PALEO RECORDS OF BIOTIC AND ABIOTIC PARTICLES IN POLAR ICE CORES

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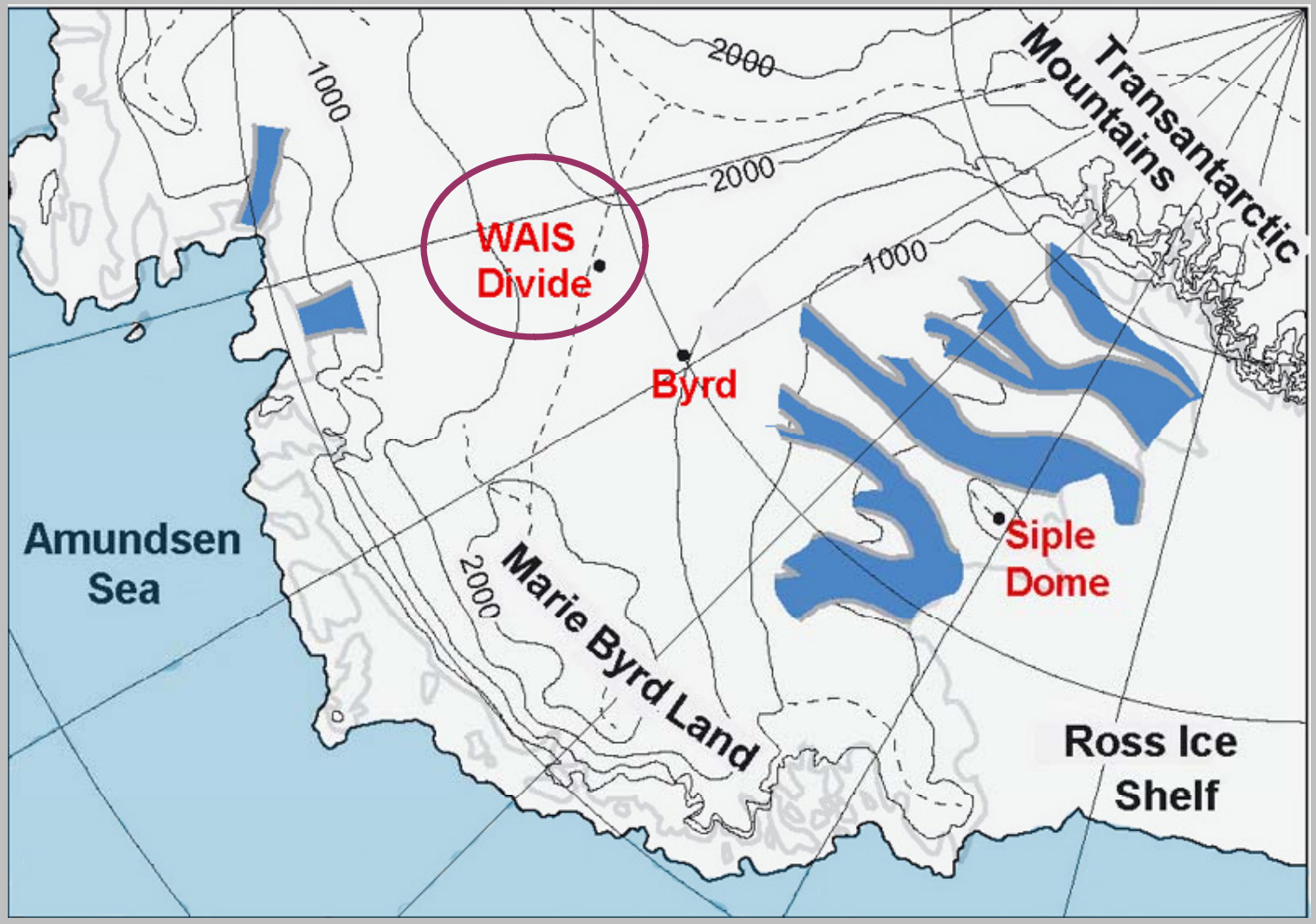
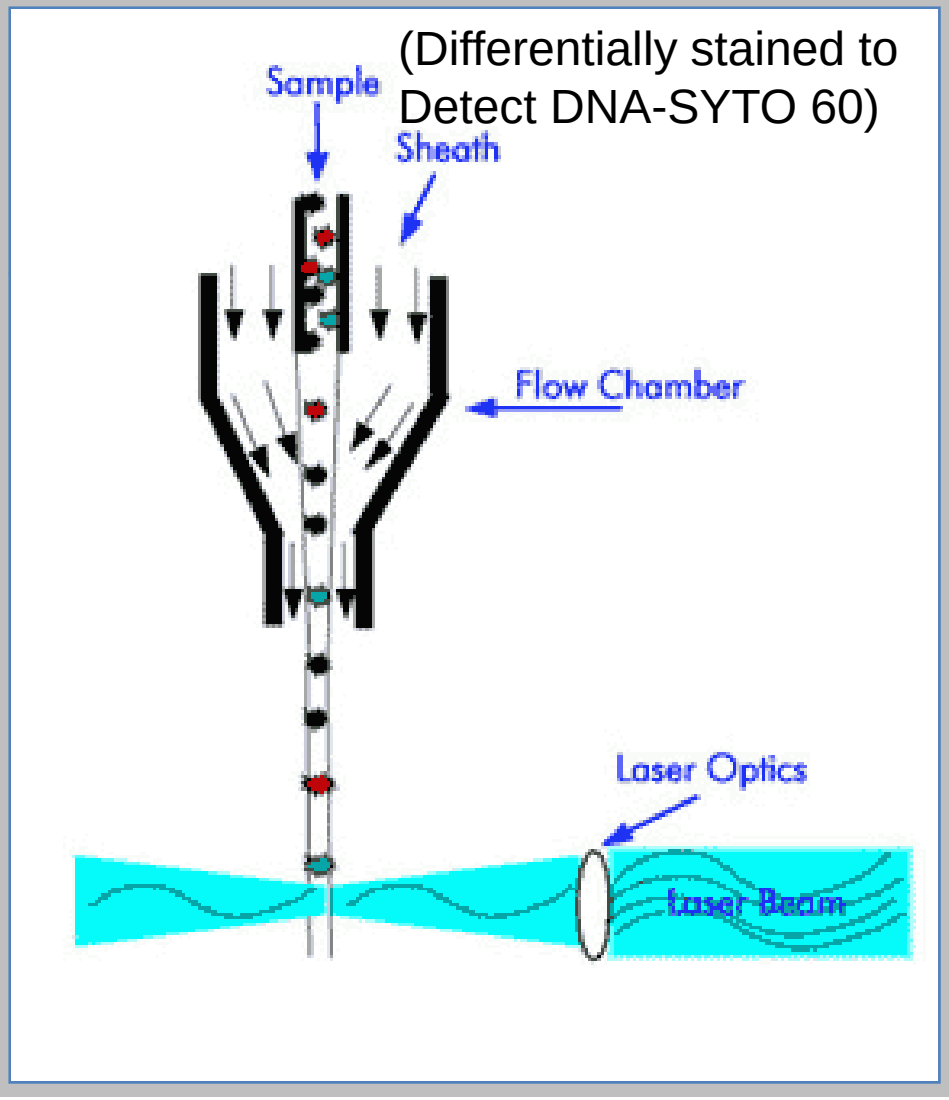


Where Am I Going?

- Methods
- WAIS particle characteristics (biotic and abiotic)
- Dissolved Organic Carbon (food for bugs!)
- Metabolic activity
- Microbial habitats in ice
- Geochemistry (DOC, Sr, Ca)

FLOW CYTOMETRY

Flow cytometry uses the principles of light scattering , light excitation, and emission of fluorochrome molecules to generate specific multi-parameter data from particles and cells in the size range of ~0.2 µm to 15µm diameter.



Comparison of a sample from Lake Vostok ice core 2334, using a coulter counter and the flow cytometer. Coulter counter data kindly provided by Ellen Moseley-Thompson of Byrd Polar Research Center, Ohio State University.

