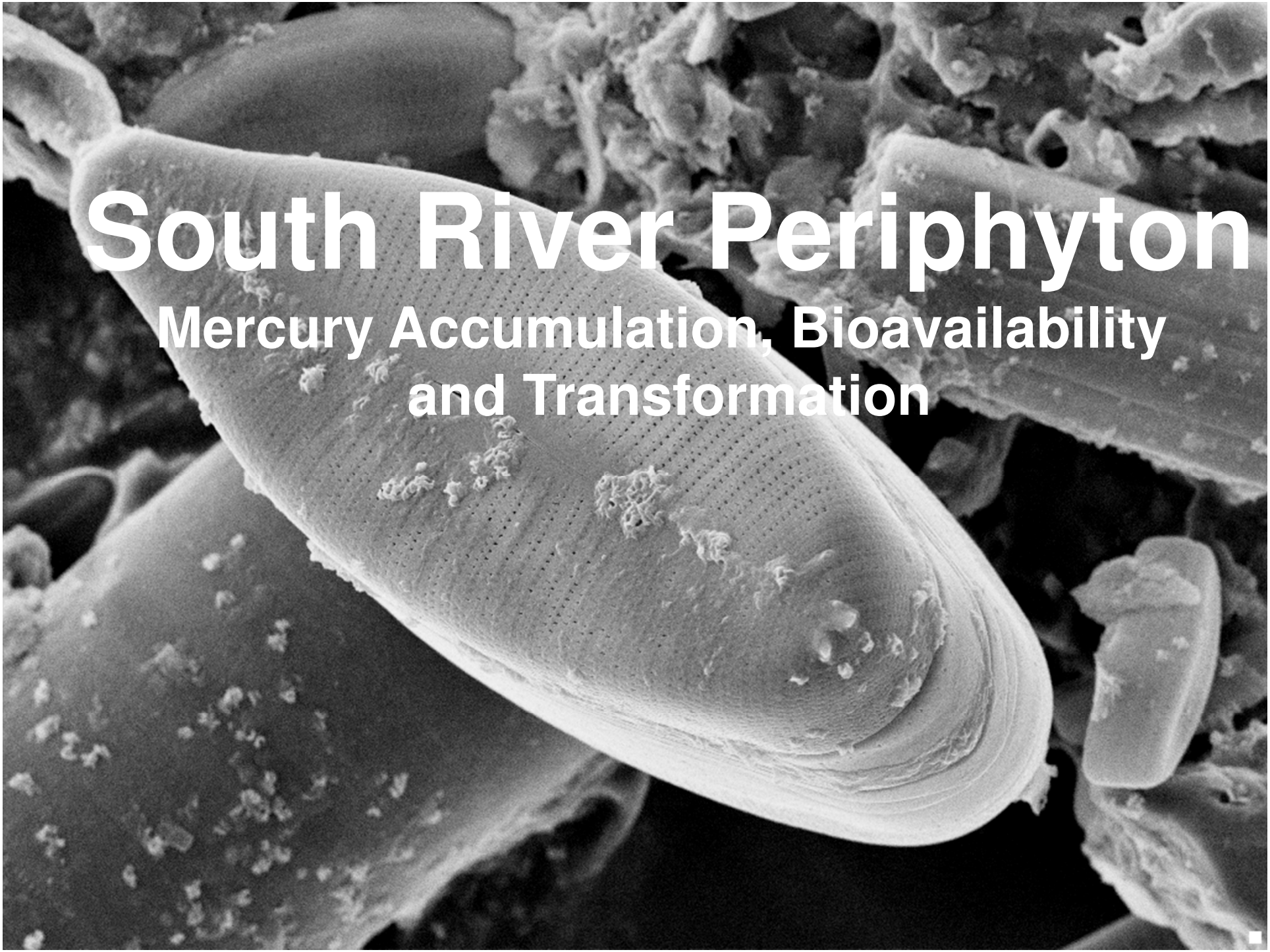


South River Periphyton

Mercury Accumulation, Bioavailability and Transformation

Conceptual Context

Biogeochemically Dynamic/Important River Component



Adsorption
Coprecipitation

Bioaccumulation
Physical Inclusion

Trophic Uptake
and Availability



"Periphyton"
Biomonitoring

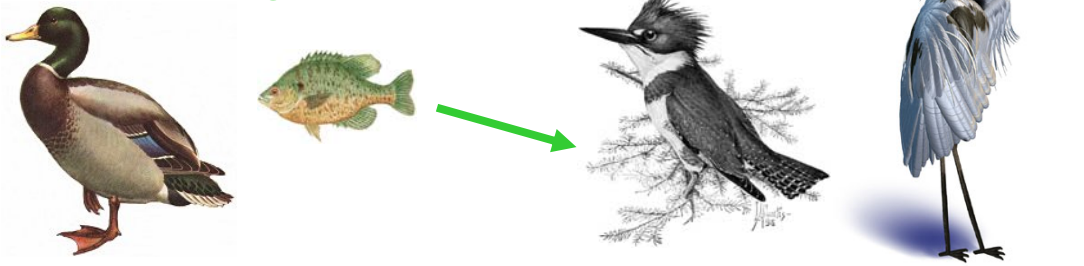


"Surface Coatings"
Metal Prospecting



Hg methylation by
sulfur-reducing
bacteria in microlayer
and deep anoxic layer

Trophic Transfer
& Magnification



Tiered Study - Hg Accumulation and Trophic Transfer

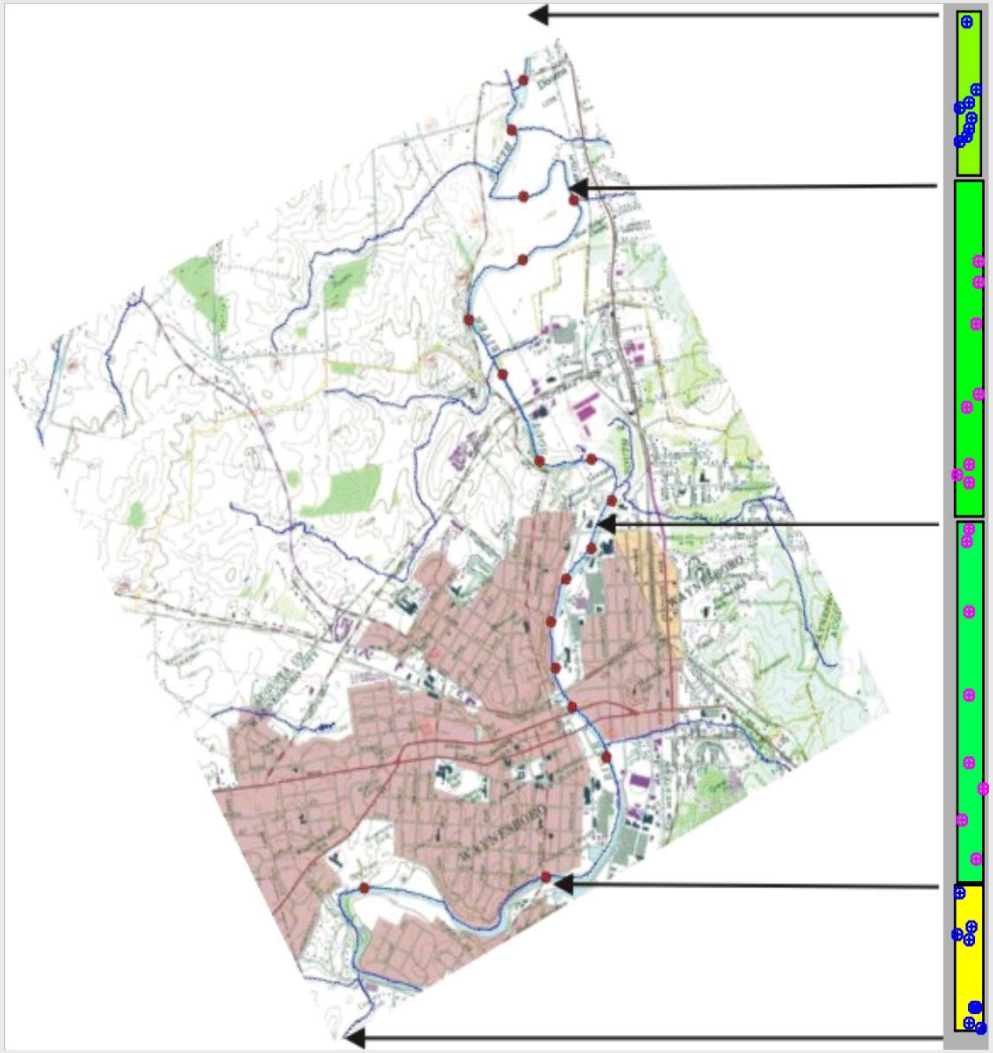
1. Define the Mercury in Site Periphyton
   - How high are periphyton mercury concentrations?
   - How high relative to other components, e.g, fish, clams, sediments, water?
   - How are periphyton mercury concentrations distributed in the study area?
   - Is there a strong correlation between periphyton mercury and mercury in other system components?
   - Within a sampling reach, do organic carbon, Mn, and Fe concentrations correlate with mercury concentration?
2. Quantify Methylmercury in Periphyton
   - Previously locations in study area
