

Permafrost degradation:

When we thought that things could not go worst

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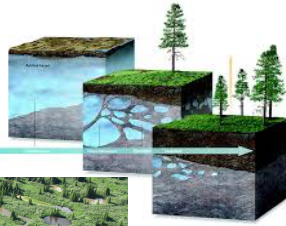

1

Permafrost thaw



2

Changes in Landscape



95% less permafrost
325% more trees

3

Formation of thaw lakes

Continuous permafrost

a Initial stage (pre-thawing)

b Thermokarst lake inception (ice-rich permafrost thawing)

c

d Mature stage (maximum lake depth)





Discontinuous permafrost

e

f

g

h impermeable soil (silt/clay)



Legend:
Lake water (blue)
Unfrozen ground (tan)
Ice-rich permafrost (grey)
Ice wedge (white triangle)
Ice lenses (white horizontal lines)

4

Carbon pool in Arctic permafrost soils

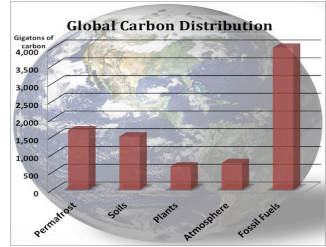
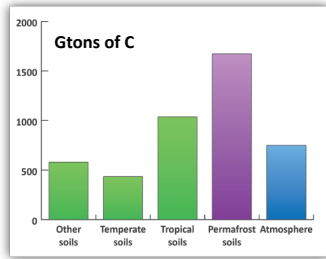
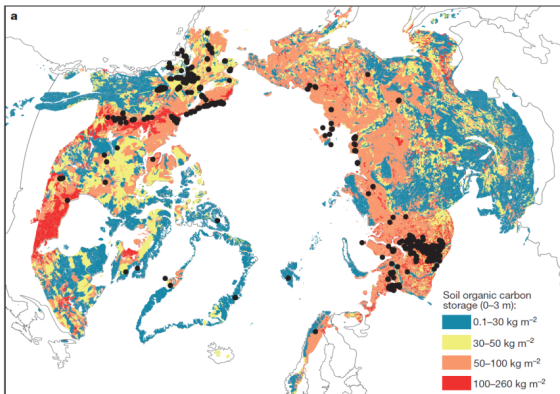
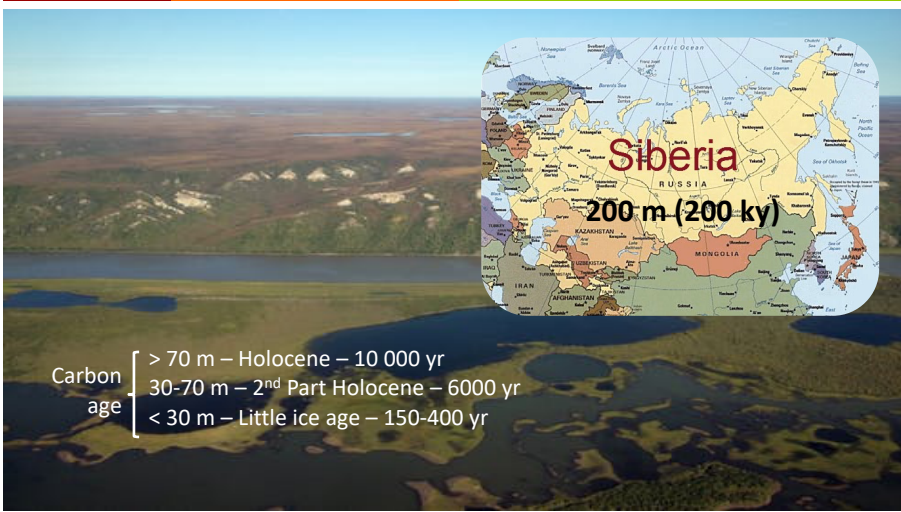


Figure 1 | Soil organic carbon maps. a. Soil organic carbon pool (kg Cm⁻²) contained in the 0-3 m depth interval of the northern circumpolar permafrost zone²⁷. Points show field site locations for 0-3 m depth carbon inventory measurements; field sites with 1 m carbon inventory measurements number in the thousands and are too numerous to show. b. Deep permafrost carbon pools (>3 m), including the location of major permafrost-affected river deltas (green triangles), the extent of the yedoma region previously used to estimate the carbon content of these deposits³¹ (yellow), the current extent of yedoma region soils largely unaffected by thaw-lake cycles that alter the original carbon content³² (red), and the extent of thick sediments overlying bedrock (black hashol). Yedoma regions are generally also thick sediments. The base map layer shows permafrost distribution with continuous regions to the north having permafrost everywhere (>99%), and discontinuous regions further south having permafrost in some, but not all, locations (<90%)³⁶.