Method	Vostok core 2334
Coulter Counter (particles ml^{-1})	24994
Flow cytometer (particles ml^{-1})	27818

WAIS Divide Core WDC05Q Stick D

Flow Cytometer Data

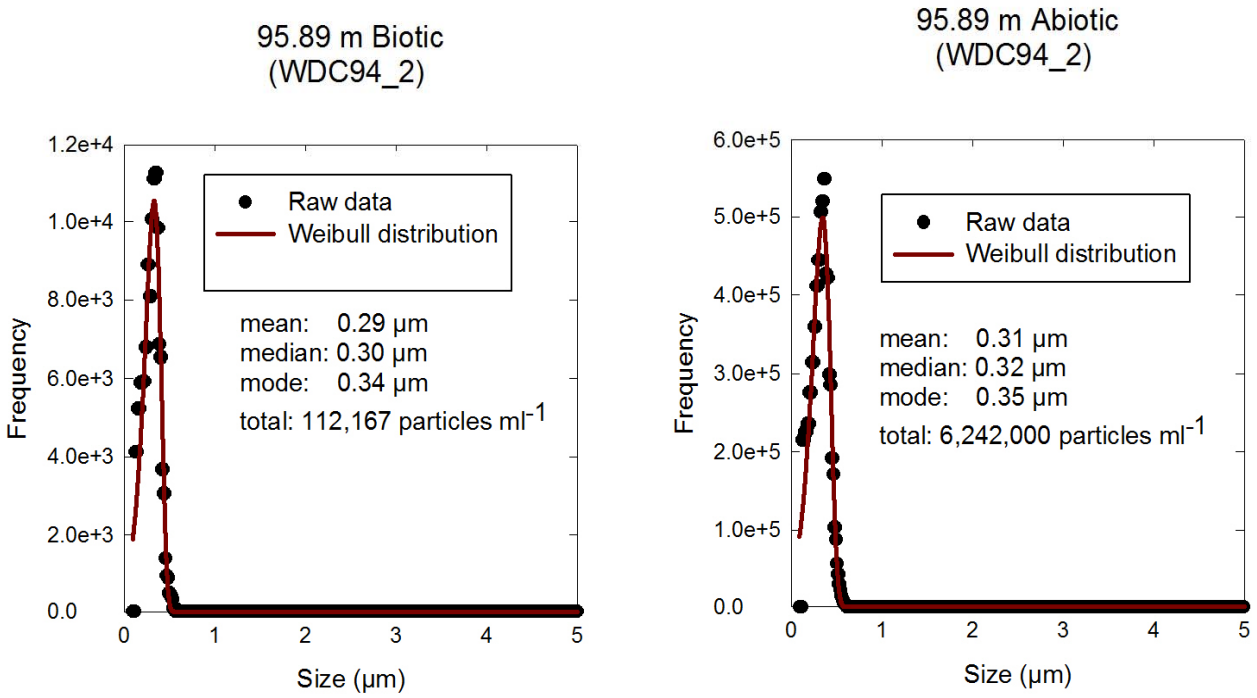
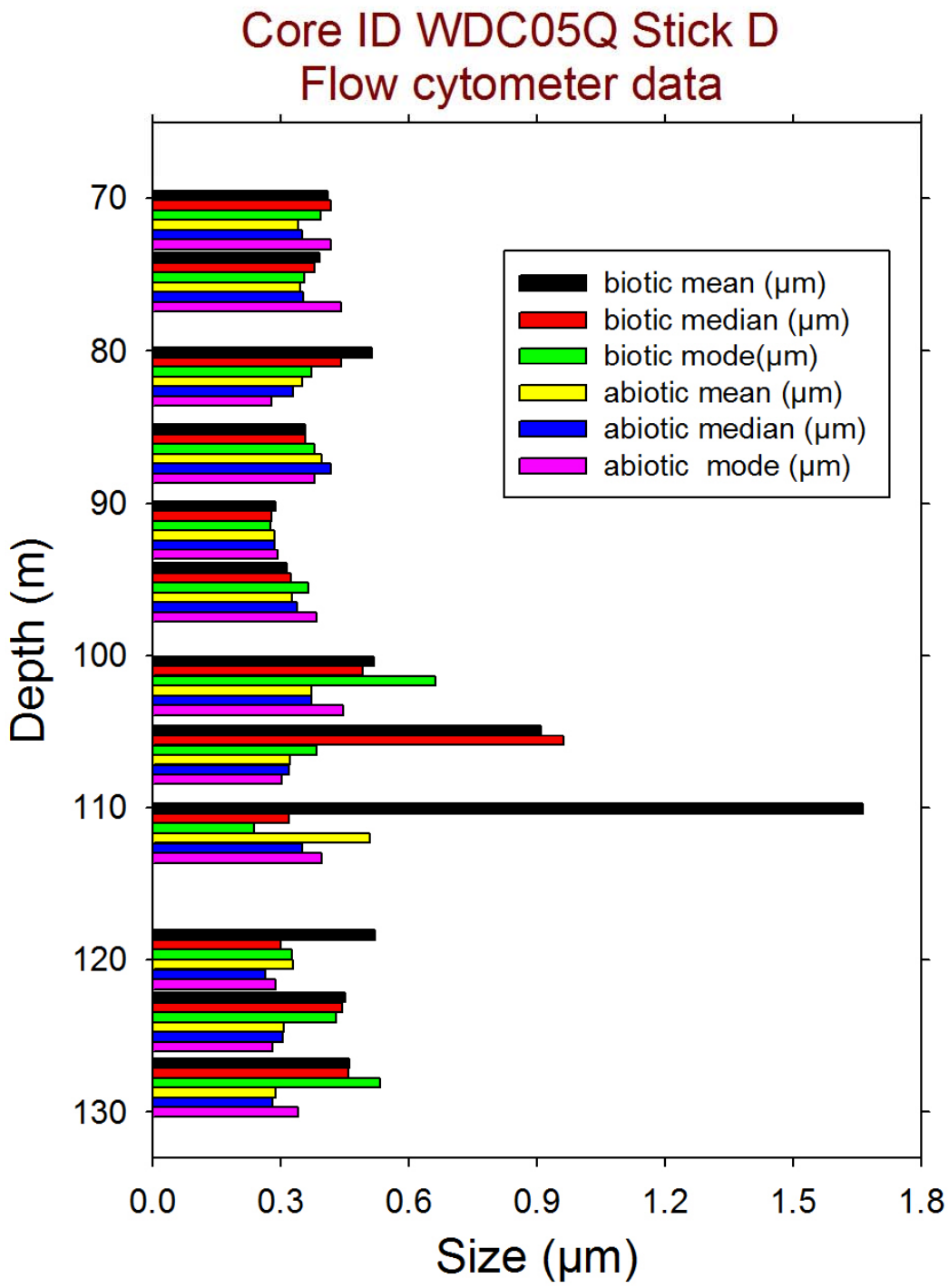
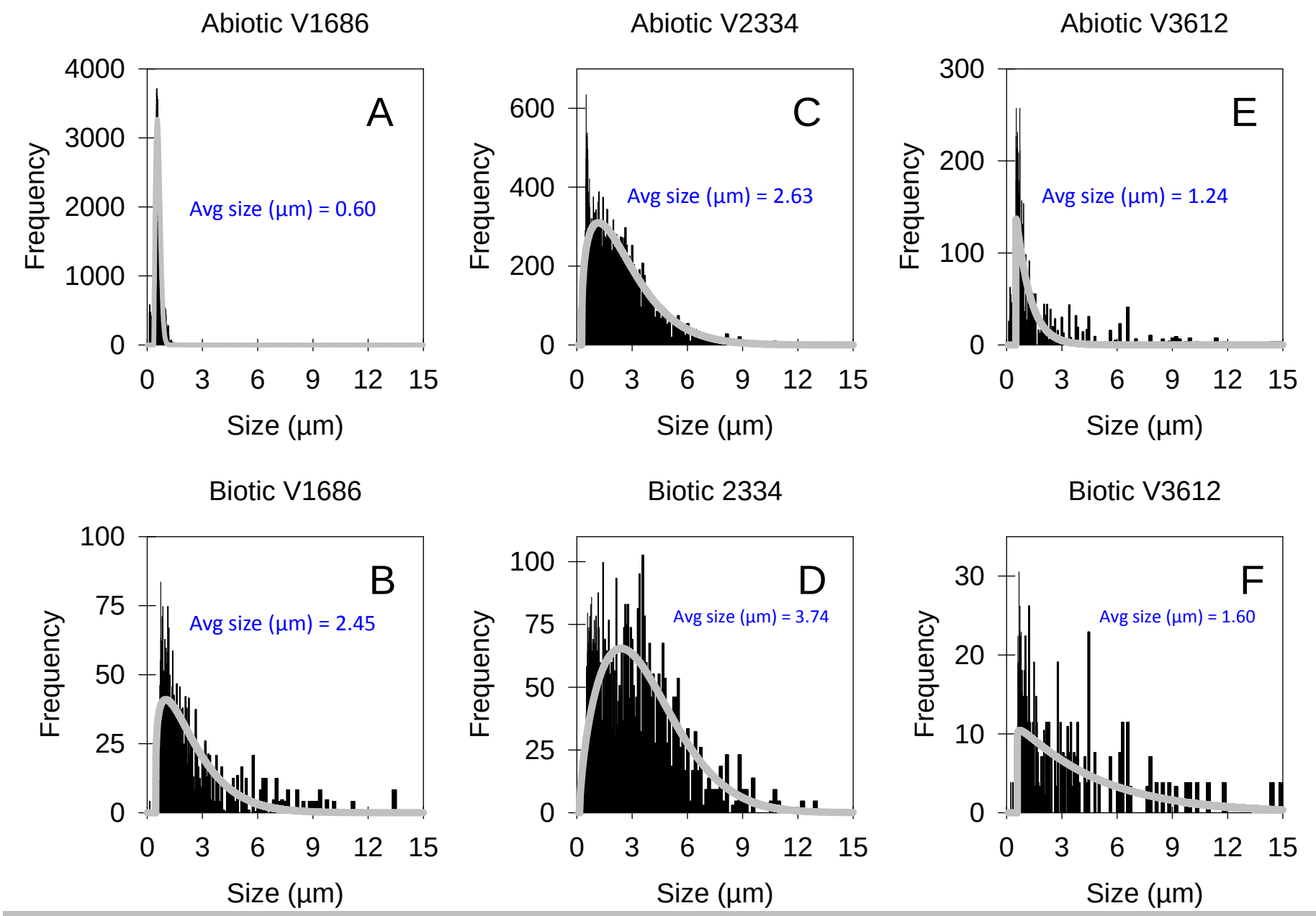