3. Define Mercury within Trophic Web
   - Periphyton, grazers, grazer consumers, predators (fish, birds)
   - Several locations within study area
   - N (and C) isotopes for quantifying trophic position
   - Regression models predicting mercury from trophic status
4. Manipulative Experiment Quantifying Bioavailability
   - *In situ* or in laboratory grazer uptake kinetics
   - Support eventual trophic model

Mercury in Site Periphyton

PRELIMINARY SURVEY

- Defining total Hg concentration in periphyton
- Test for significant difference from reference (upstream)
    - Minimally Wilcoxon Rank Sum
    - Optimally Dunnett's or Similar Test
- Multivariate Regression
    - [Hg] = f(x_1, x_2, ...)
        - location
        - organic carbon (LOI or OC)
        - iron
        - manganese
- Concordance with *Corbicula* and fish concentrations
    - Parametric or Nonparametric correlation

Define & Test [Hg] Difference



SURVEY

- Align with *Corbicula* work

-Sampling design using Battelle's VSP software

-Differences in mean total Hg in natural materials

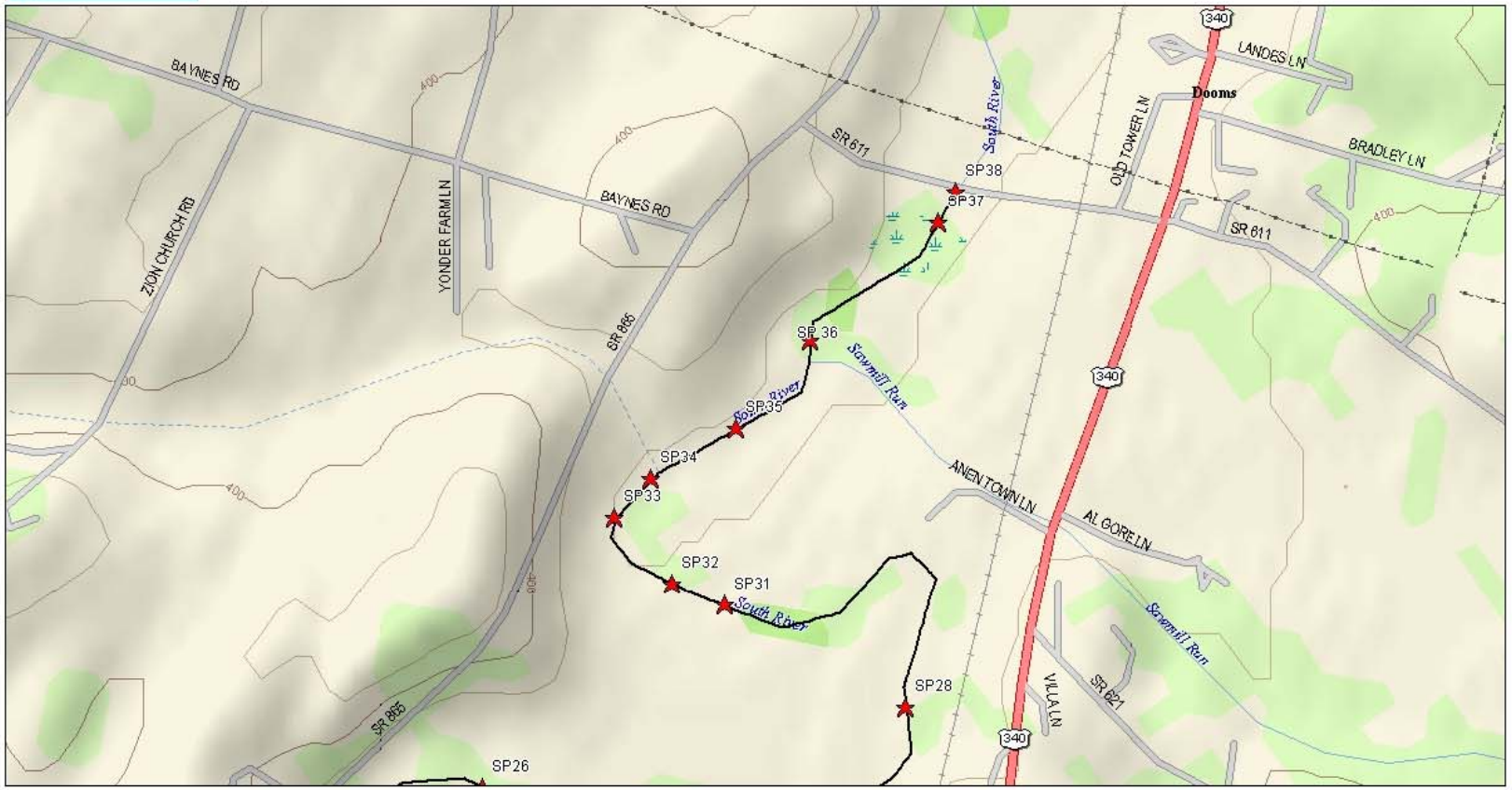
- **Equal means?**
- **Set ✂, power, cost**
- **random design**

