Kvalita stromového opadu ovlivňuje zásobu uhlíku rozdílně v mladých a vyvinutých půdách

The quality of tree litter affects carbon storage differently in young and mature soils

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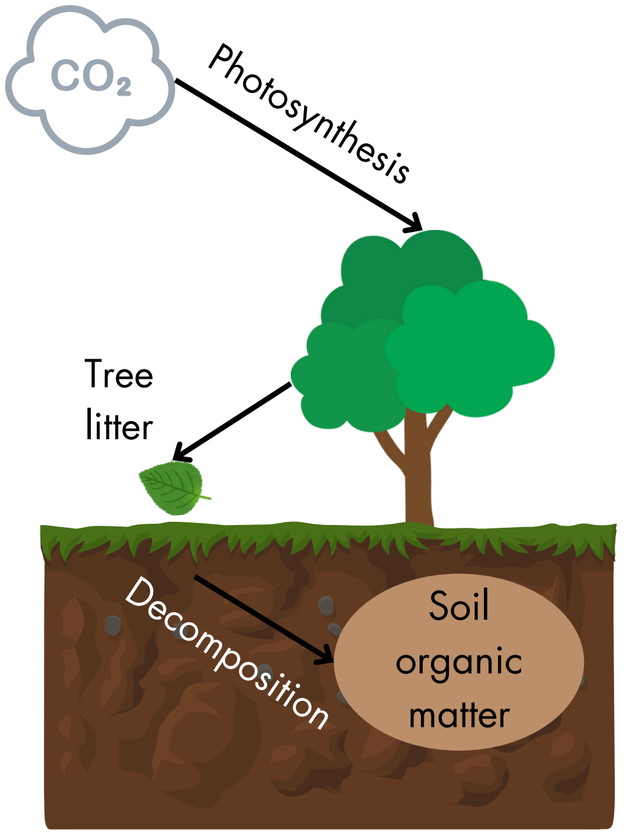
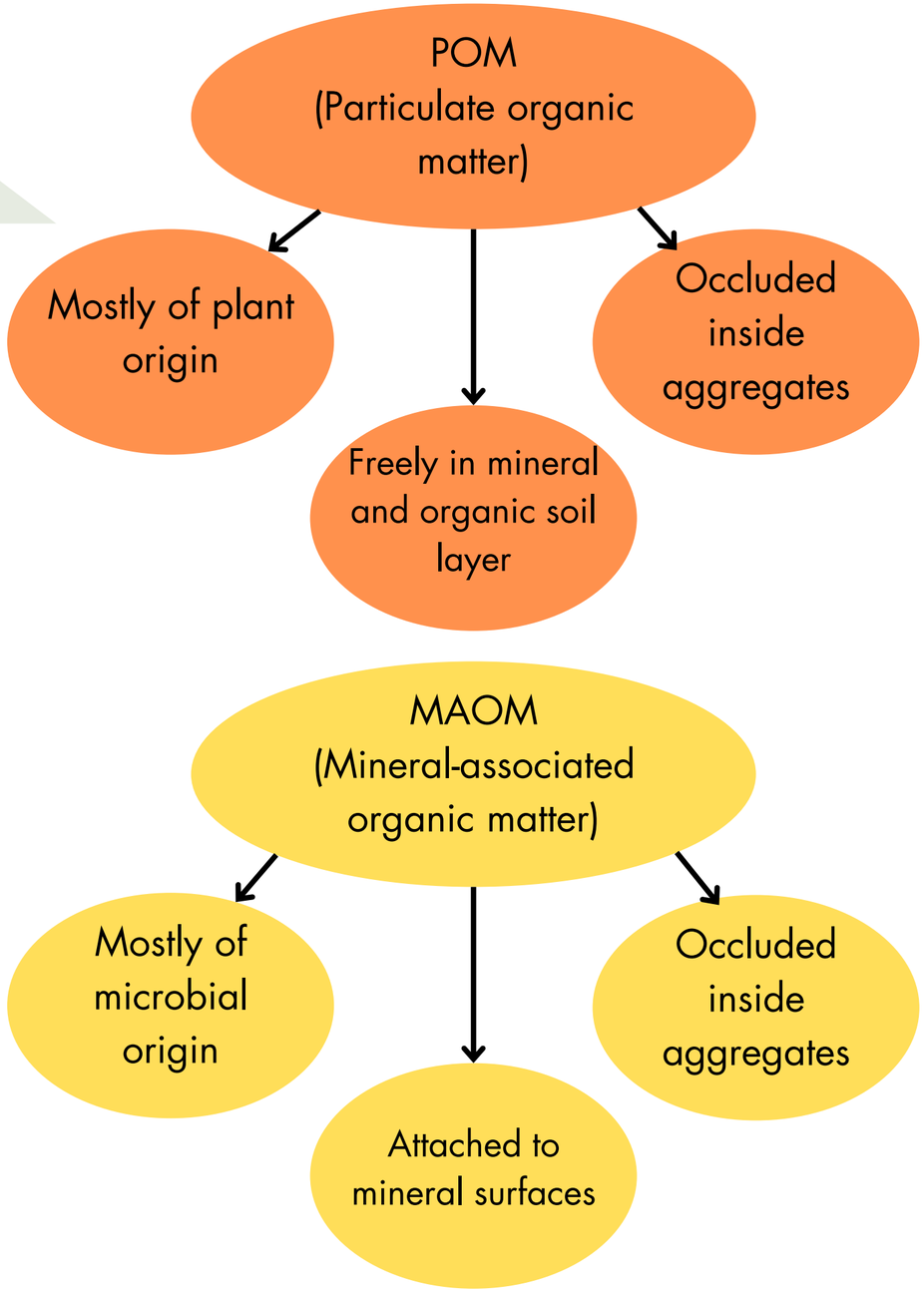
C SEQUESTRATION AND POST-MINING SOILS