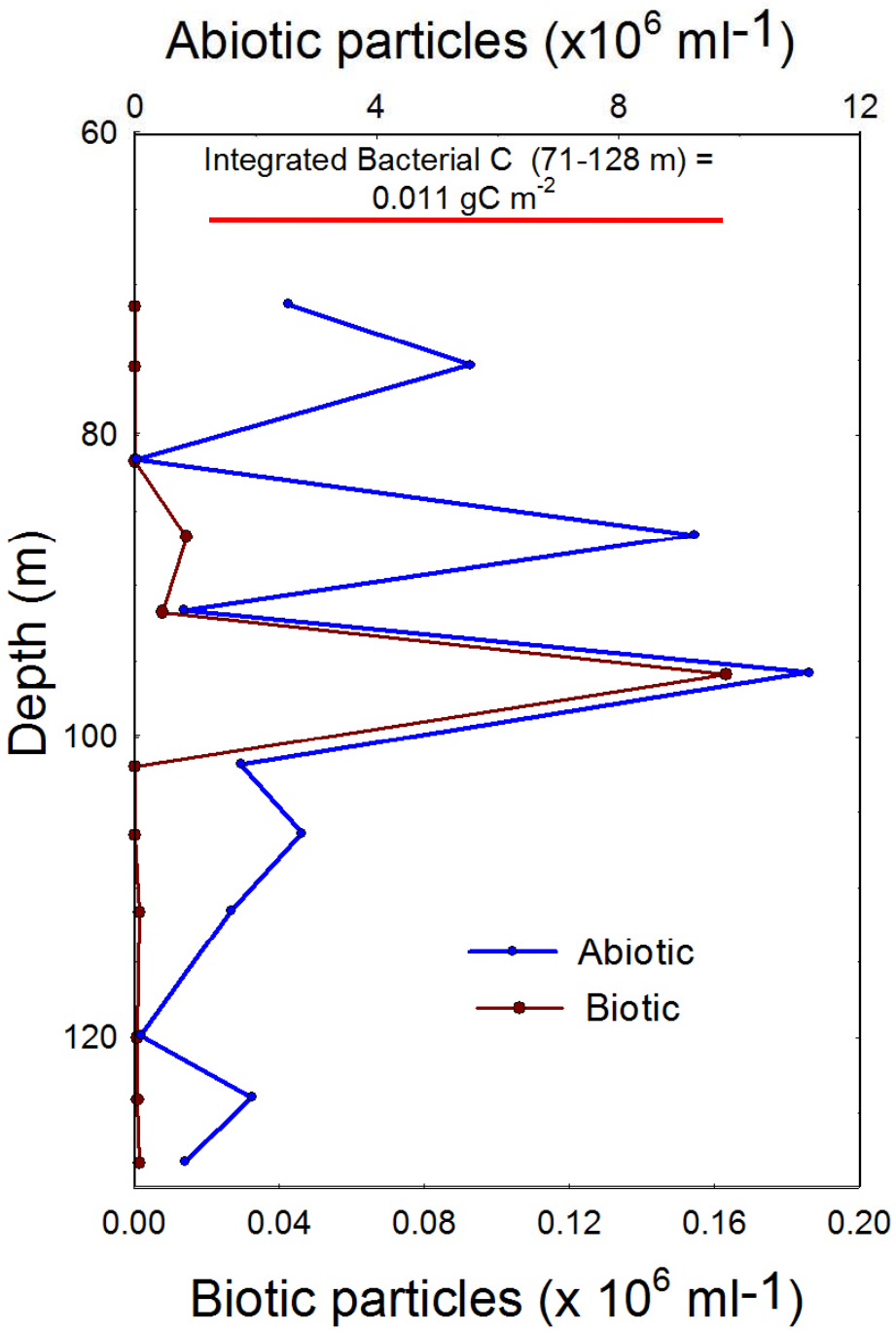
Fig. X. Biotic (bacteria) and abiotic particle distribution from a shallow WAIS Divide core section obtained with a Microcyte flow cytometer.

