciences*

Phil Whittle²;

Tom Pedersen^{1,2}, Ph.D.;

*³UBC Dept. Civil Engineering
Vancouver, British Columbia*

Greg Lawrence³, Ph.D.;

Jay McNee¹, Ph.D.

Ali Sahami¹, Ph.D.

Sponsored by



and industry



Outline

- introduction to pit lakes
- 3-year research program overview
- initial results- MainZone pit

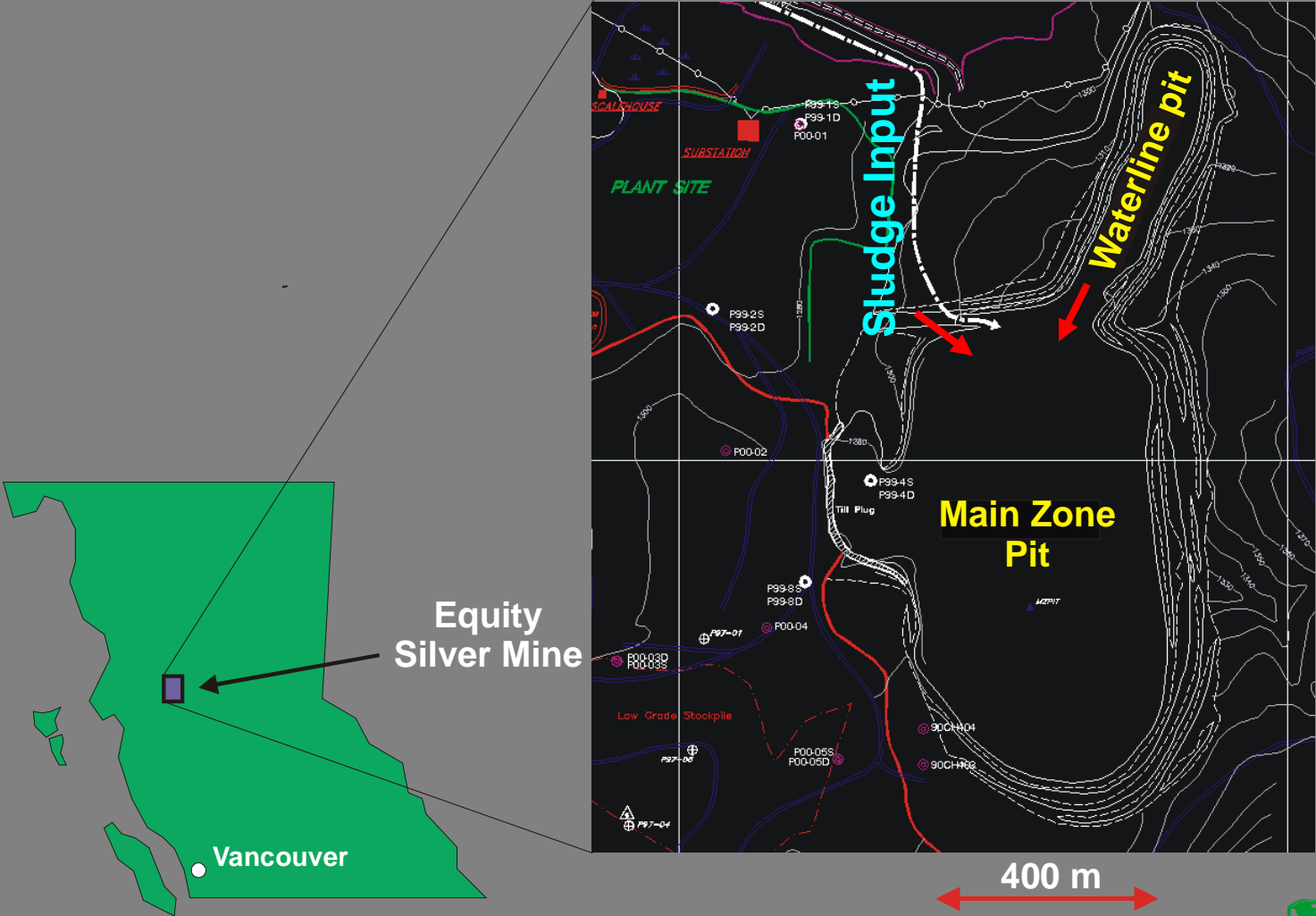
Waterline pit

- questions raised

What Are Pit Lakes??

- form when open pits fill with water (groundwater and surface runoff)
- increasingly common in western N. America
- frequently low-pH waters with elevated concentrations of many metals
- many in U.S. are Superfund sites

Site Location

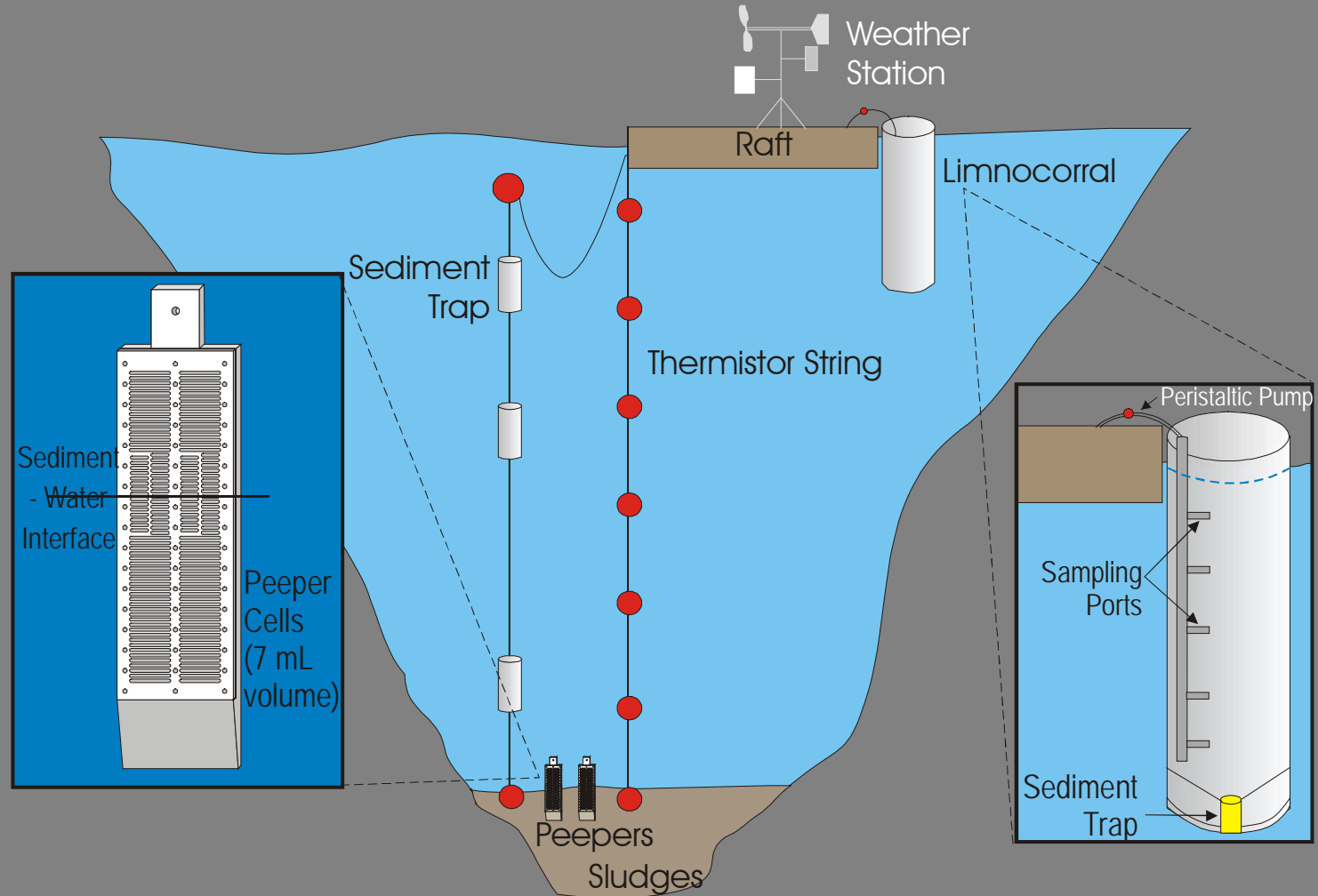


Why Equity Silver Pit Lakes?

- similar to many other pit lakes
(bathymetry, TDS)
- elevated metal concentrations in surface waters
- “easy” access from Vancouver

- **Two-year whole-lake field survey**
- **Lake manipulation in experimental enclosures
(limnocorrals)**
- **Validation and improvement of coupled physical
geochemical pit lake model**