- Concentration of CO_2 is increasing
- CO_2 can be removed from atmosphere => carbon (C) sequestration in soil
- Soils are largest C reservoirs on land
- Supporting C sequestration is essential
    - understanding of influencing factors is limited
- Post-mining sites are ideal environments to study C sequestration → large, undeveloped areas & conditions of early stages of development



SOIL ORGANIC MATTER FRACTIONS

- C in soil stored in a form of soil organic matter (SOM) → mix of different materials
- SOM can be separated into fractions → different origin and stabilization mechanisms
- POM and MAOM are most commonly used categories



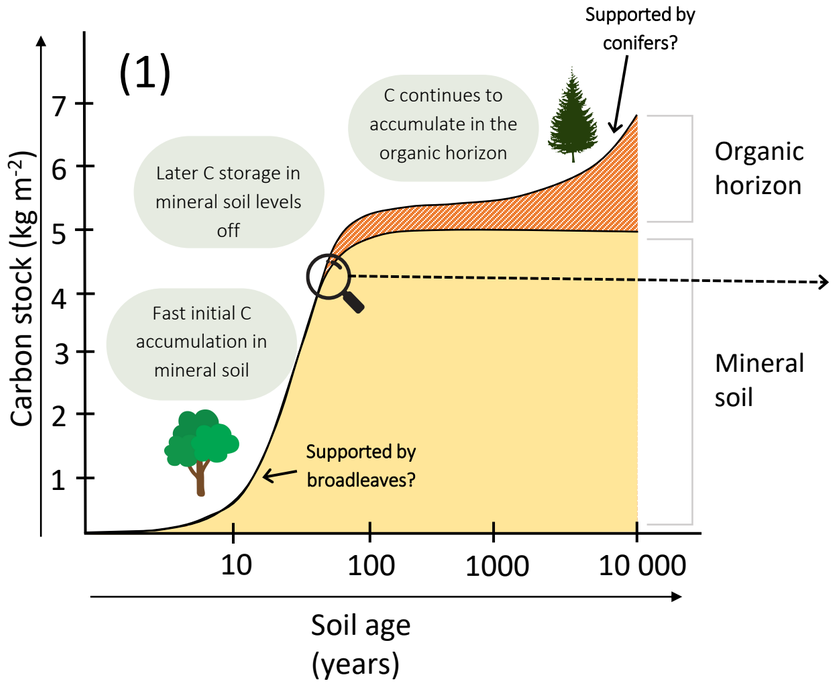
THE EFFECT OF TREE SPECIES AND SOIL AGE

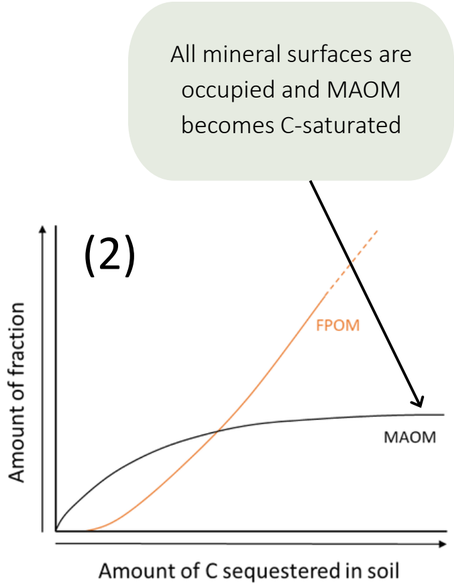
- Afforestation and reforestation are promising strategies to increase soil C storage
- But not all tree species contribute equally → different litter quality
- Soil age is another key factor influencing C sequestration

- High-quality litter (low C:N, low lignin:N)