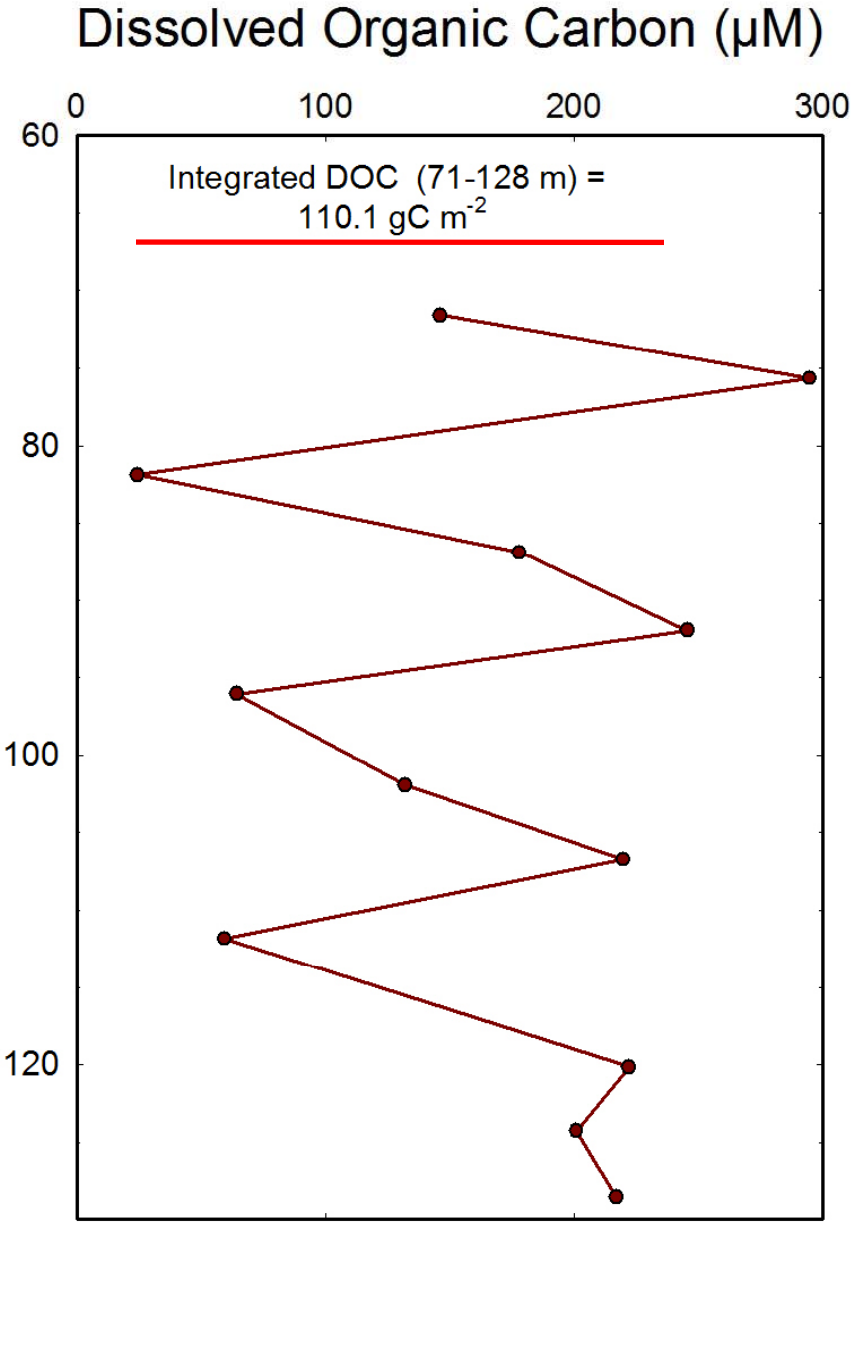

Core ID WDC05Q Stick D
Flow cytometer data
Depth (m)
70
80
90
100
110
120
130
0.0
0.3
0.6
0.9
1.2
1.5
1.8
Size (µm)
biotic mean (µm)
biotic median (µm)
biotic mode(µm)
abiotic mean (µm)
abiotic median (µm)
abiotic mode (µm)

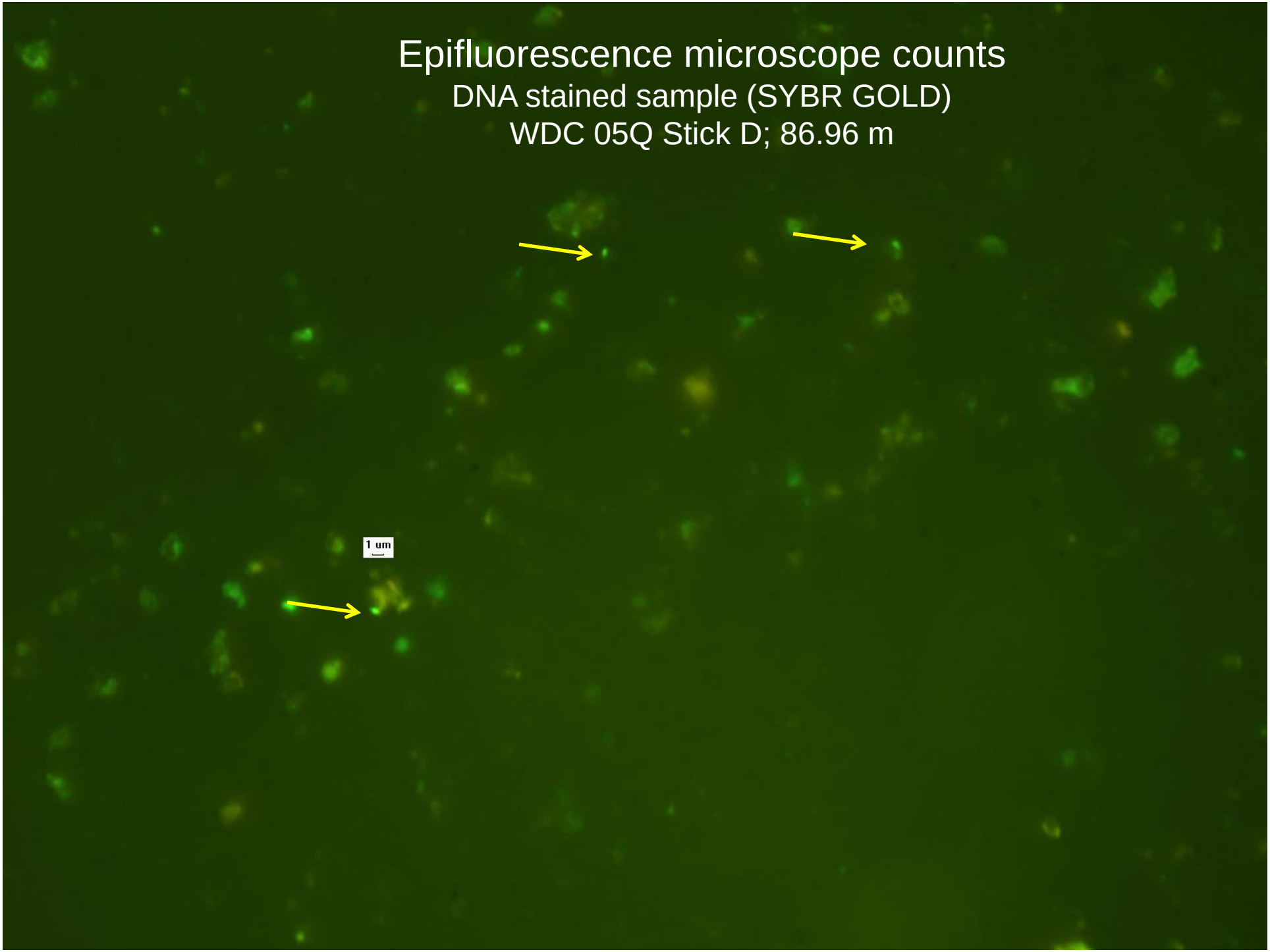
Vostoc Ice Core Particle Characterization



CORE ID: WDC05Q Stick D





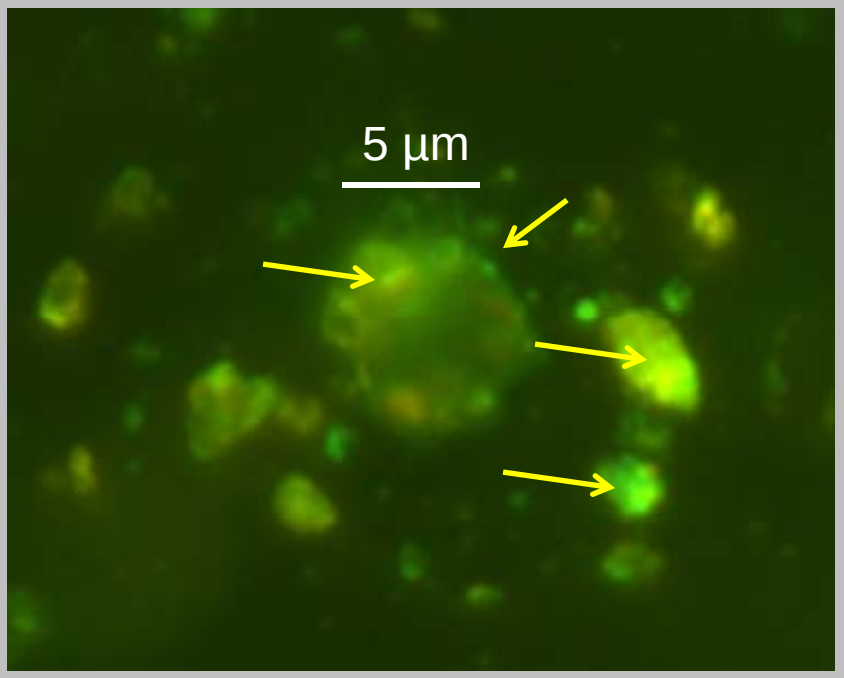

Epifluorescence microscope counts
DNA stained sample (SYBR GOLD)
WDC 05Q Stick D; 86.96 m
1 um