Field Sampling Equipment

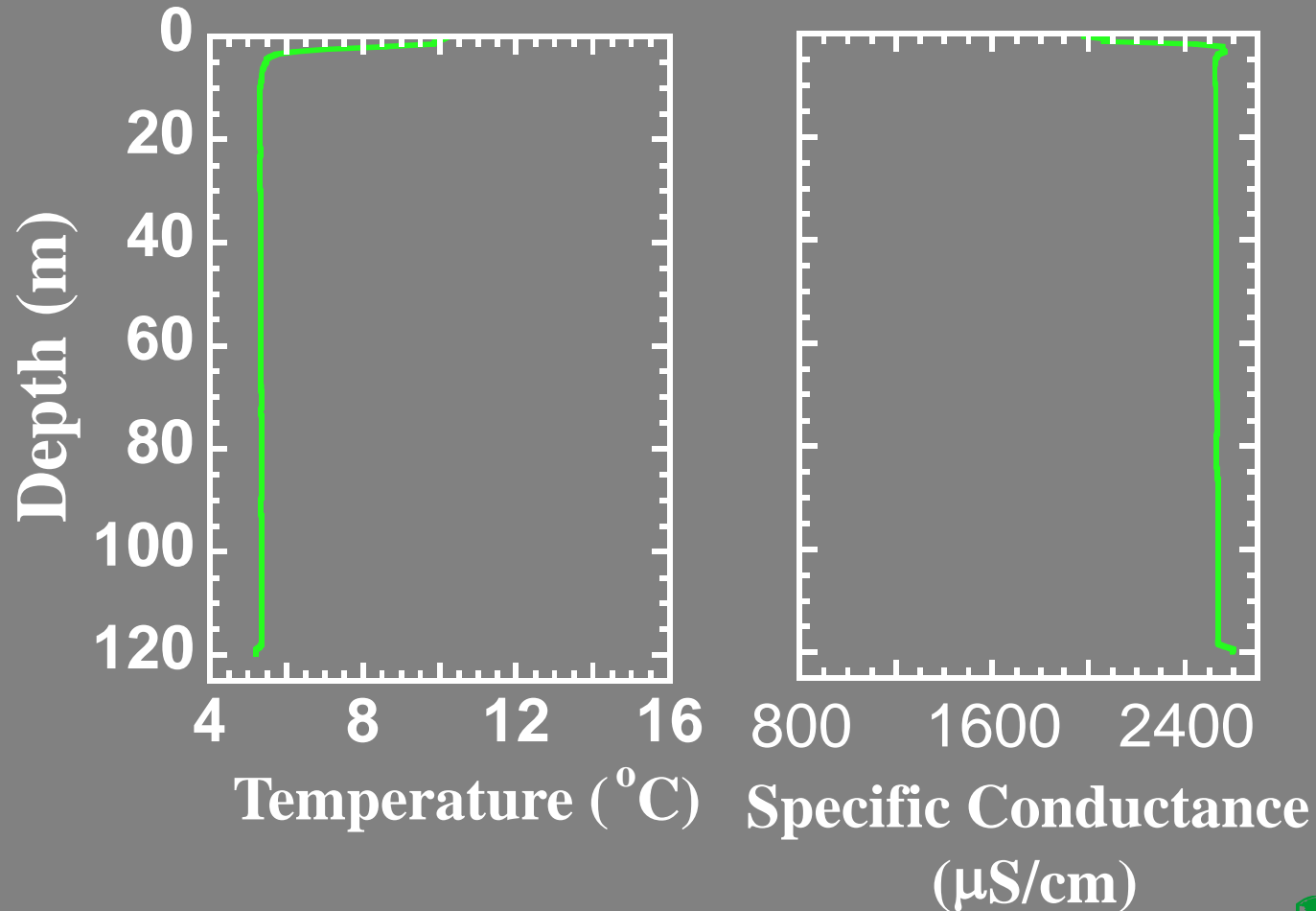


Sampling Raft

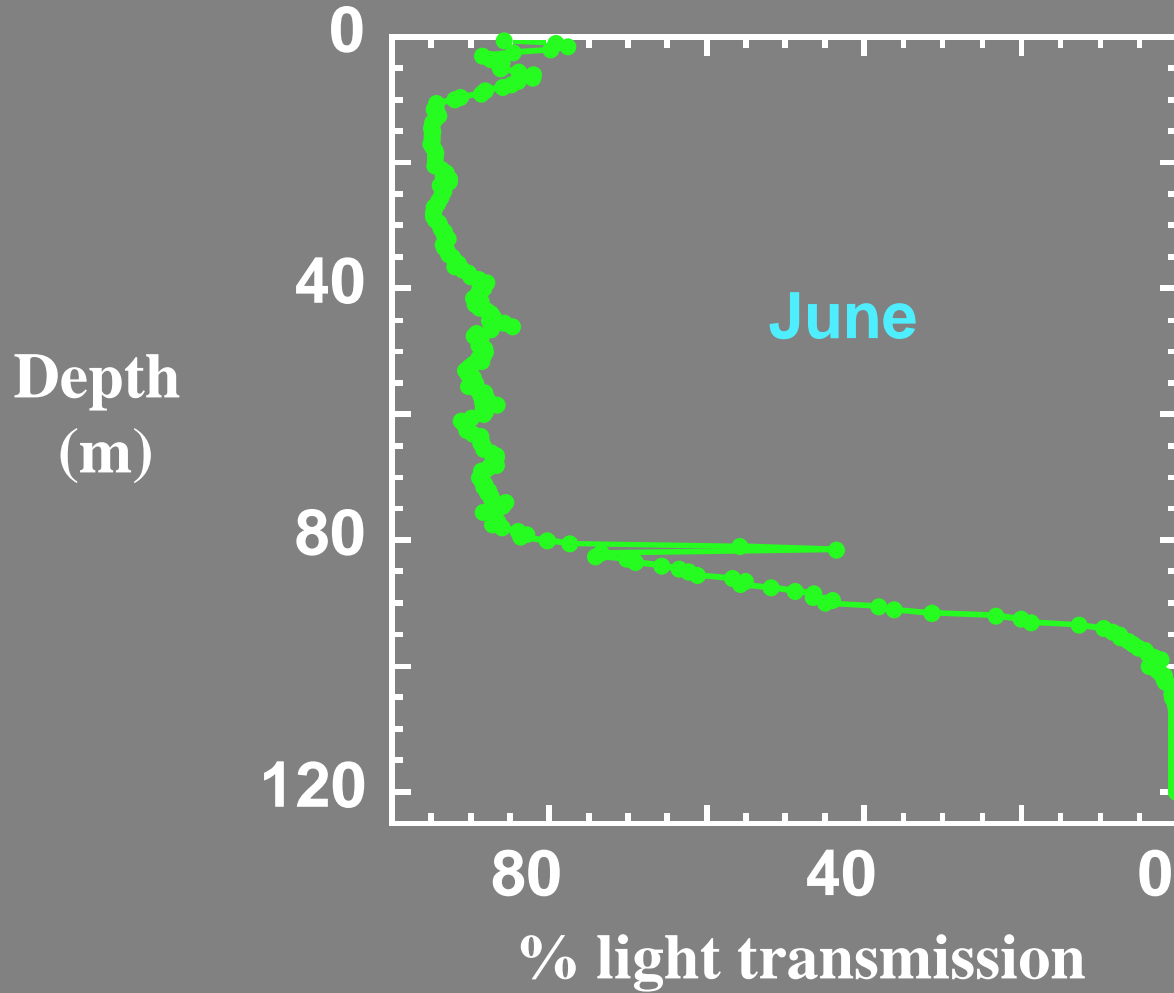


MainZone Pit Stratification

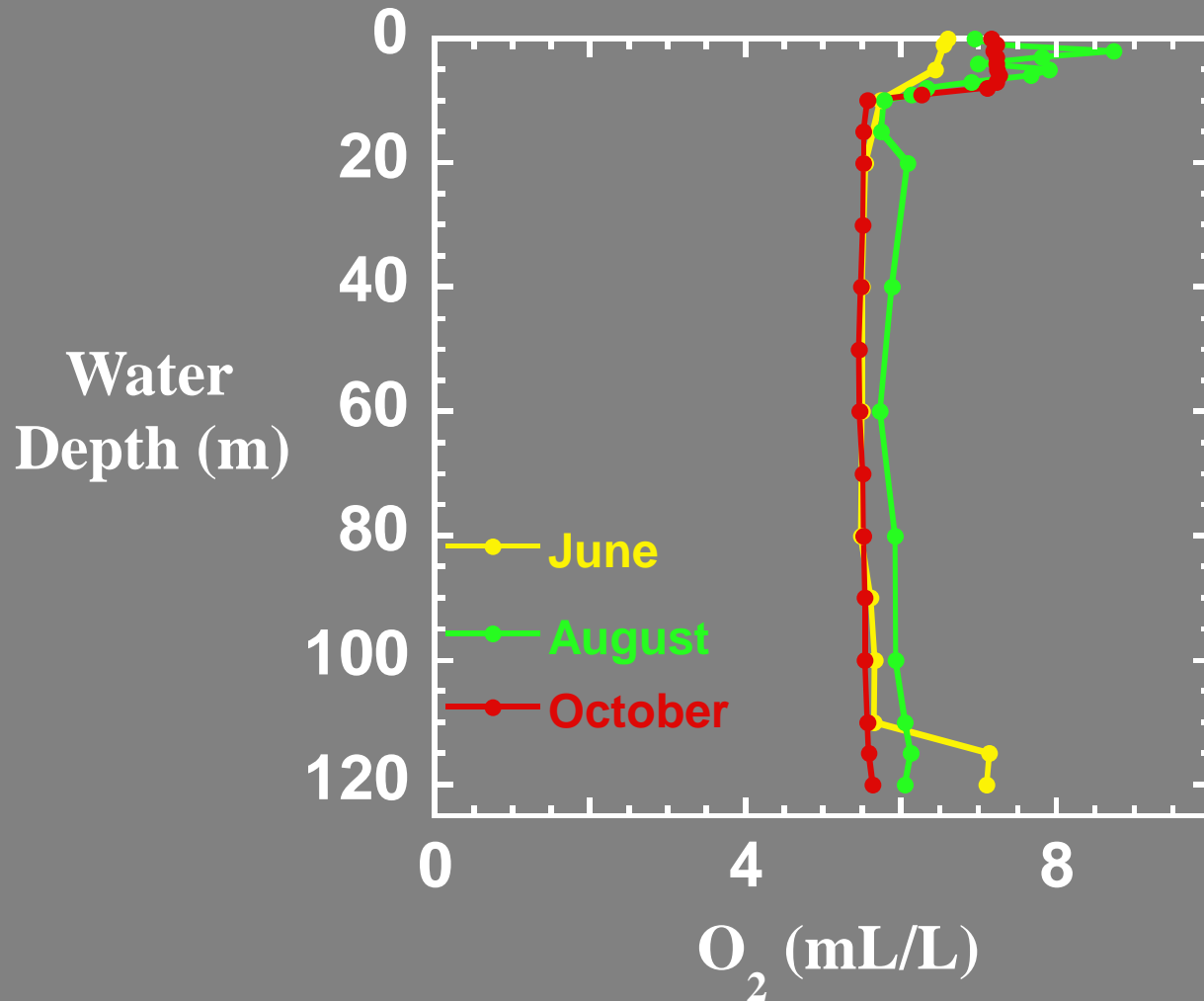
