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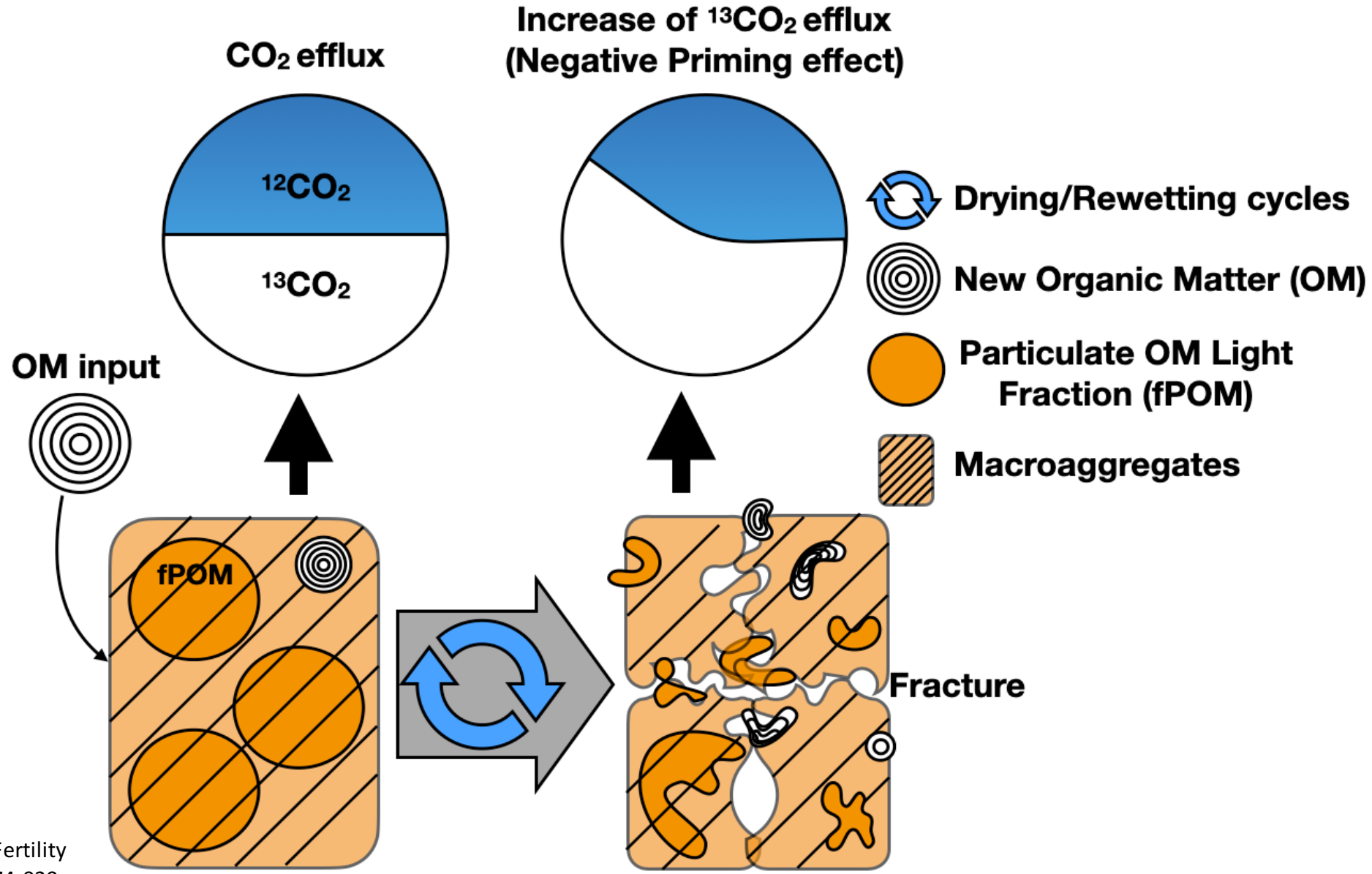
Abstract