- High C-use efficiency by microbes
- Will support C sequestration in MAOM?

- Low-quality litter (high C:N, high lignin:N)
- Low C-use efficiency by microbes
- Will support C sequestration in POM?

Cotrufo et al. (2013)

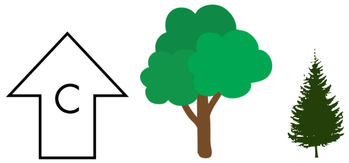




Figures adapted from (1) Vindušková et al. (2019) and (2) Castellano et al. (2015)

HYPOTHESES

H1: High-quality litter of broadleaves (represented by alder) leads to greater C storage in the **mineral soil layer** in young soil.



H2: Low-quality litter of conifers (represented by spruce) leads to greater C storage in the **organic soil layer** in both young and mature soils.

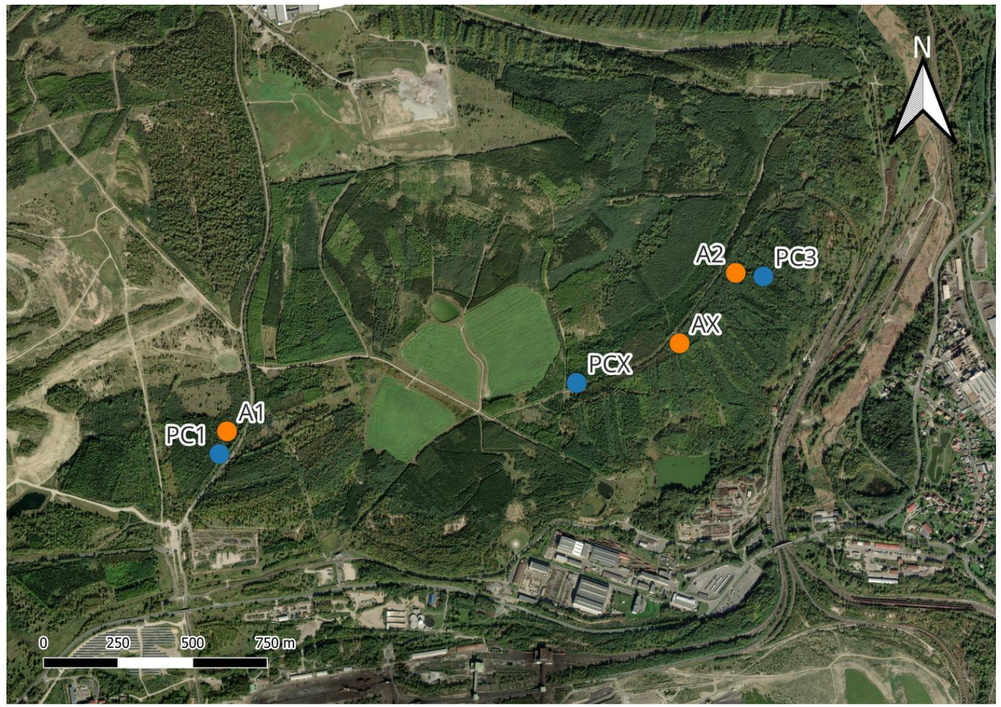
H3: In young soil, C storage in the **mineral soil layer** is driven mainly by the formation of the **MAOM-containing** fractions, which is supported by alder.

H4: In mature soil, C storage is driven mainly by the formation of **POM** fraction in the mineral soil layer and the accumulation of litter in the **organic soil layer**, which is supported by spruce.