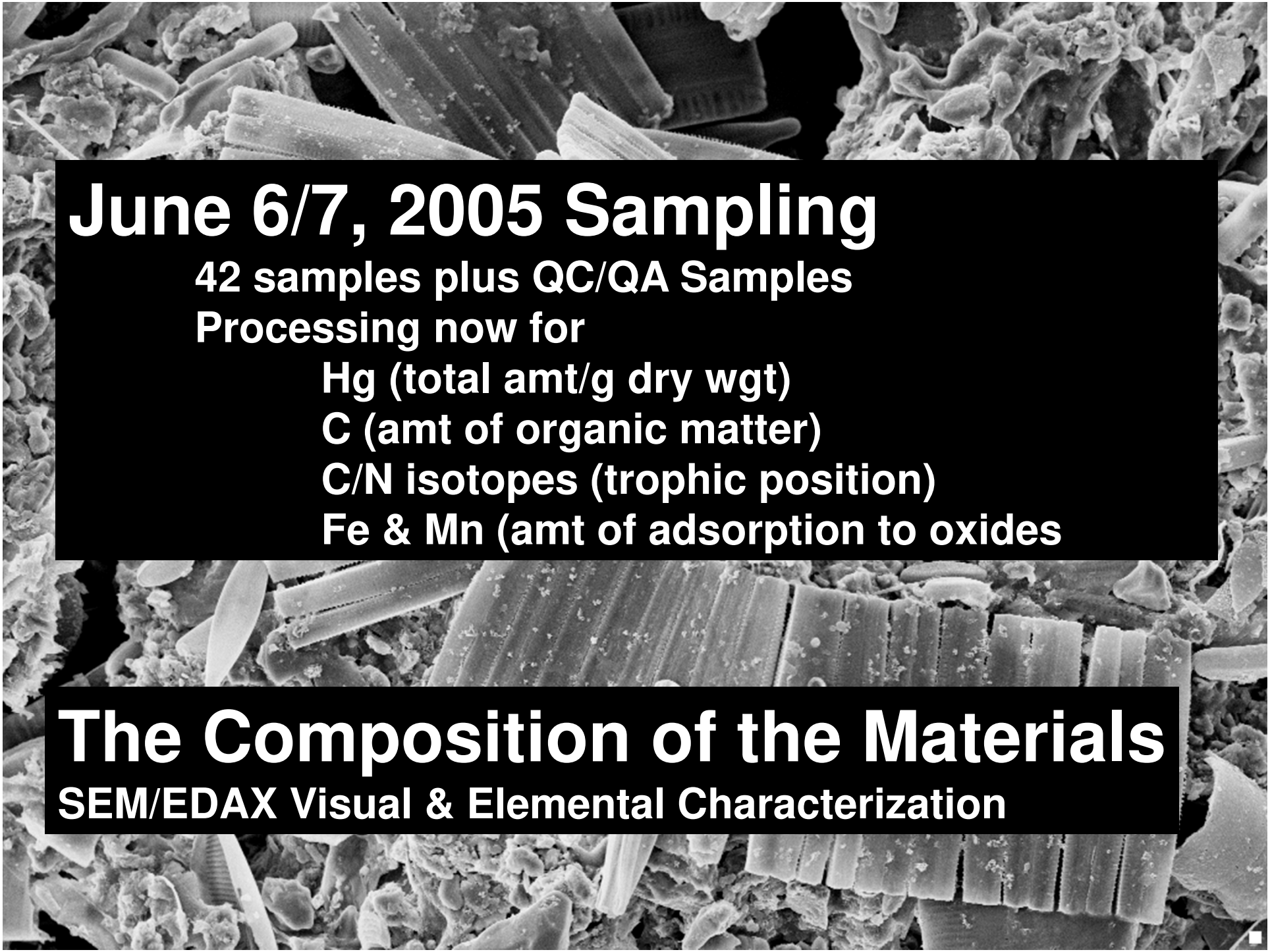
-Covariate regressions made most convenient with random sampling design within segments

-Supplement with SEM/EDAX microanalysis for confirmation

Define & Test [Hg] Difference

SP3 (N=8)





June 6/7, 2005 Sampling

42 samples plus QC/QA Samples

Processing now for

- Hg (total amt/g dry wgt)
- C (amt of organic matter)
- C/N isotopes (trophic position)
- Fe & Mn (amt of adsorption to oxides

The Composition of the Materials

SEM/EDAX Visual & Elemental Characterization

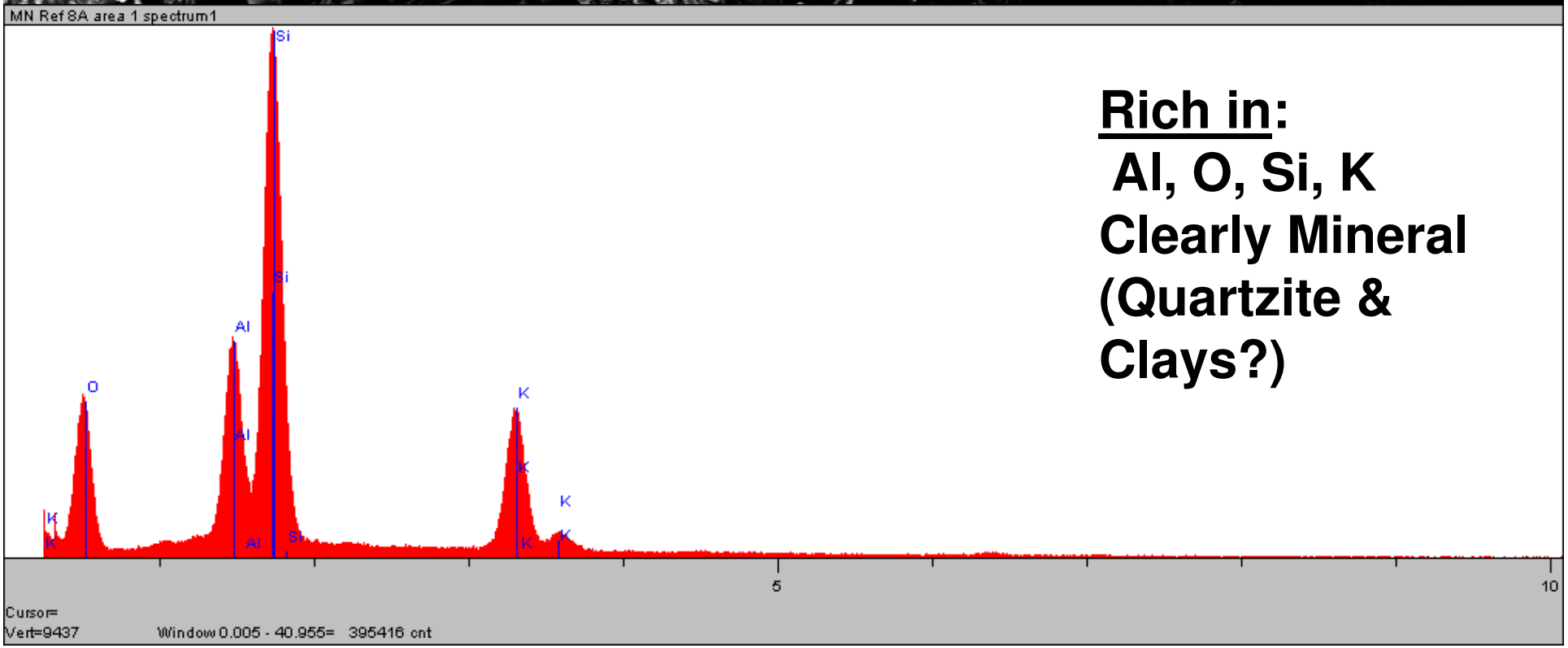
Qualitative Examination of "Periphyton"