Destabilization of soil organic matter (SOM) by microbial activity is one of the most intriguing processes with a high heterogeneity influenced by soil properties and water cycles. Drying and rewetting (D/R) or freezing and thawing (F/T) cycles accelerate POM decomposition by aggregate disruption decreasing carbon (C) availability for soil microorganism. In the present research an incubation experiment to assess the effect of F/T and D/R on SOM decomposition on soil aggregates and POM fractions was conducted. Four F/T (-18 ºC) and four D/R (5 bars) cycles in a temperate forest soil with the addition of ^{14}C glucose and ^{13}C lignocellulose were compared to amended soil without cycles and the control soil. CO_2 fluxes and priming effect (PE), i.e. the turnover acceleration or retardation of native C, was determined. Carbon use efficiency (CUE) and the C allocation in soil aggregate classes and particulate organic matter (POM, light, occluded and heavy fraction) was also determined. Labelled glucose was allocate in macro (> 250 μm) and microaggregates (< 250 μm) as part of the light-POM fraction. Lignocellulose was allocated at microaggregate size classes instead, forming part of occluded and heavy-POM fractions. PE was negative with and without cycles and it was more pronounced for F/T cycles. Therefore, CO_2 efflux was driving by F/T and D/R cycles and C:N ratio following mining theory with a constant CUE. D/R cycles clearly retarded native C mineralization by preferential use of labelled ^{13}C-lignocellulose, while F/T cycles did for ^{14}C-glucose.

Keywords: Soil priming effect, particulate soil organic matter, dual isotopic label carbon experiment.

GRAPHICAL ABSTRACT



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INTRODUCTION

Temperate rainforests in southern Chile have experienced increasing extreme events e.g. severe droughts and freezing. Therefore, it is important to understand the impact of these episodes on the turnover of SOM in these ecosystems.

