WeThaw: Mineral Weathering in Thawing Permafrost

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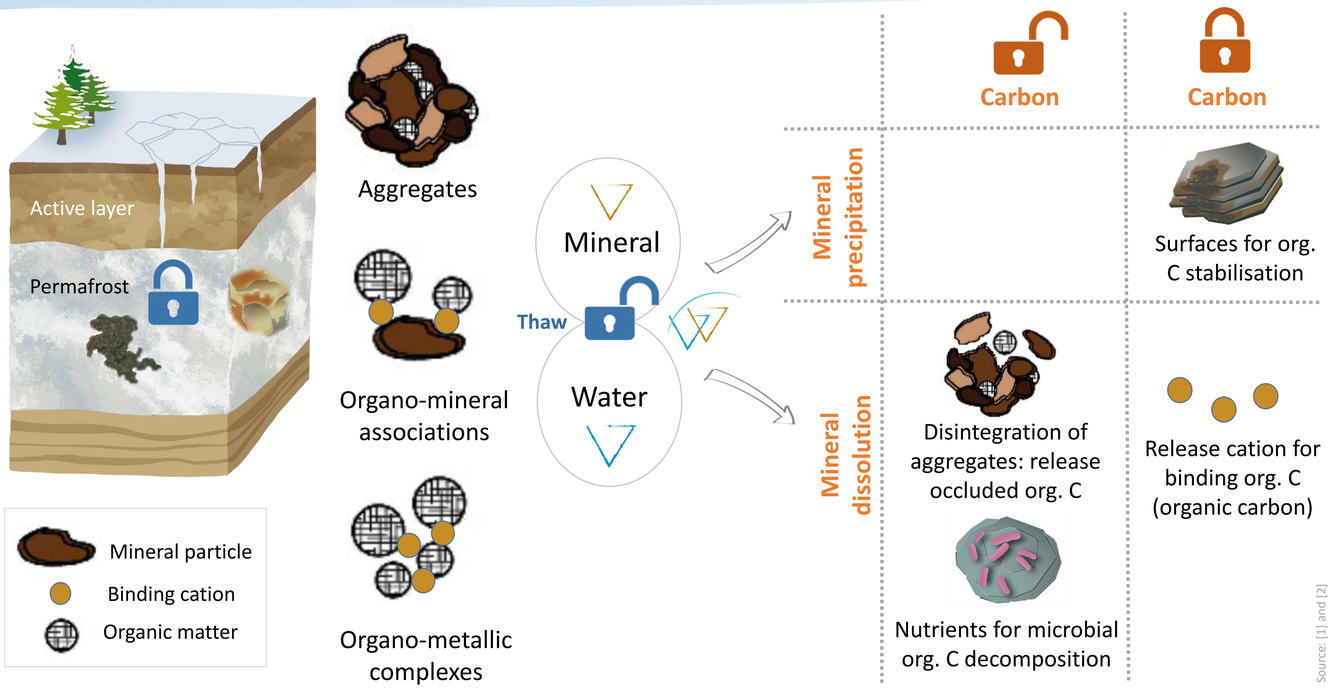
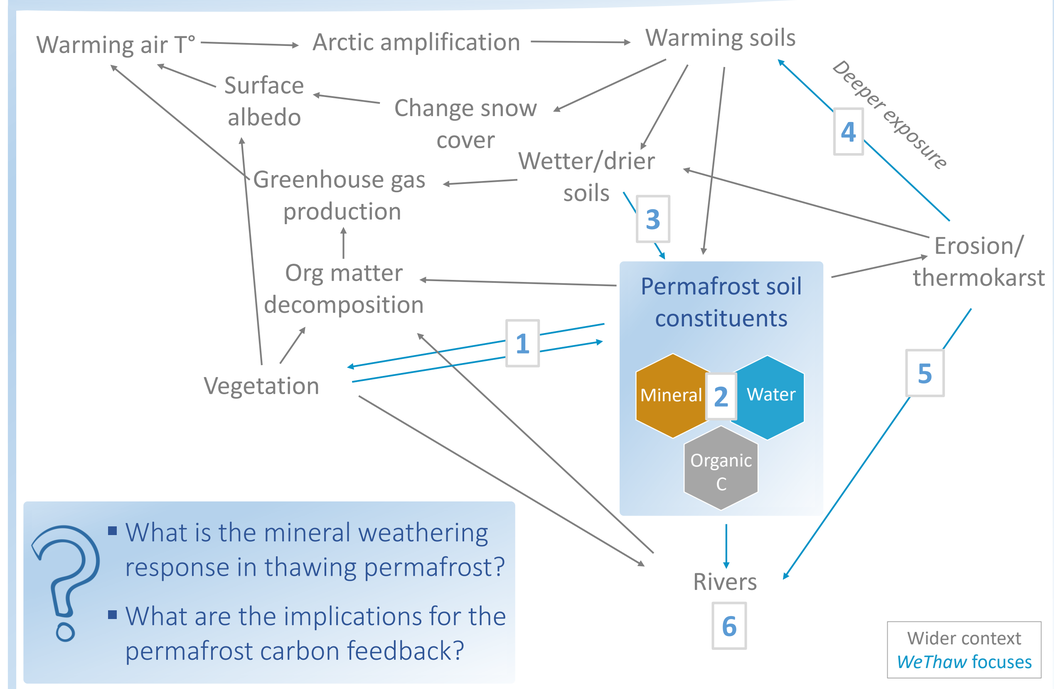
Permafrost thaws unlocking mineral elements bound to carbon



