



Glaciers as a biome: The hidden biodiversity of the Arctic and Antarctica





Arctic island sedge diversity . . . 40%



C. atrofusca



C. aquatilis var. *minor*



C. bicolor



C. bigelowii subsp. *lugens*



C. glareosa



C. glacialis



C. maritima



C. garberi



C. nardina



C. membranacea



C. petricosa



C. scirpoidea



C. ursina

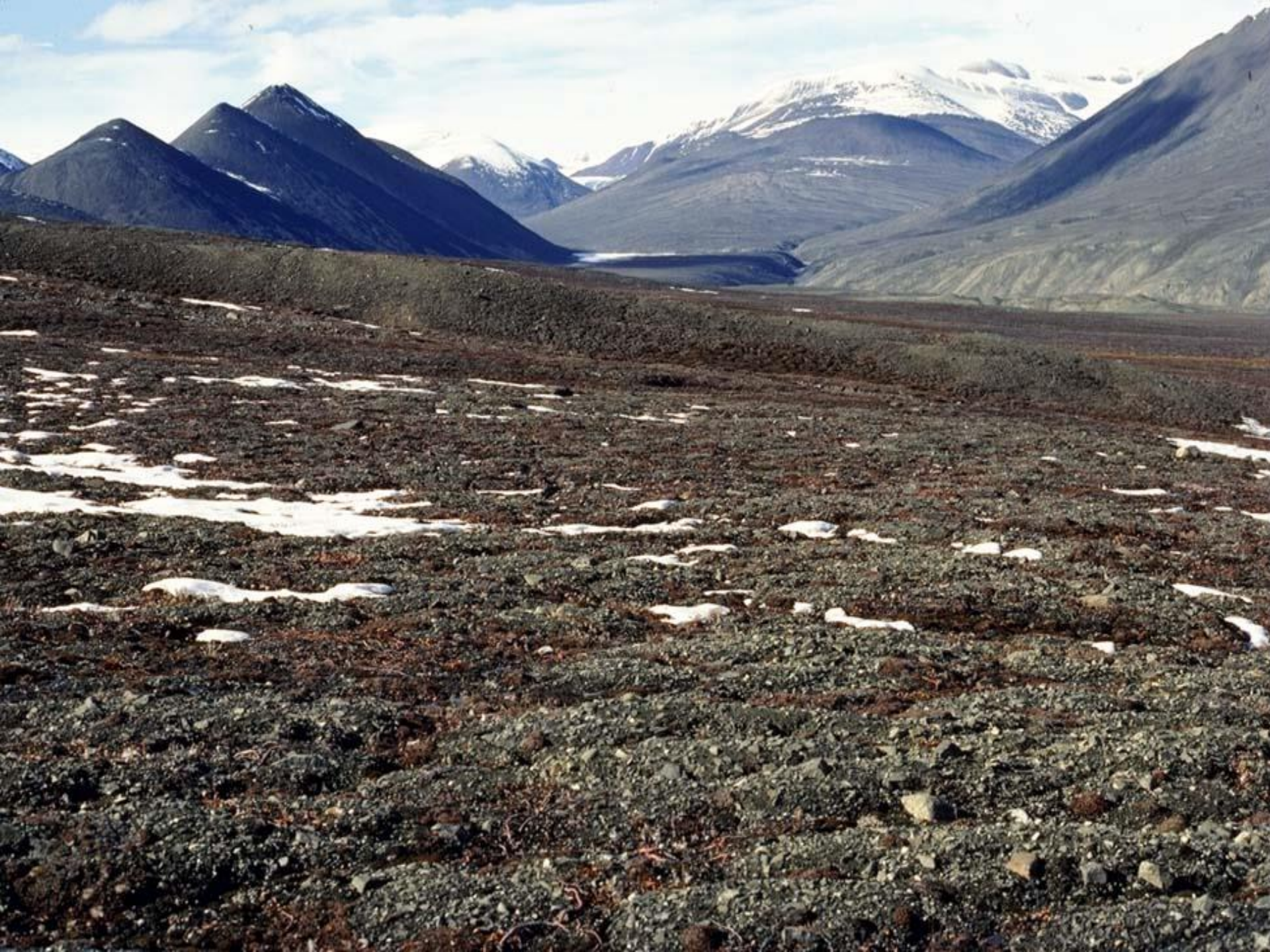


