



Using Metagenomics to Understand the Microbial Ecology of Permafrost

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Our study sites are in the cold regions of the planet



ANTARCTICA

THE ARCTIC

Select study sites



Merritt Cartographic



On the Horizon



www.nasa.gov



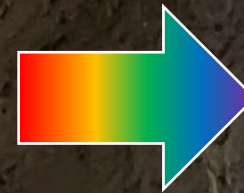
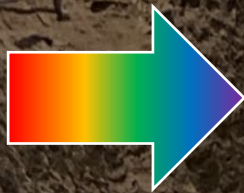
US Army Corps of Engineers

CRREL Permafrost Tunnel

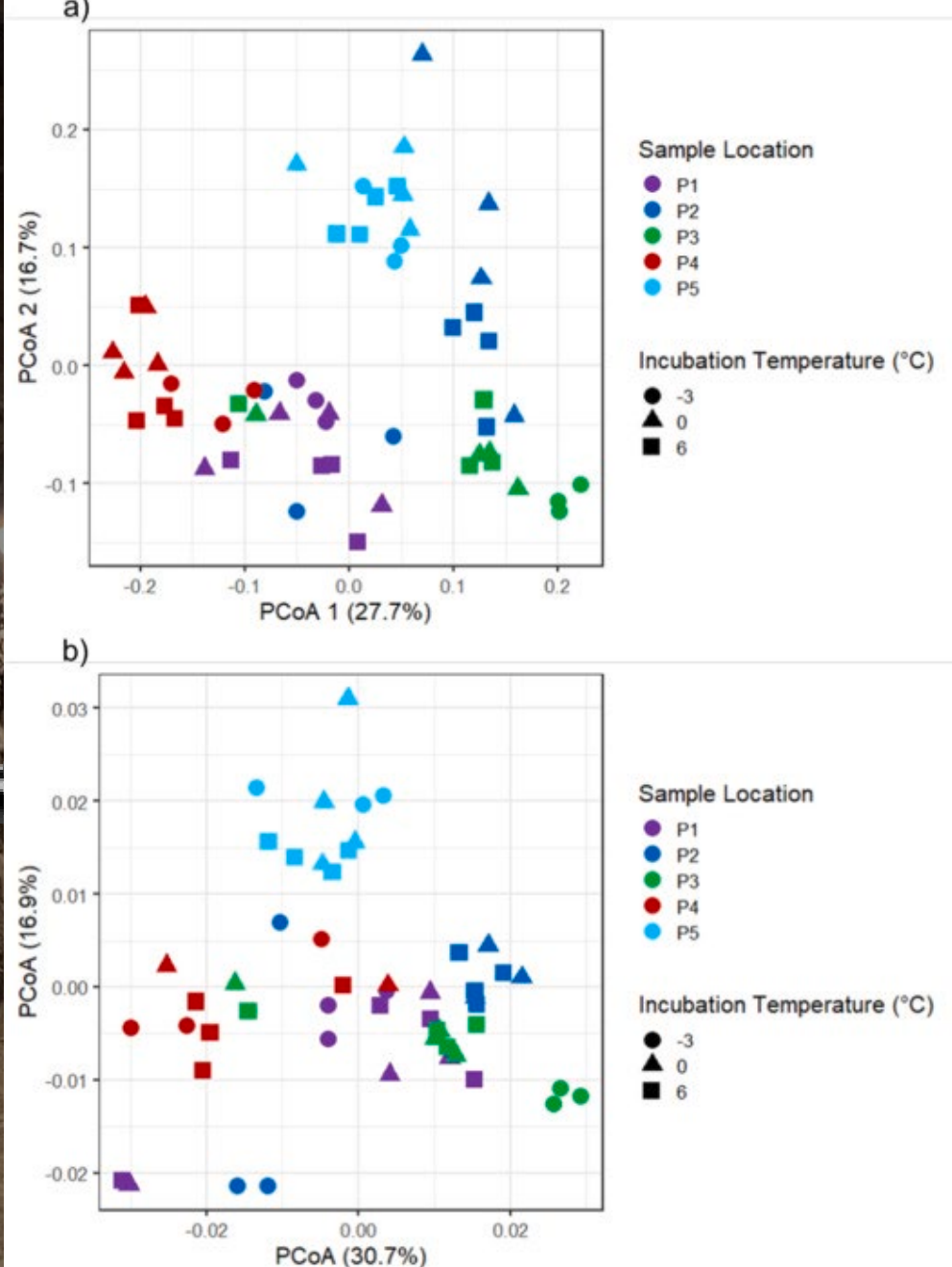


Low biomass
Inhibitors
Handling frozen samples

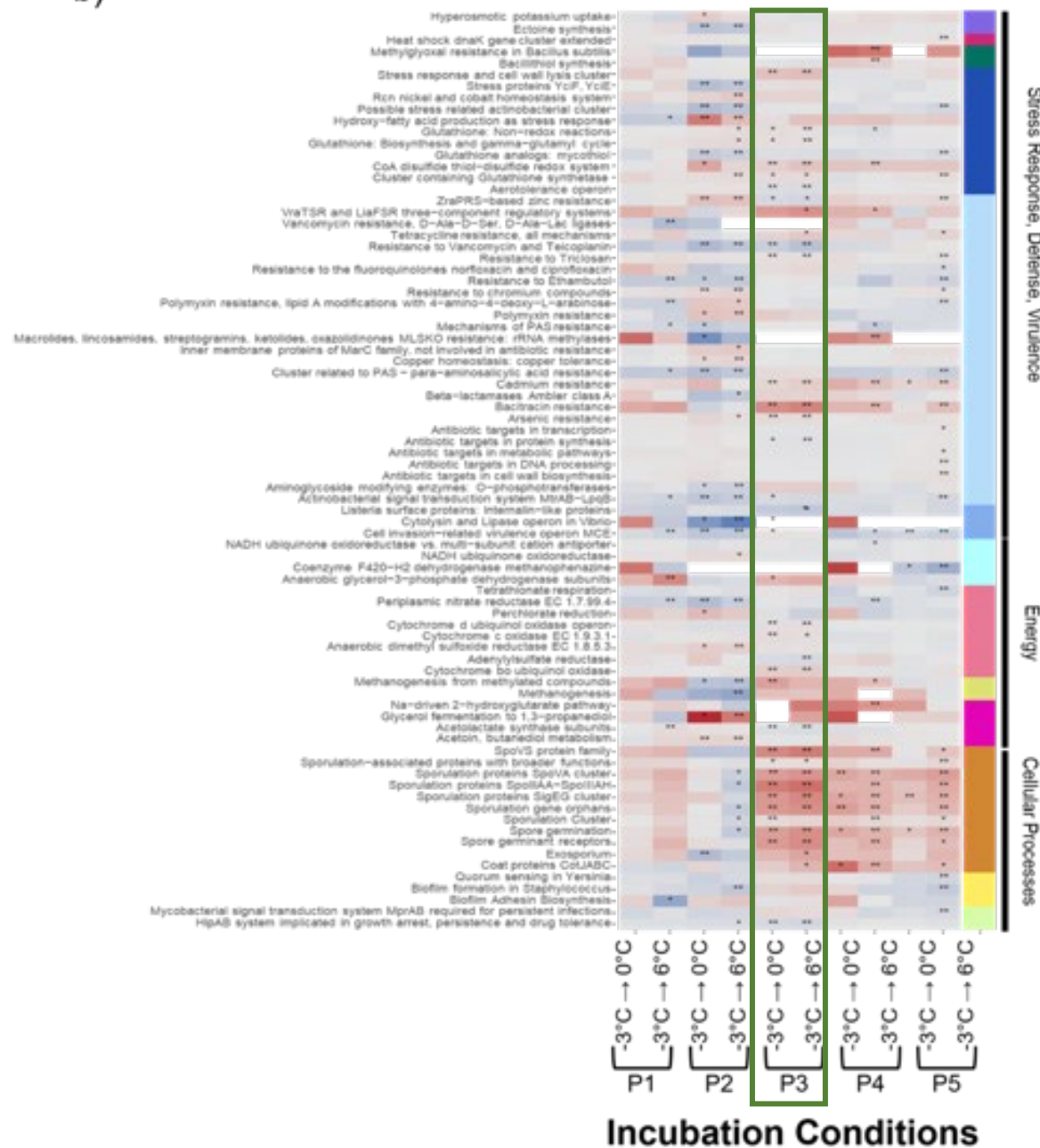
Processing permafrost cores for microbial research



Role of location and temperature on microbial community structure and function



b)



Robert Jones

Mining our
shotgun
metagenomics
datasets for
genes of interest

Barbato et al. 2022. Soil Biology
and Biochemistry, 167, p.108605.