The Composition of the Materials

(Backscatter Electron Image & X-Ray Spectra)

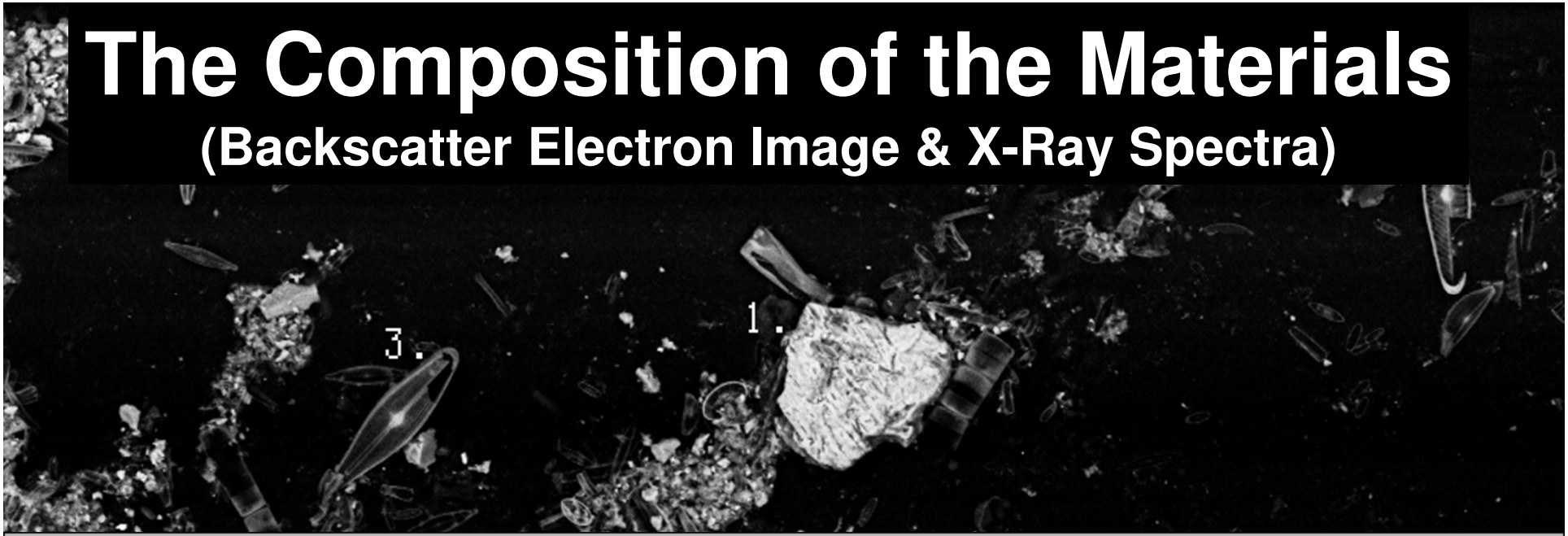


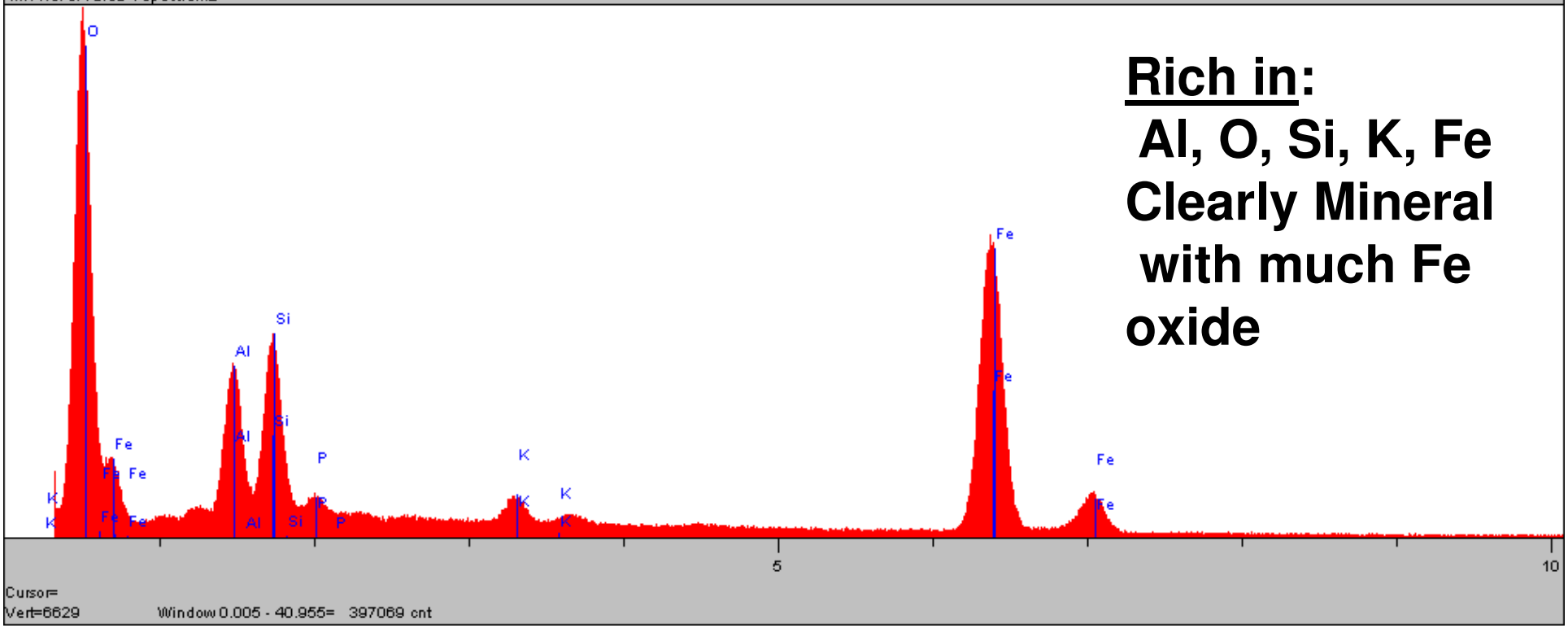


<u>Rich in</u>:
Al, O, Si, K
Clearly Mineral (Quartzite & Clays?)