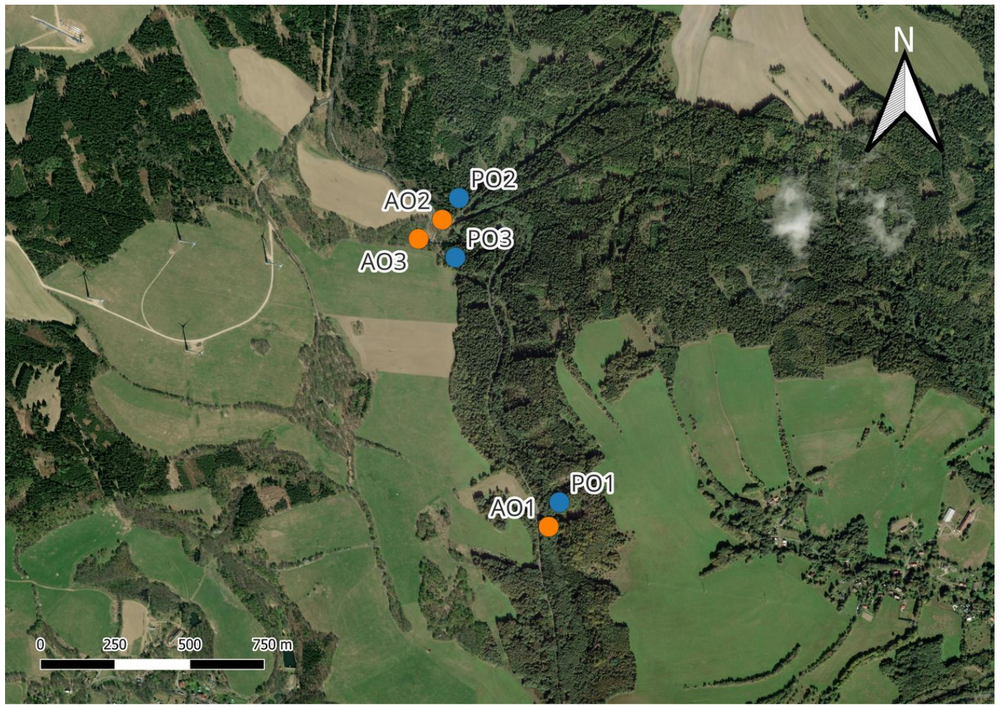
STUDY SITES

- Located in Czech Republic, near the town of Sokolov
- Two sites: post-mining spoil heap (young soil) and surrounding landscape (mature soil)
- Plots with pure alder and spruce stands, located next to each other
- Tree stands at both sites were approximately 50 years old