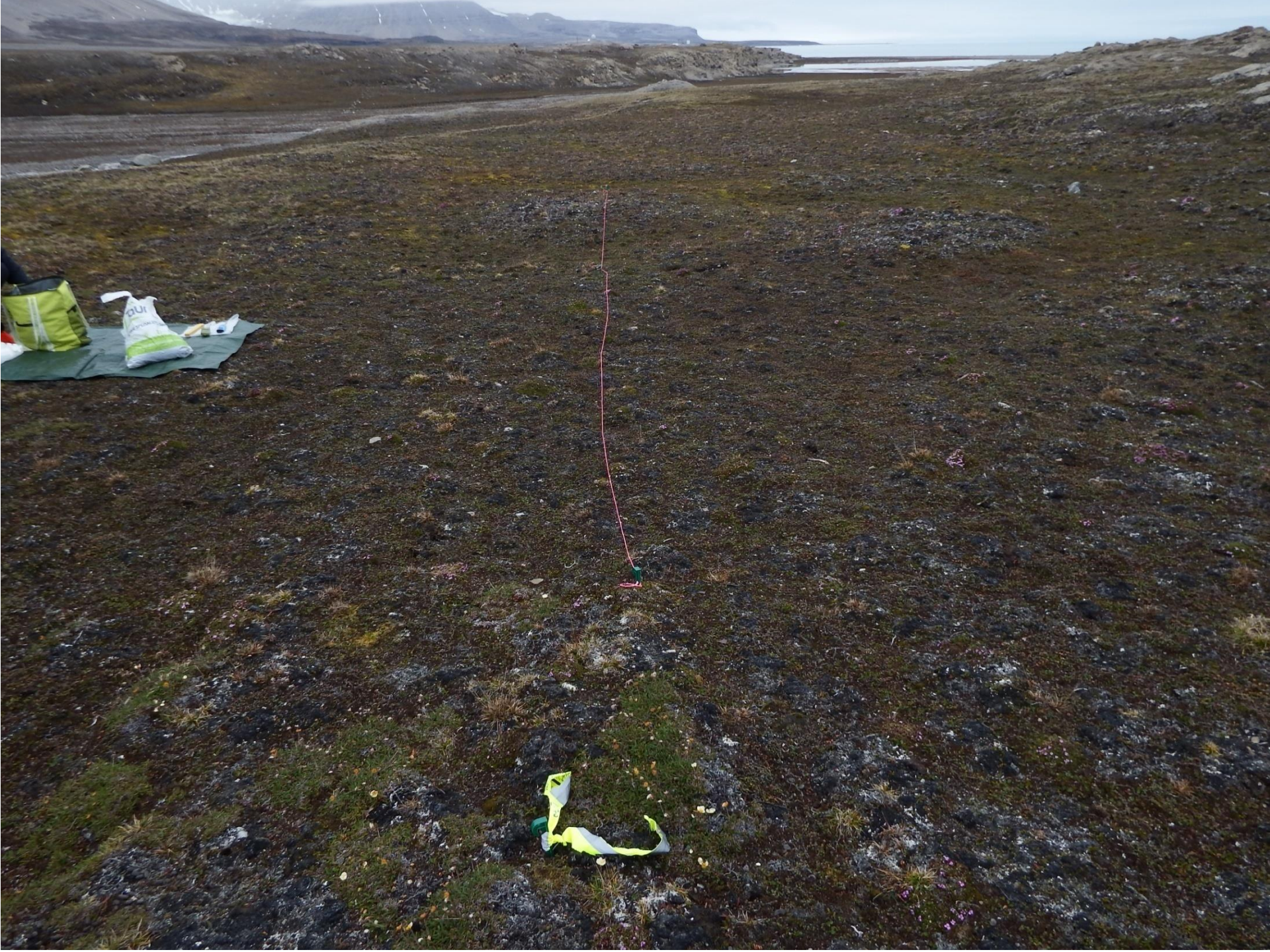
Tormod Amundsen © Biotopo

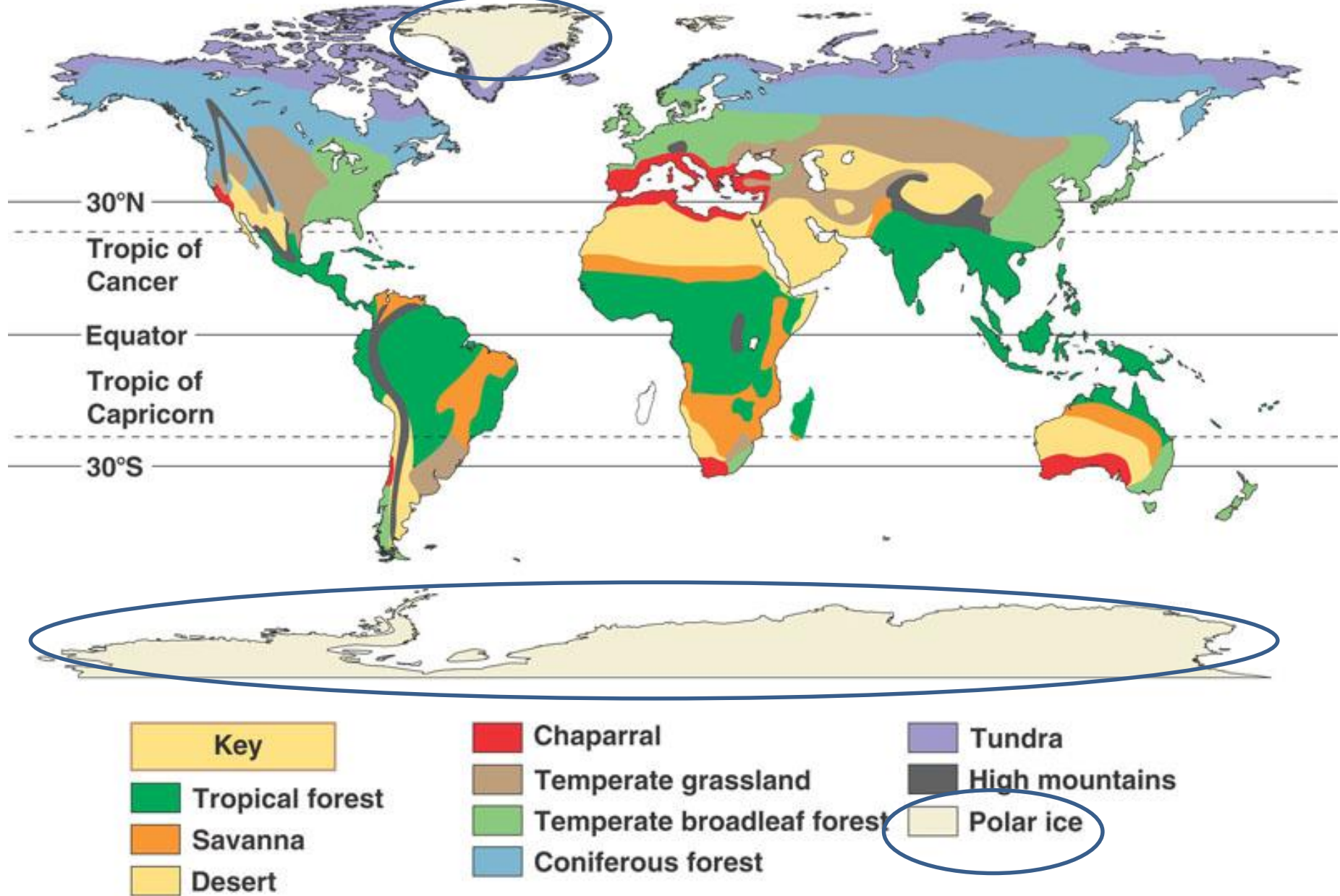




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Life at the surface of glaciers











Evolution of a cryoconite hole

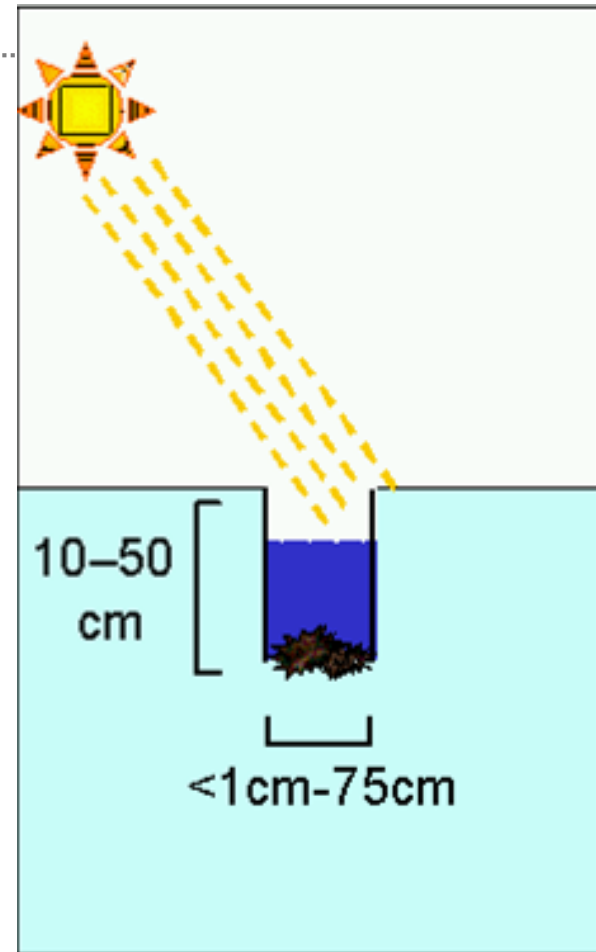
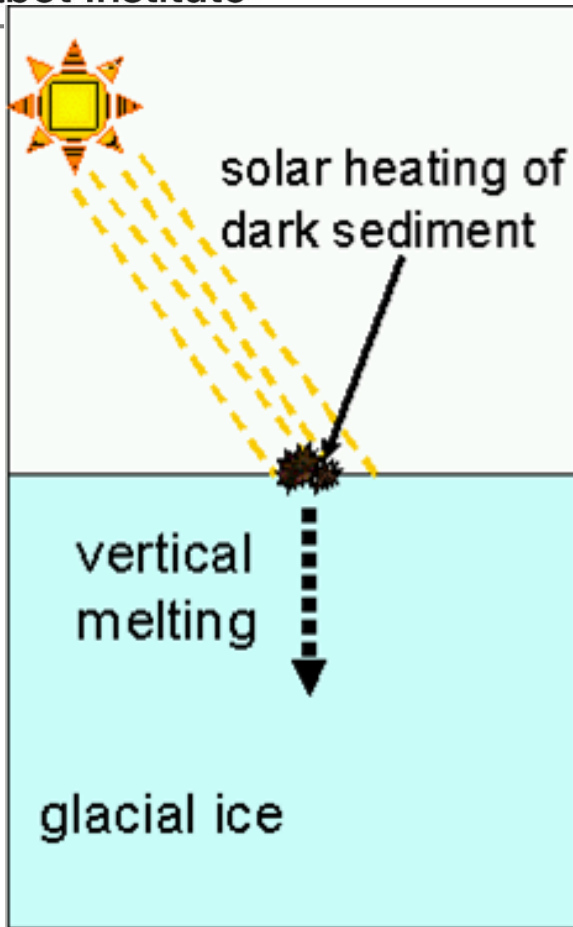
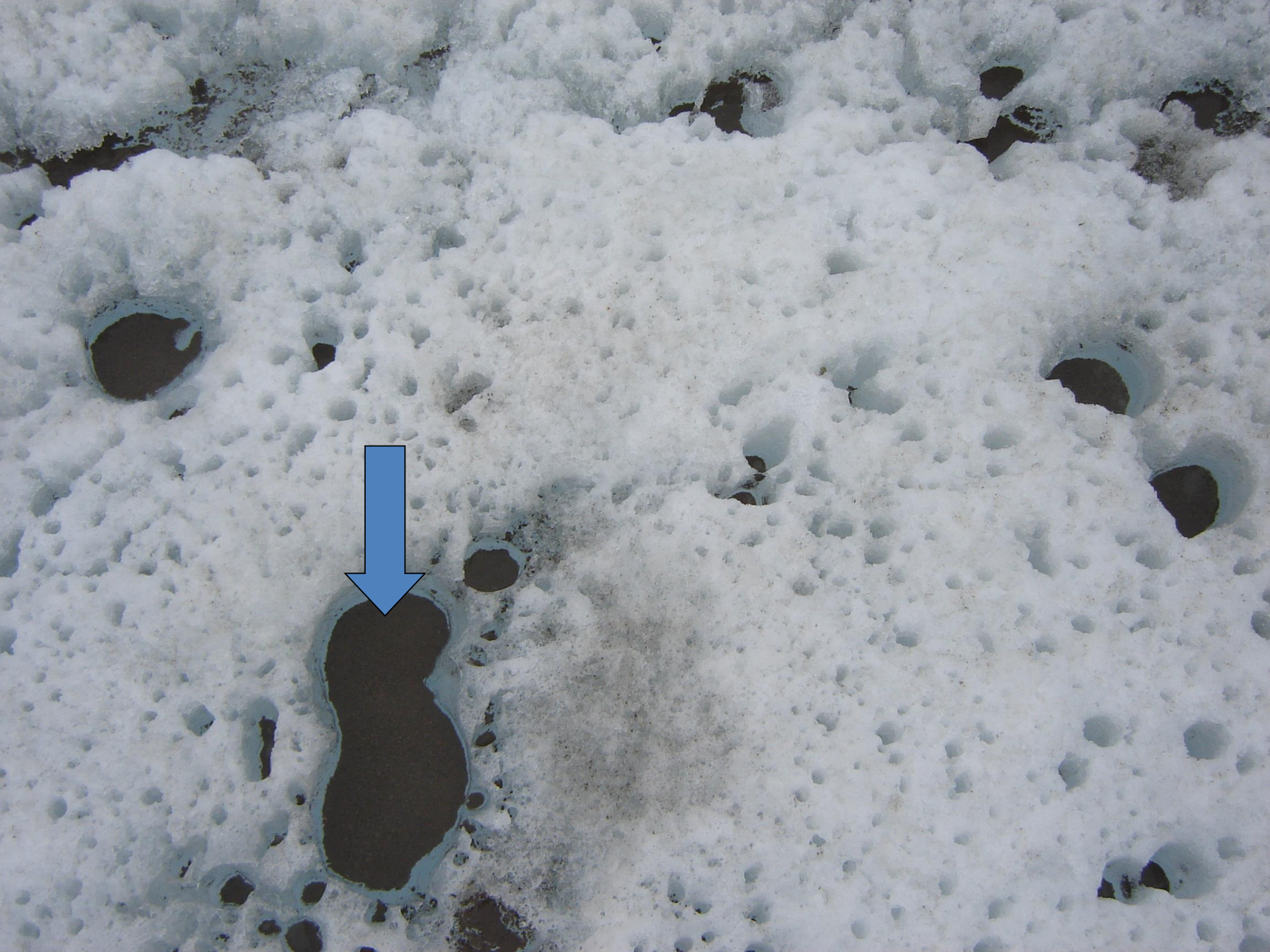


