How much fire-derived carbon is transported vertically through the soil and what controls its mobility?

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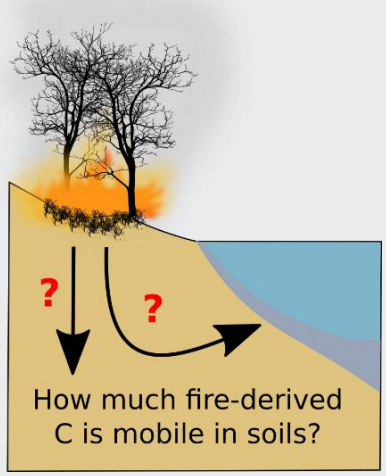
Background and research question

Fire-derived C is one of the oldest and largest terrestrial C pools and component of soil organic matter

Its fate and vertical mobility in soils remain unknown but are assumed to control its long-term mobility on landscape scale

Furthermore, its mobility in soils is reported to increase with aging



Findings so far

Two- to sevenfold higher vertical mobility of oxidized fire-derived carbon

Higher mobility of oxidized fire-derived C in sandy soil but not for fresh fire-derived C

Increased retention of fire-derived C in subsoils

Up to threefold higher mobility of native soil organic carbon with addition of fire-derived carbon

Experimental design

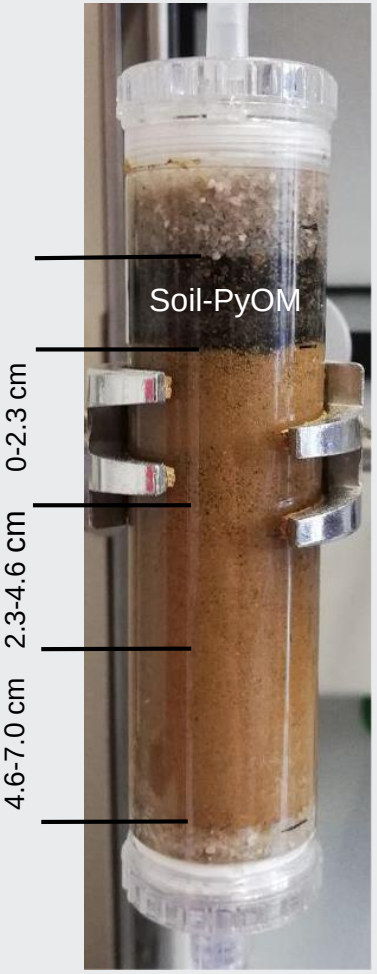
Continuous percolation of saturated soil columns with 1,000 – 18,000 L m^{-2} of 0.01 M $CaCl_2$

Highly labelled ^{13}C ryegrass (4 atm%) char was applied to trace fire-derived C and native soil organic C (nSOC) in soils and percolates

Fresh and oxidized (with H_2O_2) fire-derived C was applied to simulate an aging effect

Topsoils (2.0-2.1% SOC) and subsoils (0.3-0.6% SOC) of a sandy and a loamy soil were used to obtain a range of texture and SOC content

Soil column set-up



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Preliminary results

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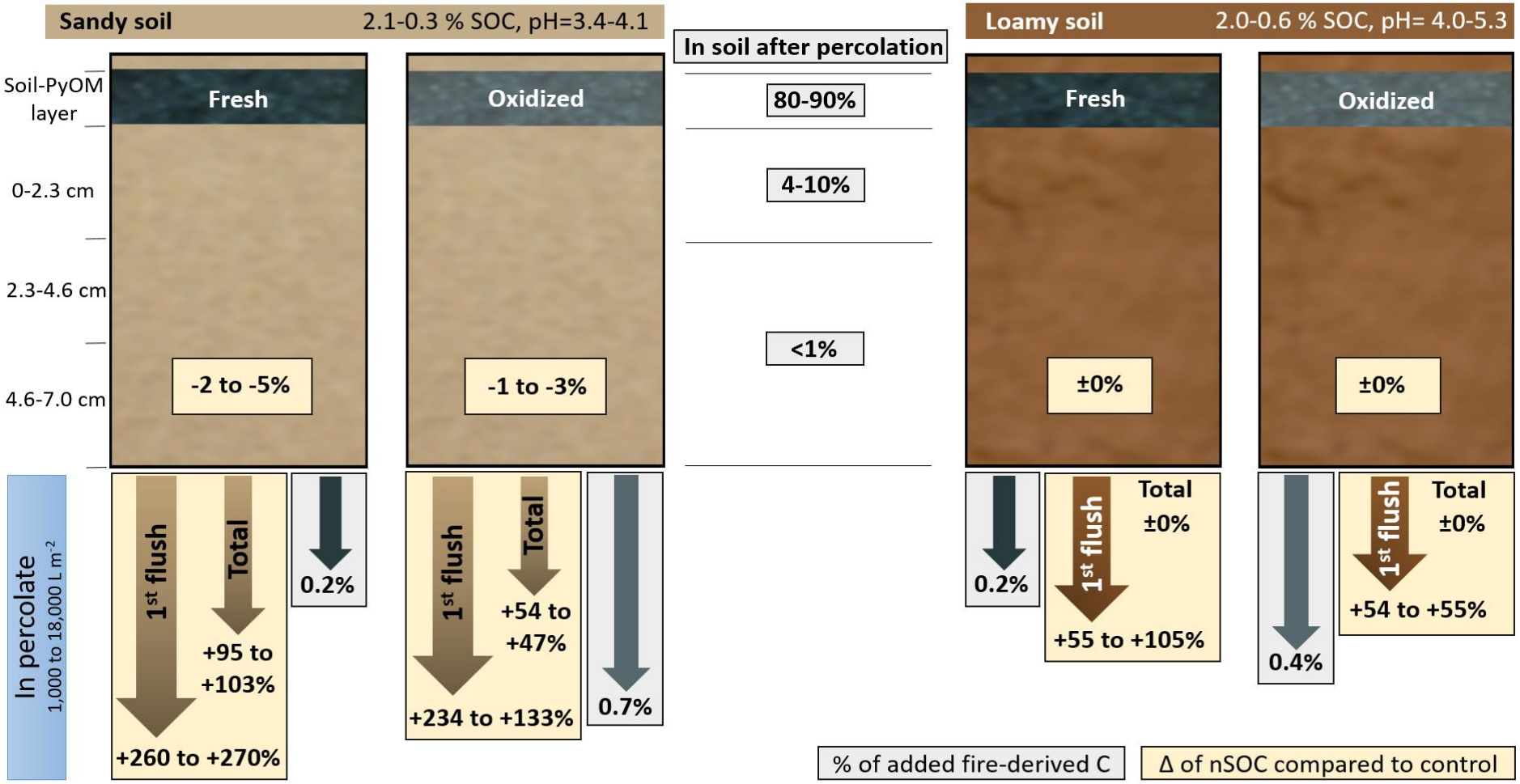

In percolates:

- First flush contained up to 84% of total percolated fire-derived C
- Increase in pH by 0.2-0.7 units with fire-derived C
- Between 1.7-3.5% of total nSOC percolated from control
- Up to 10% of total nSOC percolated with fire-derived C addition

In soils:

- Higher recovery of oxidized fire-derived C in 2.3-7.0 cm
- More fire-derived C retained in subsoil than in topsoil
- Up to 40% of the fire-derived C was associated to the mineral fraction in the loamy soil

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