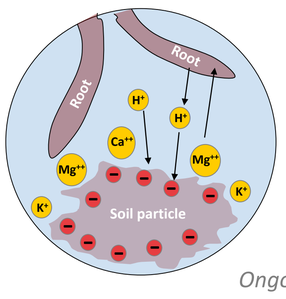
The six focuses of the *WeThaw* project in a wider context



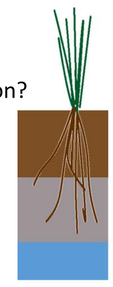
- What is the mineral weathering response in thawing permafrost?
- What are the implications for the permafrost carbon feedback?

GRADUAL THAW

1 Soil to plant element transfer



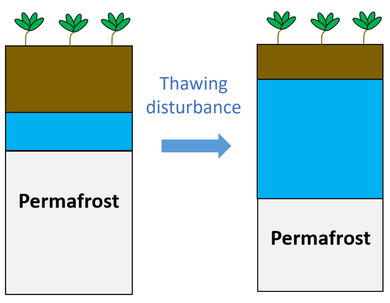
- Is there a change in mineral nutrient uptake by vegetation?
- Implications for litter composition?



Nutrients from deeper soil horizons?

Ongoing PhD thesis of E. Mauclet

2 Solid-water interactions in soils

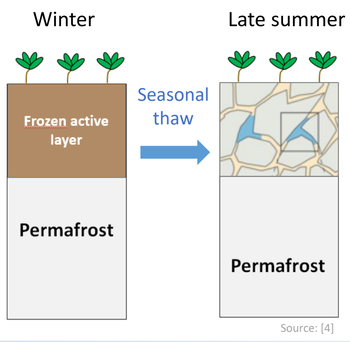


- Soil warming experiment : mineral element distribution in soils?

See poster by Mauclet et al.