The Composition of the Materials

(Backscatter Electron Image & X-Ray Spectra)

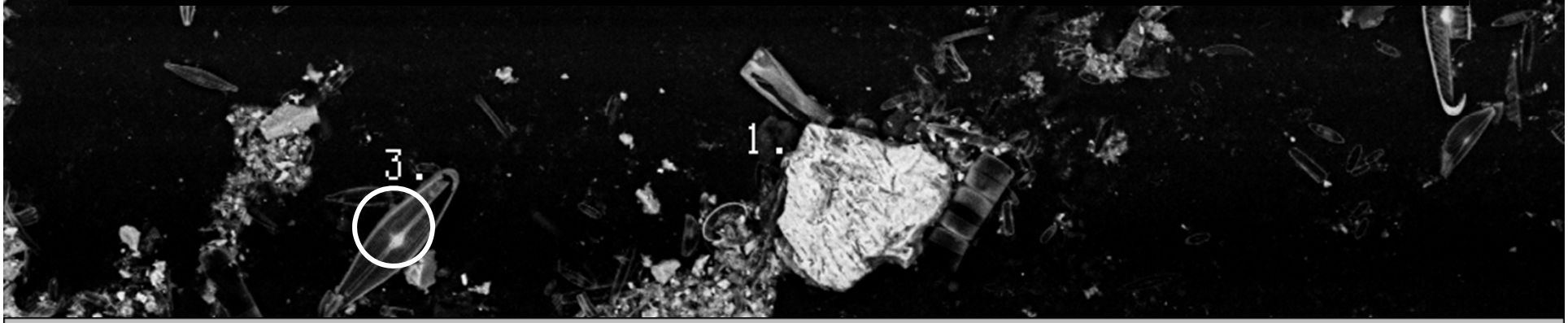


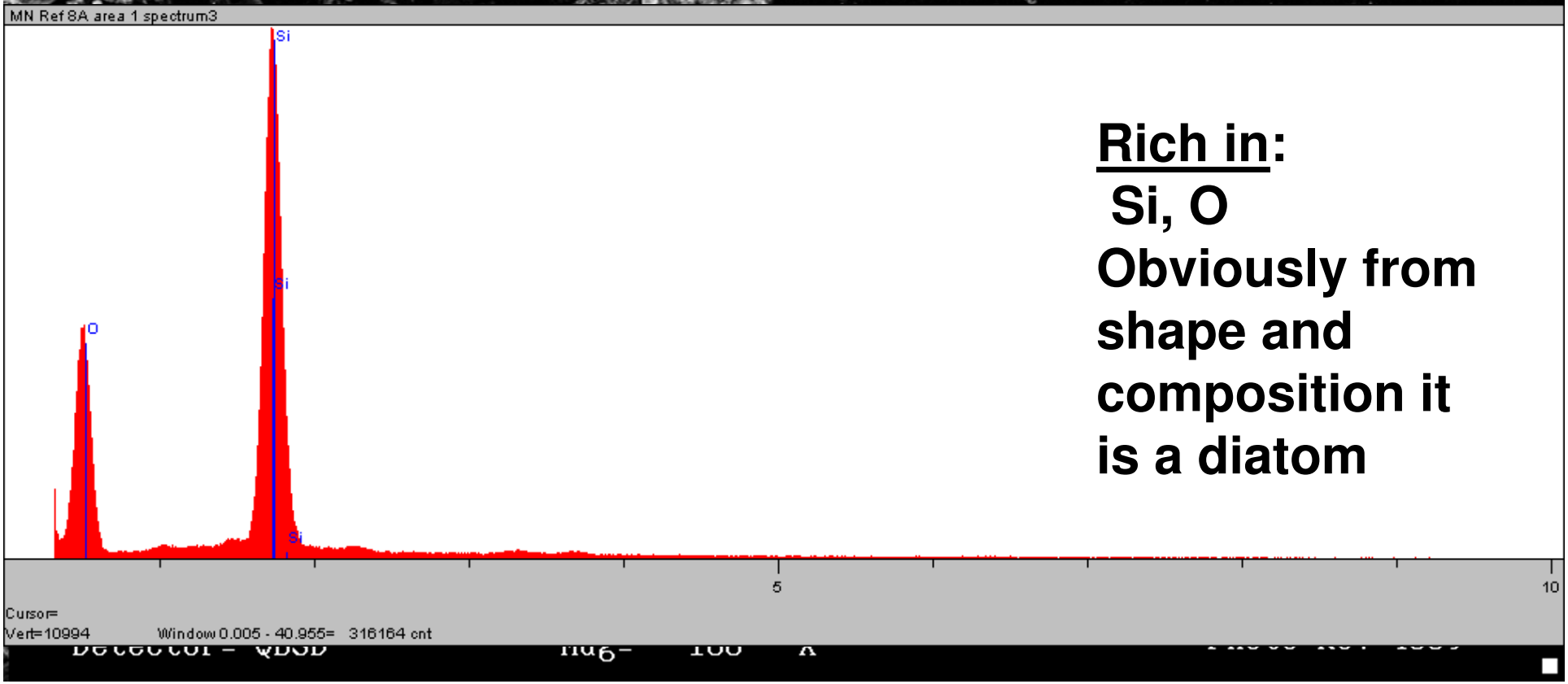


<u>Rich in</u>:
Al, O, Si, K, Fe
