Permafrost Thawing at High Latitudes and its Affect on the Carbon Cycle

Jeff Chanton,
Department of Earth, Ocean and Atmospheric Science, Florida State University
Temp increases at 20m depth in Alaskan permafrost soils

HINZMAN et al, 2005, Climate Change, 72: 251–298
Schuur et al. 2008 Bioscience 58, estimate

- 1672 gigatons of C in permafrost worldwide of which 277 gigatons is in peatlands
- 455 gigatons of C in boreal and sub-arctic peatlands (Gorham, 1991, Ec. App. 1, 182.)
The Pleistocene, last Glacial Maximum

No glaciers

Mammoth steppe ecosystem.

In the Pleistocene, NE Siberia remained relatively un-glaciated with vast dust-covered plains. Mammoth steppe ecosystem.

The ground froze, contracted, and cracked each winter. In spring, water penetrated and froze creating networks of ice wedges.

Over time, due to the accumulation of dust, river silt, and ice, Siberia became covered with a thick sedimentary mantle of frozen loess. These frozen sediments are filled with rootlets of grasses. LABILE!
Permafrost Decomposition

- Ice
- Pleistocene Age organic matter
Thermokarst lakes
Katey Walter

10-20 m drop in landscape, with ice thaw.
Field sites, 100 km N of High Level

NWT, 60° N

Edmonton

Alberta, Canada

Peoples Republic of Canada
Collapse Scars with Moats in Discontinuous Permafrost Region

No ice wedges
Peat soil
Relief upon subsidence
1 m 10 x LESS
Question is, when this wad of old organic matter falls into the moat, does influence the age of the respiration products?
Permafrost decomposition in Alberta
Moat edge

Stable edge
$^{14}$C in DIC and CH$_4$ are identical. Chanton et al. 2008 GBC
Is there Old Carbon in the respiration products of the MOAT??
Not observed, old carbon respiration overshadowed by respiration of surface Carbon
Respiration products shifted to older, but still dominated by surface production
You saw earlier that primary production was the lowest at these sites, so surface production no longer masks the respiration of old carbon.
In conclusion

• Permafrost Decomposition stimulates methane emission but in different ways.
  • In Siberia, by decomposition of old OM.
  • In Alberta, mostly by providing habitat for vascular plant colonization.
  • In Sweden, we are just getting started.

Thank you for your attention