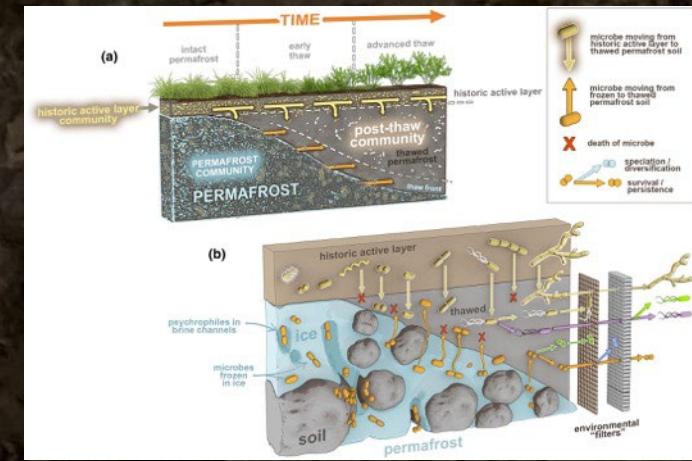
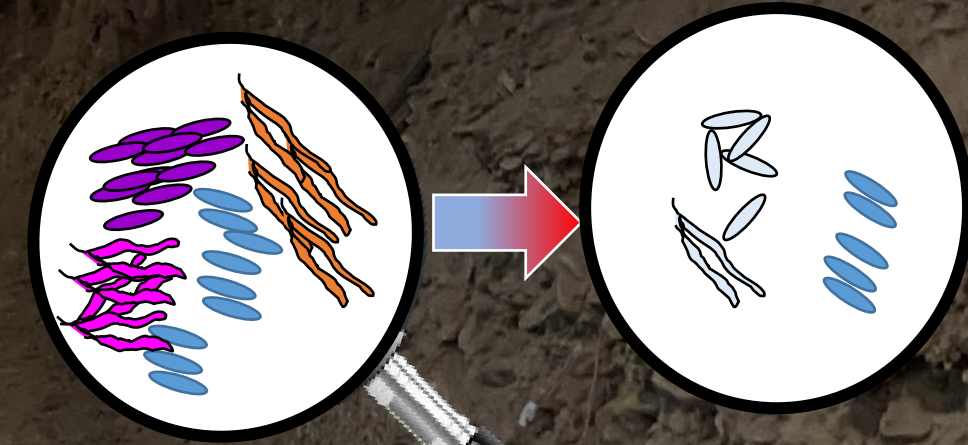
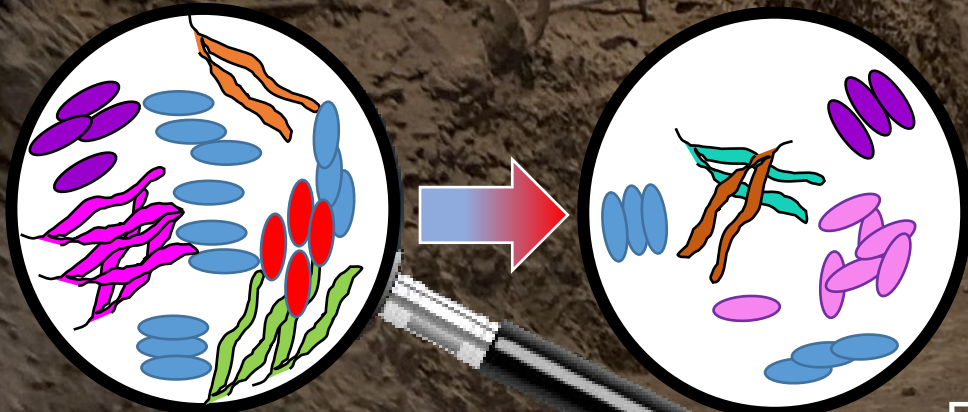
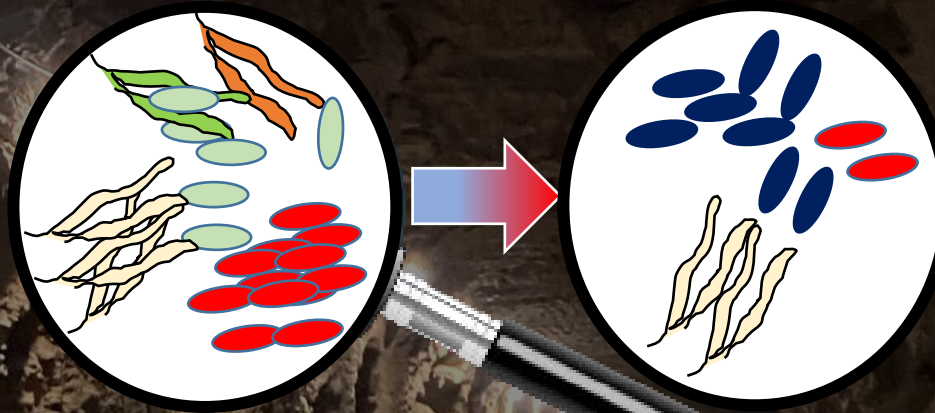