Clearly Mineral with much Fe oxide

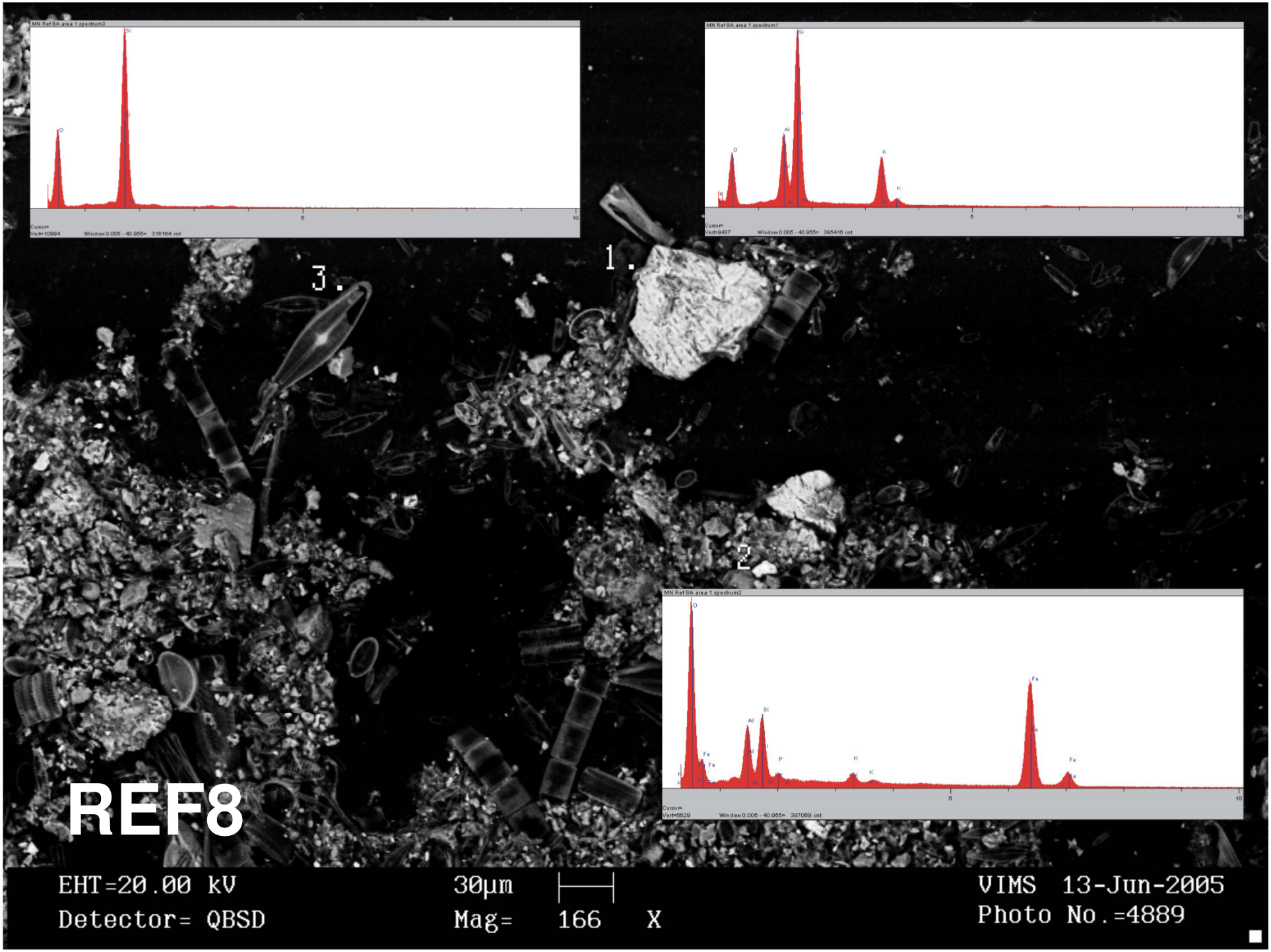
The Composition of the Materials

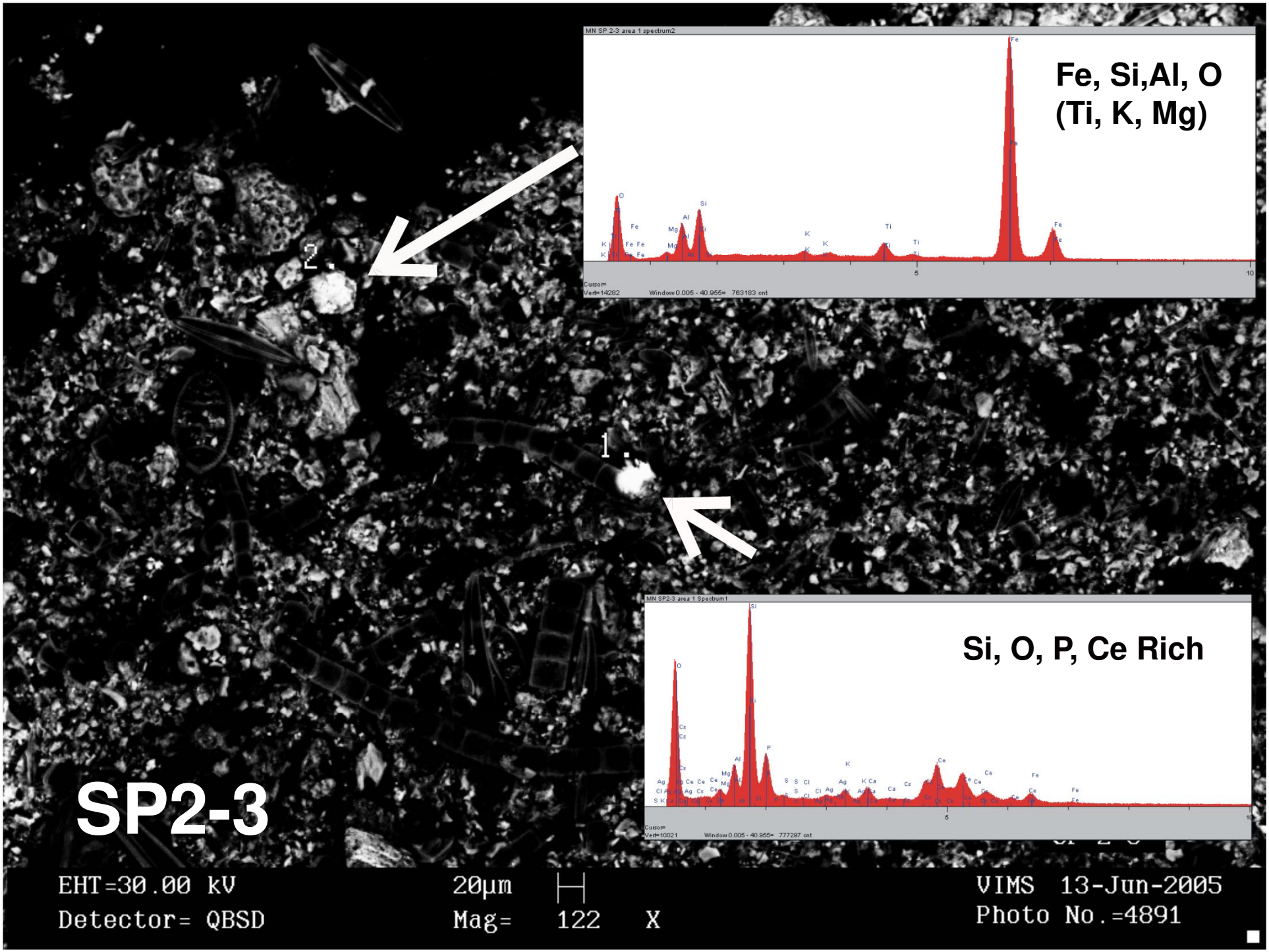
(Backscatter Electron Image & X-Ray Spectra)