Alder Spruce



Post-mining spoil heap



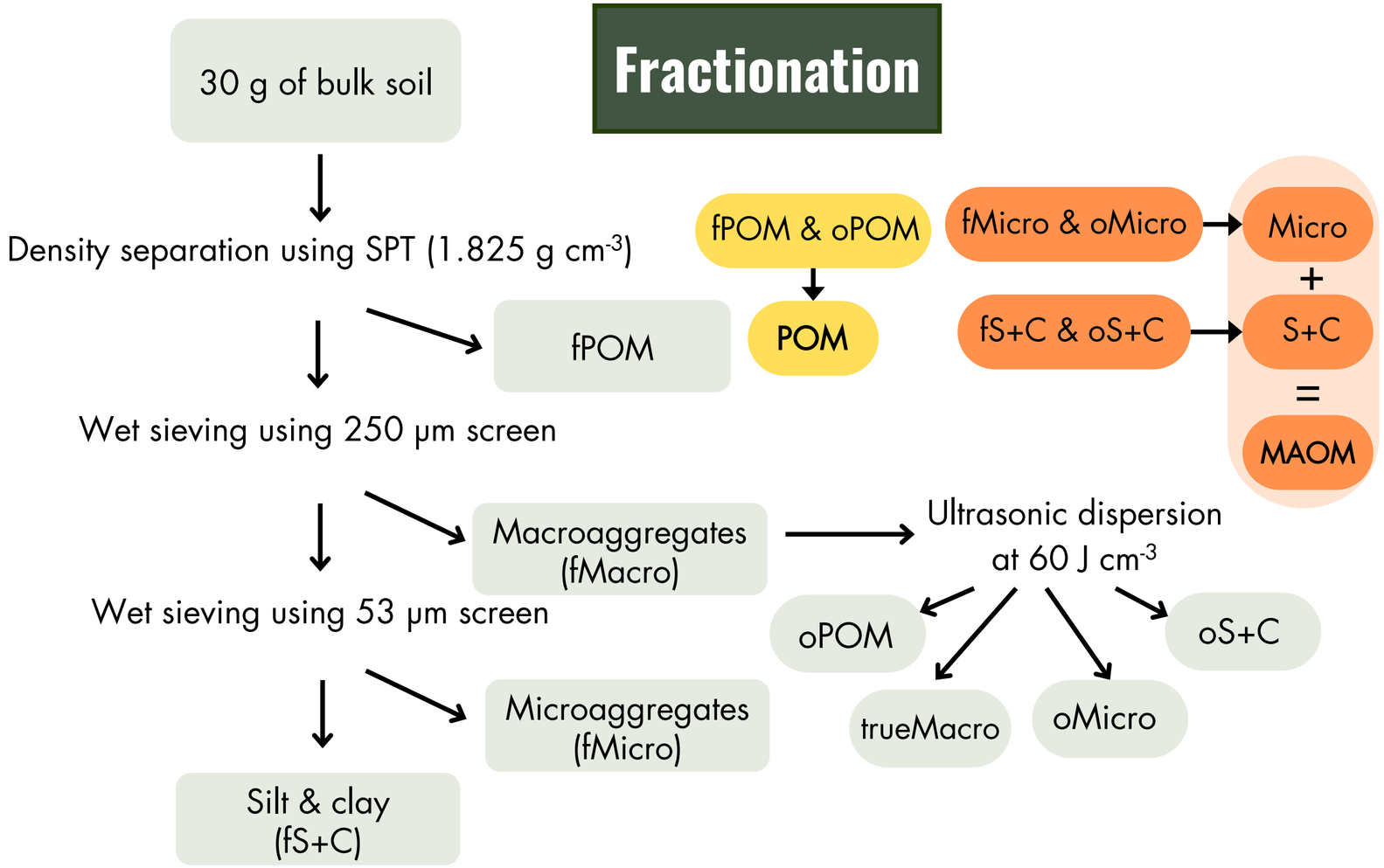
Surrounding landscape

SOIL SAMPLING

- Soil samples collected using a soil probe
- From each soil core we sampled:
    - Organic layer (Oi + Oe)
    - Mineral layer (0 – 15 cm)
- Three soil cores combined into one composite sample per plot
- Samples were air dried and sieved through 2 mm screen before laboratory analyses

LABORATORY ANALYSIS

Fractionation

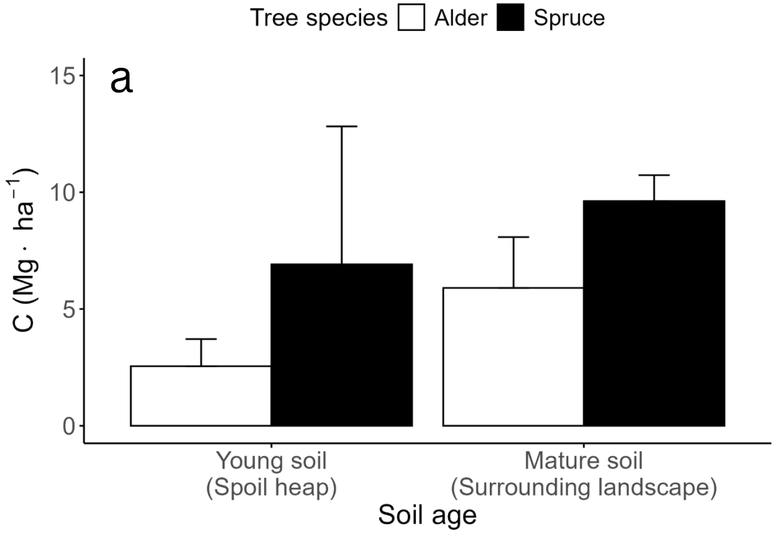


Other analyses

- Elemental analysis → C concentration in organic layer, mineral layer, and fractions
- Radiocarbon (^{14}C) → correction for fossil C (only spoil heap samples)