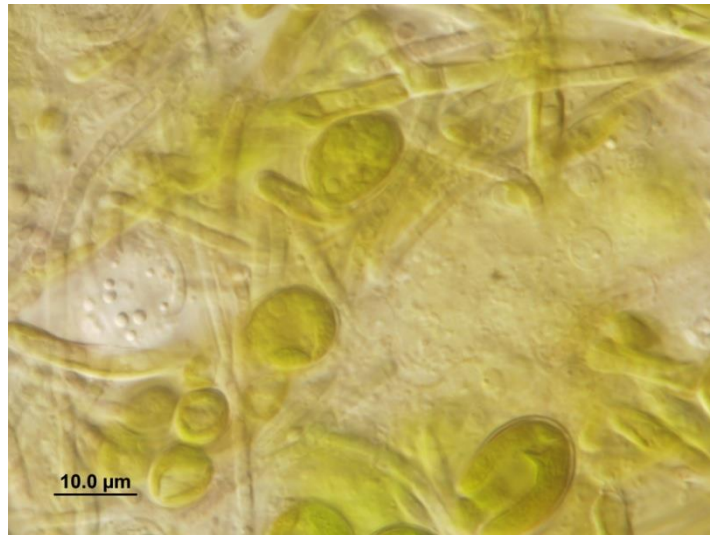
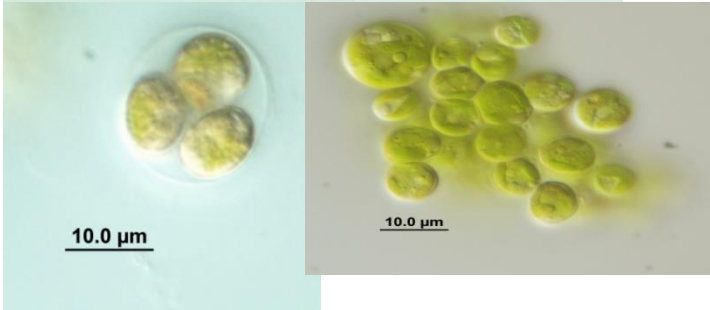
Figure from Brian Kvitko (2002)
<http://people.cornell.edu/pages/bhk8/undergrad1.htm>



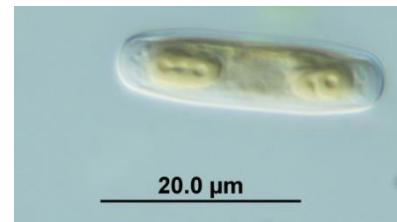
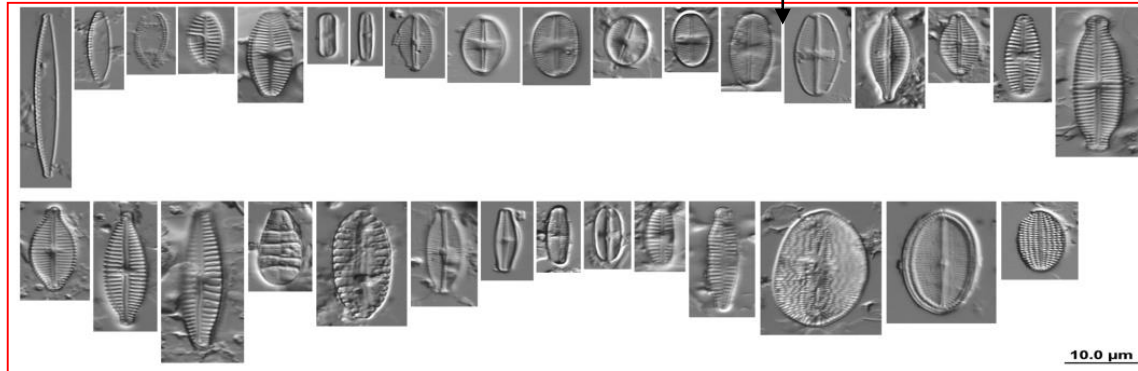
Cryoconite holes in the Dry Valleys, Antarctica