<u>Rich in</u>:
Si, O
Obviously from shape and composition it is a diatom


MN Ref 8A area 1 spectrum3
MN Ref 8A area 1 spectrum1
MN Ref 8A area 1 spectrum2
3.
1.
2
REF8
EHT=20.00 kV
Detector= QBSD
30µm
Mag= 166 X
VIMS 13-Jun-2005
Photo No.=4889


Fe, Si,Al, O
(Ti, K, Mg)
Si, O, P, Ce Rich
SP2-3
2.
1.
EHT=30.00 kV
Detector= QBSD
20µm
Mag= 122 X
VIMS 13-Jun-2005
Photo No.=4891

Trophic Transfer

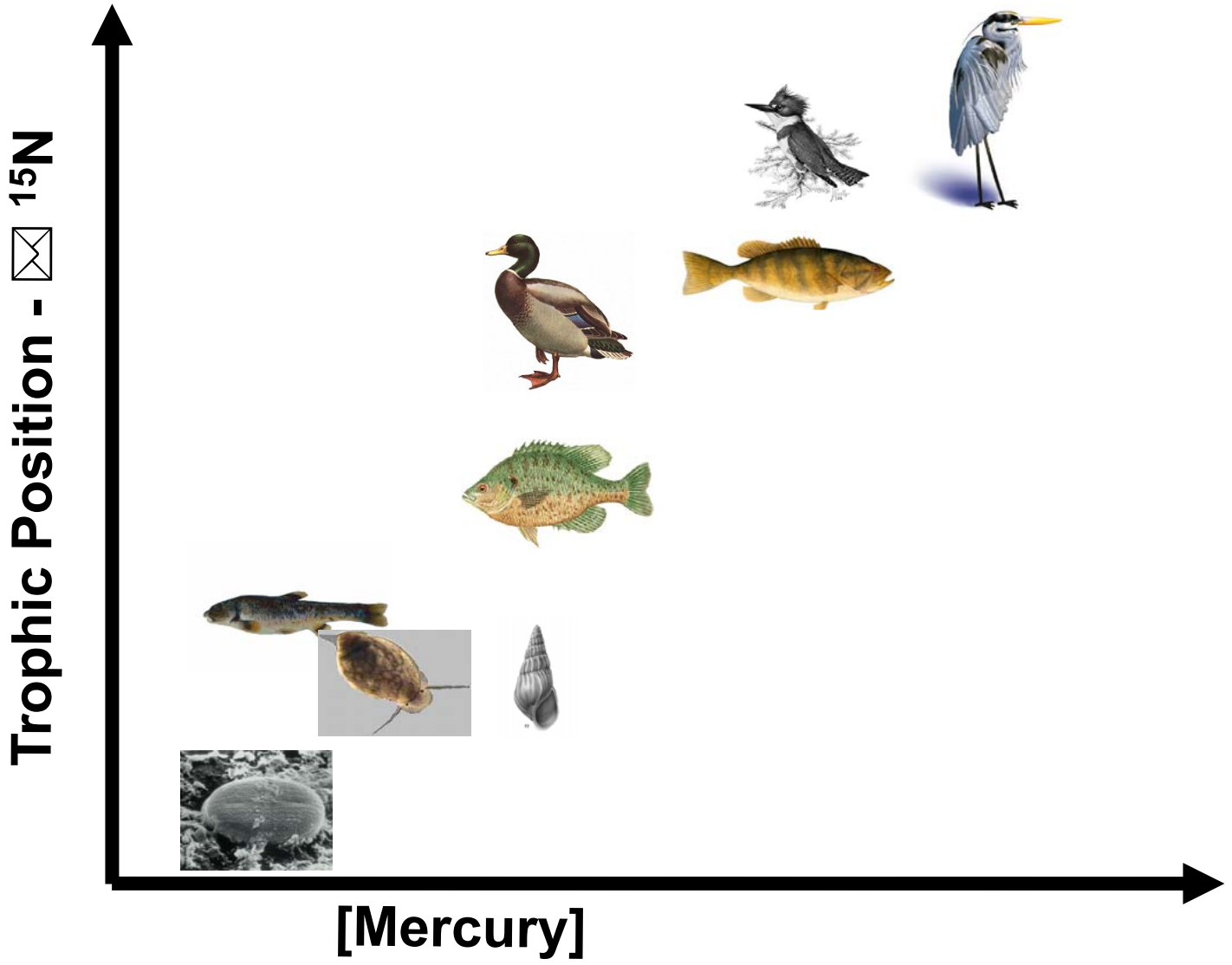
In situ regression via Isotopic Discrimination Technique

Isotopic discrimination tends to reduce the amount of lighter isotopes (^{12}C, ^{14}N, or ^{32}S) in organisms relative to the heavier isotopes (^{13}C, ^{15}N, or ^{34}S)