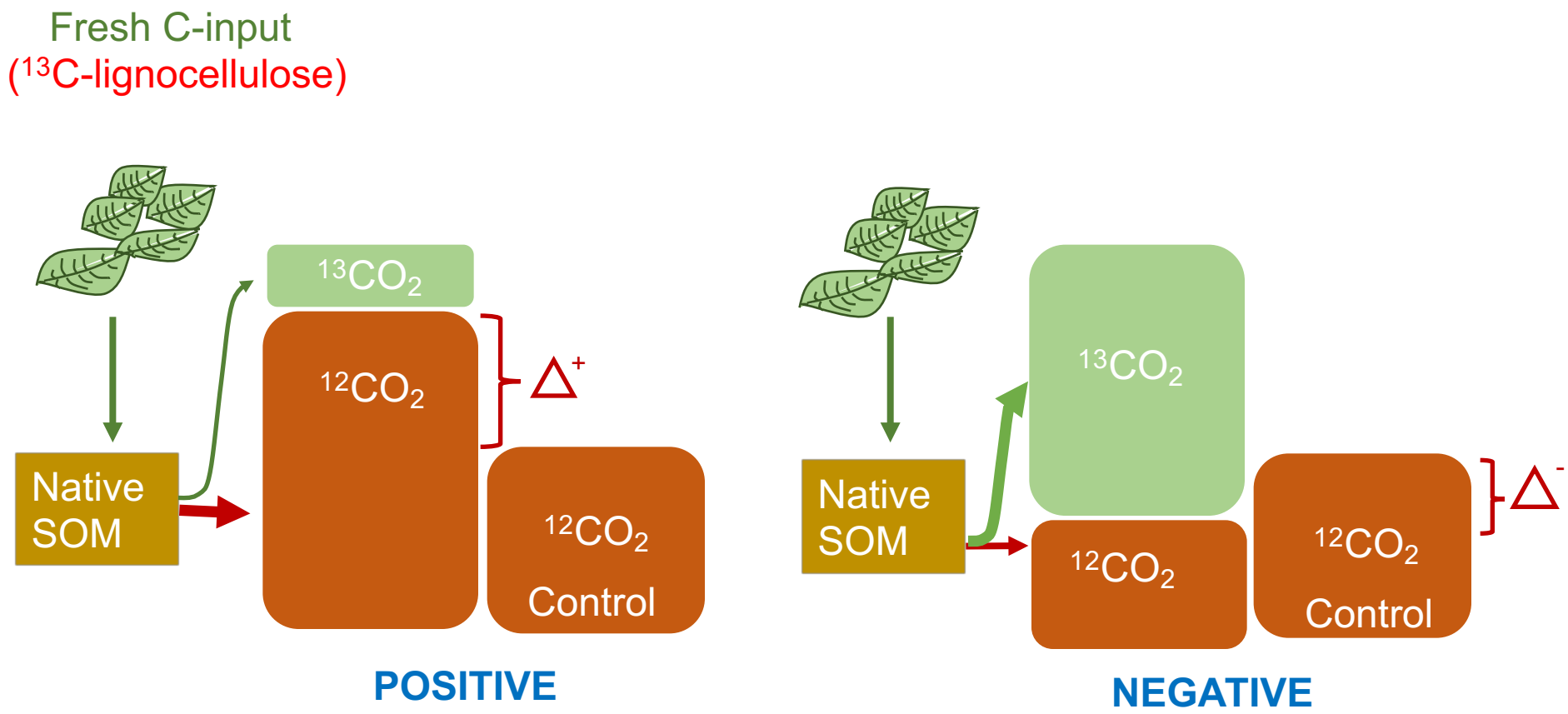
HYPOTHESIS

Drying/rewetting and freezing/thawing cycles release newly formed POM-C locked away in soil macroaggregates for microbial consumption. As consequence, we predict prolonged negative priming effect (PE).