RESULTS

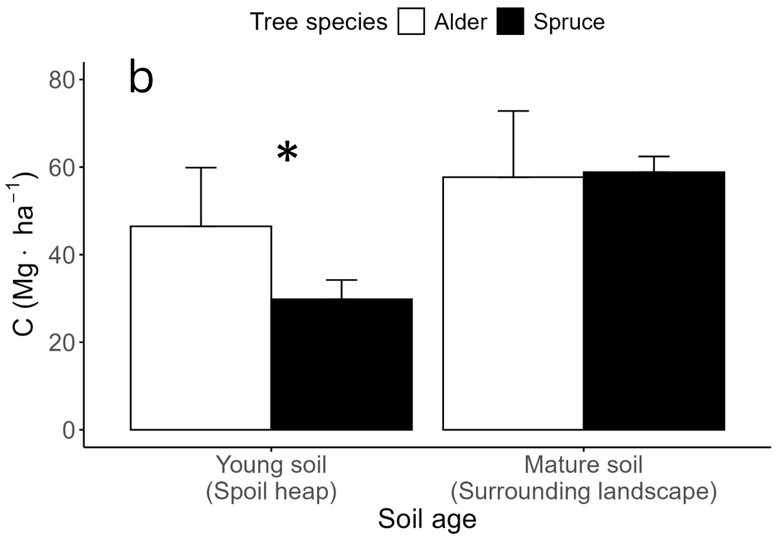
Organic layer



	F	p	
Tree species	5.6	0.04	*
Soil age	6	0.04	*
Interaction	0.3	0.6	

- Spruce stored more C in both young and mature soils

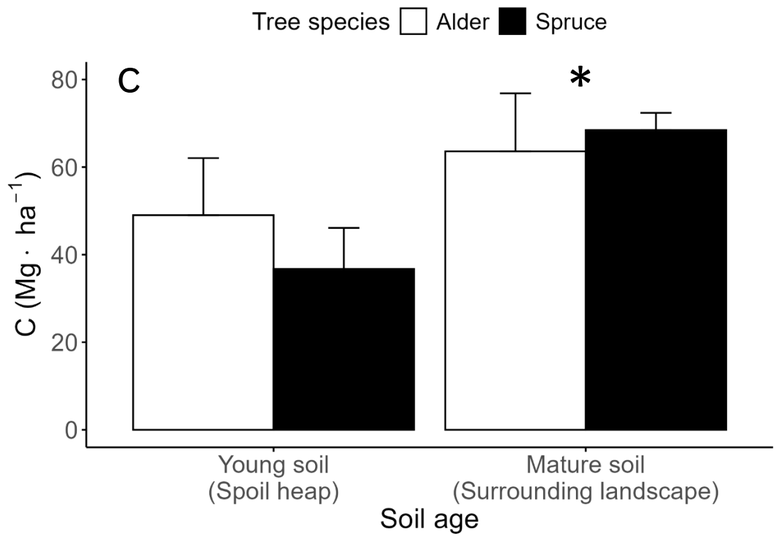
Mineral layer



	F	p	
Tree species	2	0.2	
Soil age	13	0.006	*
Interaction	3.6	0.09	·

- Alder had higher carbon stock in young soil
- C stocks were similar in mature soil

Pooled organic & mineral



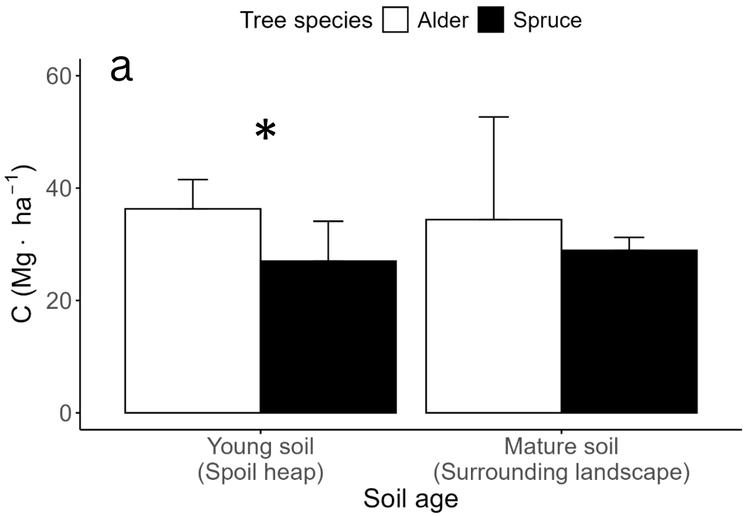
	F	p	
Tree species	1	0.4	
Soil age	14	0.006	*
Interaction	2	0.2	

- No significant difference in young soil
- Spruce stored more C in mature soil

Presented data are mean values ± SD, n = 3 for each tree species and soil age combination, * => $p < 0.05$, · => $p < 0.1$.