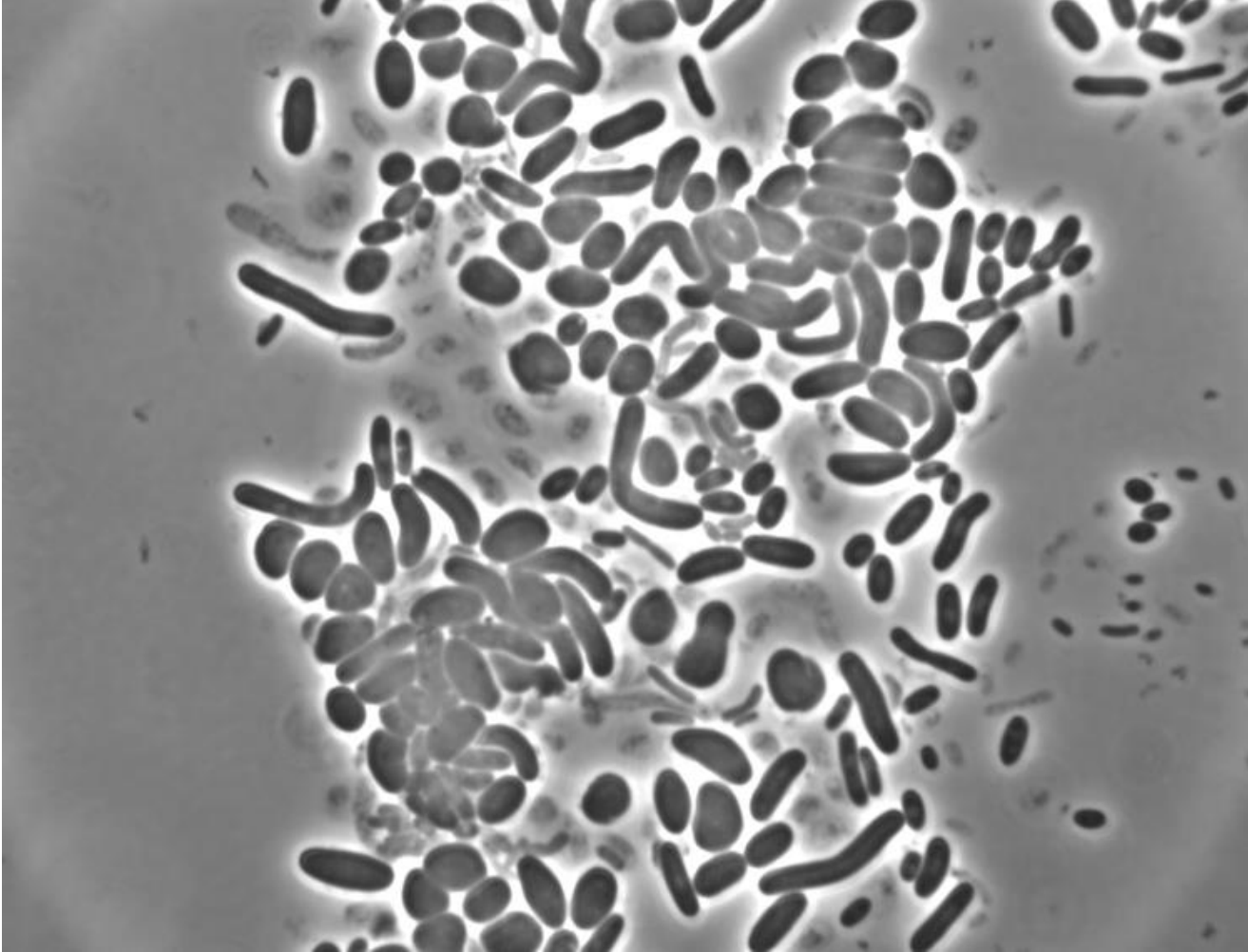
Colonial and
unicellular
Chlorophyceae



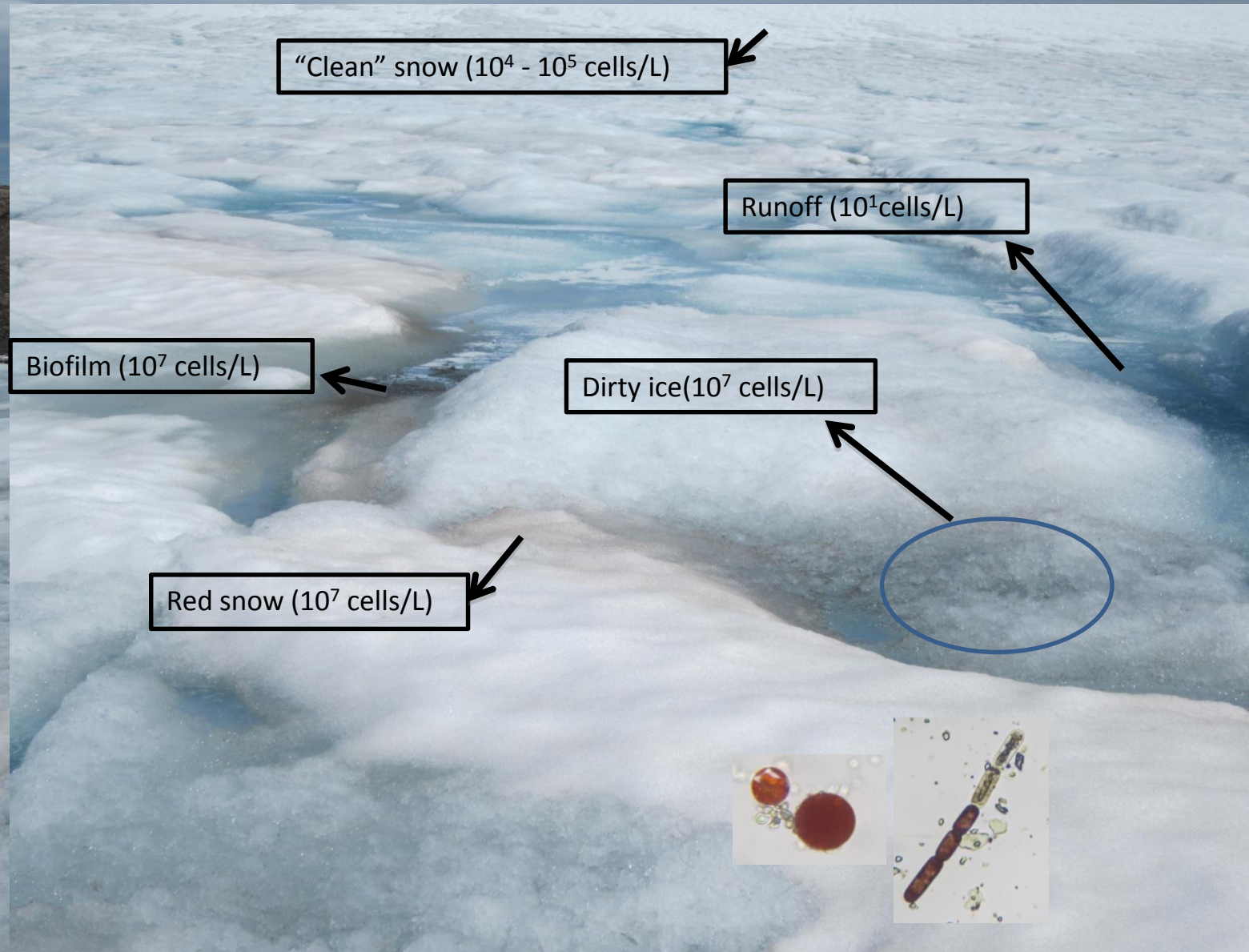
Diatoms (big diversity – all
sorts of adaptations)



Bacteria



Many different habitats on the surface of ice




Are microorganisms important??



