The sensitivity of carbon in Arctic permafrost soils to climate change

Mats P. Björkman¹, Pascal Boeckx², Janet Rethemeyer³, Frida Lindwall^{4,5}, Bo Elberling⁵ and Robert G. Björk¹

¹Dep. of Earth Sciences, University of Gothenburg, Sweden. ²Dep. of Applied Analytical and Physical Chemistry, Ghent University, Belgium. ³Inst. of Geology and Mineralogy, University of Cologne, Germany. ⁴Dep. of Biology, University of Copenhagen, Denmark. ⁵Center of permafrost (CENPERM), University of Copenhagen, Denmark.



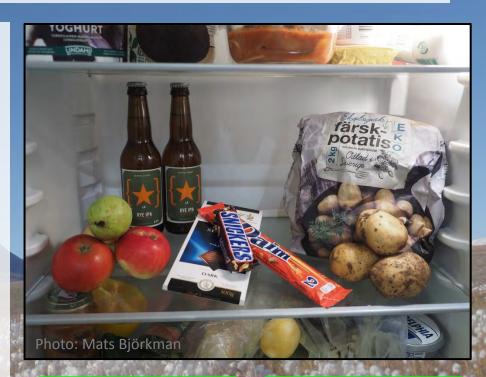






What we are interested in

- Easy / hard to eat?
- How well packed is the food?
- Expiry date?
- Who's eating?
- Who's eating what?
- How much faster will they eat?





150°W 180° 150°E 60° N 90° E 90° W **Adventdalen** (Svalbard) **Zackenberg** Soil Organic Carbon content (Greenland) $0-10 \text{ kg m}^{-2}$ 10-25 kg m⁻² 25-50 kg·m⁻² 60° N (Hugelius et al. 2012) 50-100 kg m⁻² 30°W 30°E

Heath



Meadow



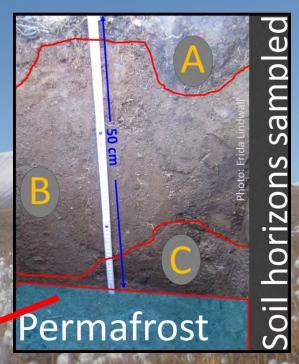






,5°C





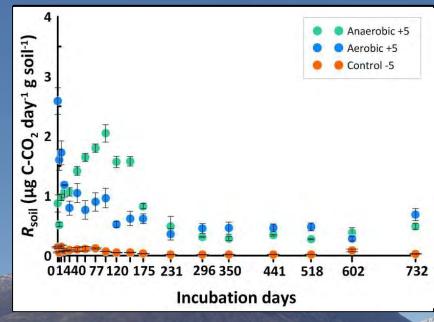
How much faster will they eat?