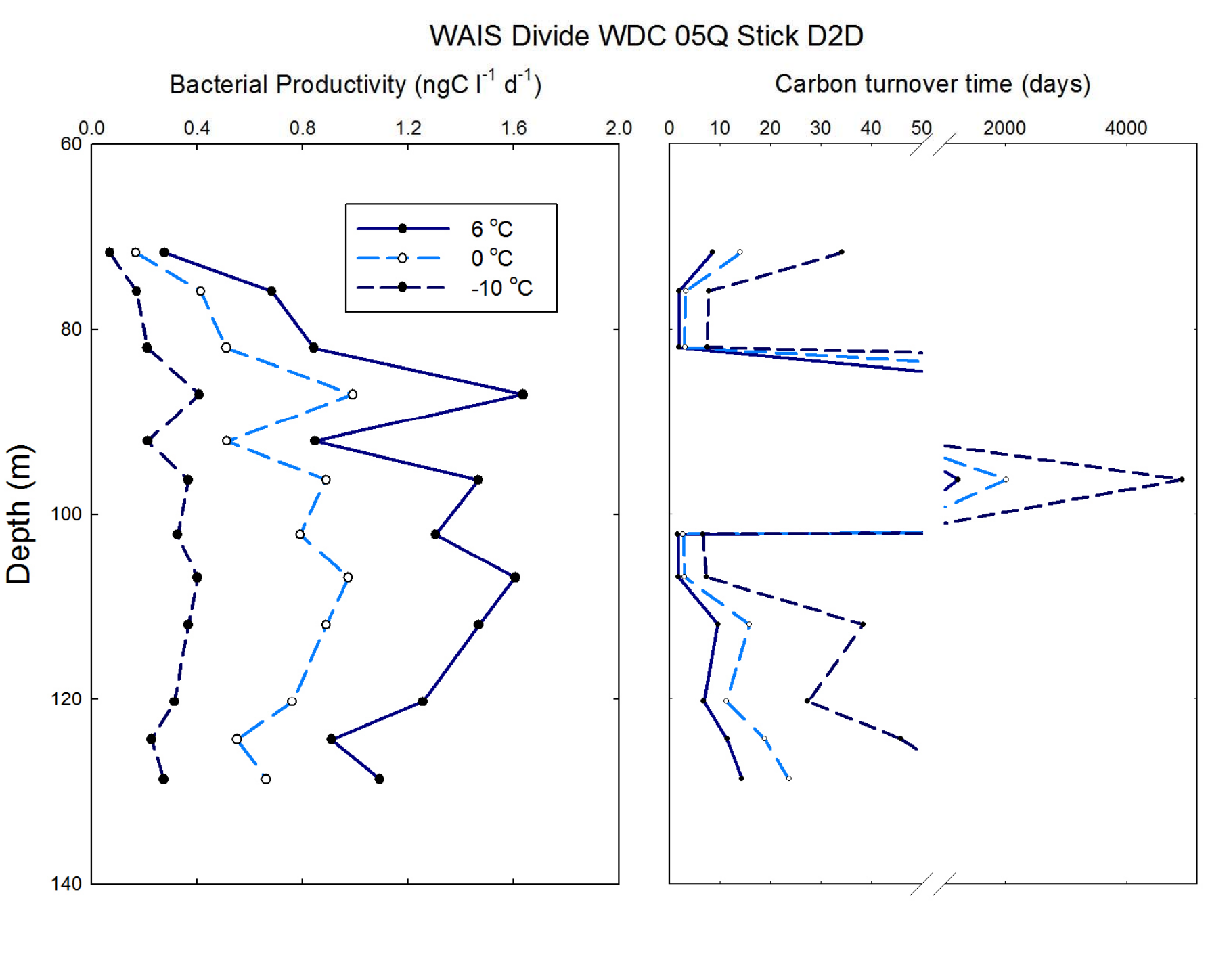
Epifluorescence microscope counts

DNA stained sample (SYBR GOLD)

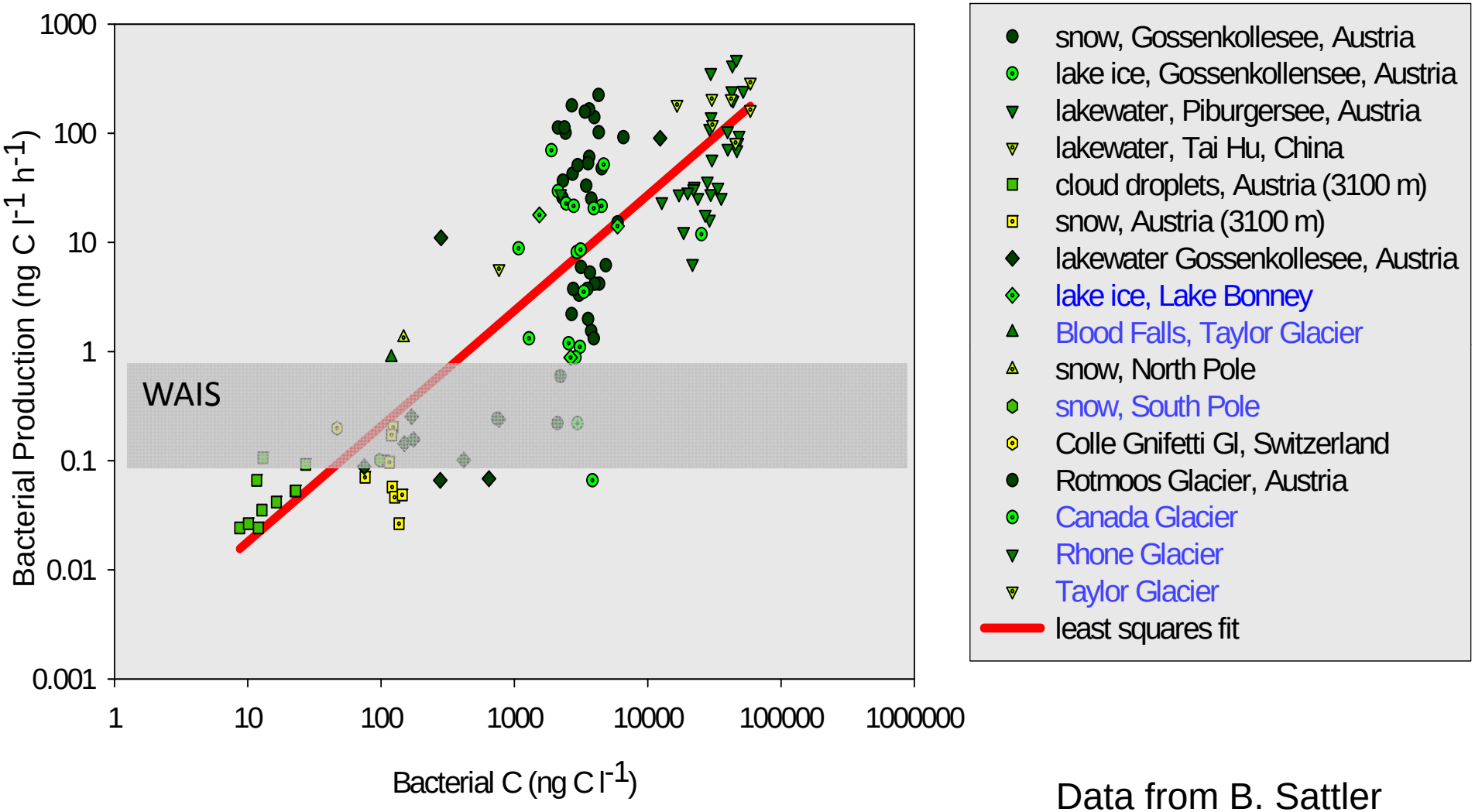
WDC 05Q Stick D; 86.96 m

"ATTACHED BACTERIA"




WAIS Divide WDC 05Q Stick D2D
Bacterial Productivity (ngC l-1 d-1)
Carbon turnover time (days)
Depth (m)
0.0
0.4
0.8
1.2
1.6
2.0
0
10
20
30
40
50
2000
4000
60
80
100
120
140
6 °C
0 °C
-10 °C