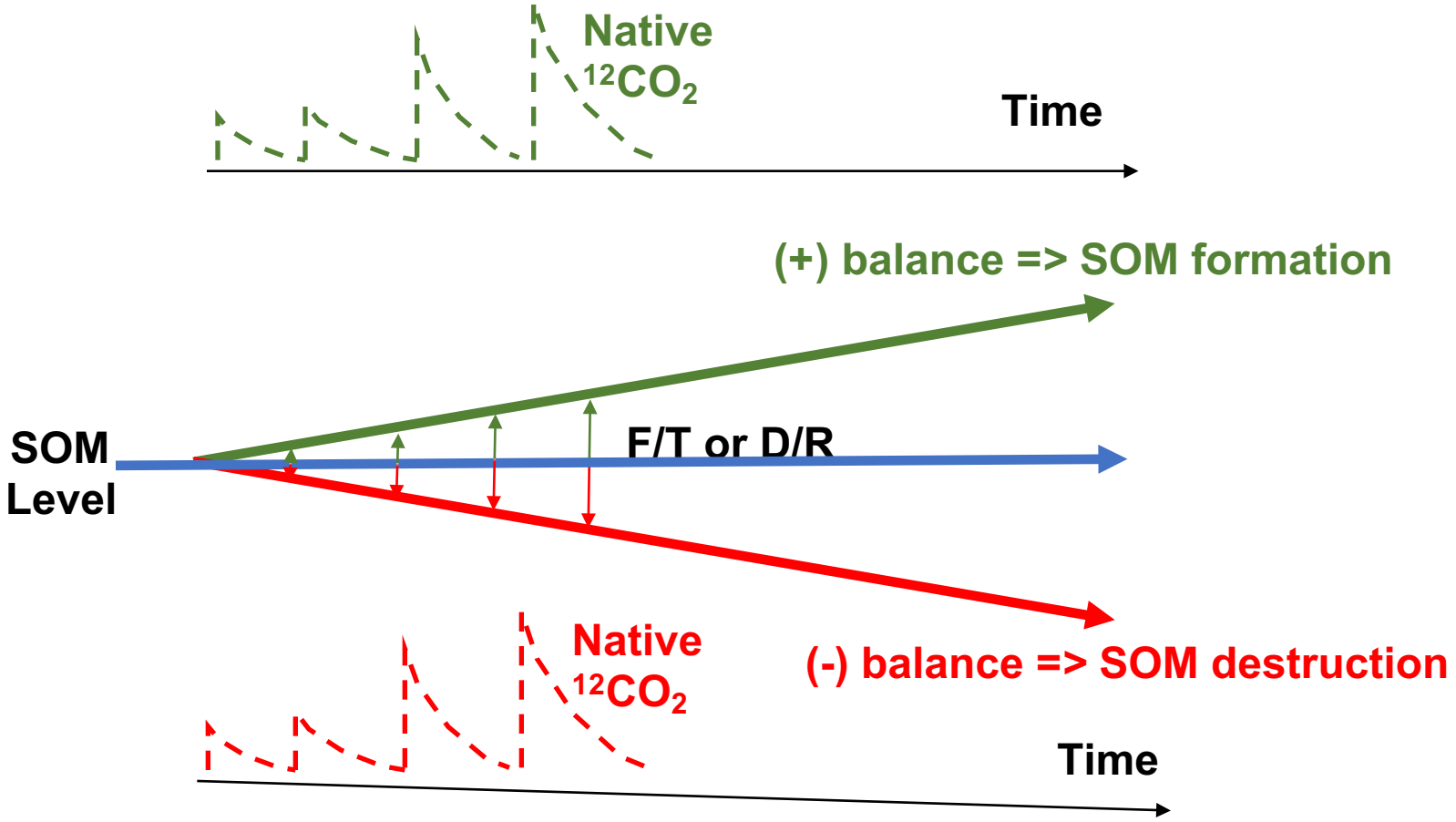
AIM

Evaluate frequent drying/rewetting and freezing/thawing on soil aggregate disruption labelled with ^{13}C-lignocellulose and ^{14}C glucose addition in an ancient temperate forest soil.

