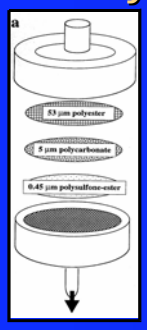
Log 20 Wednesday

1. 212100Z September 2005
2. Position: Lat: 0-30.1N LONG 127-48.0W
3. Course: 090-T
4. Speed: 11.0 kts
5. Distance: 127.4 NM
6. Steaming Time: 11H 48M
7. Station Time: 12H 12M
8. Fuel: 2951 gals
9. Sky: Ptly Cldy: Ci, Ac, Cu, Sc
10. Wind: 110-T, 15 kts
11. Sea: 110-T, 2-3 ft
12. Swell: 130-T, 4-6 ft
13. Barometer: 1013.1 mb
14. Temperature: Air: 26.0 C, Sea: 24.9 C
15. Equipment Status: No change.
16. Comments: En route to station #21.

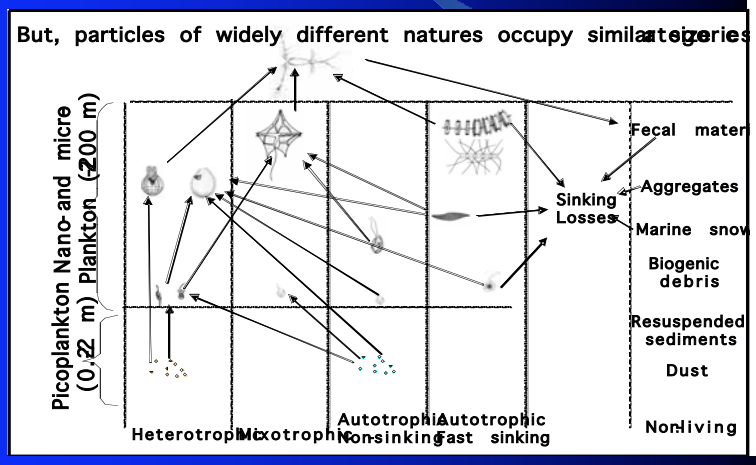
Dr. Stephen Baines of Stonybrook University in New York is out here taking samples to look at individual cells and analyze their trace elements. He is working with a group of scientists from several other institutions. Some of them went on the previous cruise. Here is a brief explanation of what Dr. Baines and his colleagues are trying to accomplish.

Opening the "Black Box":
Use of synchrotron based x-ray fluorescence microscopy (SXRF) to study trace elements in aquatic protests

Why use XRF? Opening the "Black Box"



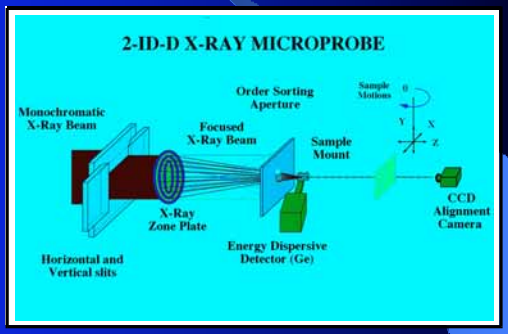
- Typical methods collect particles on filters
  - Standard chemistry: GFAAS, ICP-MS
  - Radioisotope tracers



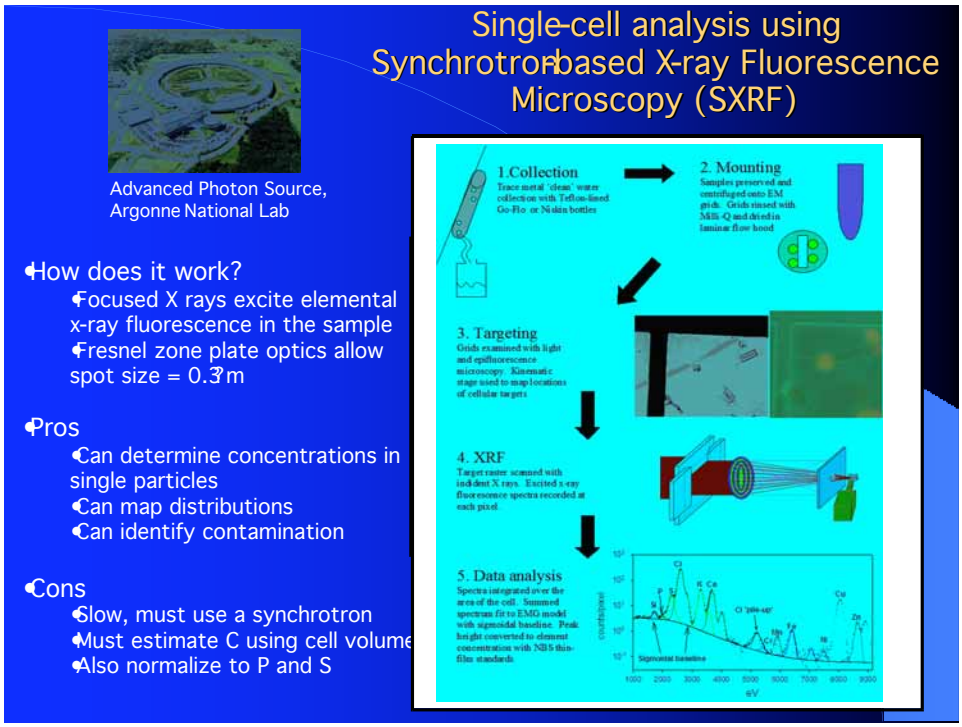
Single-cell analysis using Synchrotron-based X-ray Fluorescence Microscopy (SXRF)