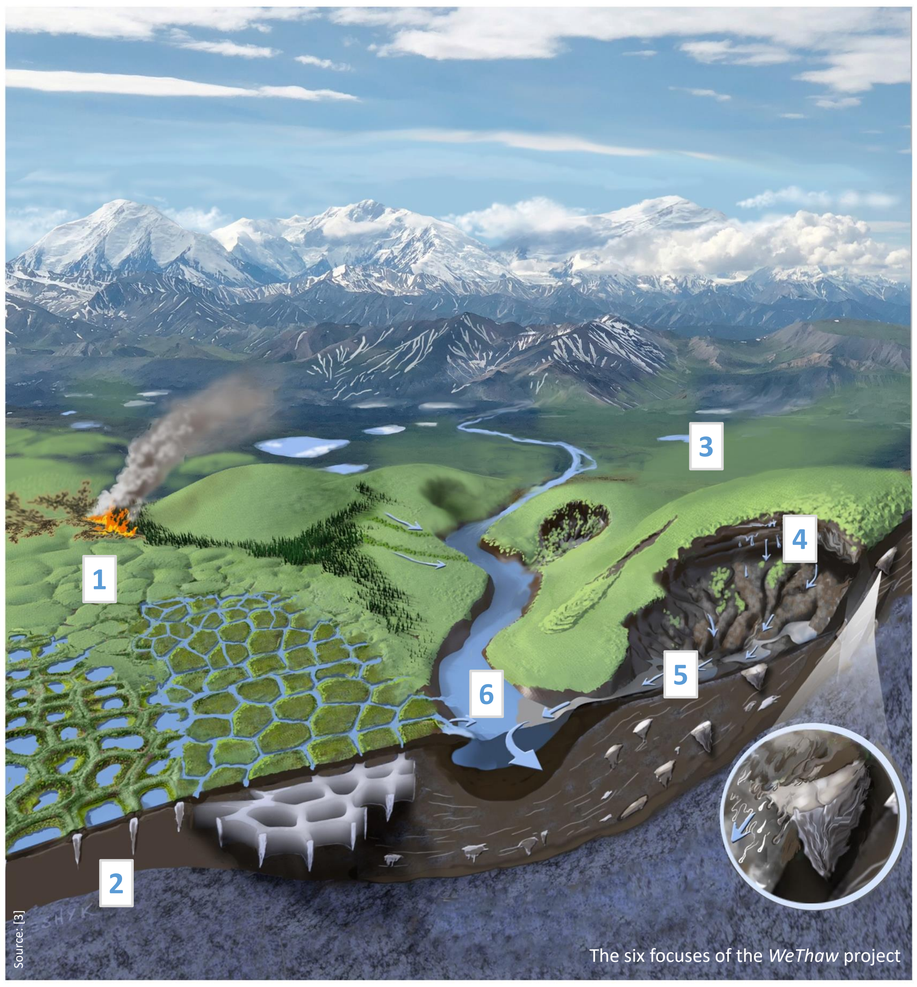
- Natural thaw : impact of wet/dry conditions for Fe?

Ongoing PhD thesis of A. Monhonval



- Dissolved and colloidal mineral element export from soils?
- Implications for C-storage and C-export from soils?

Ongoing postdoctoral research of C. Hirst



6 Riverine element export

Gradual thaw

- Dissolved and suspended mineral element export

Abrupt thaw

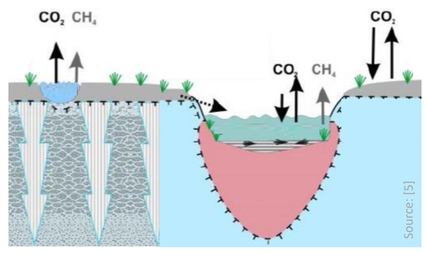
Ongoing postdoctoral research of C. Hirst

- How can glacial-fed rivers be affected by permafrost weathering? Si isotopes as a proxy

See oral presentation by Hirst et al.

ABRUPT THAW

3 Learning from Holocene thermokarst



- Redox conditions in past thermokarst disturbances?
- Impact on Fe oxides: org. C stabilization and methanogenesis?

See poster by Monhonval et al.

4 Modern thermokarst : effect on carbon storage

One-time *vs.* repeated hillslope processes

- Impact on element release?
- Implication for soil aggregation?