Simplified Global Carbon Cycle

Atmospheric Carbon Net Annual Increase
3 – 4 GtC/y

 GtC/y: Gigatons of carbon/year

Atmosphere
(800)

Net terrestrial uptake
0 – 1

120

Photosynthesis

Plant biomass
(500)

0 – 1

Respiration

Microbial decomposition

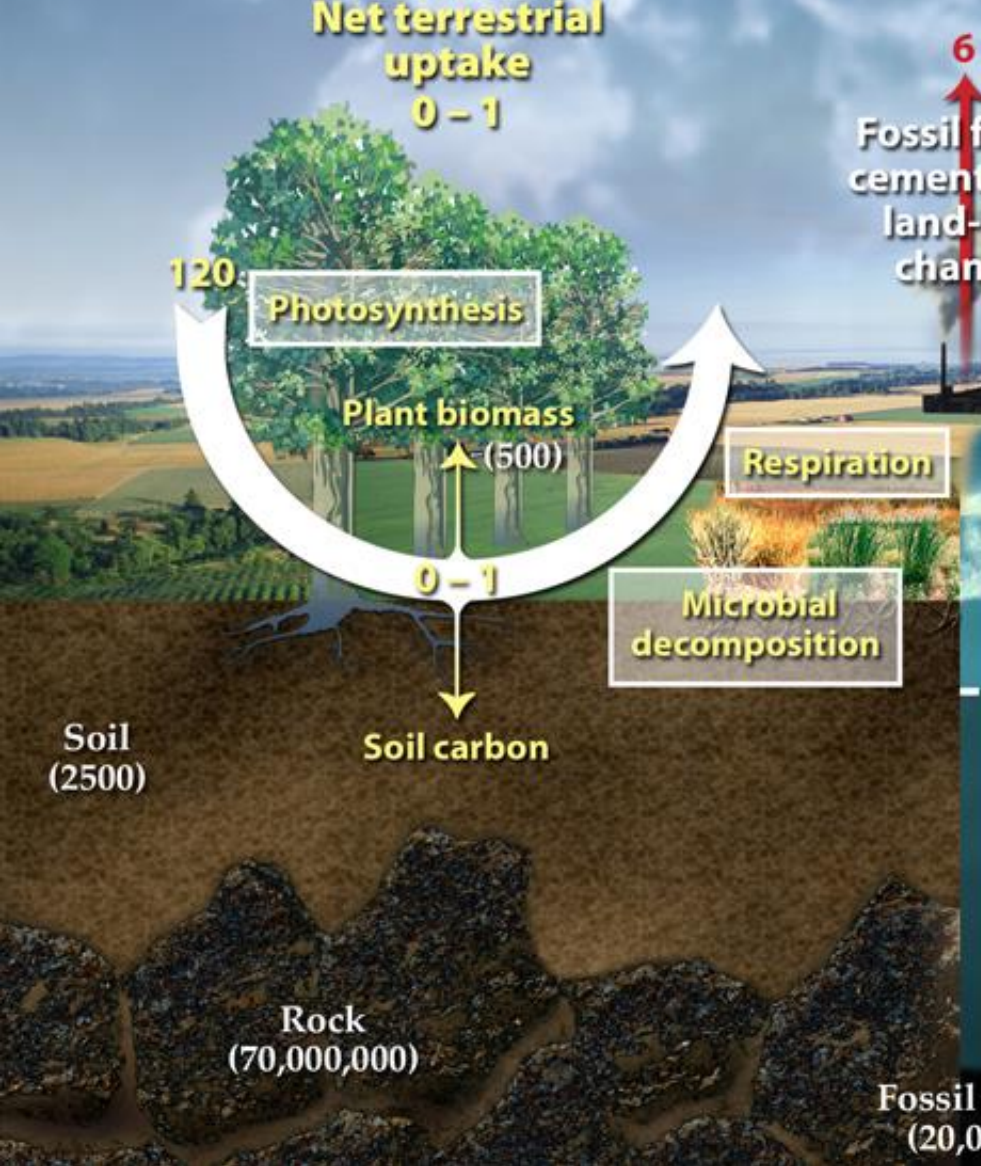
Soil carbon

Soil
(2500)

Rock
(70,000,000)

6
Fossil fuel
cement
land-use
change

Fossil
(20,000,000)