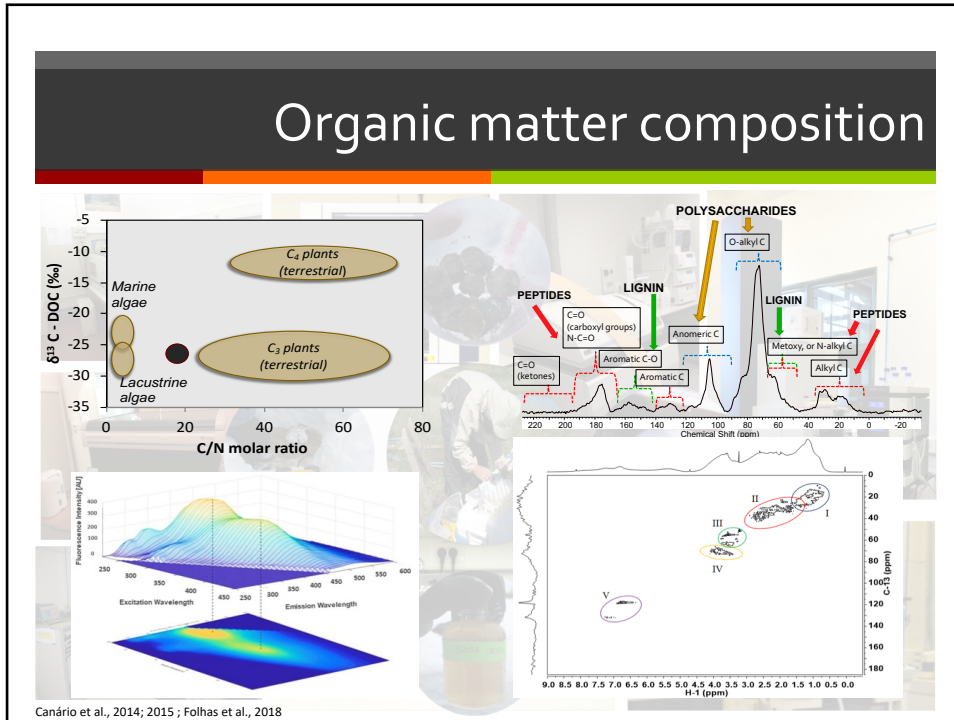
Schuur et al 2015

5

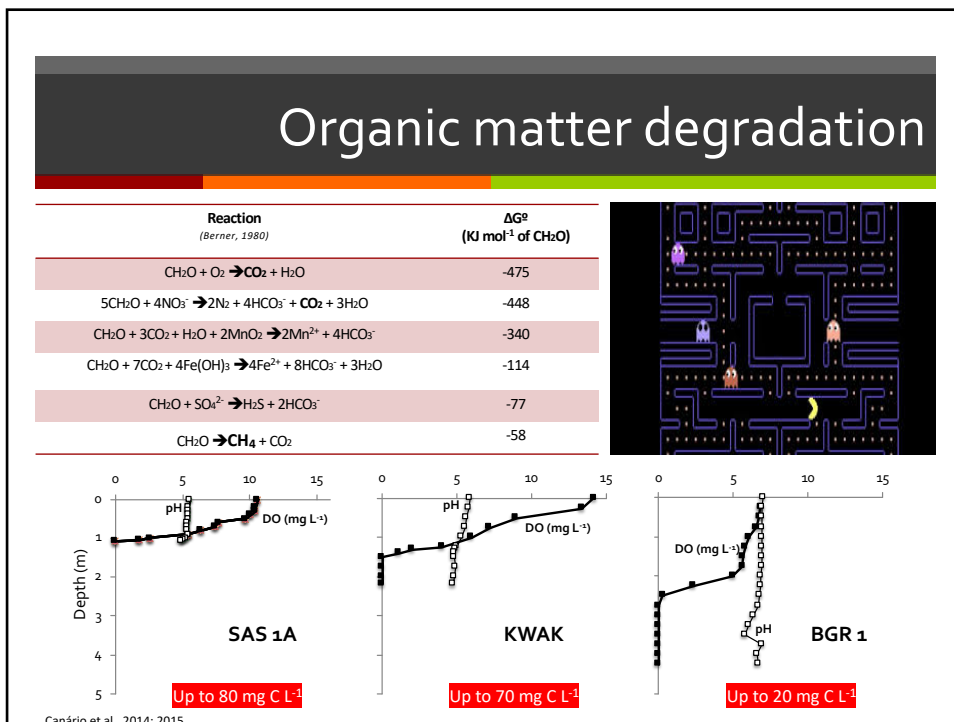
Carbon age



6



7



8

Carbon feedback

**11 mg CH₄ m⁻² h⁻¹
(0.02 mg nearby river)**

The impact of the permafrost carbon feedback on global climate
Kevin Schwmer¹, Hugues Lantieri^{2,3}, Vladimir E. Romanovsky⁴, Edward A. G. Schuur⁵ and Renato Witt⁶

Gabielle Walker, 2007. Nature 442:718-721; Pilote et al., 2016

9

Permafrost thaw the new climate bomb ?