June 21-29



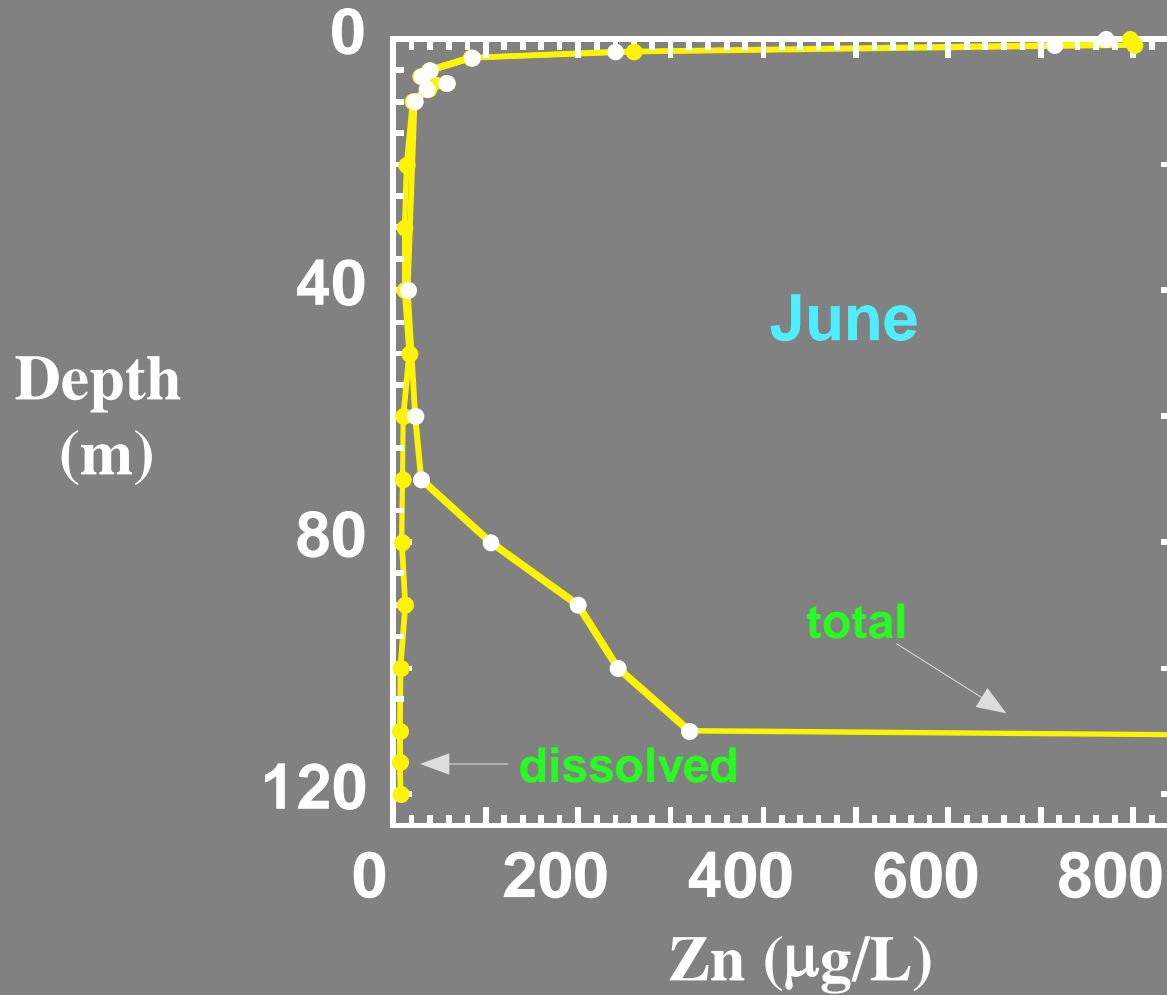
MainZone Pit



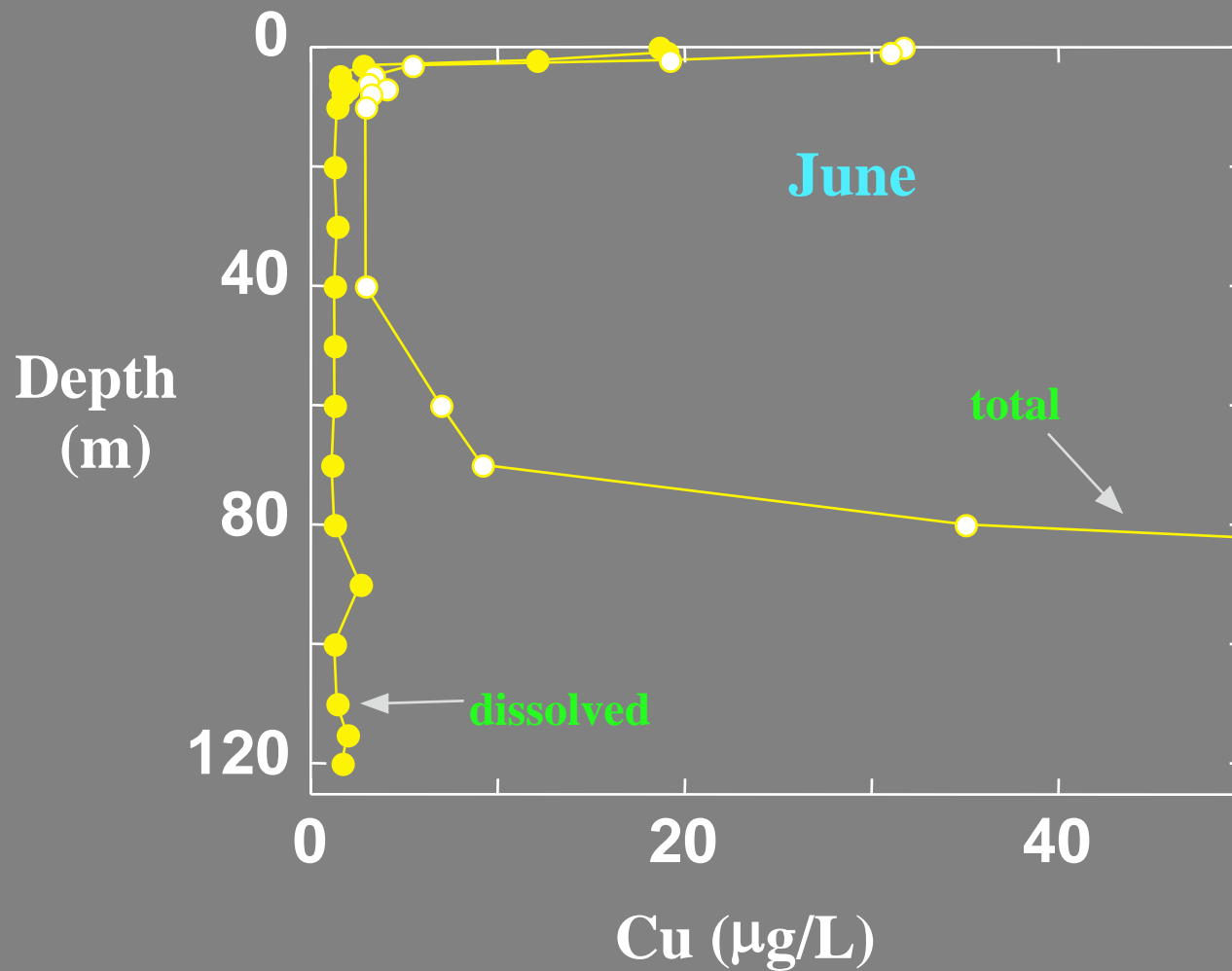
MainZone Pit



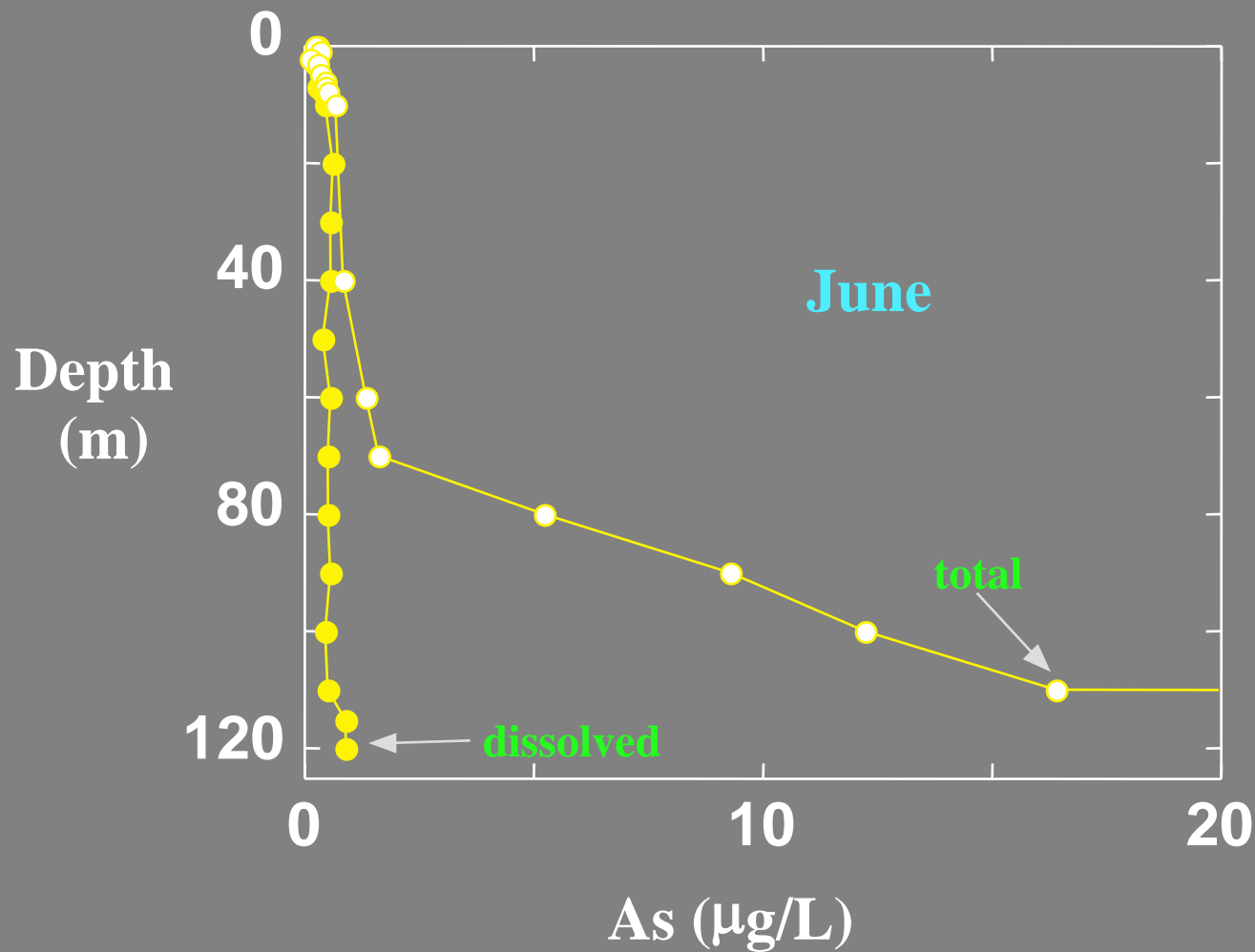
MainZone Pit