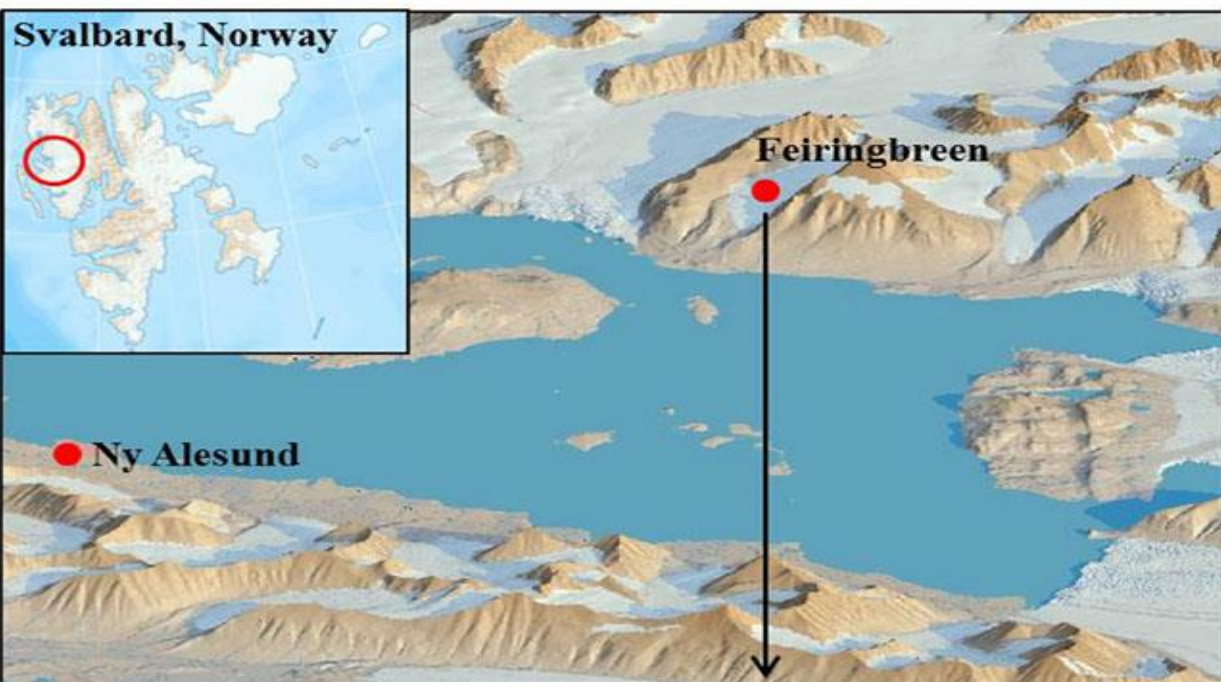


Svalbard, Norway



Feiringbreen

Ny Alesund

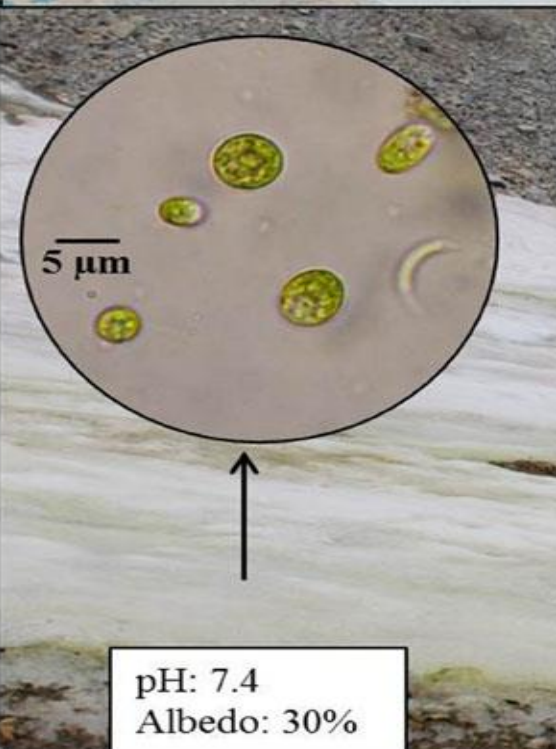


Feiringbreen

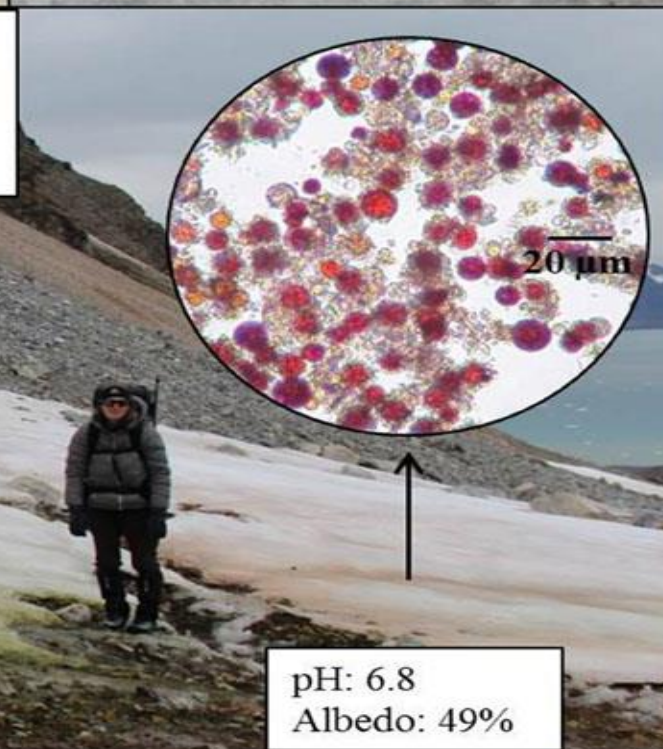
Coordinates: 79.0136°N, 12.4767°E

Elevation: 350 m a.s.l.

Date: 05.08.2013

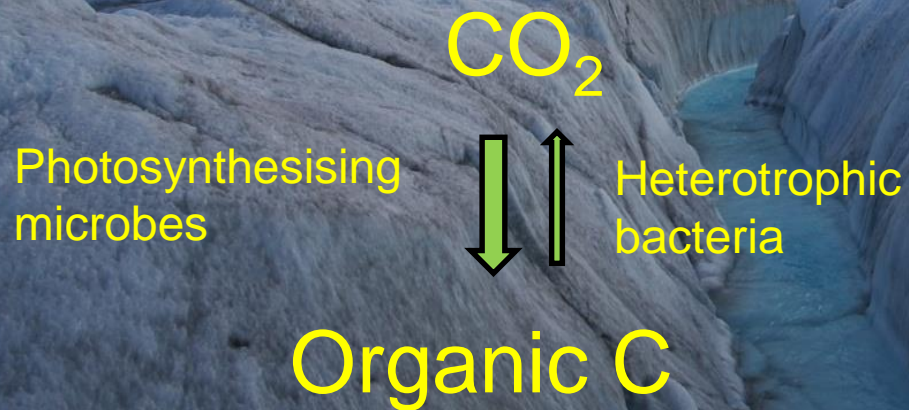


pH: 7.4
Albedo: 30%



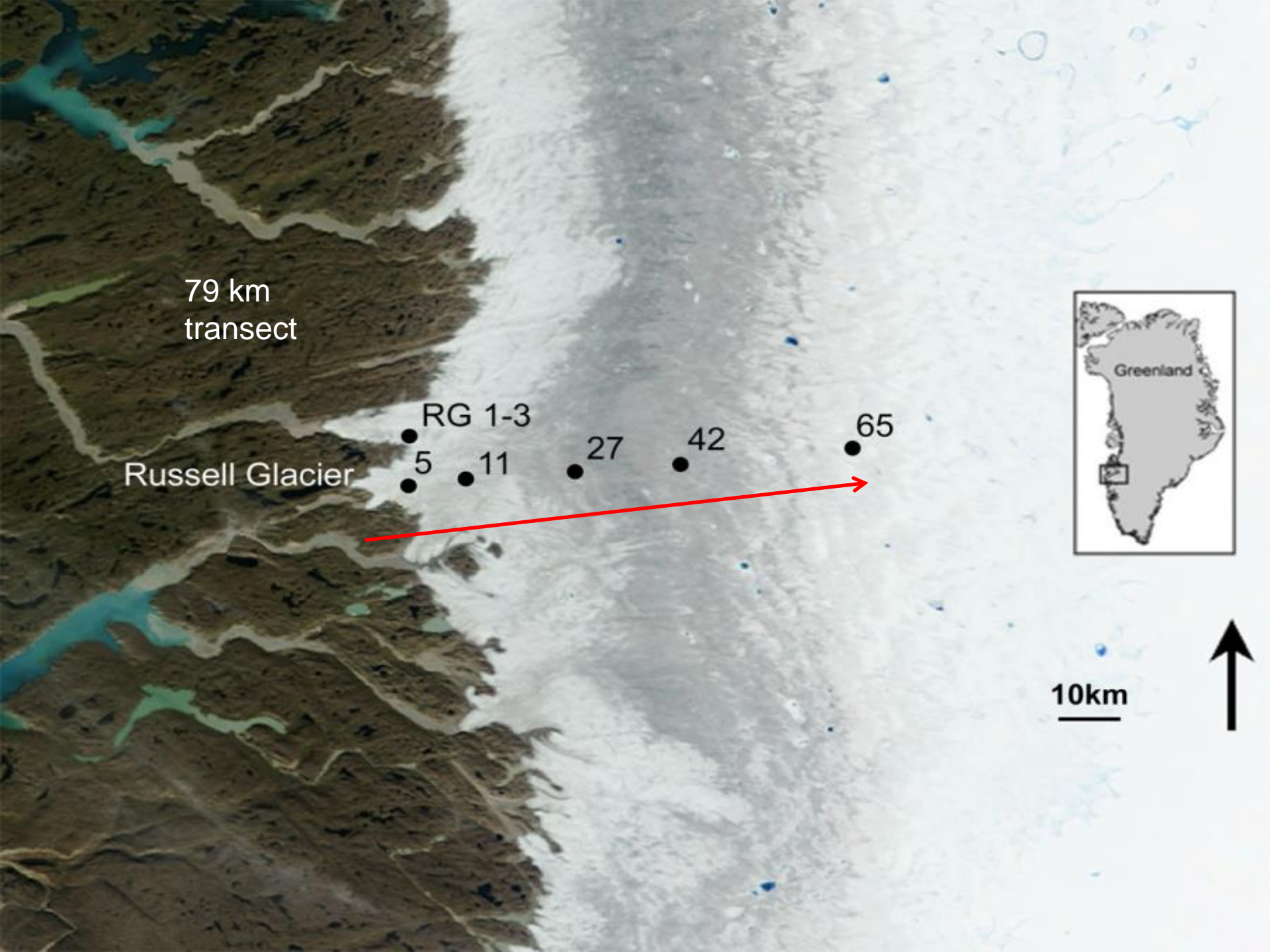
pH: 6.8
Albedo: 49%

Does presence mean activity?