ARCTIC PORTAL THE ARCTIC GATEWAY

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The Climate Bomb Lurking Under Arctic Permafrost

Details

Published: 03 July 2017

New research aims to better understand how much methane – a potent greenhouse gas – is bubbling to the surface of the Mackenzie Valley in Canada's Northwest Territories as the permafrost thaws.

Hidden beneath the frozen ground of the Arctic could be a ticking time bomb. Vast reservoirs of methane – a greenhouse gas 30 times more potent than carbon dioxide – lie beneath the permafrost, and as global temperatures rise and the permafrost thaws, it could heat up and speed up the pace of climate change in an ever-tighter vicious circle.

A team of researchers from Germany spent two years measuring the release of methane from the Mackenzie River Delta in northern Canada. They were trying to figure out how much of the gas was the normal "biogenic" emissions produced each summer by decomposing organic matter in Arctic wetlands, and how much is coming from ancient underground "geologic" sources leaking through gaps in the permafrost year-round.

The scientists used aircraft to collect and analyze air samples in a survey of 10,000 square kilometers (4,000 square miles) of the delta and found that the area produces about 20,000 tons

KATE TYDGER SCIENCE 03.15.19 09:00 AM

THE ARCTIC'S 'CARBON BOMB' COULD SCREW THE CLIMATE EVEN MORE

RETROPOD A DAILY PODCAST FOR HISTORY LOVERS

Climate and Environment

The Arctic's carbon bomb might be even more potent than we thought

POLAR TREC About Virtual Base Camp PolarConnect For Educators

11 May 2019 Frozen Fuel of Climate Change

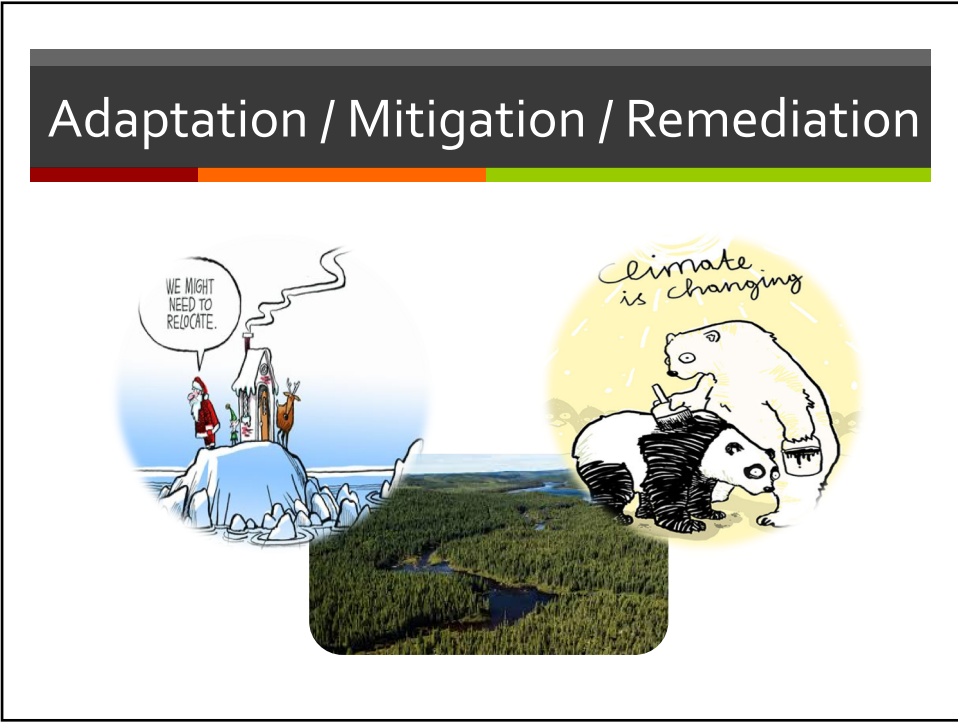
Virtual Base Camp / Carbon in the Arctic

Journal

Frozen Fuel of Climate Change

Austin, Texas
May 11, 2019

10



11

But carbon is not the only threat

Climate and Environment

The Arctic is full of toxic mercury, and climate change is going to release it






As melting permafrost releases mercury, some will make it into the food chain—and into animals such as these Alaskan caribou.