Microbial communities assemble after thaw



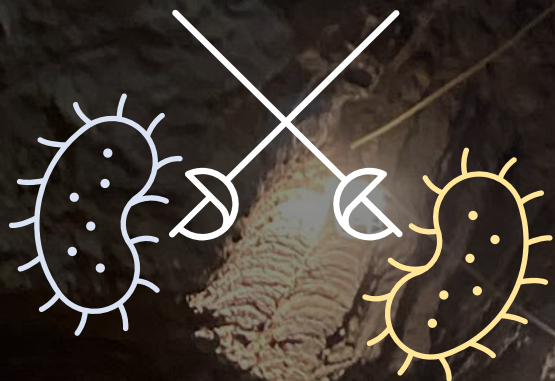
Stacey Doherty

>100 permafrost samples with
shotgun metagenomics data



Ernakovich et al. 2022. Global Change Biology.
Doherty et al., 2020. Frontiers in Microbiology.

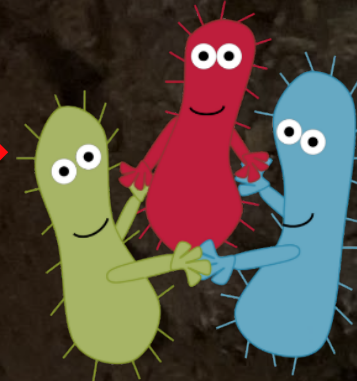




Under frozen conditions, metabolites associated with antagonism

FROZEN

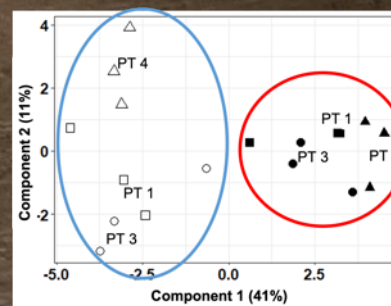
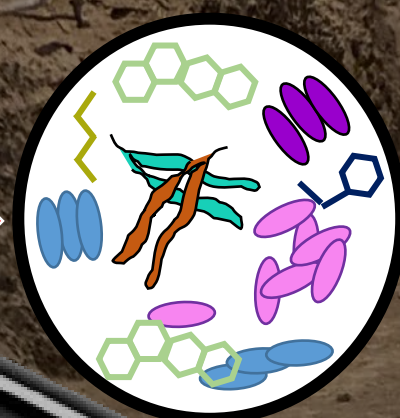
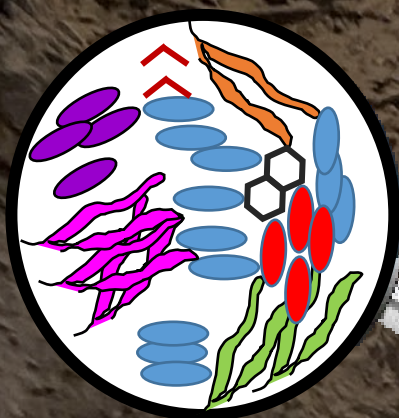
THAWED