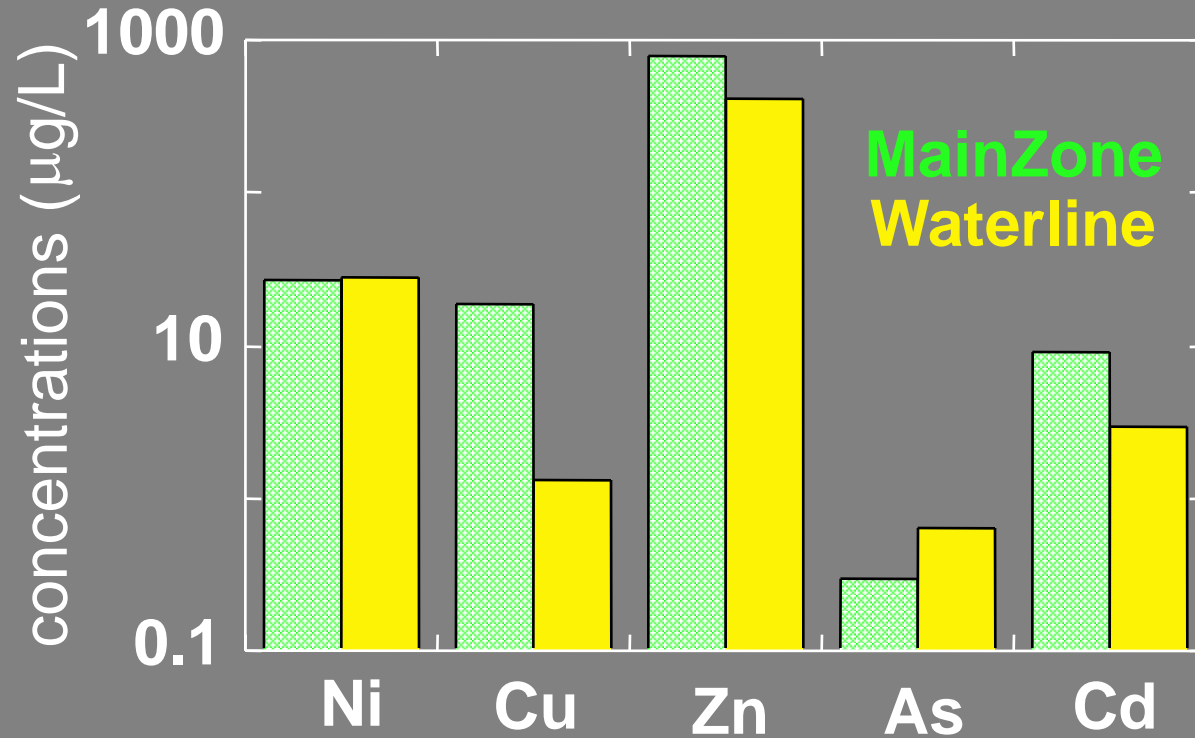
MainZone Pit



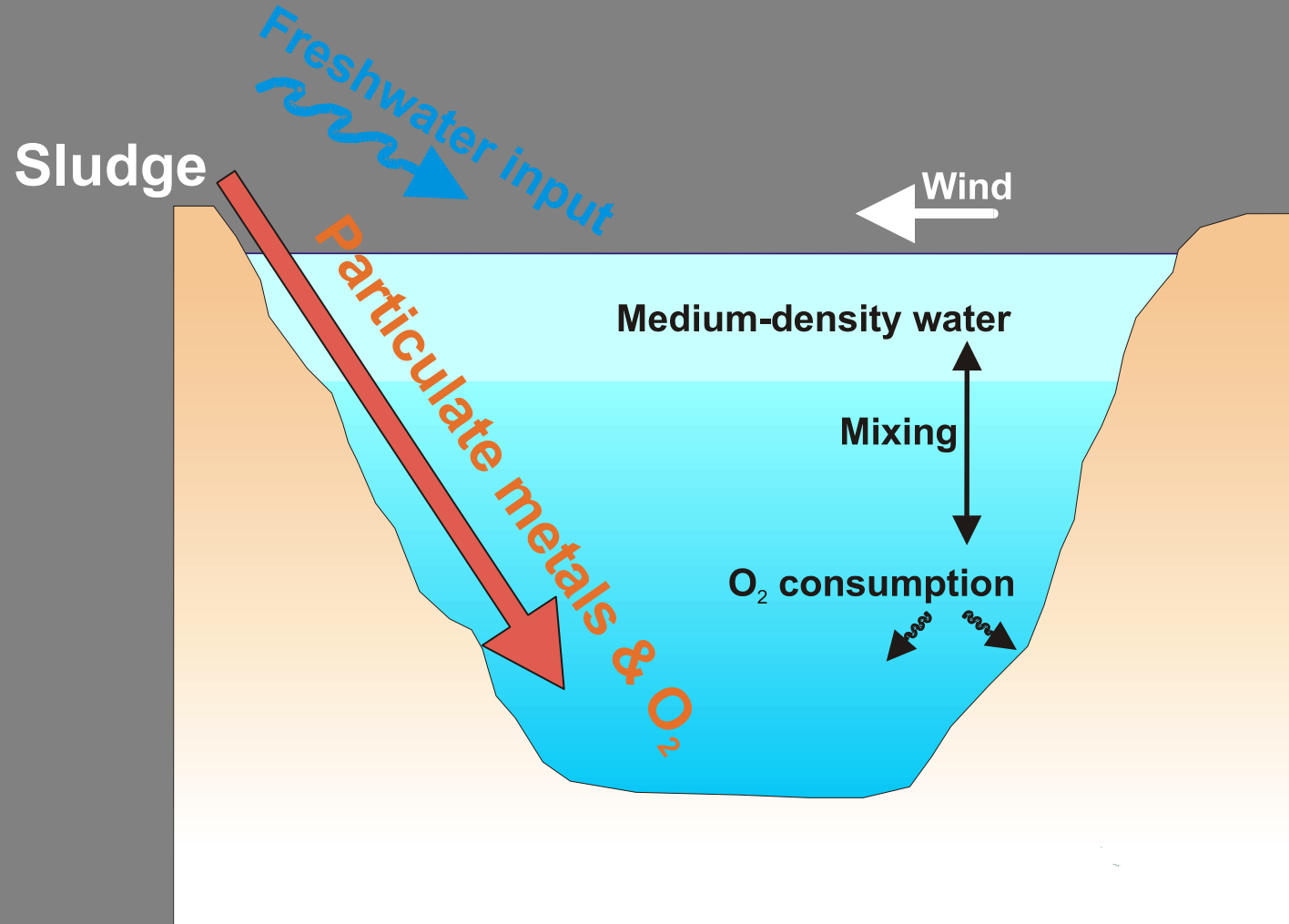
MainZone Pit



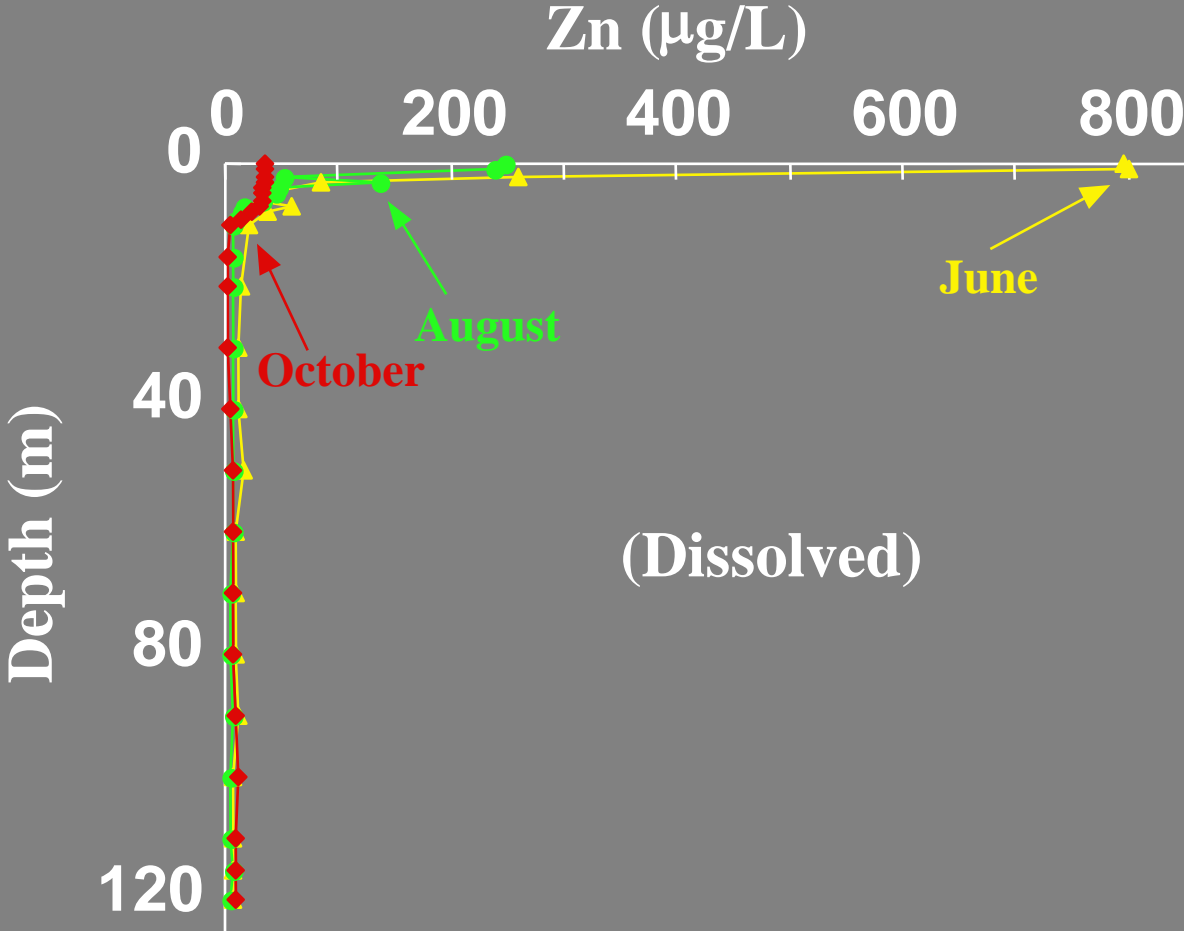
Surface Water Metal Concentrations (June)