PHOTOGRAPH BY JOEL SARTORE, NAT GEO IMAGE COLLECTION

AGU PUBLICATIONS

Geophysical Research Letters

RESEARCH LETTER **Permafrost Stores a Globally Significant Amount of Mercury**

10.1002/2017JGLO75371

Key Points:

- Permafrost stores a significant amount of mercury
- Permafrost degradation could lead to a future increase in atmospheric mercury, the most widespread environmental contaminant
- Thawing permafrost is a significant source of mercury to the atmosphere

Supporting Information:

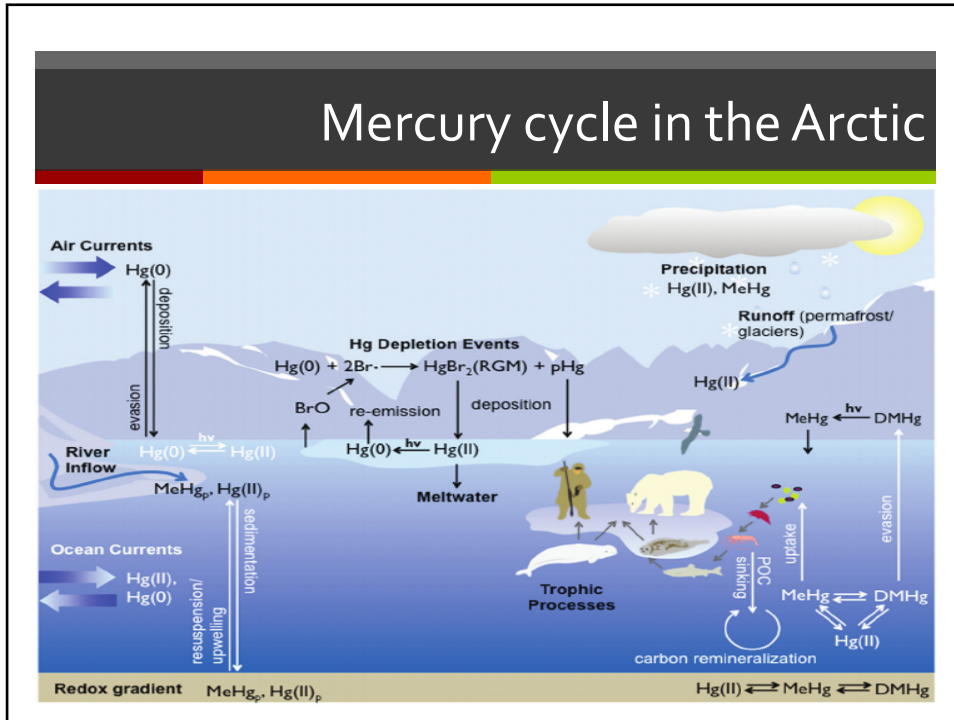
- Supporting Information S1
- Table S1-2

Correspondence to:

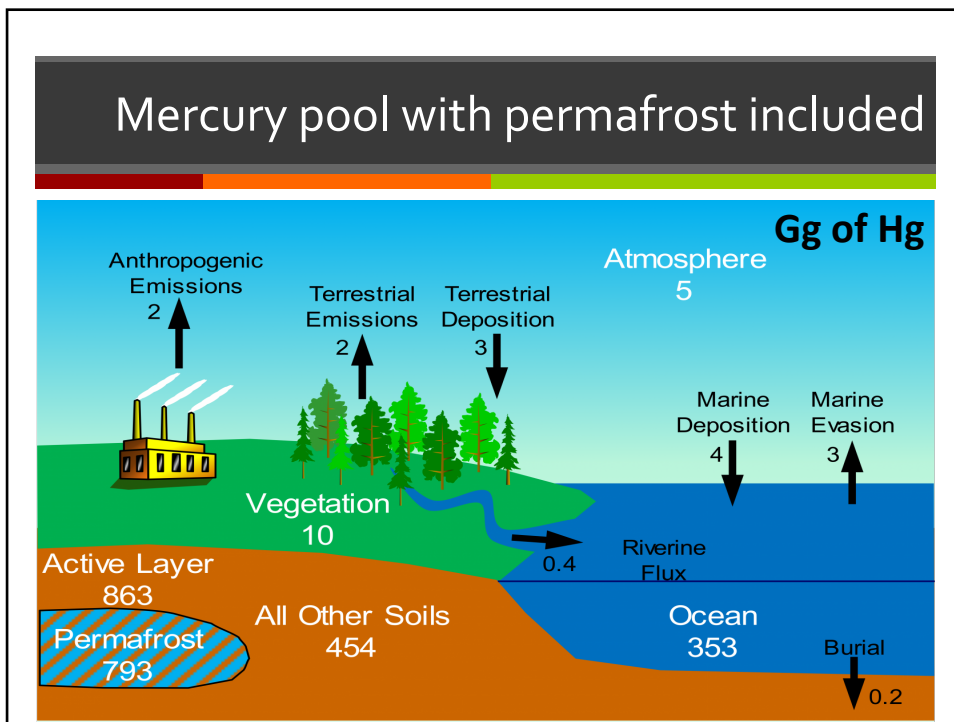
Paul F. Schuster¹, Kevin M. Schaefer², George R. Aiken³, Ronald C. Antweiler⁴, John F. Dewalle⁵, Joshua D. Griggs⁶, Alessio Giannone⁷, Gustaf Högström⁸, Edoardo Jafarov⁹, David P. Krabbenhoft¹⁰, Lin Lin¹¹, Nicole Horsman-Mercer¹², Carol Mui¹³, David A. Roth¹⁴, Tim Schaefer¹⁵, Robert C. Strang¹⁶, Kimberly P. Wickland¹⁷, and Tingting Zhang¹⁸