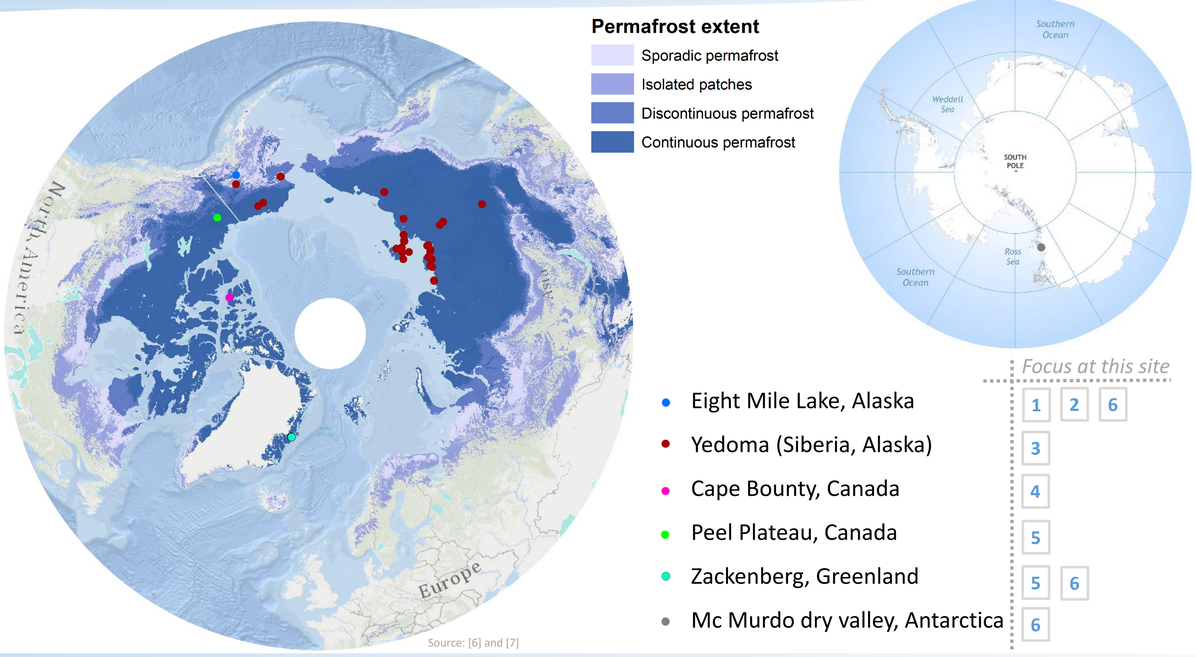
See poster by Thomas et al. (Cape Bounty)

5 Erosion with modern thermokarst

- Origin of sediment eroded to streams?
- Implications for organic carbon transport?

See poster by Thomas et al. (Peel Plateau)

Study sites involved in *WeThaw*

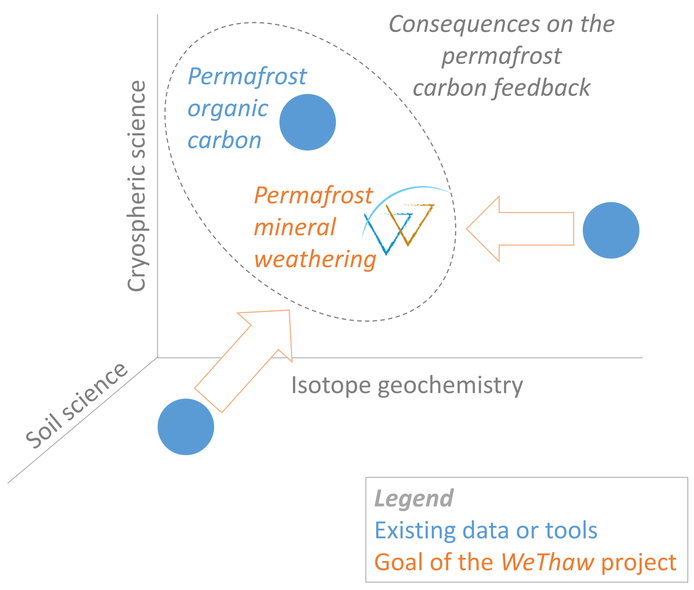


	Focus at this site
Eight Mile Lake, Alaska	1, 2, 6
Yedoma (Siberia, Alaska)	3
Cape Bounty, Canada	4
Peel Plateau, Canada	5
Zackenberg, Greenland	5, 6
Mc Murdo dry valley, Antarctica	6

Upscaling

- Synthesis of the mineral element content in the permafrost
  - *Call for data*: do you want to contribute with total content in Ca, Mg, K, Na, Si, Al, Fe in active layer and permafrost?
- Wet/dry conditions in permafrost regions
  - Do you have monitored sites with time-series measurements of the soil water table depth?

Across disciplinary boundaries



Acknowledgements

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Collaborations

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References

[1] Modified from Rillig et al., 2017, ISMA J. 11, 1943-1948.
[2] Modified from Chorover et al., 2007, Elements 3, 321-326.
[3] Modified from Schuur and Mack, 2018, Annu. Rev. Ecol. Evol. Syst. 49,279-301.
[4] Modified from Jansson & Tas, 2014. *Nat. Rev.Microbiol.* 12, 414-425.
[5] Modified from Strauss et al., 2017, Earth-Science Reviews 172, 75-86.
[6] Base map from Word Ocean Base Esri, Garmin, GEBCO, NOAA NGDC.
[7] Permafrost map from Obu et al., 2019, Earth-Sci. Rev. 193, 299-316.