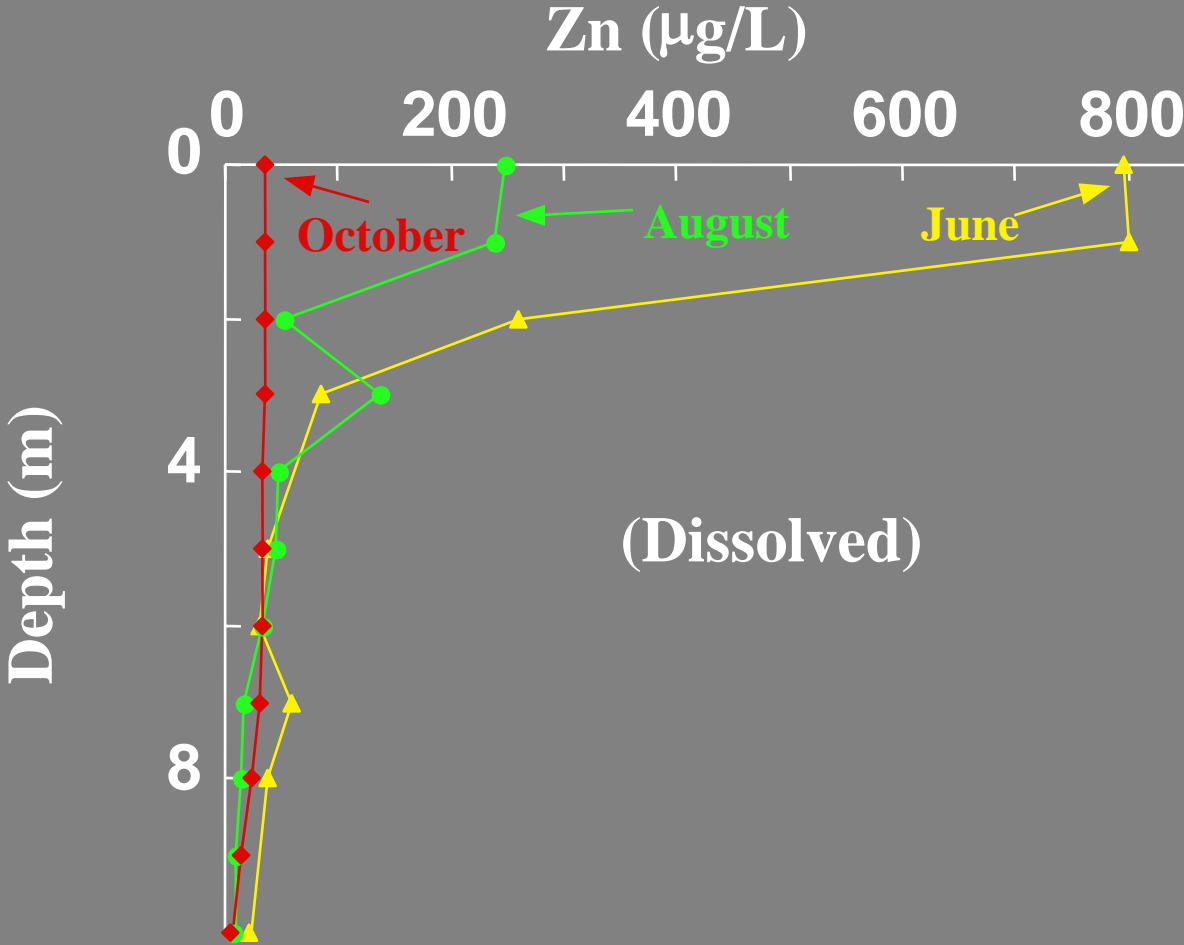
MainZone Schematic



MainZone Pit

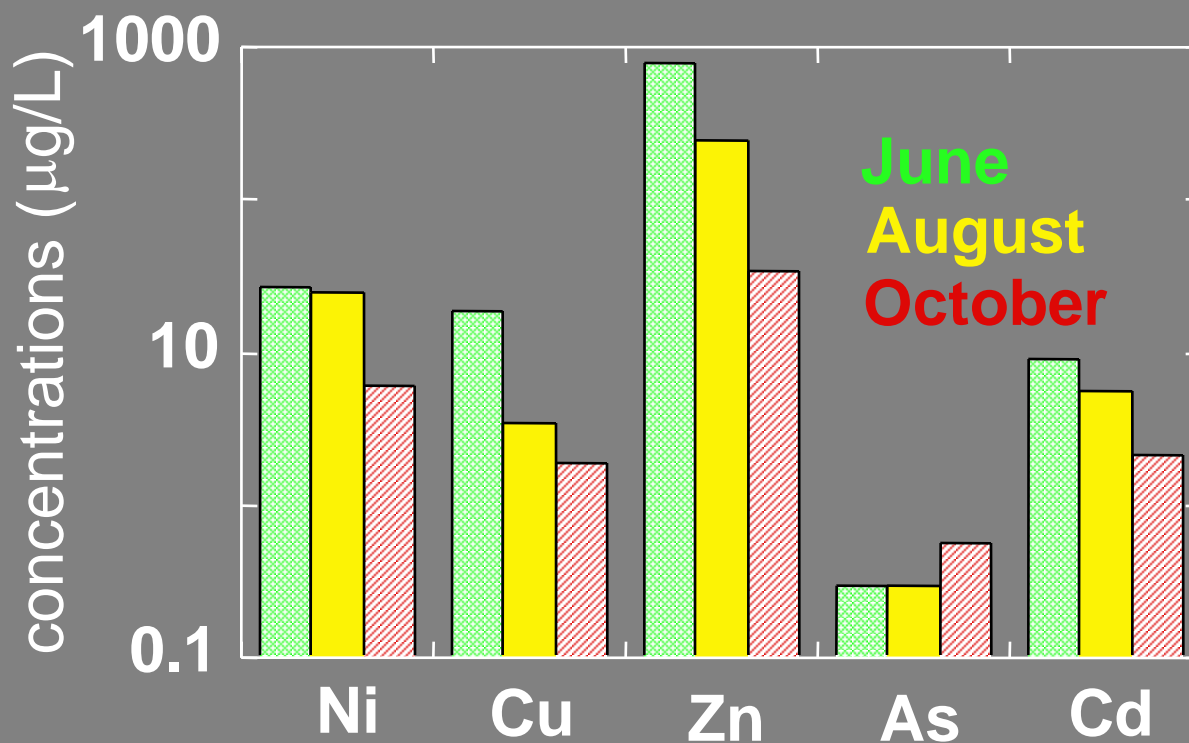


MainZone Pit

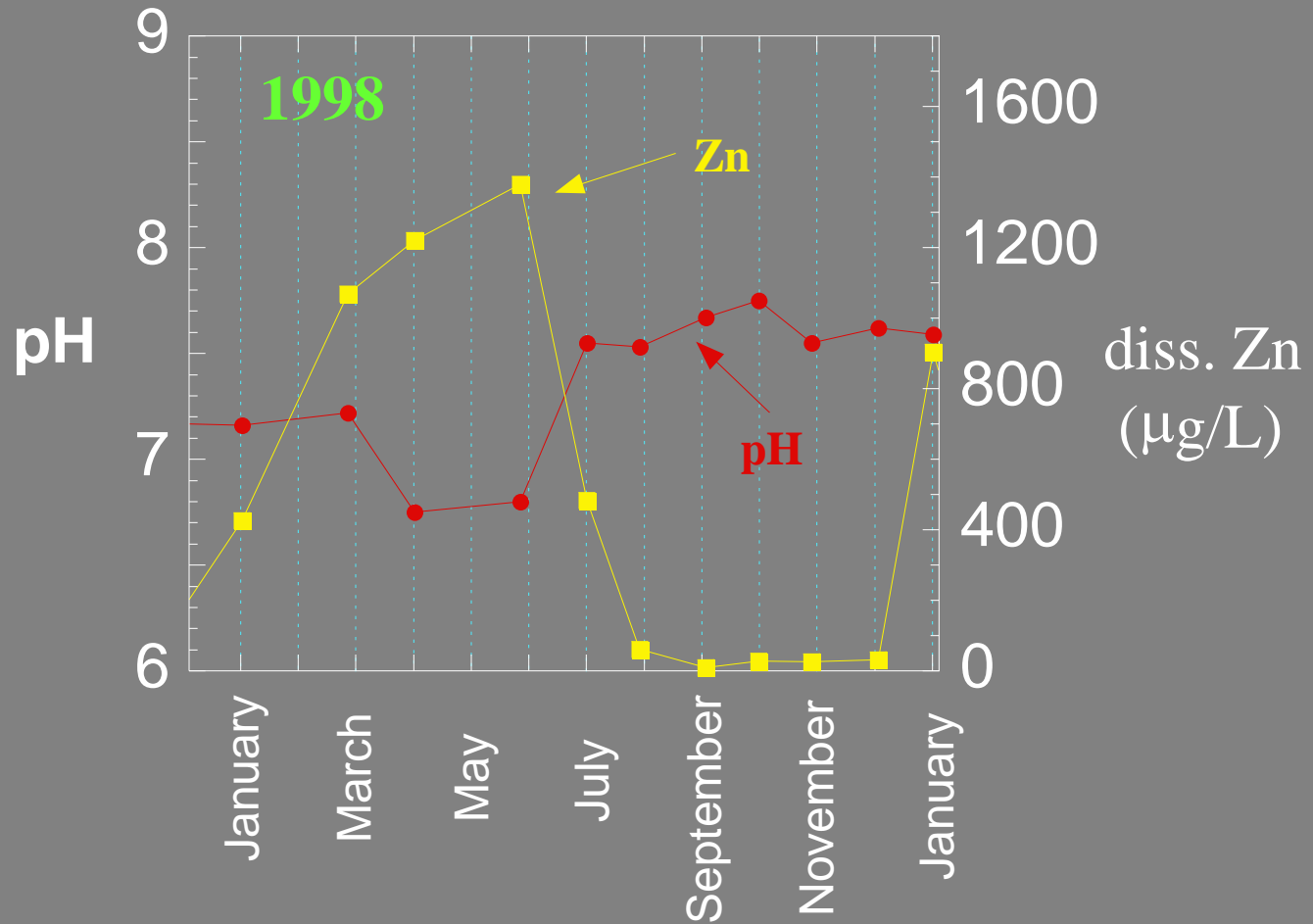


Surface Water Metal Removal

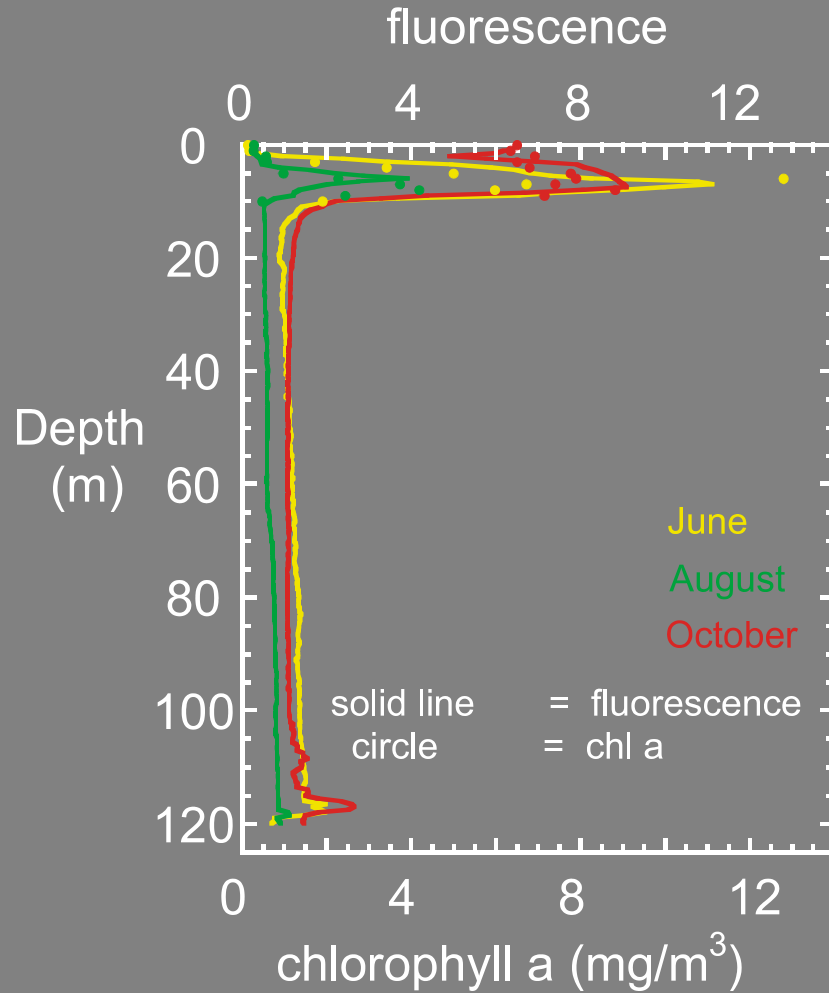
MainZone pit 2001



MainZone Pit Surface Waters

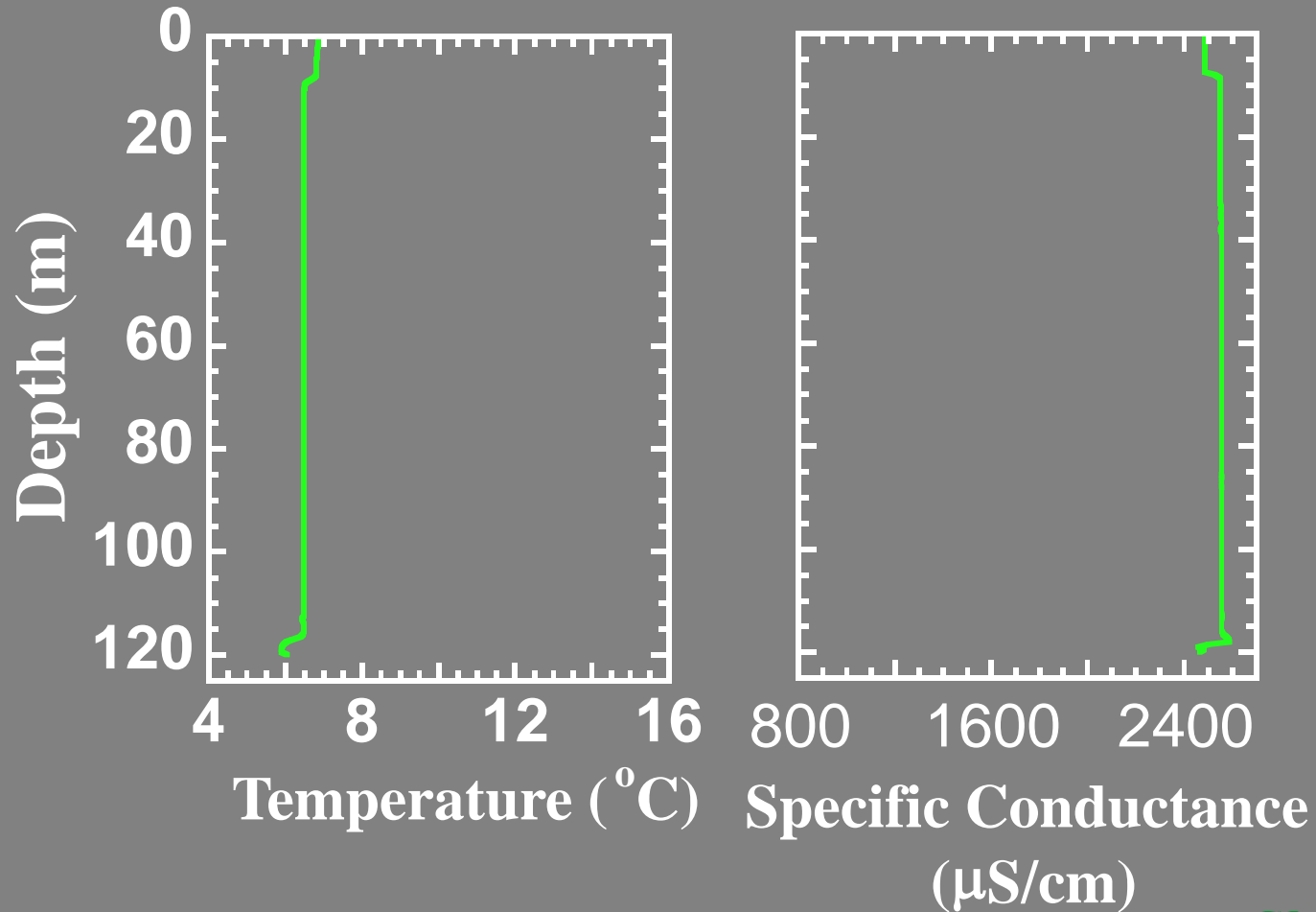


MainZone Pit

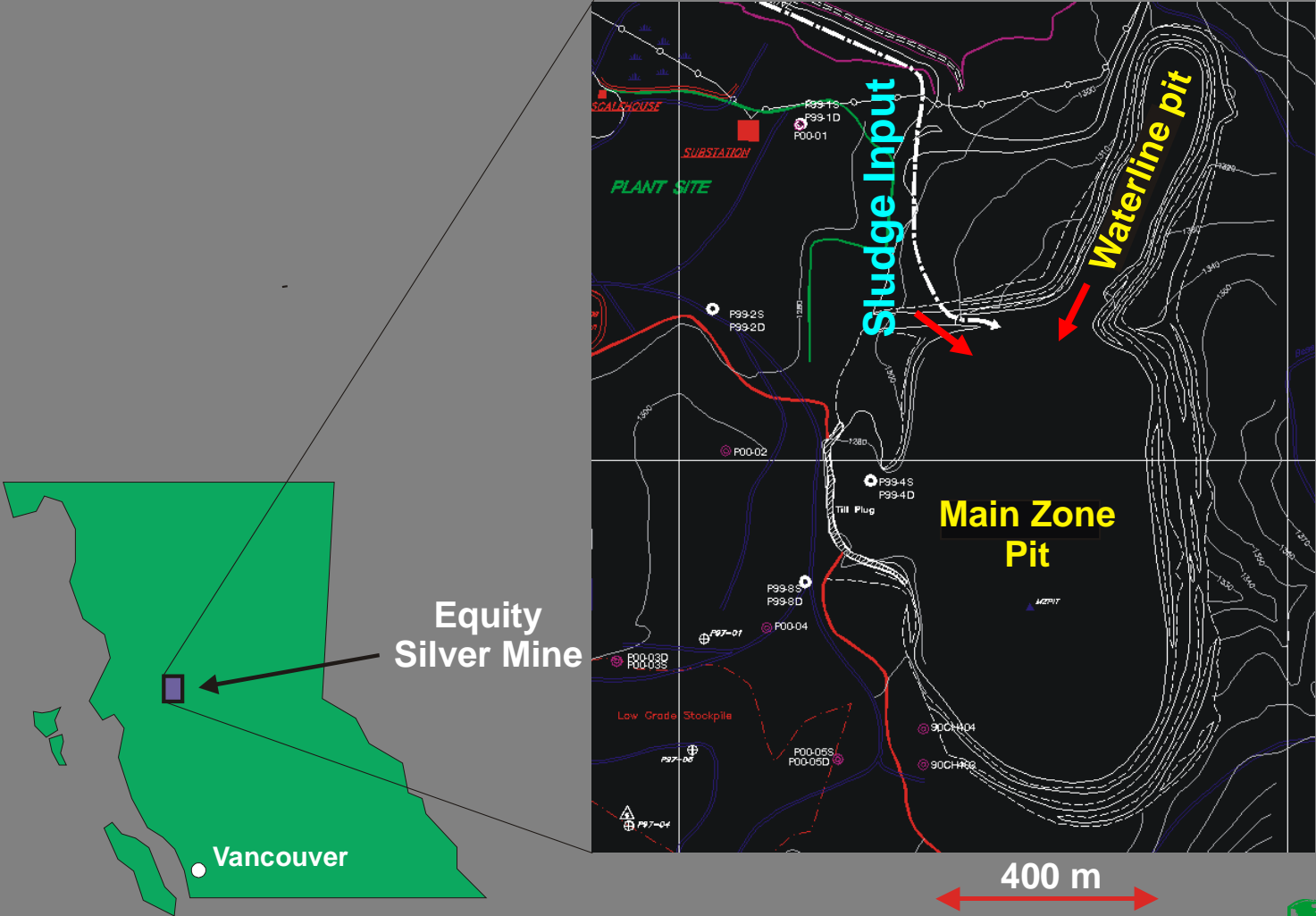