¹U.S. Geological Survey, National Research Program, Boulder, CO, USA; ²National Snow and Ice Data Center, Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder, Boulder, CO, USA; ³Department of Geological Sciences, Princeton University, Princeton, NJ, USA; ⁴Environmental Sciences Laboratory, University of Colorado Boulder, Boulder, CO, USA; ⁵Department of Geological Engineering and Science, Norwegian University of Science and Technology, Trondheim, Norway; ⁶Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ⁷Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ⁸Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ⁹Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ¹⁰Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ¹¹Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ¹²Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ¹³Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ¹⁴Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ¹⁵Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ¹⁶Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ¹⁷Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA; ¹⁸Department of Earth and Atmospheric Sciences, University of Colorado Boulder, Boulder, CO, USA

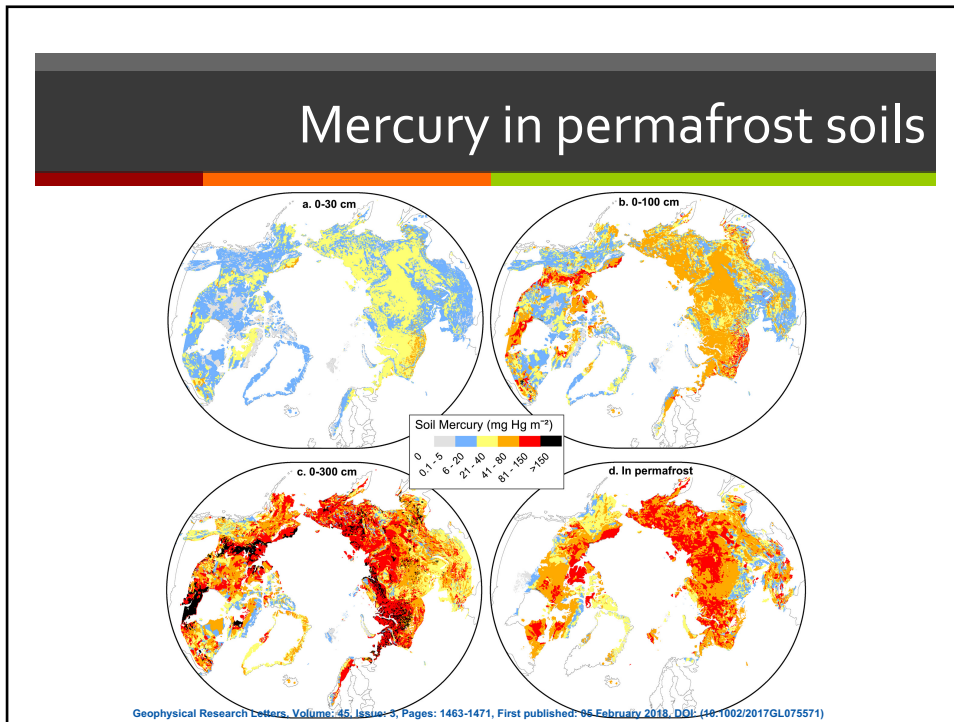
12



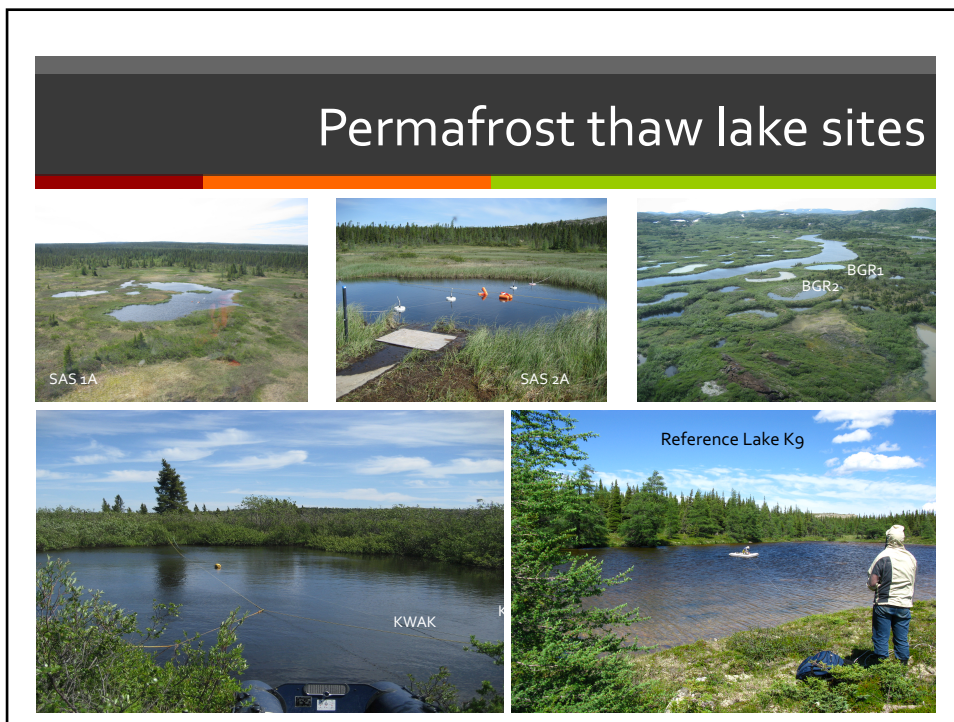
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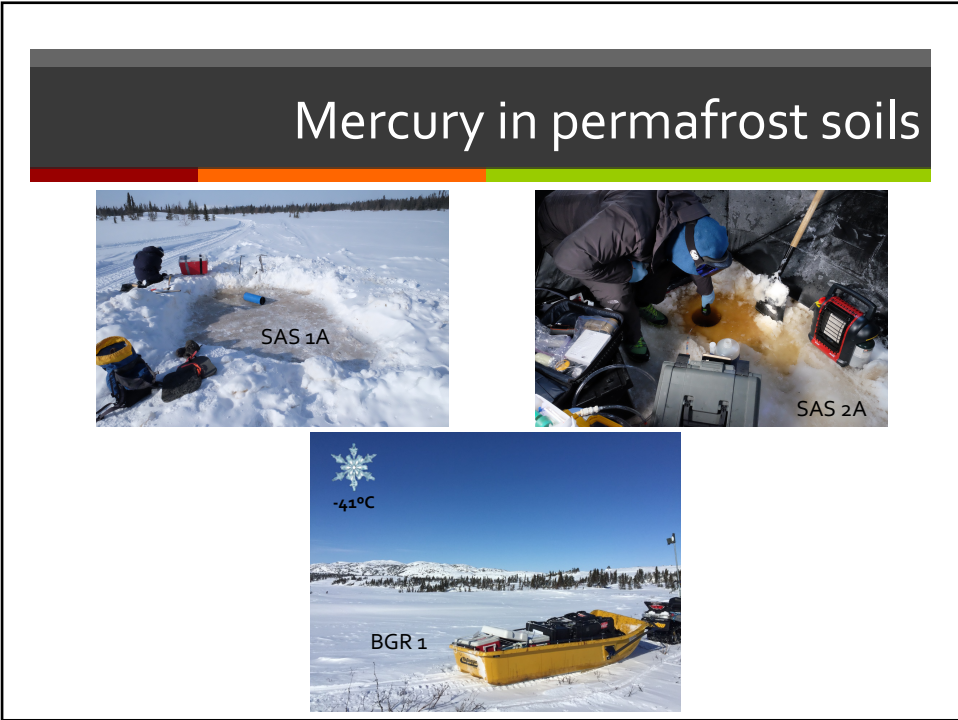
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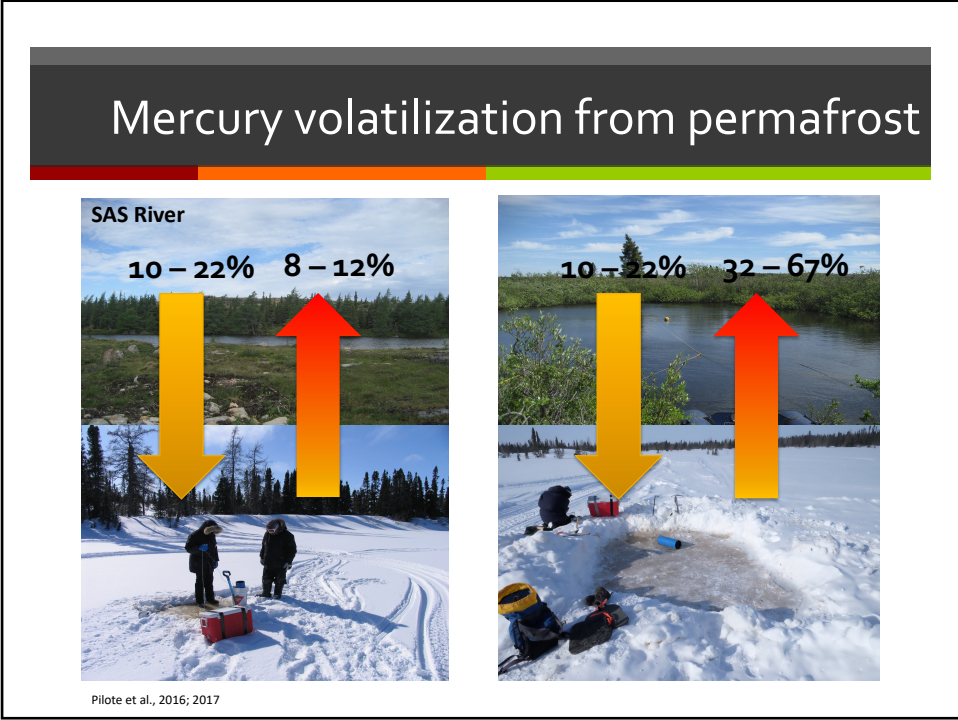
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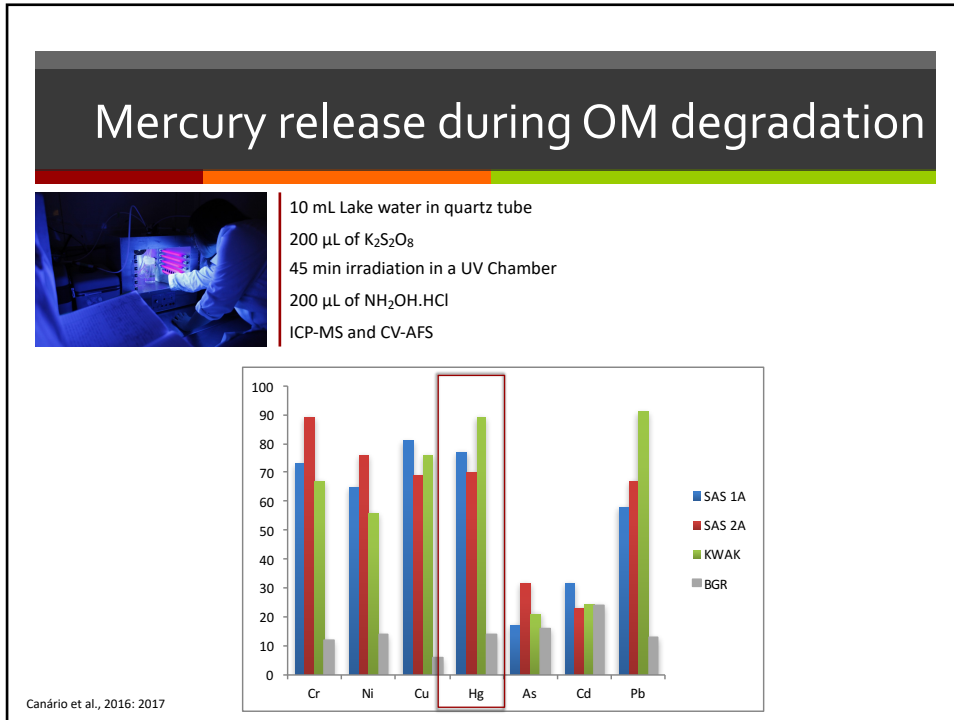
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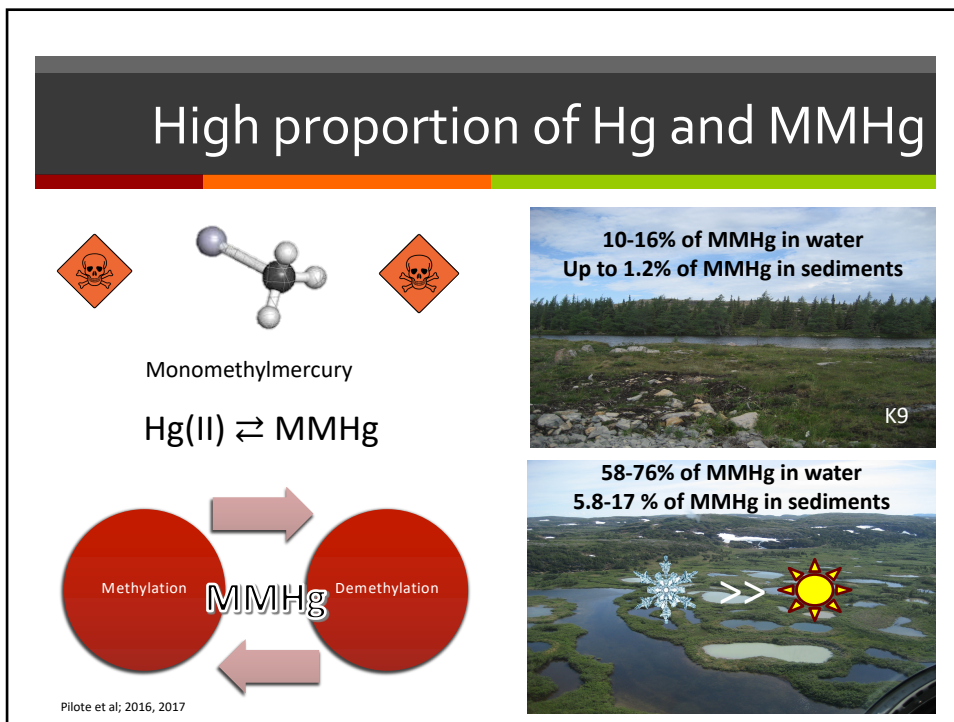
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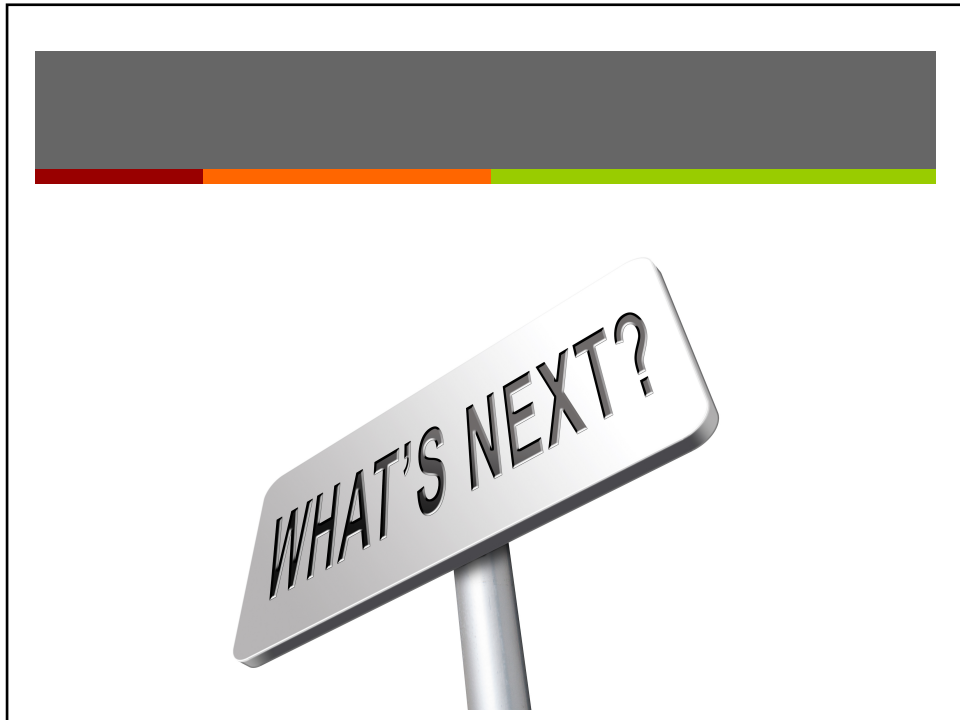
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19