Advanced Photon Source, Argonne National Lab

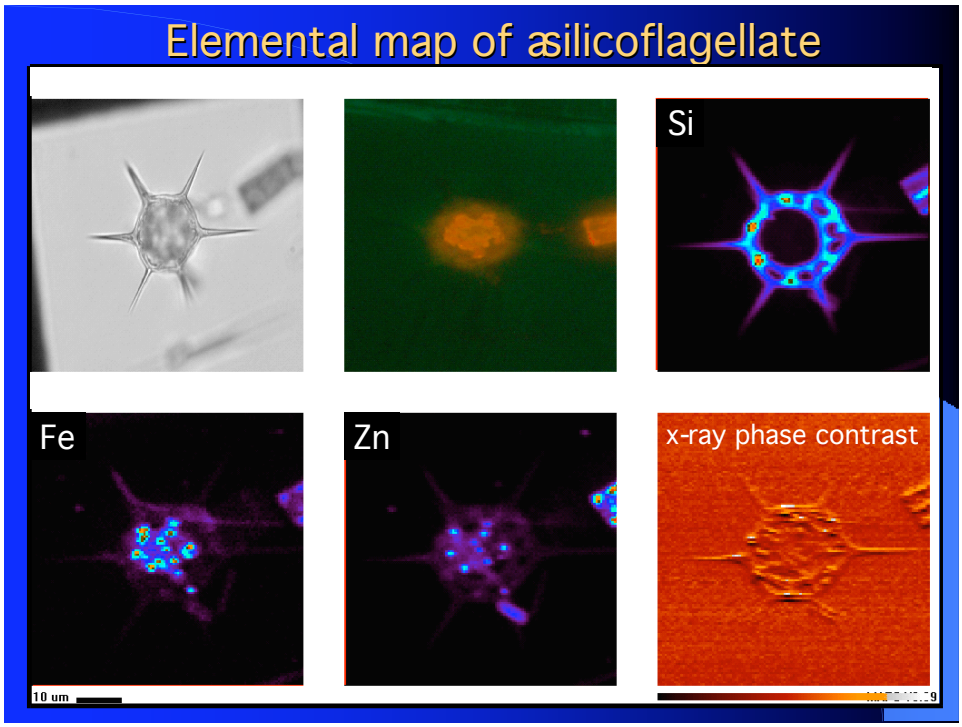
- How does it work?
  - Focused X rays excite elemental x-ray fluorescence in the sample
  - Fresnel zone plate optics allow spot size = 0.3 m
- Pros
  - Can determine concentrations in single particles
  - Can map distributions
  - Can identify contamination
- Cons
  - Slow, must use a synchrotron
  - Must estimate C using cell volume
  - Also normalize to P and S



So his groups can look at the plankton being collected out here at the molecular level and determine concentrations of tracemetals in individual cells and show their location.



It is difficult to accurately determine exact amounts of trace metals and concentrations, but they can be mapped to show where they are located. This is a good reference for the biocomplexity study as it can give them individual locations for concentrations of trace metals and nutrients to compare to the communities averages that they are seeing. They are not able to differentiate between how each difference species is using the Si or Fe or nutrients and so it becomes more difficult to determine how the iron is truly effecting the system. By using this process they can see which individual species are using the materials and in what concentrations.



The upper left picture is using a light microscope, the upper middle is fluorescence, where you hit a cell with blue light and the choloroplasts can't use it to photosynthesize so they give it back at a lower energy level and it fluoresces red. So what you are seeing are the chloroplasts in the cell. The upper right is showing the Si concentrations in the cell. The lower left is the Fe concentrations, the middle is Zinc and the lower right is the same cell in X-ray phase contrast to give you a feel for the size and thickness of the cell.

So what did they do last time?

Protistanelementalstoichiometries quotas during EB04

- Target categories
  - Diatoms
  - Heterotrophicflagellate
  - Autotrophicflagellate
  - Picoplankton
- Carboy experiment (shot and analyzed)
  - Only one experiment analyzed so far
  - Control, +Fe and +Si (1 day)
  - Single pennatediatom species
- Transects (shot but not quantified yet)
  - 1 depth (30‰)
  - 5 N-S stations for all cell types
  - 5 Equatorial stations for diatoms

And what did that analysis find?