Under thawed conditions, metabolites associated with growth and cooperation



Dr. Komi Messan

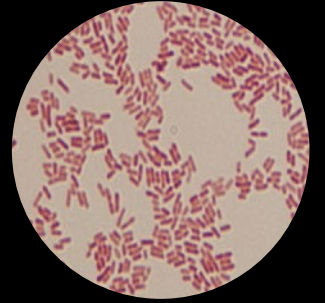
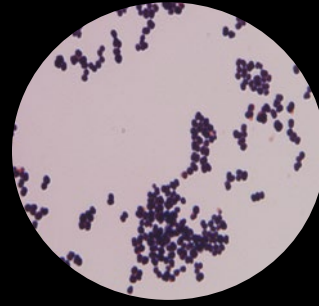


ESI +



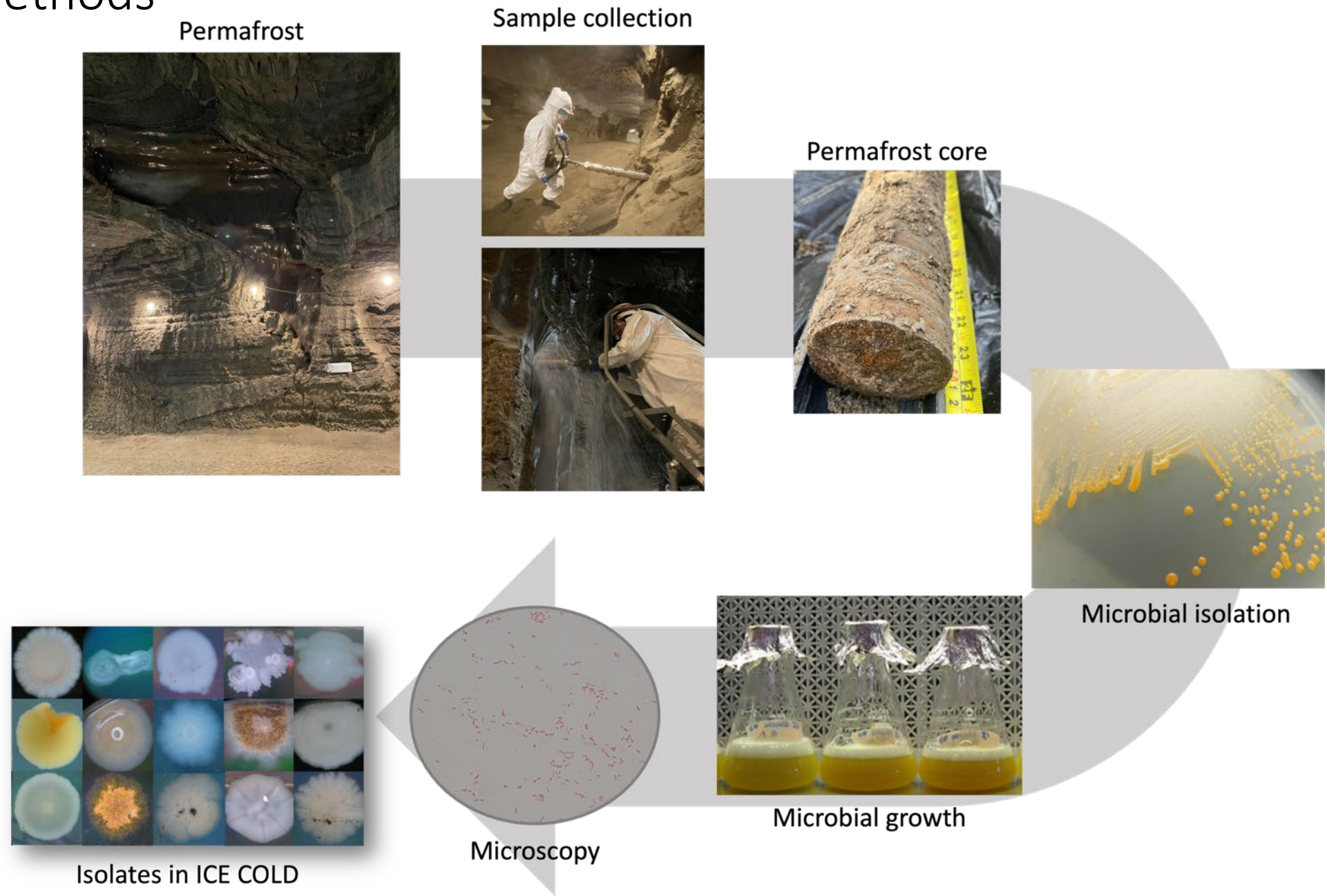
Messan et al. 2020. PloS ONE.