Life requisites

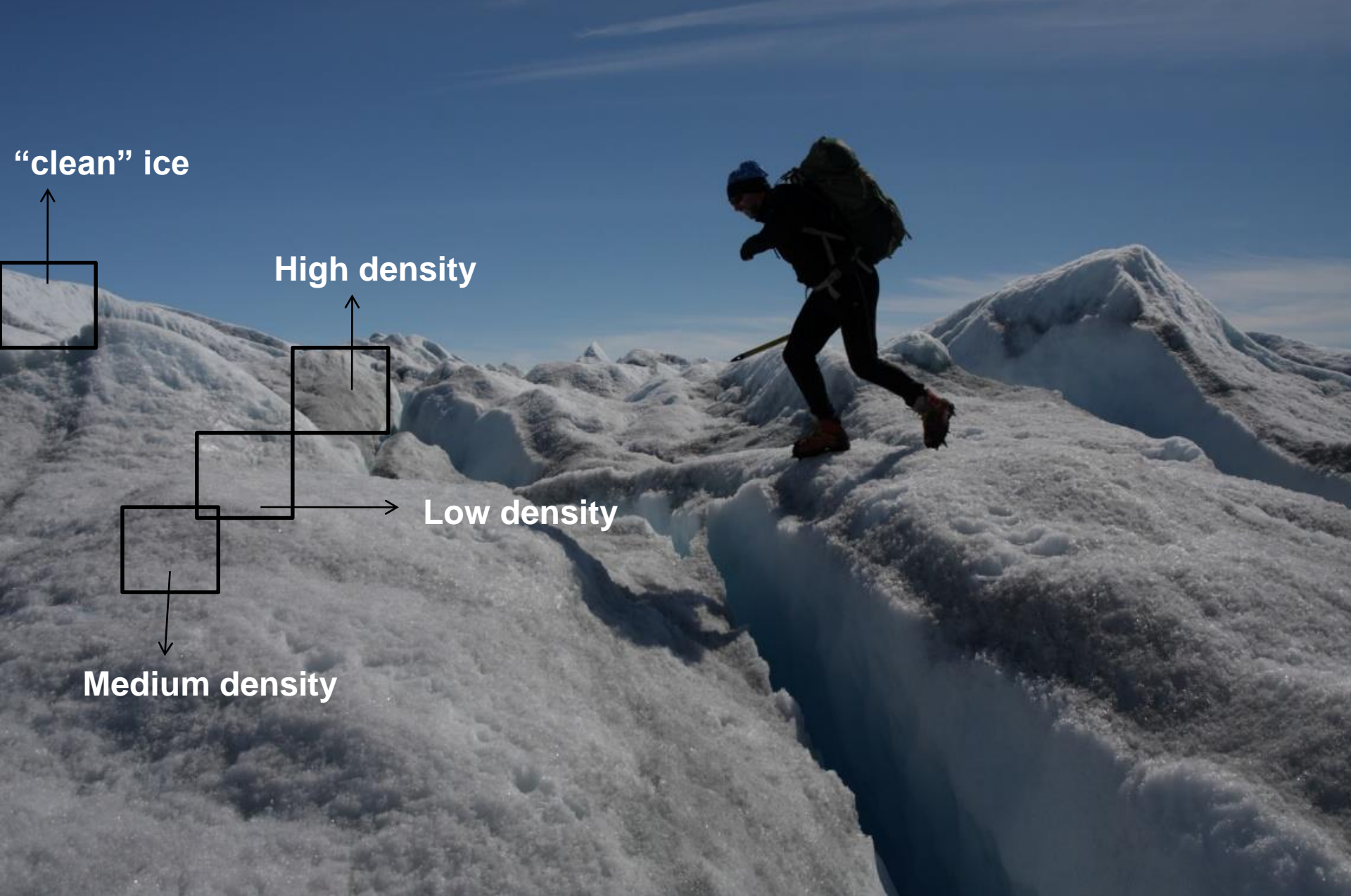
- 1) liquid water,
- 2) chemical elements and
- 3) energy sources,





SW Greenland
Ice Sheet
ablation zone
transect (Aug
2010)





"clean" ice

High density

Low density

Medium density

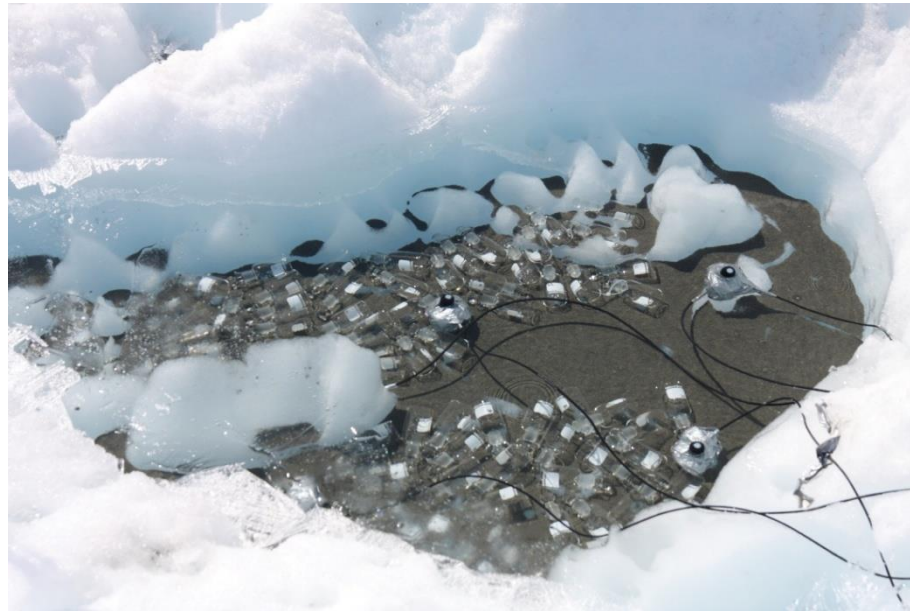
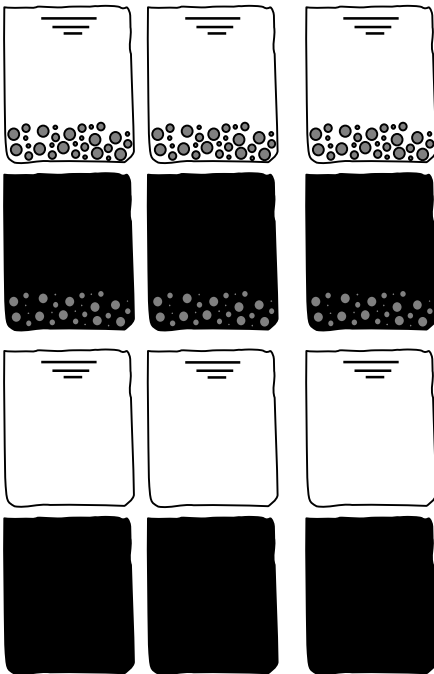
Photosynthesis, community respiration and bacterial production