RESULTS

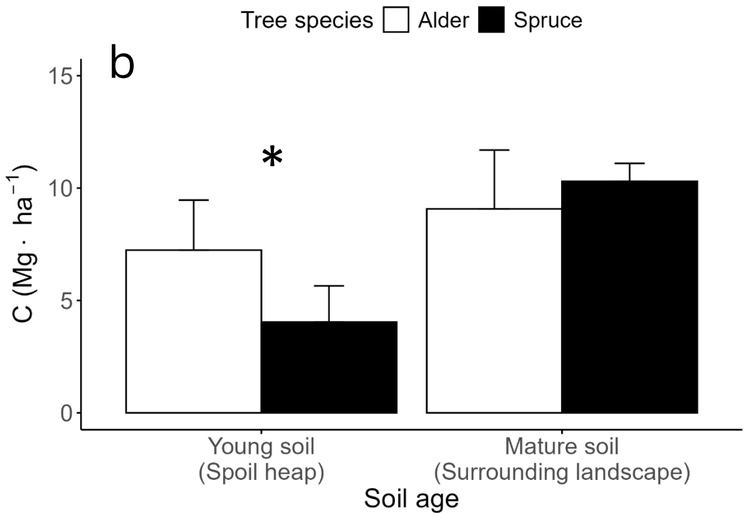
POM



	F	p
Tree species	0.6	0.5
Soil age	0.05	0.8
Interaction	0.4	0.6

- No significant effects
- Site-level t-test showed more C under alder in young soil

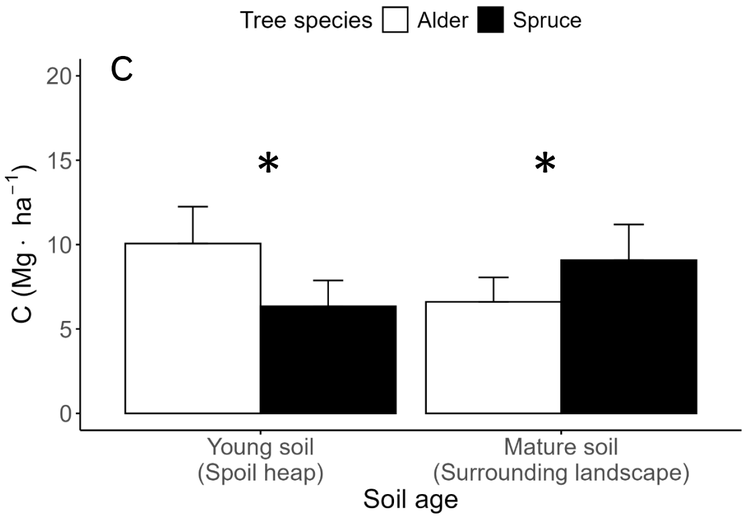
Microaggregates



	F	p	
Tree species	2	0.2	
Soil age	12	0.008	*
Interaction	5	0.06	·

- Stored more C under alder in young soil

Silt & clay



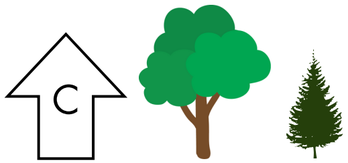
	F	p	
Tree species	0.3	0.6	
Soil age	0.1	0.8	
Interaction	8	0.02	*

- Stored more C under alder in young soil, but under spruce in mature soil

Presented data are mean values ± SD, n = 3 for each tree species and soil age combination, * => $p < 0.05$, · => $p < 0.1$.

CONCLUSION

H1



High-quality litter of broadleaves (represented by alder) leads to greater C storage in the **mineral soil layer** in young soil.

More C found under alder in young soil.

H2

Low-quality litter of conifers (represented by spruce) leads to greater C storage in the **organic soil layer** in both young and mature soils.

More C found under spruce in soils of both ages.

H3

In young soil, C storage in the **mineral soil layer** is driven mainly by the formation of the **MAOM-containing** fractions, which is supported by alder.

Both microaggregates and S+C stored more C under alder, but POM also contributed to this pattern.

H4

In mature soil, C storage is driven mainly by the formation of **POM** fraction in the mineral soil layer and the accumulation of litter in the **organic soil layer**, which is supported by spruce.

Higher amount of C under spruce in organic layer, but no difference between tree species for POM.

Thank you for your attention

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