PRIMING EFFECT

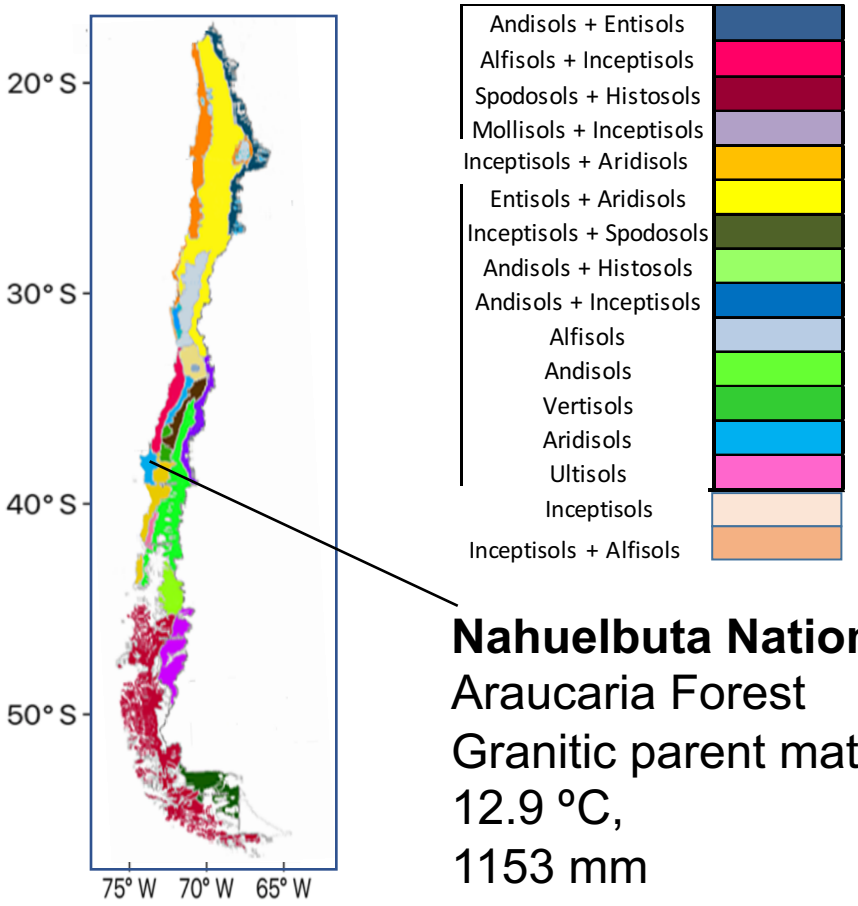


IMPLICATION FOR THE ECOSYSTEM IN THE SHORT-TERM



METHODS

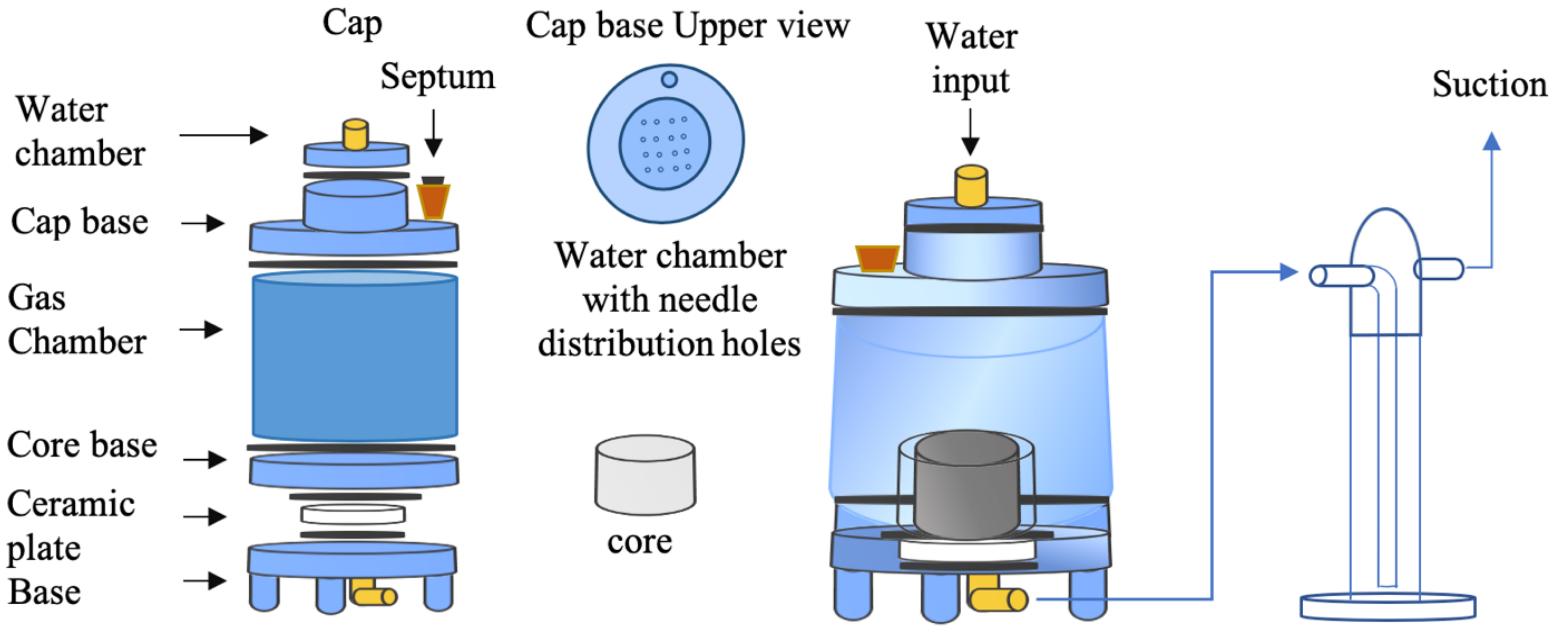
Soil of Chile (USDA Classification)



Nahuelbuta National Park
Araucaria Forest
Granitic parent materials
12.9 ºC,
1153 mm
37.81” S -73.01” W
SOC 8-9 %
pH 4.5-5.0

