# Mineralogical control of soil organic carbon persistence at the multidecadal time scale

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## Introduction

- Higher persistence of soil organic carbon (SOC) in temperate soils with high phyllosilicate minerals content (Feng *et al.*, 2011).
- The ability of different clay minerals (phyllosilicates) to stabilize SOC and the characteristics of SOC stabilized by different phyllosilicates are still being discussed.
- Long term bare fallows (LTBF) offer a unique opportunity to study *in situ* carbon dynamics: no carbon input and continuing biodegradation (Barré *et al.*, 2010).

**Objective**: Determine SOC dynamics in different particle-size fractions having contrasted mineralogies and (ii) compare the chemical quality of SOC associated to these different clay size fractions.


## Materials & methods

- Soil: Versailles *42 Plots* LTBF (France), 5 sampling dates (year 0, 10, 22, 52 and 79), 4 field replicates.
- Size fractionation by wet sieving and centrifugation, three clay fractions: fine 0-0.05 µm, intermediate 0.05-0.2 µm, coarse 0.2-2µm.
- Mineralogy determined by X-ray Diffraction.
- Total Organic Carbon (TOC) and Nitrogen determination on CHN autoanalyser.
- Chemical characterization of SOC by NEXAFS STXM at the Carbon K-edge threshold (280 eV), CLS synchroton (Canada).

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References
Barré et al., Biogeosciences, 2010
Feng et al., Biogeochemistry, 2011

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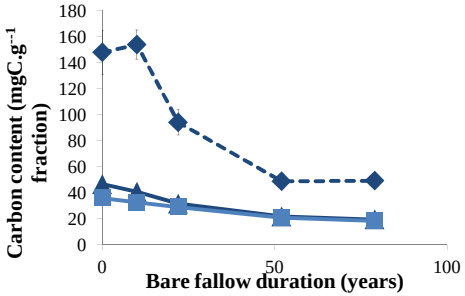
## Results

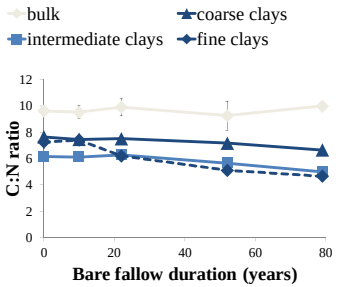
Stabilized C content after 50 years of BF.

Coarse and intermediate clays have same final C content but coarse fraction loses more C.

Highest losses and highest final C content in the fine clays.

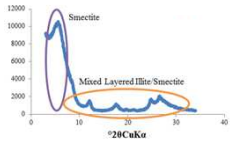
**Different carbon dynamics in different clay fractions**



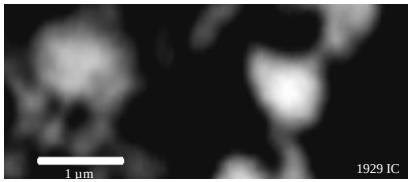




C:N ratio is really low and decreasing with time in all clay fractions, evidencing presence of microbial SOC.

**Fine and intermediate clays**

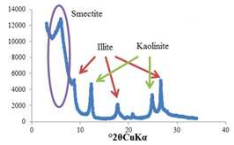



All mineral particles are associated with OC (homogeneous NEXAFS signature).

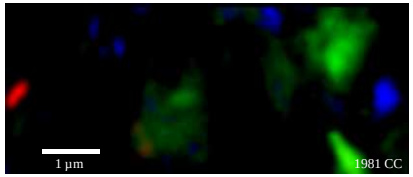



White: organo mineral association (K)

**Coarse clay**




SOC displays more diversity. With time, more mineral particles not associated with OC appear, and NEXAFS signature is also more diverse.




Blue: mineral particles (K)
Green: organo mineral association (K)
Red: aromatic material

## Discussion & Perspectives

- Clay fractions showed different C dynamics. Fine clays contain more labile C and more stable C, compared to intermediate and coarse clays.
- SOM associated to clay fractions have a low C:N ratio that decreases with BF duration. However, C:N of coarse clays is higher suggesting (i) a better protection of compounds enriched in N in finer fractions or (ii) the protection of a higher amount of plant-derived compounds in coarse clays.
- SOC protection by the mineral matrix is different in coarse clays compared to finer clays: (i) some minerals in the coarse fraction do not protect SOM and SOM protected in coarse clays displayed more variability.
- The evolution of C-NEXAFS signature with BF duration remains to be studied.