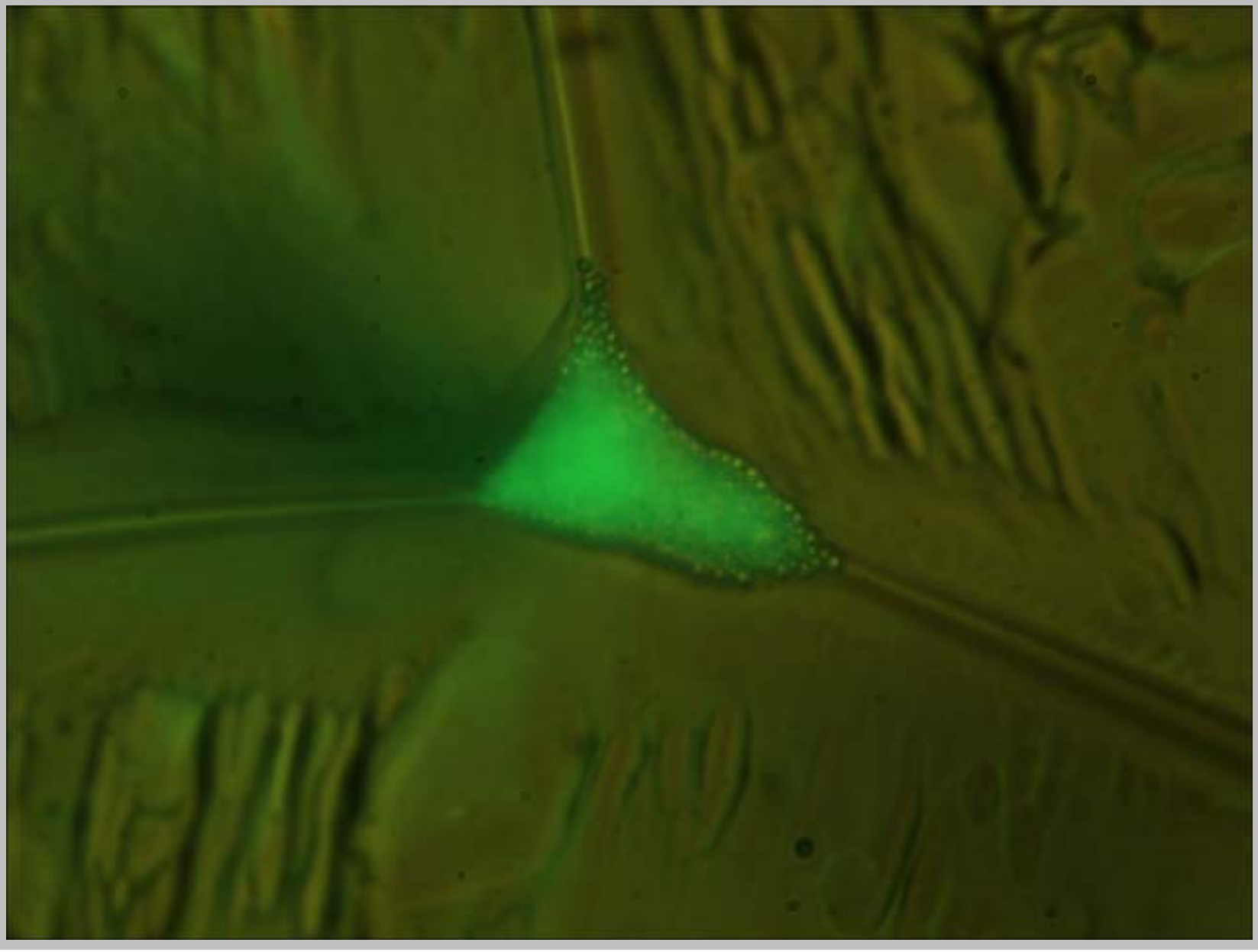
BACTERIAL ACTIVITY IN ICY SYSTEMS



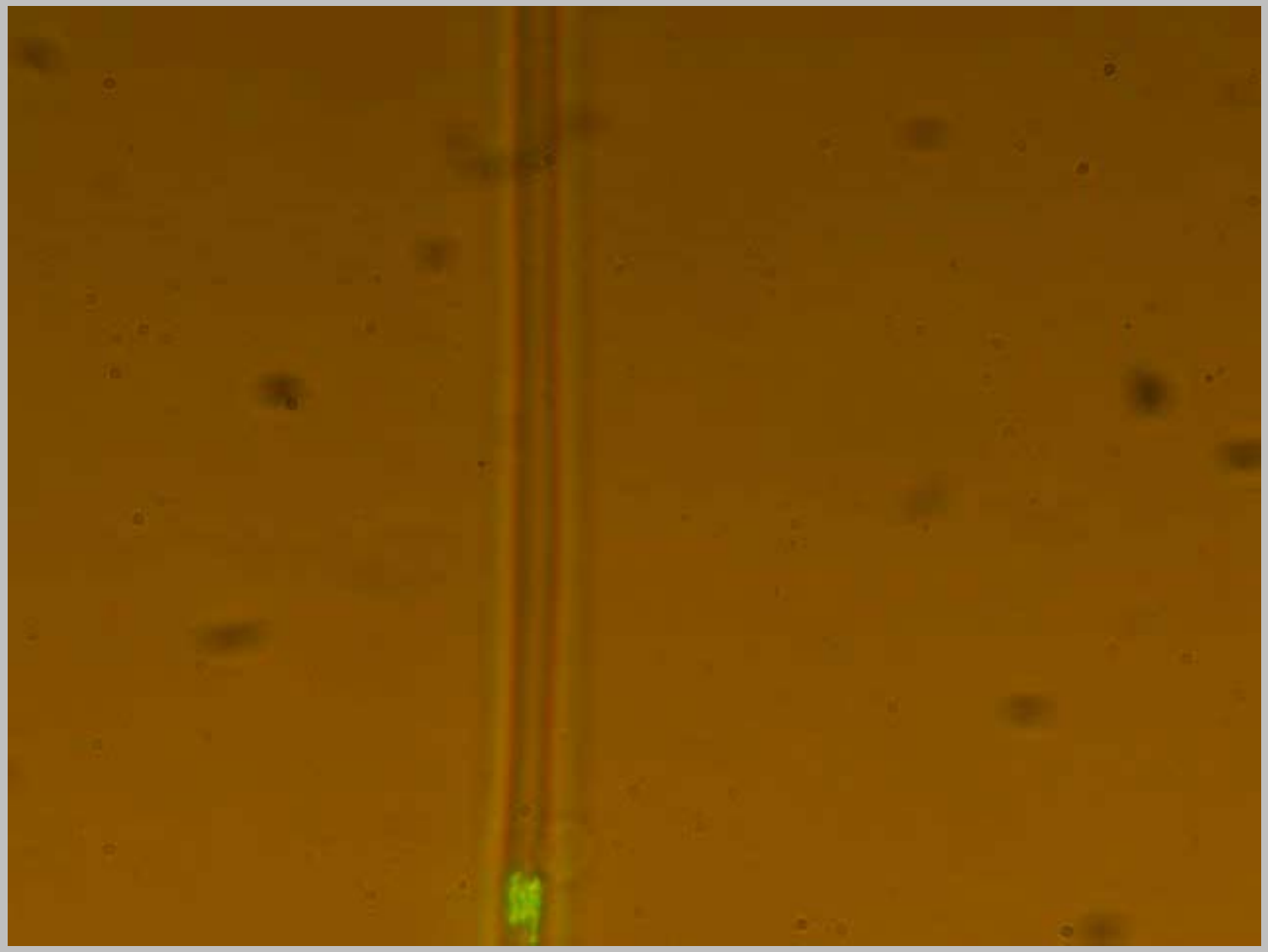
Average carbon turnover time = 63 days

Data from B. Sattler and J. Priscu (melted Cores; ~1 °C incubation)