Godoy R., 2016

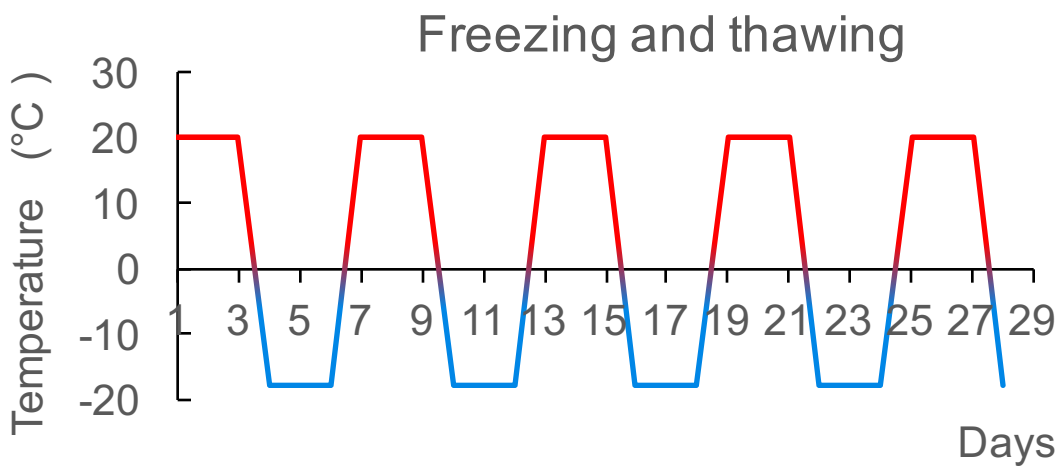
MICROCOSM EXPERIMENT

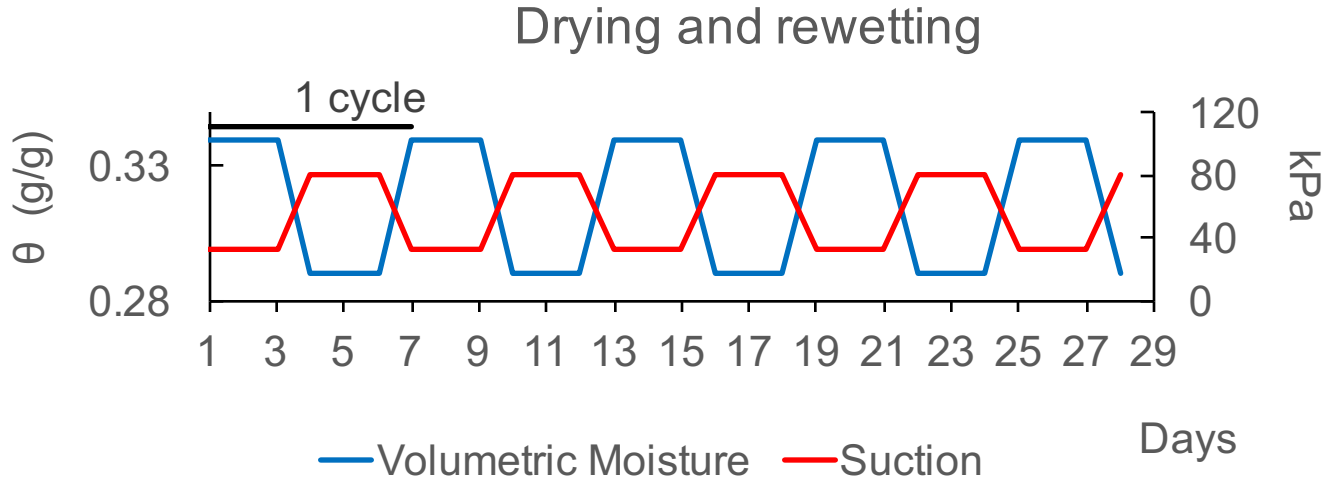


Treatments

^{13}C-lignocellulose + ^{14}C-glucose

1) D/R
2) F/T
3) No cycle amended
4) Control





RESULTS

AGGREGATES