MainZone Pit Stratification

October 1-5

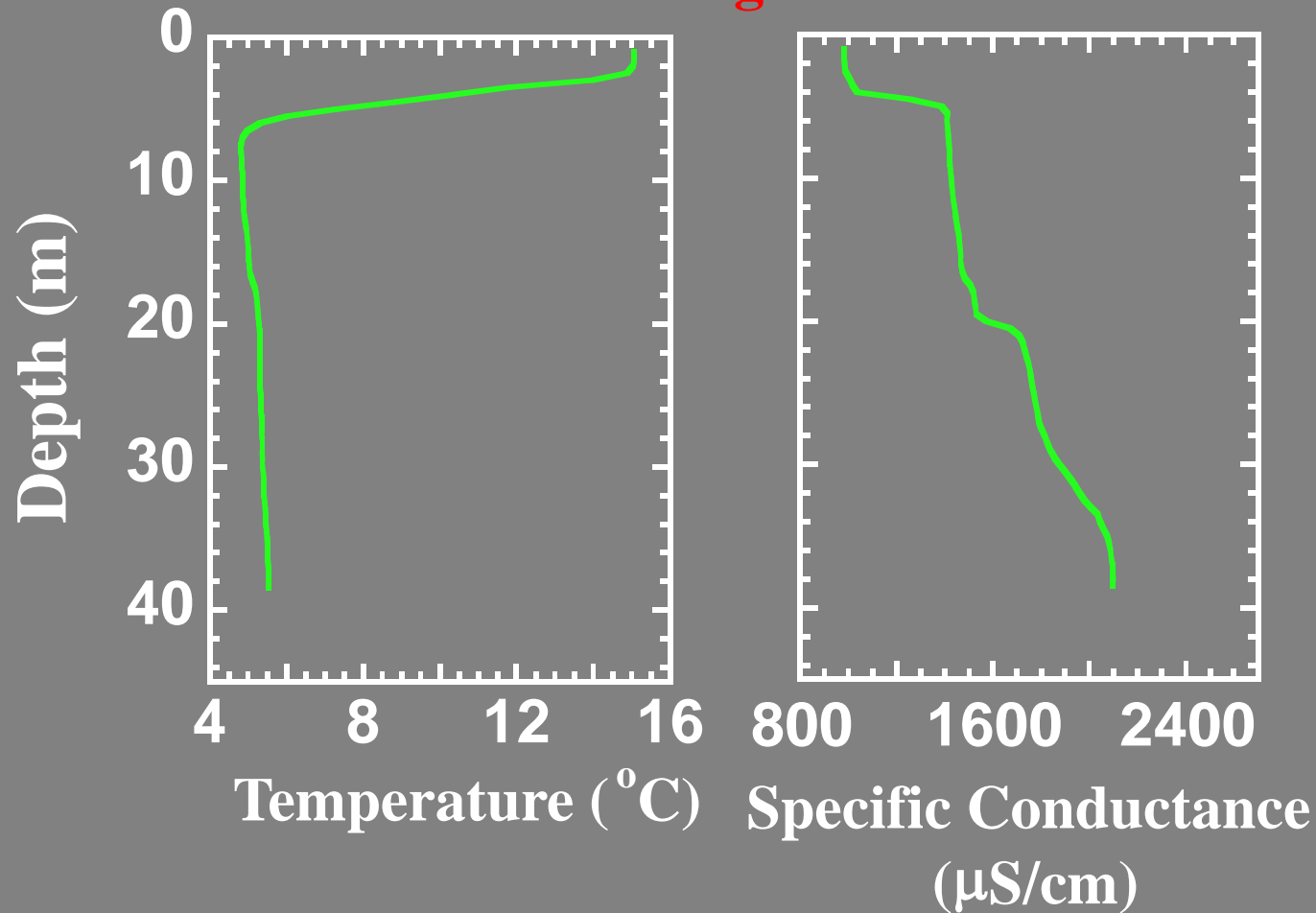


Site Location



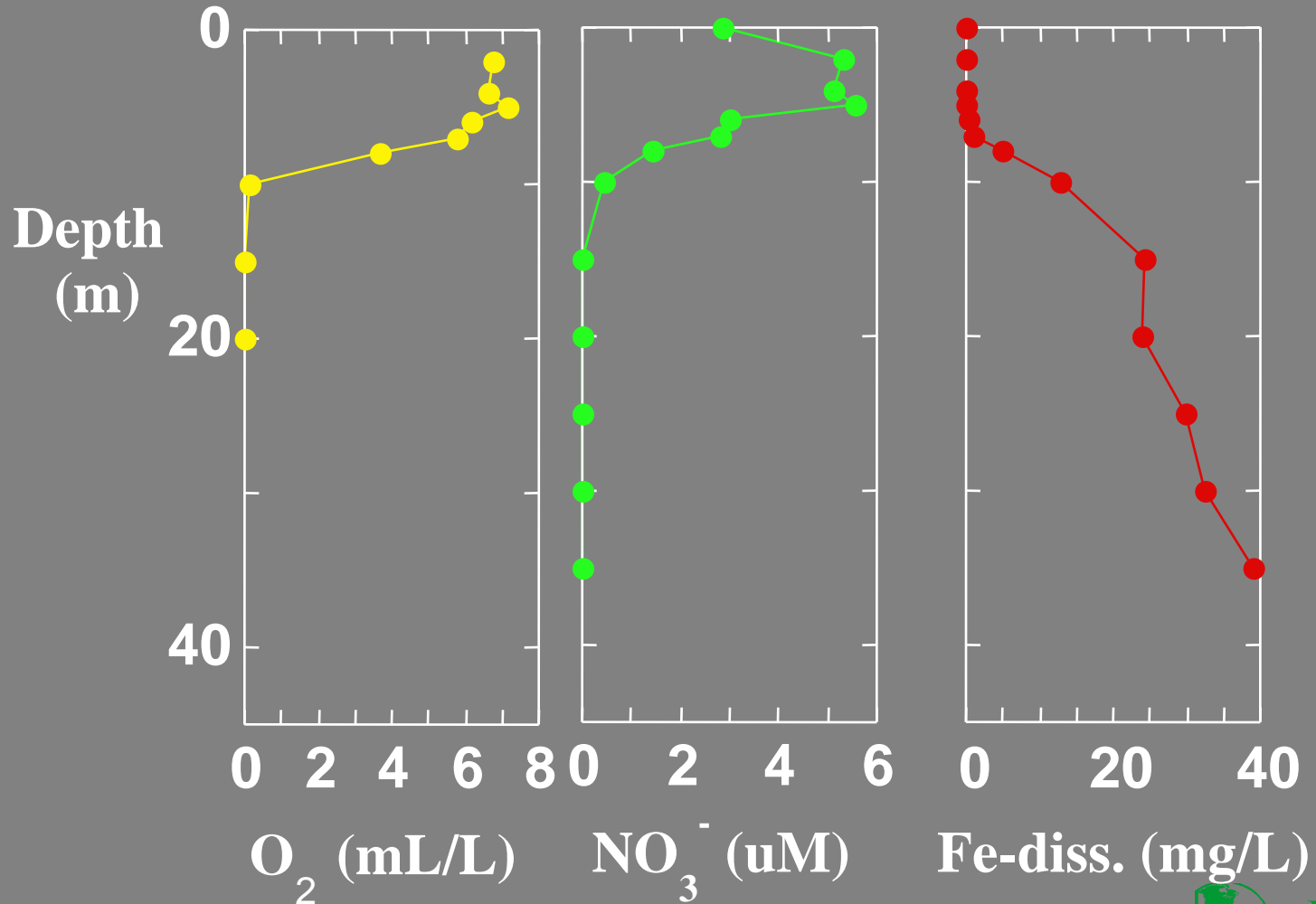
Waterline Pit Stratification

August



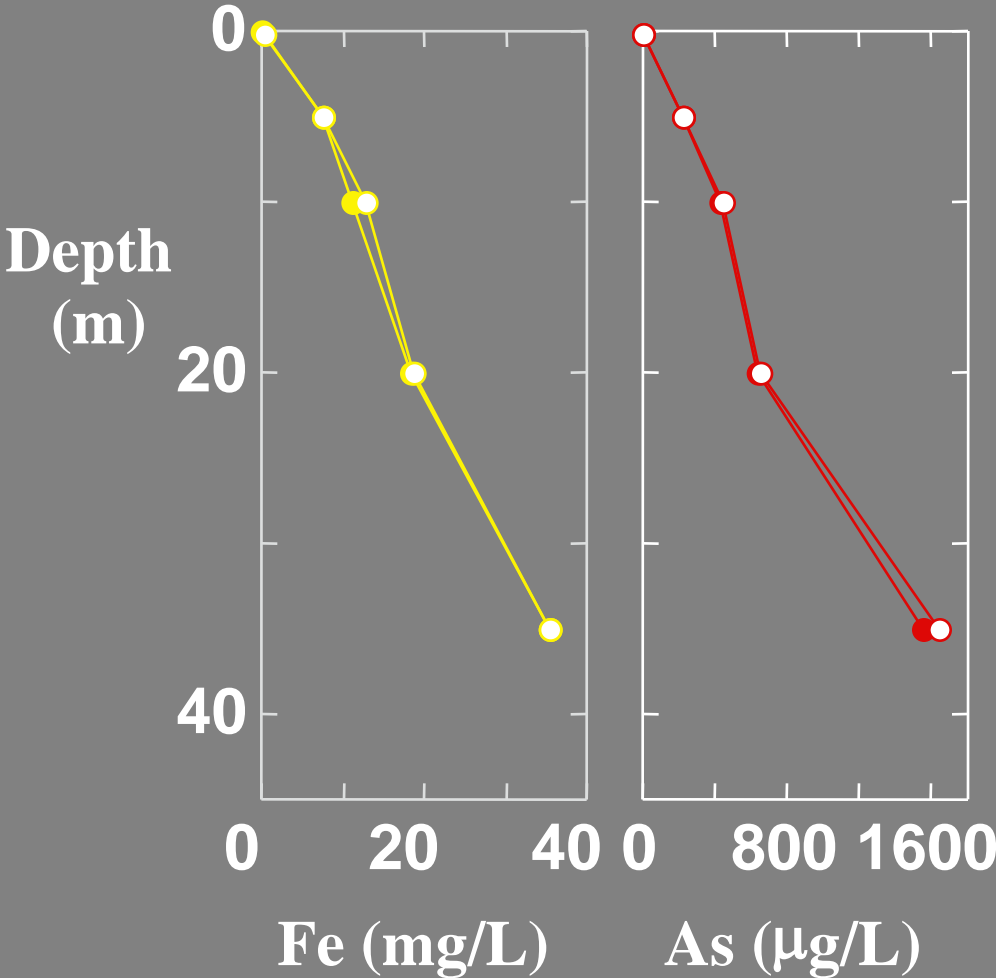
Waterline Pit Redox Conditions

October



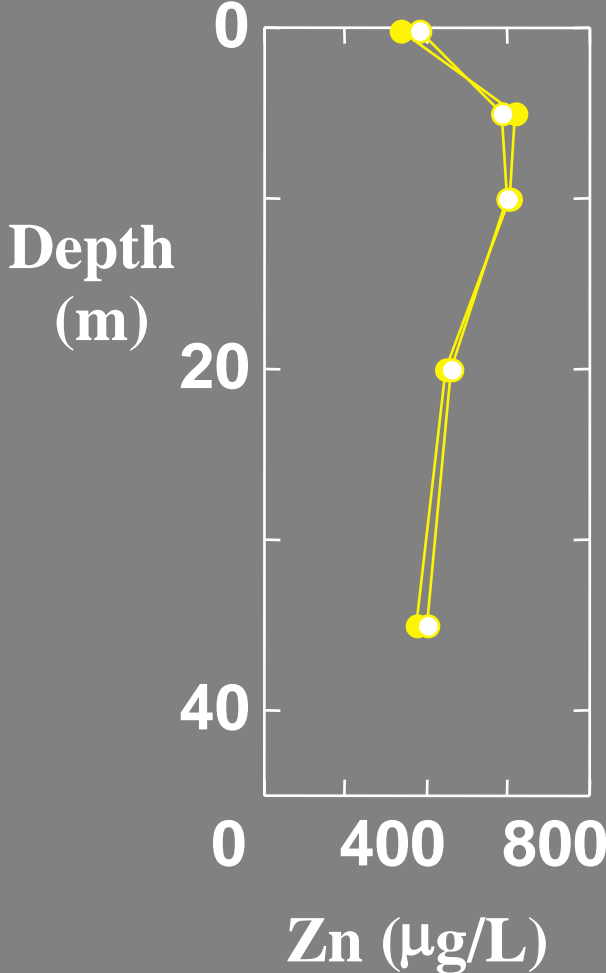
Waterline Pit

August

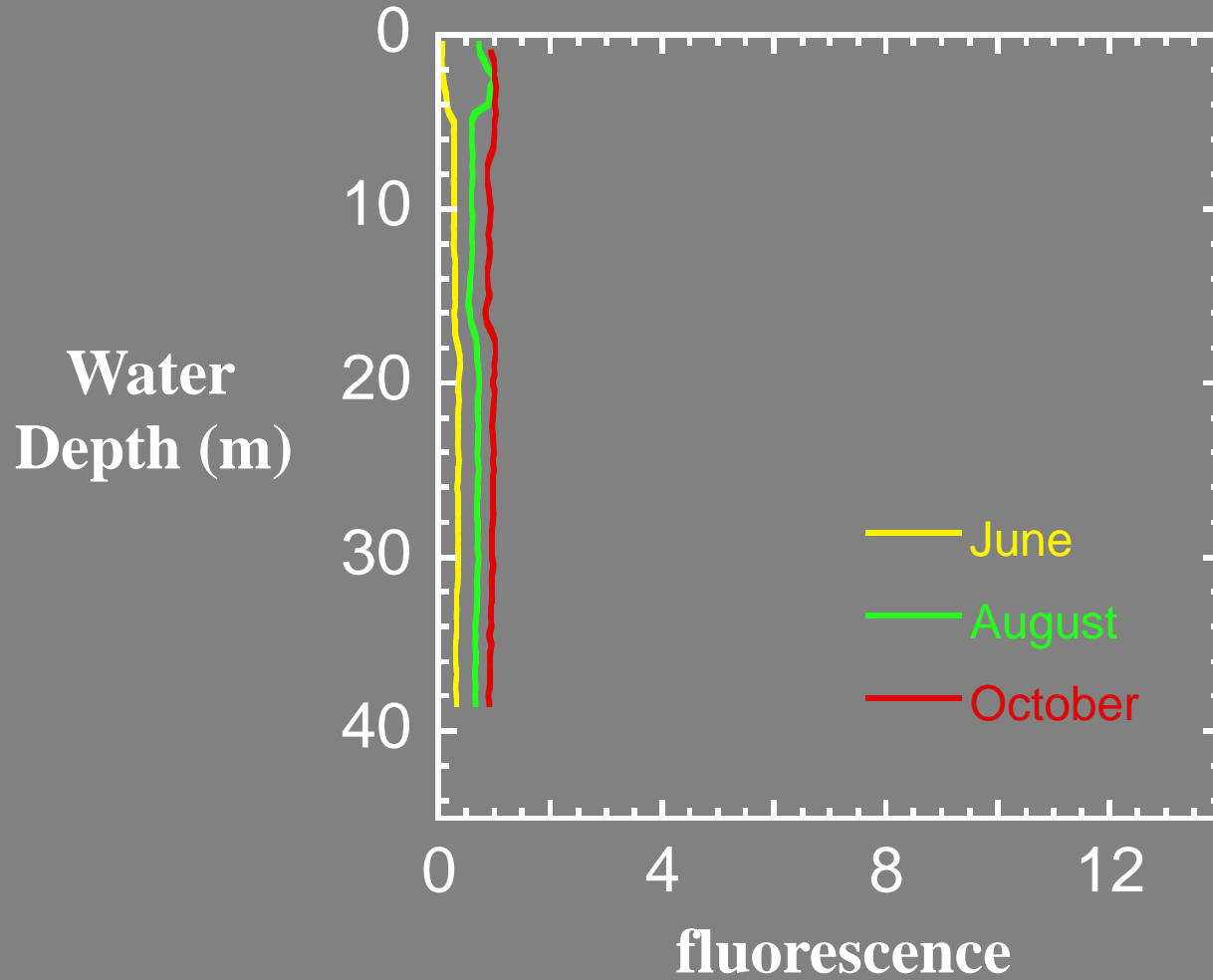


Waterline Pit

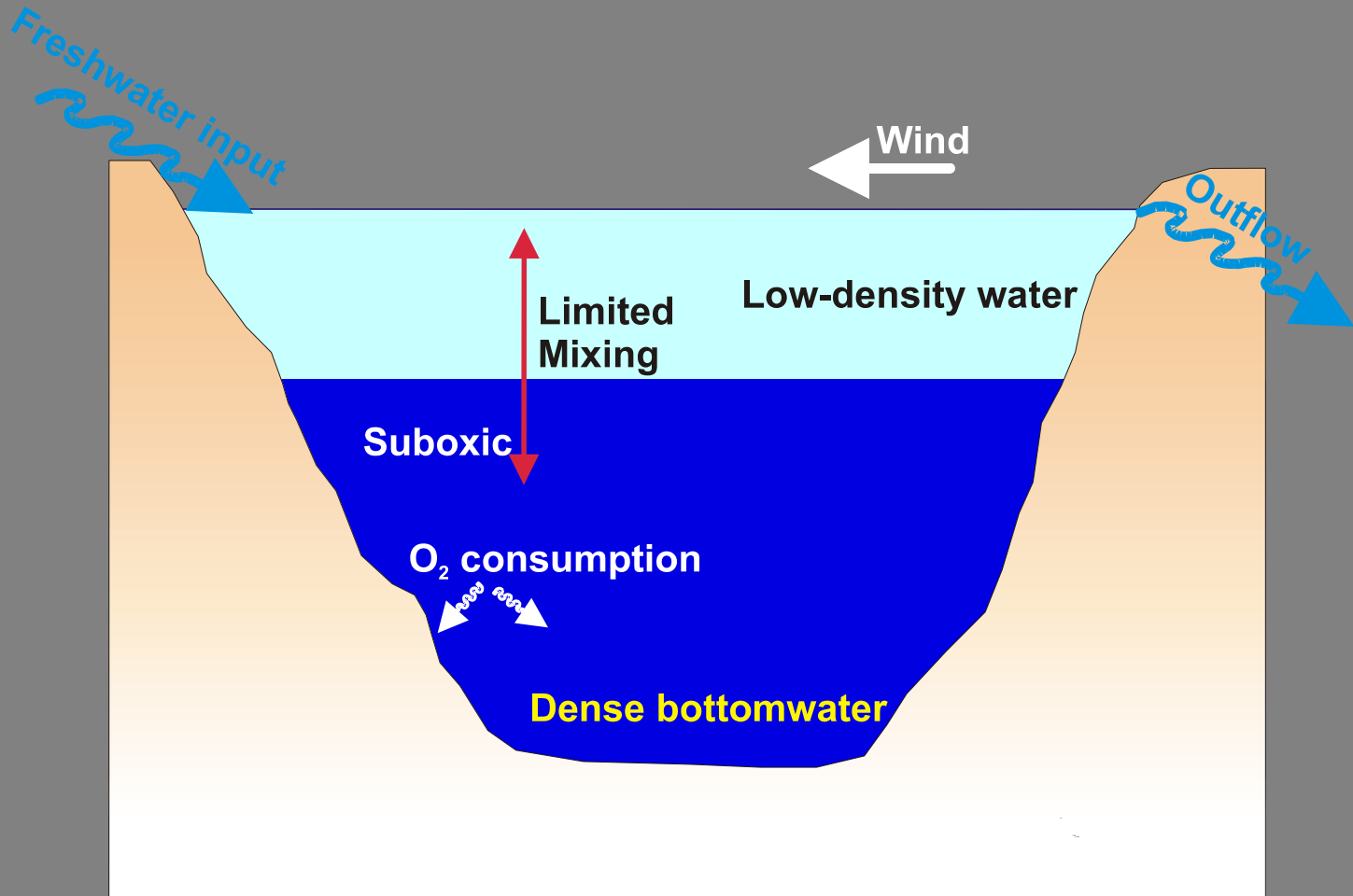
August



Waterline Pit



Waterline Schematic



Remaining Questions

MainZone pit

- What is long-term stability of sludge ?
- Can we better define....
 - source of metals
 - fate of removed metals

Waterline pit

- How permanent is the stratification?
- How rapidly are deep waters becoming more reducing?

As well as....

- Why is productivity higher in Main Zone pit?
- Why is Waterline pit better stratified ?

Summary

MainZone pit

- weakly stratified (seasonally)
- elevated metal concentrations in surface (seasonally)
- summertime metal removal
- well oxygenated due to sludge inputs & weak stratification, *despite* moderate productivity

Waterline pit

- more strongly stratified
- mildly reducing (suboxic) *despite* low productivity
- elevated Fe & As concentrations in deep waters