EB04: Cellular Fe in carboy experiment

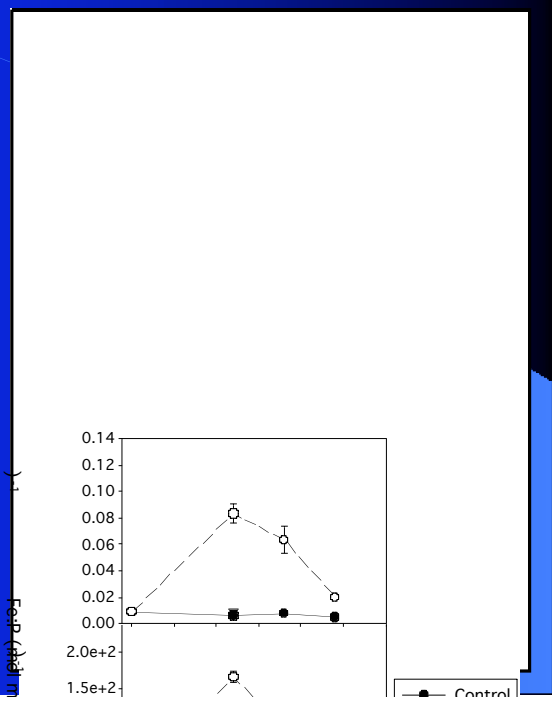
Cellular Fe increased >15-fold in Fe addition treatments

Cellular Fe in controls stayed constant

Cellular Fe was not affected by Si addition

Cellular Fe decreased after the 2nd day

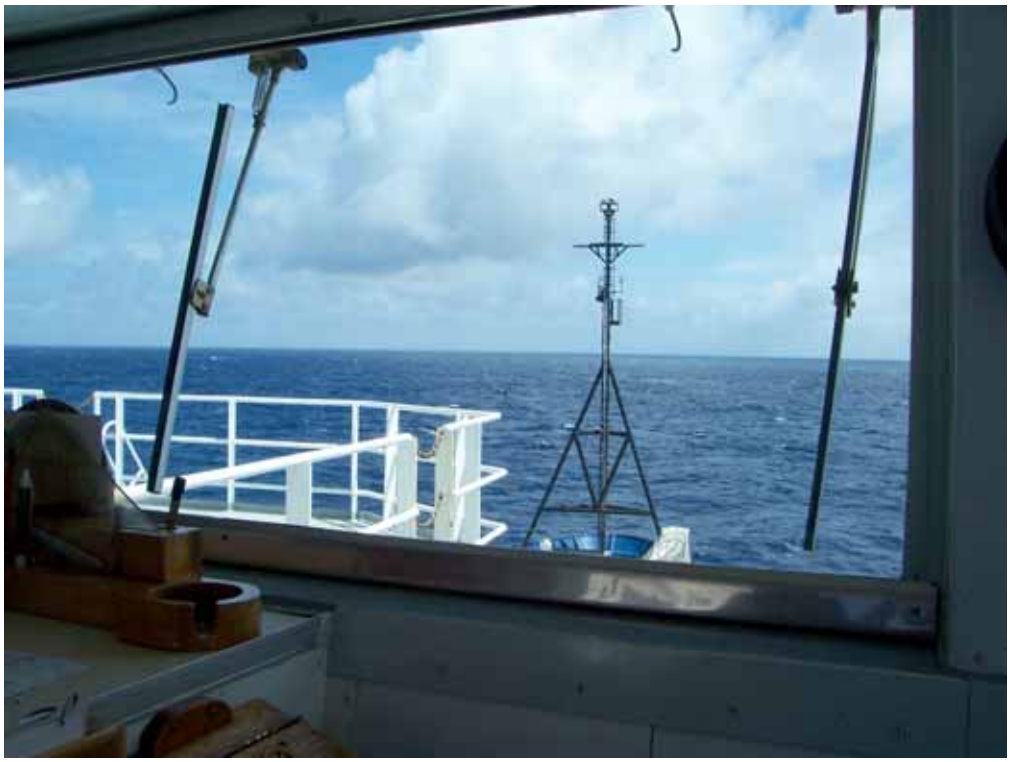
Still, final concentrations are >5-fold above controls



What they hope to see on our cruise

What are we interested in during the EB05 cruise

- Changes in elemental stoichiometries of protists in response to Si and Fe supply gradients?
  - Does release from Fe and Si limitation affect cell quotas of other elements ?
  - How do shifting elemental ratios affect long term cycling of elements under different Fe and Si supply ratios ?
- Differences among cell types?
  - Are phagotrophs better at acquiring Fe under limiting conditions ?
  - Do differences among cells reflect different requirements ?
  - How does size affect elemental ratios ?
- How do protistan elemental stoichiometries affect Fe regeneration rates ?
  - Does remineralization rate vary predictably with supply?
  - Which parts of the microbial food web are responsible for mineralization



Looking out toward the bow of the ship from the bridge. Calm seas.