^{14}C – bicarbonate

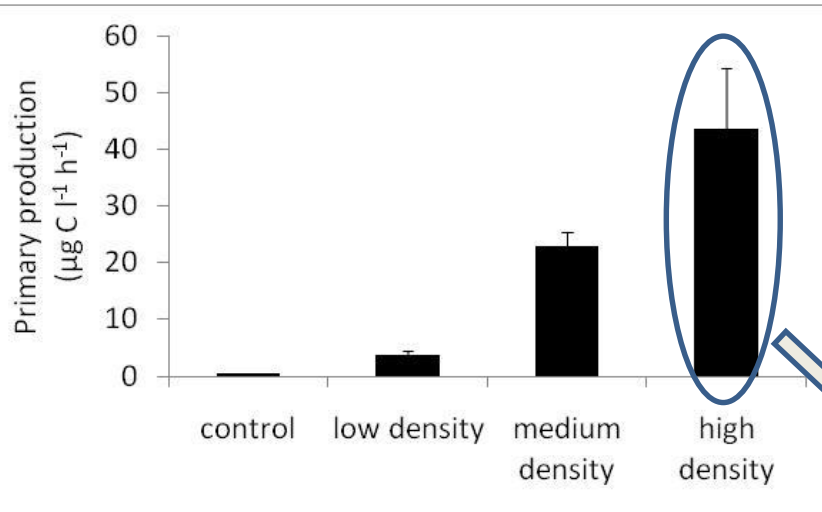
Oxygen consumption/production

CO_2 production/consumption

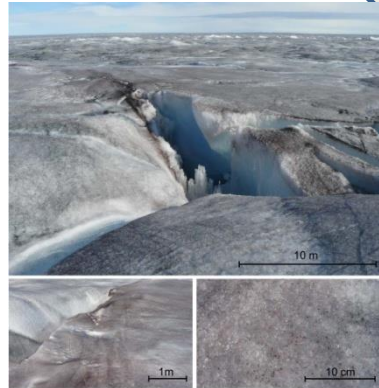
^3H - leucine



Primary production

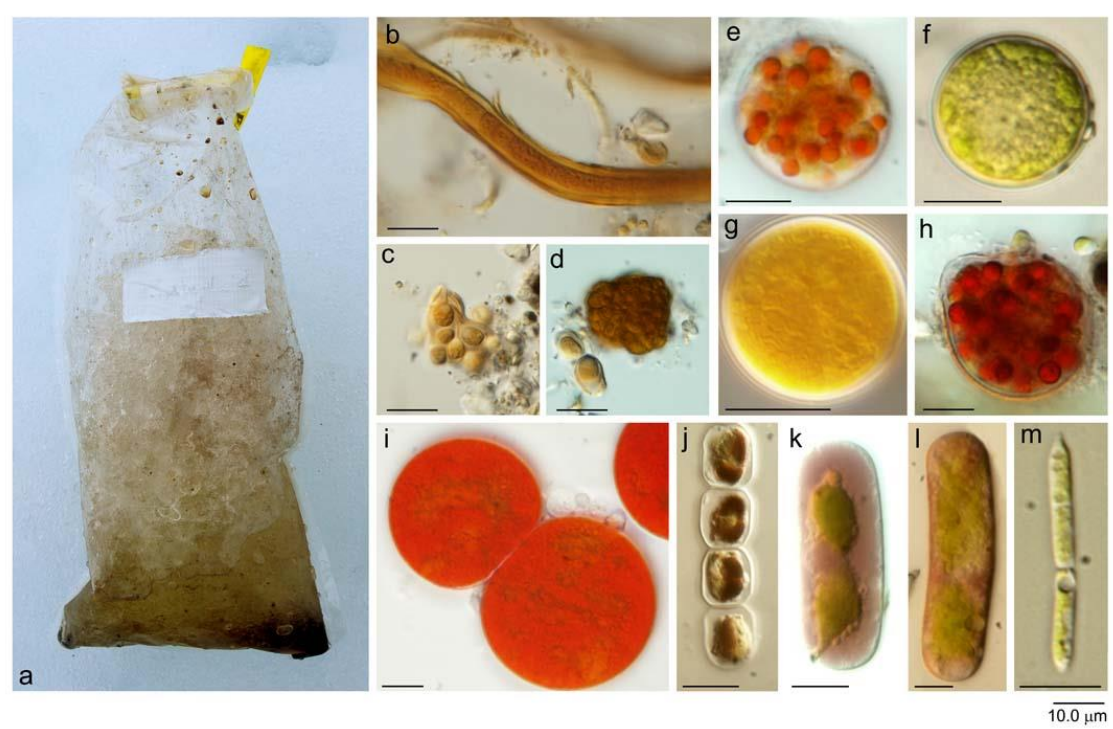
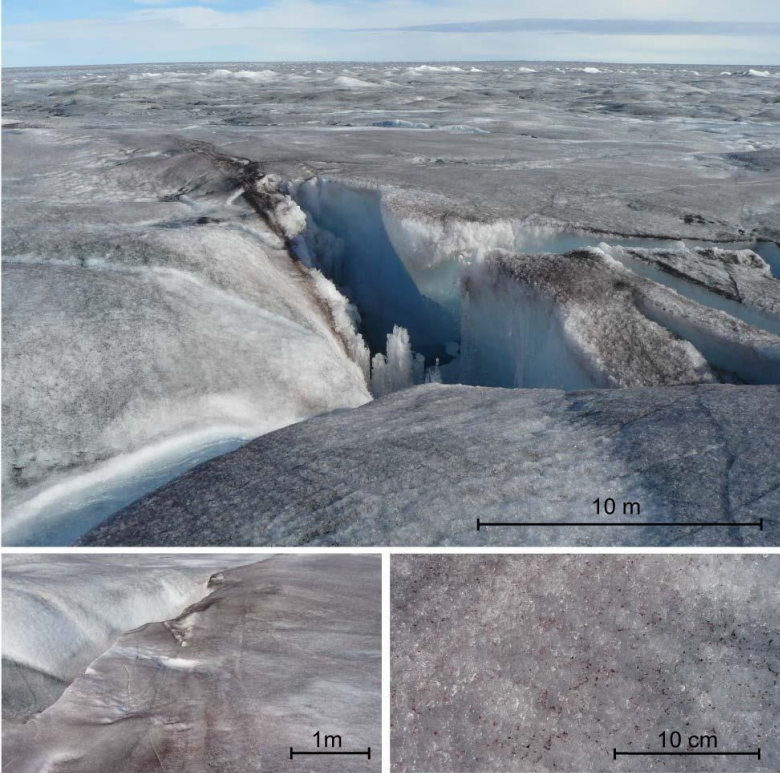


Yallop, Anesio et al. 2012. *ISME Journal*



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Yallop, Anesio et al. 2012. *ISME Journal*

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http://www.youtube.com/watch?v=xHFmVvDS8rQ&feature=youtu.be&desktop_uri=%2Fwatch%3Fv%3DcyvLZEs_Gps%26feature%3Dyoutu.be&app=desktop

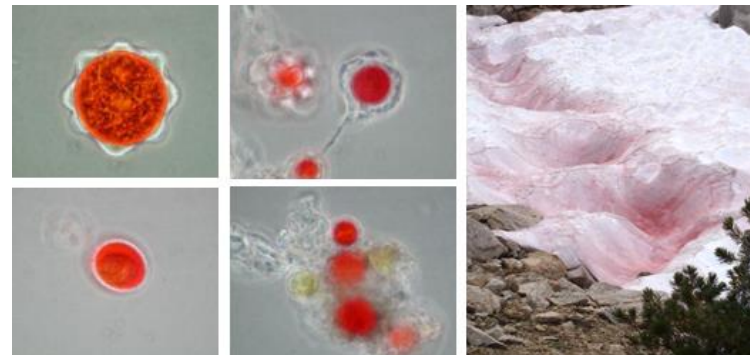
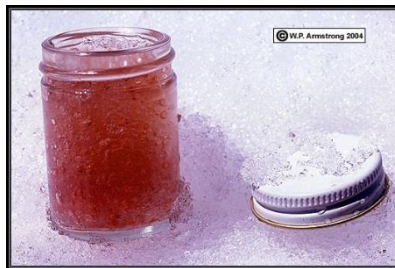
Definition of a biome

- “- Driven mostly by patterns in precipitation and temperature
- A large community of plants and animals that occupies a distinct region”
- Distinct interactions between communities
- Distinct feedbacks between the physical, chemical and biological environment”

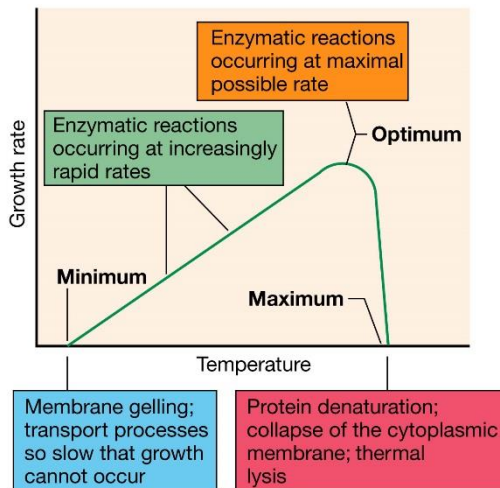
Microorganisms are not pretty like a polar bear. Why do we care?



1) The UK cosmetics market is worth £8.4 billions



2) Laundry detergent unit sales in U.S. supermarkets in 2015 = 350 million units



3) Cold adaptation in live attenuated vaccines – do you need a value?

Attenuated live vaccines

Cold-adapted attenuated influenza vaccines have been developed for humans and equines.





Frost on Mars

Image credit: NASA/JPL-Caltech/University of Arizona/Texas A&M University

Thank you for listening