*Isolates surviving in
terrestrial ice and
permafrost*

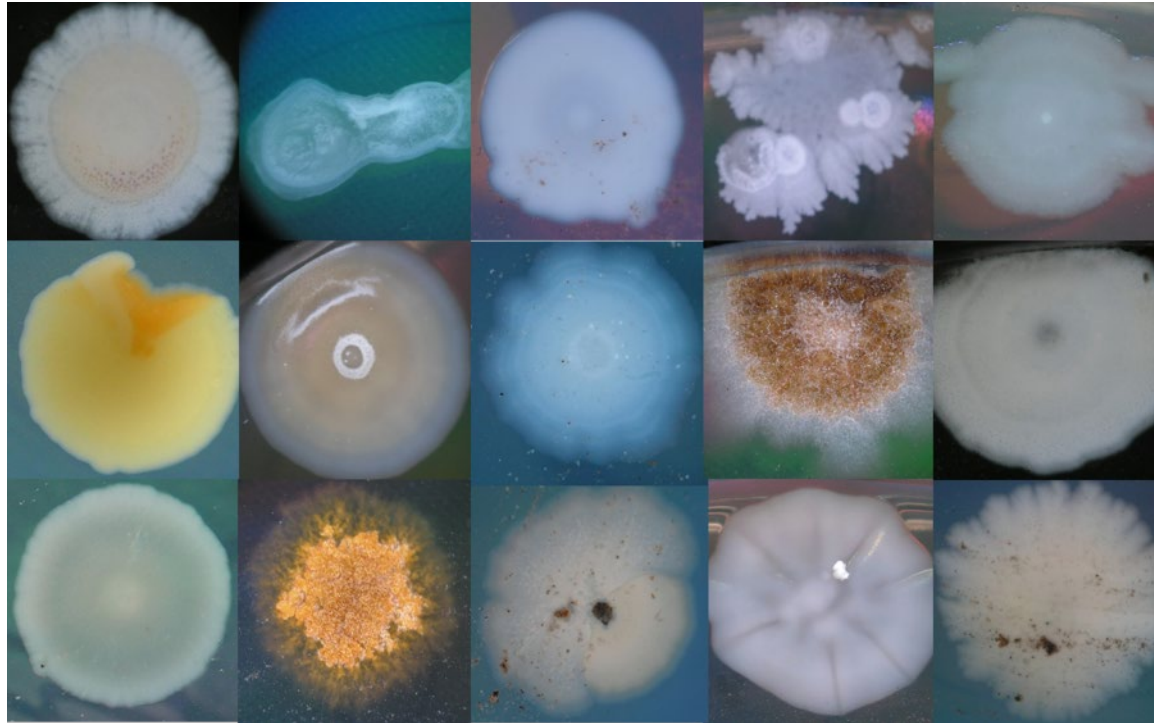
Isolation Methods



Cold Regions Microbiology

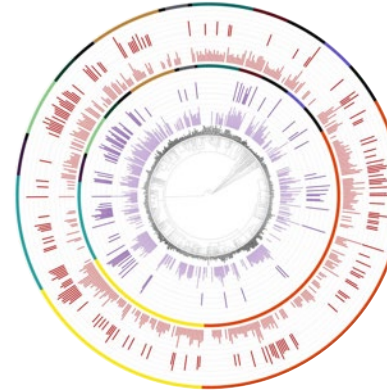
POC: Dr. Robyn Barbato
CRREL Soil Microbiology

Innovative, Collaborative, Exploratory
Cold regions Organism Library for Discovery