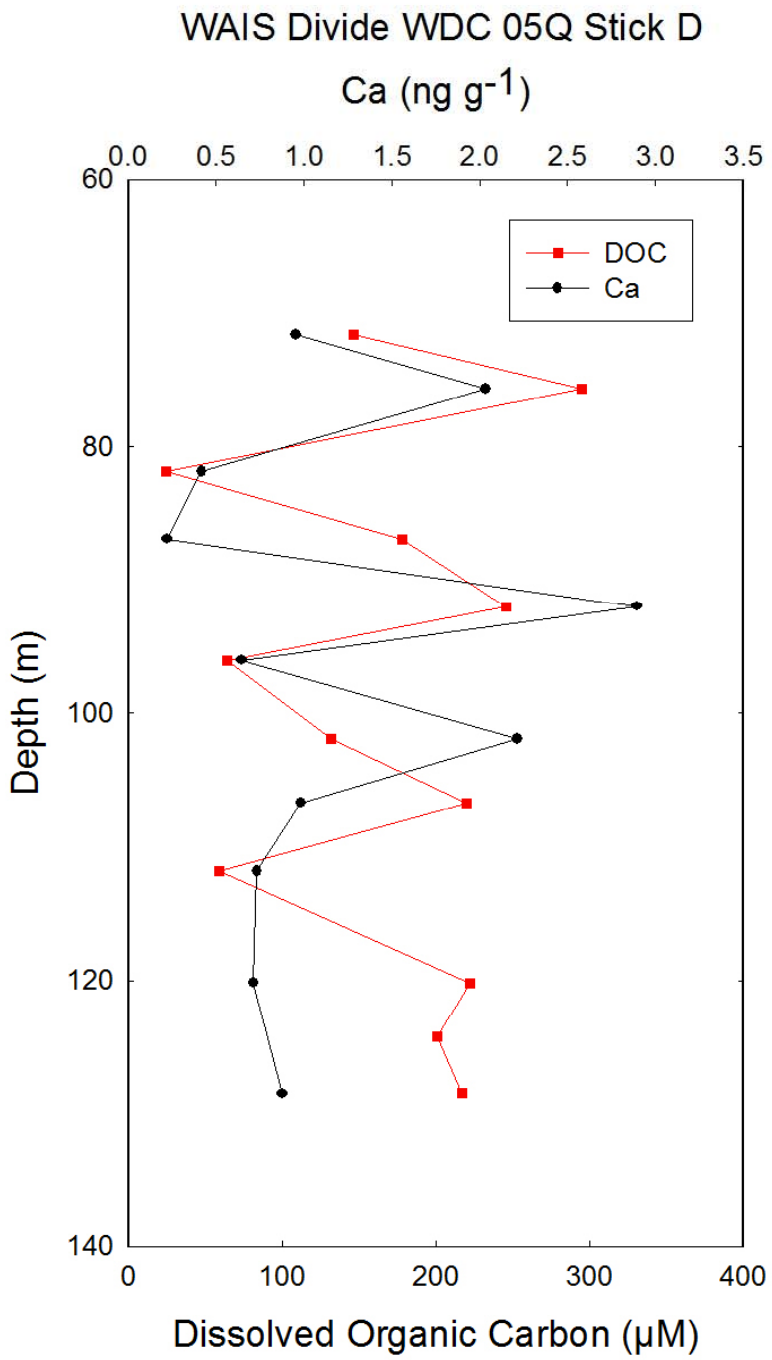
1 micron fluorescent beads in an ice vein.

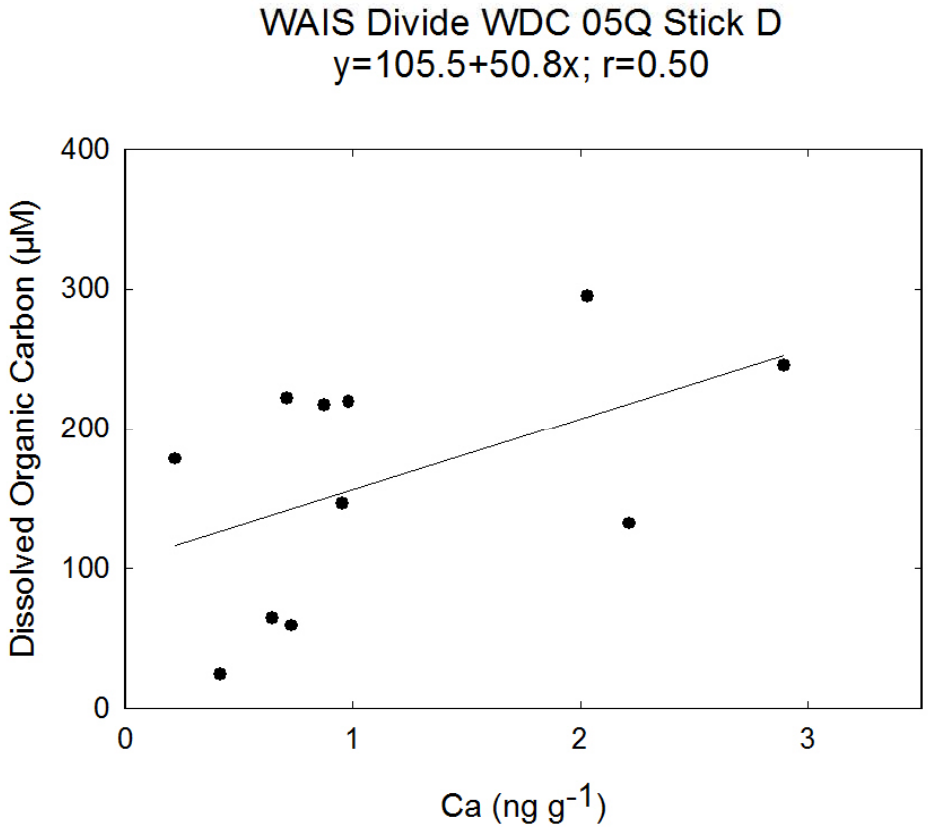


1 micron fluorescent beads in an ice vein subjected to a 0.2 ^{o}C temperature gradient (Avg ice temp = -15 ^{o}C)