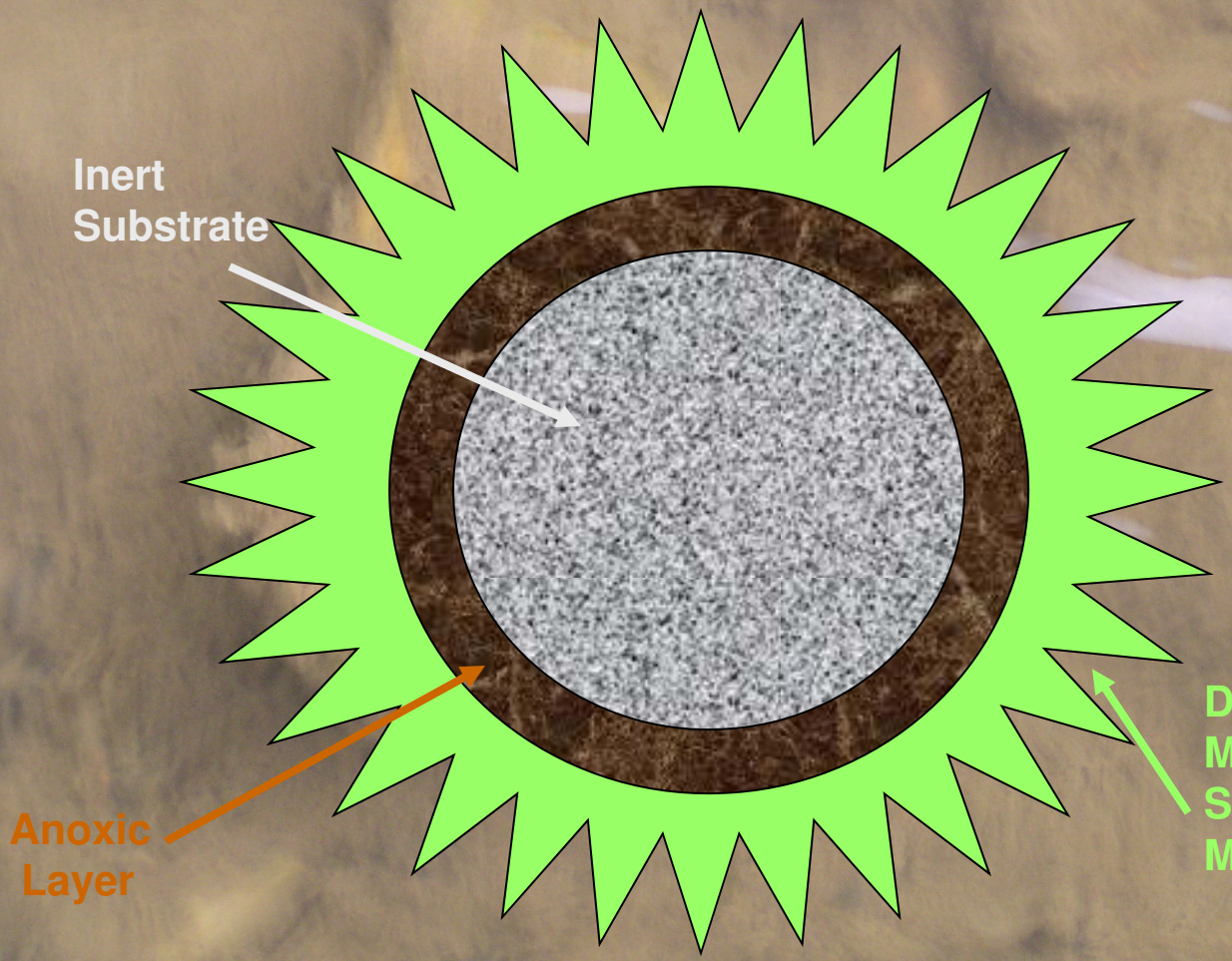
Nitrogen isotopes work best for trophic position

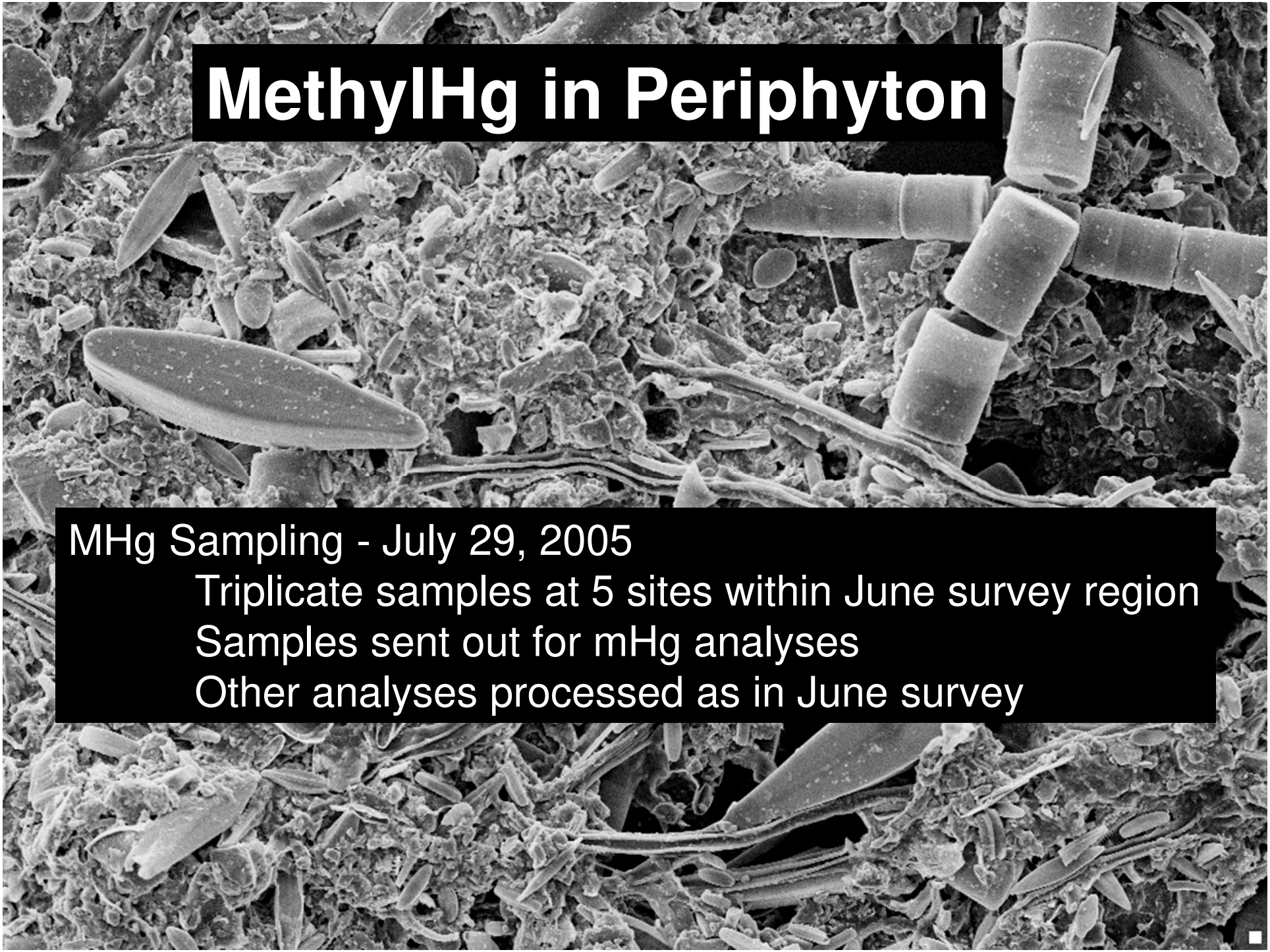
$$\delta^{15}N = 1{,}000\left[\frac{(^{15}N_{sample})/(^{14}N_{sample})}{(^{15}N_{air})/(^{14}N_{air})} - 1\right]$$

Trophic Structure - N Isotopes



Mercury Methylation





MethylHg in Periphyton

MHg Sampling - July 29, 2005

- Triplicate samples at 5 sites within June survey region
- Samples sent out for mHg analyses
- Other analyses processed as in June survey

Proposed Periphyton Program

YEAR 1

-How much mercury is present in periphyton/surface coatings?
-What is the nature of the periphyton/surface coatings?
-How is the periphyton mercury spatially distributed?
-Preliminary N/C isotope samples to design sampling program

YEAR 2

-What is the trophic status of selected biota?
- Regression model of mercury concentration and trophic status
-How much methylmercury is associated with periphyton?
-Use C is suggest algal/macrophyte/floodplain source(s)?

YEAR 3

-Quantitative model of periphyton mercury uptake by grazers
-Potential additional trophic transfer to grazer consumer