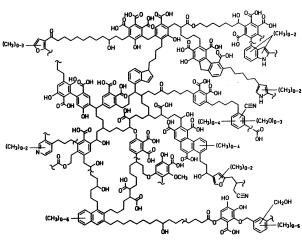


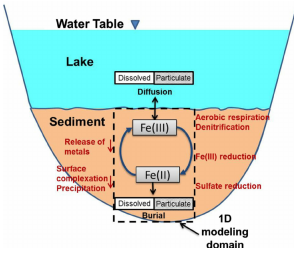
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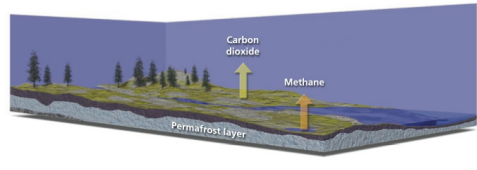
21


What's next: NOM characterization











22

What's next: Hg methylation and fate

Monomethylmercury

Methylation MMHg Demethylation

Rates

Mechanisms

Microbes

biotic

abiotic

23

What's next: Fluxes

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ARCTIC FOOD WEB

24

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Terrestrial Multidisciplinary distributed Observatories for the Study of Arctic Connections

<http://www.t-mosaic.com>

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25

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Arctic Science Summit Week 2021

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26

13


Acknowledgements



The slide features a dark grey header with the word "Acknowledgements" in white. Below the header is a horizontal bar with red, orange, and green segments. The main content area contains eight logos arranged in two rows. The top row includes CQE (Química Estrutural), Técnico Lisboa, Environment and Climate Change Canada (with a Canadian flag), and PROPOLAR (Programa Nacional de Apoio à Investigação Científica e Tecnológica). The bottom row includes Universidade de Aveiro, Université Laval, IGOT (Instituto de Geografia e Ordenamento do Território, Universidade de Lisboa), and FCT (Fundação para a Ciência e a Tecnologia, Ministério da Ciência, Tecnologia e Ensino Superior).

27

Thank's a lot for your attention !!



The slide features a dark grey header with the text "Thank's a lot for your attention !!". Below the header is a horizontal bar with red, orange, and green segments. The main content area is a collage of six images: the aurora borealis in a snowy landscape, a person in a full snow suit standing on a beach at sunset, a large glacier meeting the water, a polar bear standing on snow, a seal resting on a rocky shore, and a tundra landscape with a stream and patches of snow.

28