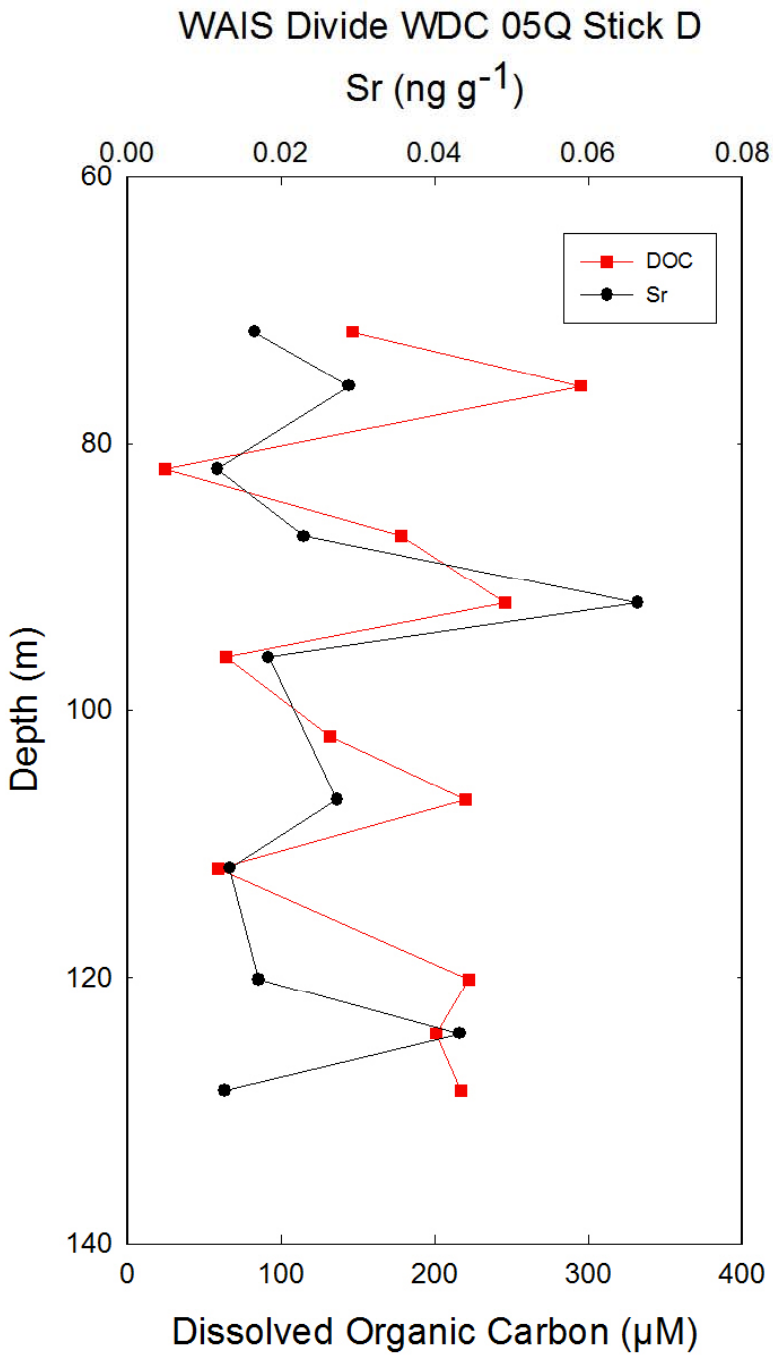


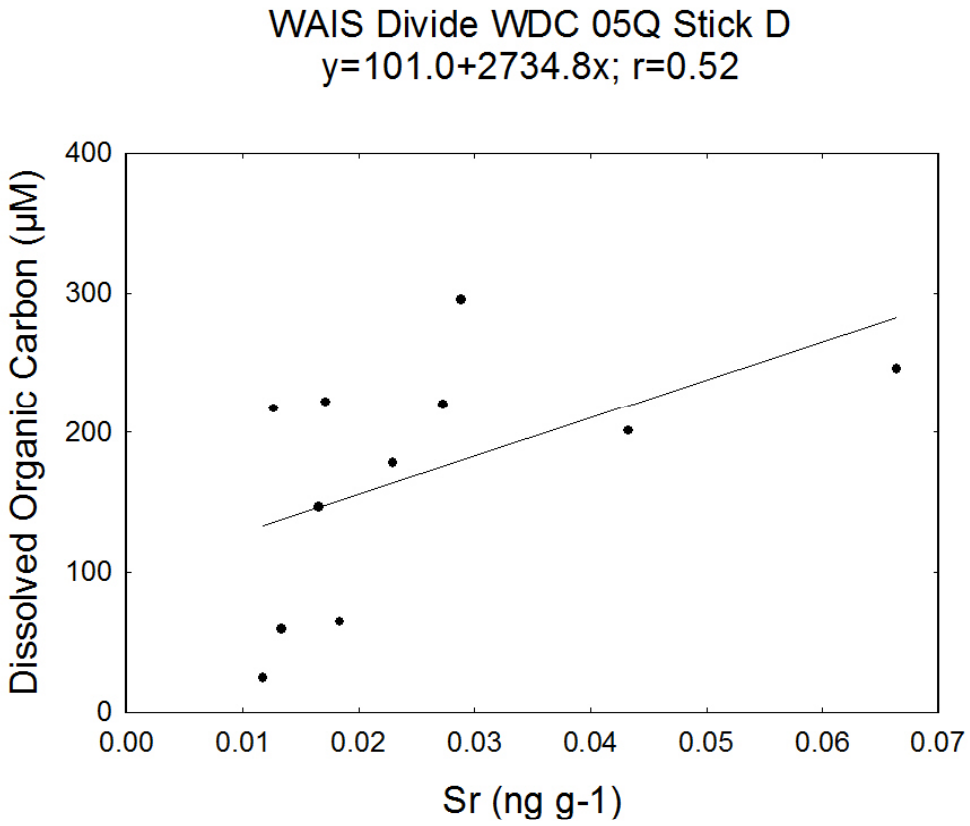
GEOCHEMISTRY



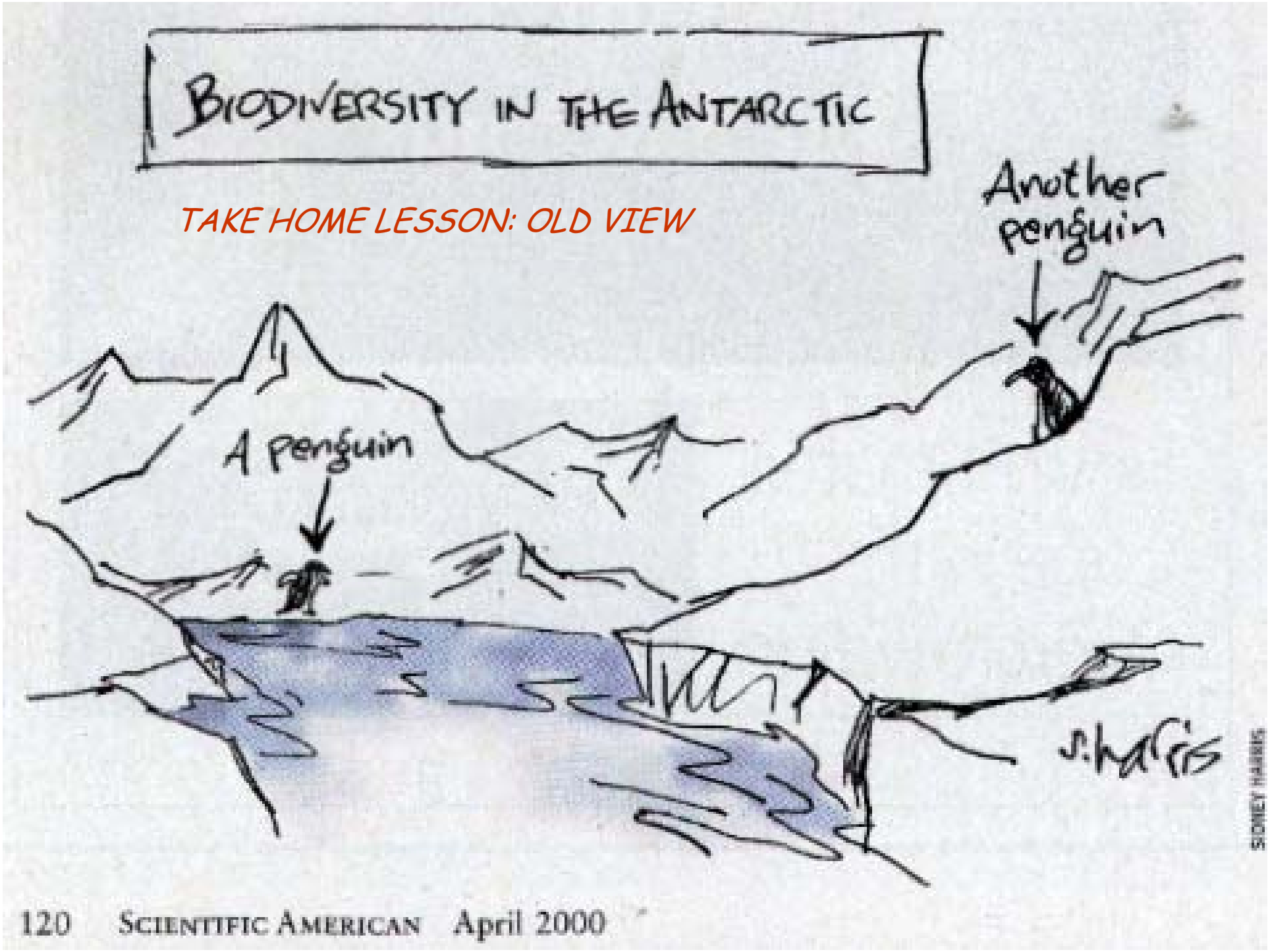


GEOCHEMISTRY





DOC of Seawater Origin?



TAKE HOME LESSON: OLD VIEW

Typical Numbers of Prokaryotic Cells in Natural Habitats

Habitat	Cells ml $^{-1}$
Colon/Rumen	0.1-1 x 10^{10}
Soil	0.1-100 x 10^{7}
Marine (open water)	0.05 - 460 x 10^{6}
Fresh and saline lakes	1.0 x 10^{6}
Rivers	1.0 x 10^{6}
Ocean sediments	0.34 - 220 x 10^{6}
Glacial ice	**1.0 - 2.0 X 10^{3}**

Background data from Whitman et al. 1998, “Prokaryotes: the unseen majority”, PNAS, 95:6578-6583.

Future Plans

•Try to make continuous measurements (or discrete samples using a fraction collector)?

→Or would it be best to work on annual cycles (i.e., melt a length of ice representing one year)?

•Examine diversity using genomic methods (most easily done if we worked on ice cores integrated over a year)

•Directly measure the mass of particulate organic C and N

•Continue our attempts to measure metabolism *in situ*