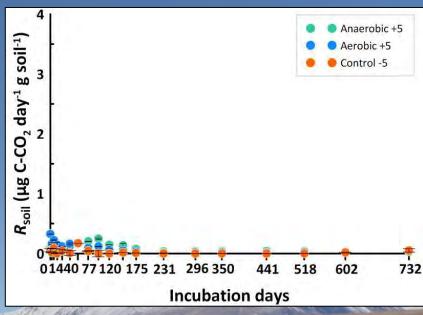


Adventdalen A Horizon

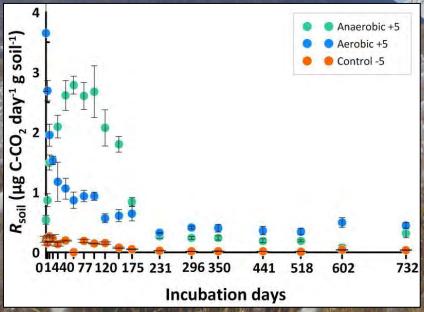
C Horizon

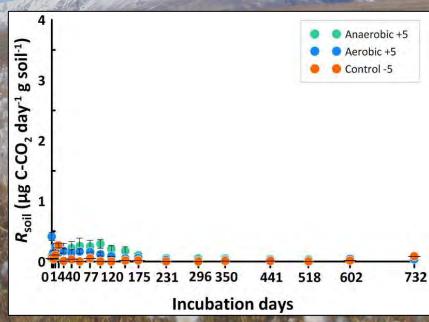








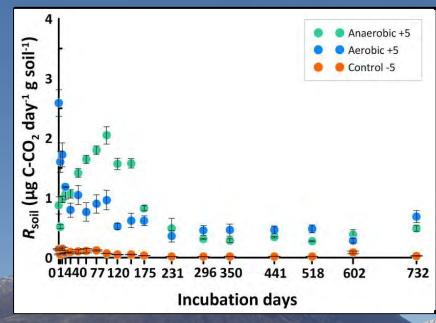


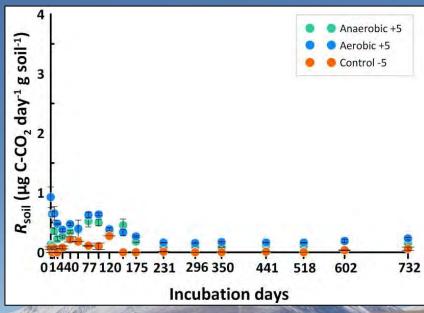


Adventdalen A Horizon

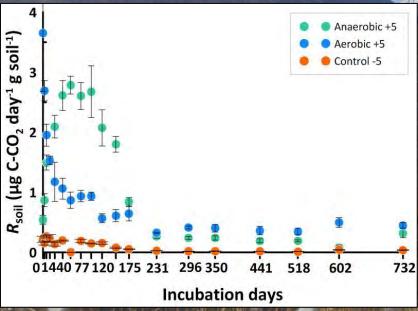
Permafrost

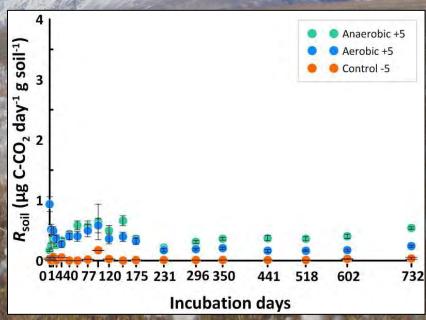








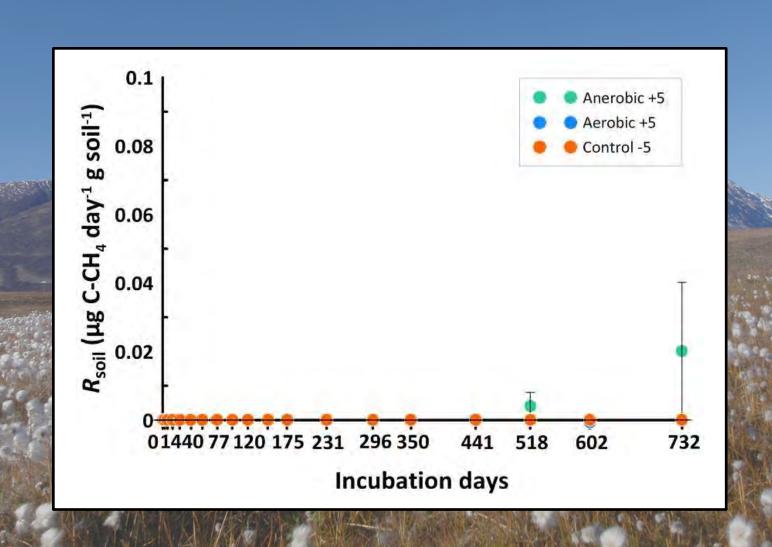




Adventdalen A Horizon C Horizon 600 600 Cumulative R (µg C-CO₂ g soil⁻¹) Cumulative R (µg C-CO₂ g soil⁻¹) Anaerobic + 5 Anaerobic + 5 Aerobic +5 Aerobic +5 Control -5 Control -5 400 400 Heath 200 200 01440 77 120 175 231 296 350 441 518 602 732 01440 77 120 175 231 296 350 441 518 602 732 **Incubation days Incubation days** 600 600 Cumulative R (µg C-CO₂ g soil⁻¹) Cumulative R (µg C-CO₂ g soil⁻¹) Anaerobic + 5 Anaerobic + 5 Aerobic +5 Aerobic +5 Control -5 Control -5 400 400 Meadow 200 200 0 11111111 01440 77 120 175 231 296 350 441 518 602 732 01440 77 120 175 231 296 350 602 518 732 441 **Incubation days Incubation days**

Adventdalen A Horizon **Permafrost** 600 600 Cumulative R (µg C-CO₂ g soil⁻¹) Cumulative R (µg C-CO₂ g soil⁻¹) Anaerobic + 5 Anaerobic + 5 Aerobic +5 Aerobic +5 Control -5 Control -5 400 400 Heath 200 200 01440 77 120 175 231 296 350 441 518 602 732 296 350 01440 77 120 175 231 441 518 602 732 **Incubation days Incubation days** 600 600 Cumulative R (µg C-CO₂ g soil⁻¹) Cumulative R (µg C-CO₂ g soil⁻¹) Anaerobic + 5 Anaerobic + 5 Aerobic +5 Aerobic +5 Control -5 Control -5 400 400 Meadow 200 200 01440 77 120 175 231 296 350 01440 77 120 175 231 296 350 441 518 602 732 441 518 602 732 **Incubation days Incubation days**

What about CH₄



Expiry date?



Heath Meadow **Day 602** A Aerobe A Aerobe A Anaerobe A Anaerobe A Control A Control C Aerobe C Aerobe **Day 35** C Anaerobe C Anaerobe C Control C Control P Aerobe P Aerobe P Anaerobe P Anaerobe P Control P Control -2000 0 2000 4000 6000 8000 10000 -2000 -1000 0 1000 2000 3000 4000 5000 ¹⁴C Age ¹⁴C Age modern Permafrost 0 1000 2000 3000 4000 5000 6000 5000 10000 15000 20000 25000 30000 ¹⁴C Age ¹⁴C Age

Summary

They will eat faster in the future, but no real difference between aerobic and anaerobic

Expiry date?

- They eat younger C than the bulk C age.
- But, is bulk C age actually relevant for the C that can be eaten?

Methane consumption?