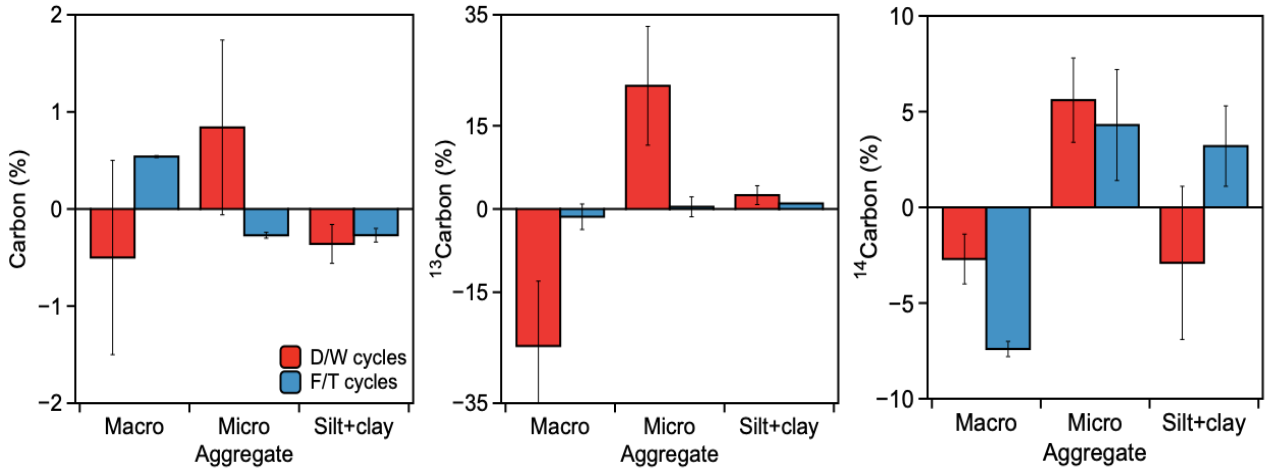
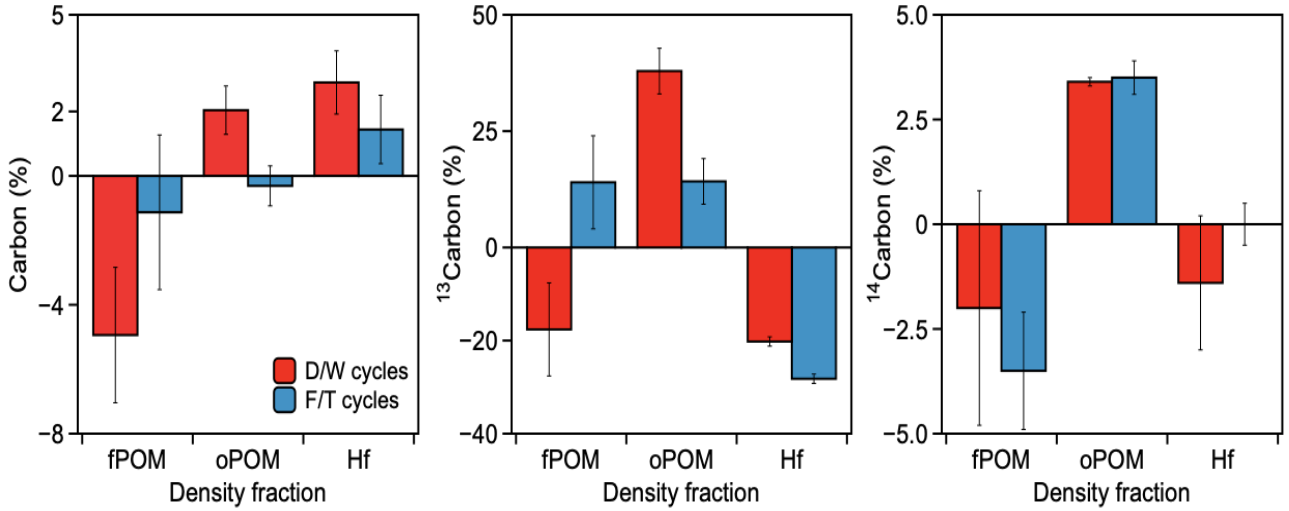


Fig. 1 Net efect by substracting zero treatment (without cycling+labelled C) to drying/rewetting or freeze/thawing on aggregate-C and POM-C distibution.