Characterizing isolates collected from cold regions

CRREL ICE COLD Psychrophile Library



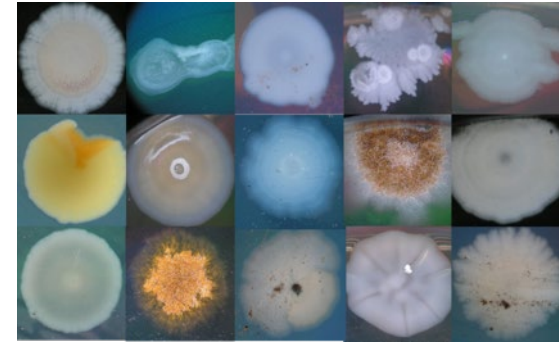
Genetic Characterization



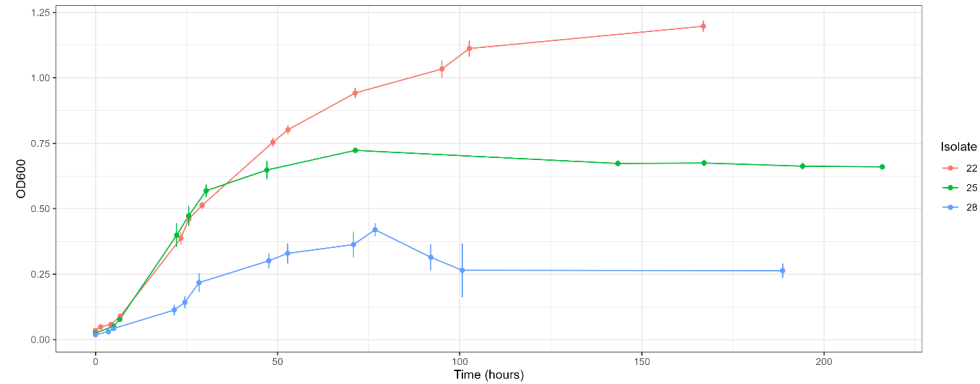
*Functional
Characterization*



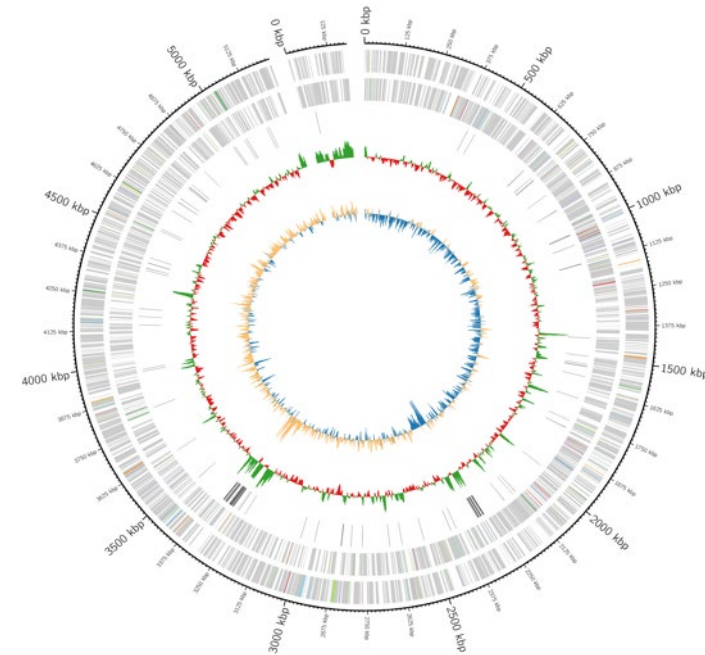
Detailed isolate characterization



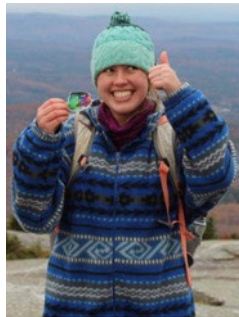
Growth Curves



Assembled Genomes



Dr. Quincy Faber



Gail Shepherd



Dr. Jaimie West

Summary

- Permafrost, snow, and ice microbiomes are active at sub-zero temperatures
- Low temperature, low biomass environments harbor unique microbial communities
- Metagenomics enables the characterization of microbial taxonomy and potential function, but does not elucidate the active microorganisms
- Culturing enables a deeper, more controlled characterization of the microorganisms; however, the microorganisms have been removed from their habitat





Thank you! Questions?

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Dr. Amanda Barker
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Photo by Dr. Amanda Barker