POM-C



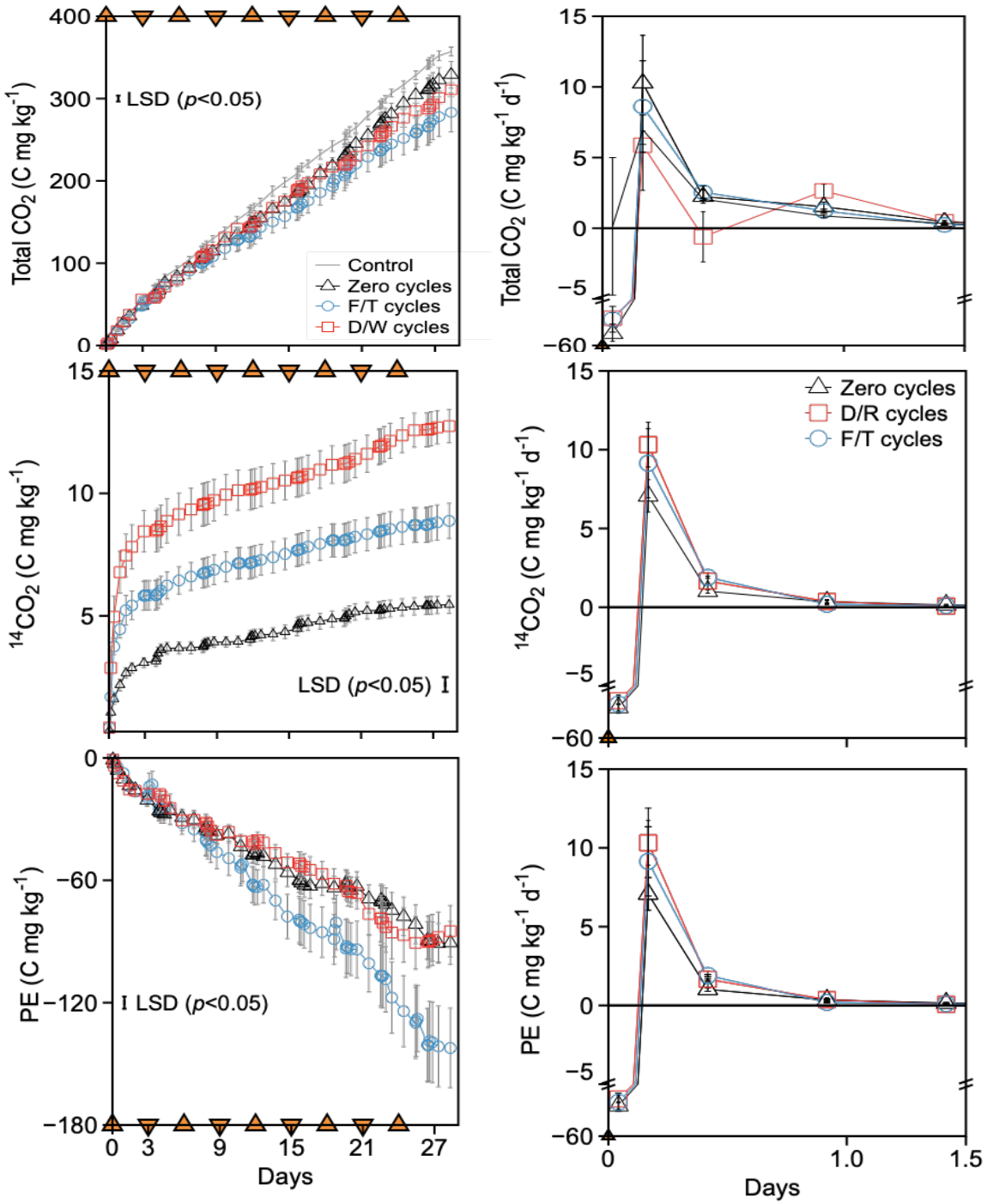


Fig 2. CO_2 efflux and priming effect (PE) 28 days after ^{13}C-lignocellulose o4 ^{14}C-glucose addition. Drying or freezing (▽), rewetting or thawing (△). Vertical bars on data point is SEM. LSD is indicated.

CONCLUSIONS

- Both, drying and rewetting and freezing and thawing increased macroaggregates-C and free POM-C.

- The most primed C-pool was free POM in the macroaggregates. This was consistent for both substrate added ^{13}C and ^{14}C.

- The mineralization estimated by drying and rewetting was the most significantly rate during the first days of incubation.

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