



ADJUSTMENTS OF THE ROCK-EVAL® THERMAL ANALYSIS FOR SOIL ORGANIC AND INORGANIC CARBON QUANTIFICATION

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Ravelojaona, Herman ⁽¹⁾; Eric Verrecchia ⁽²⁾; Chevallier, Tiphaine ⁽³⁾

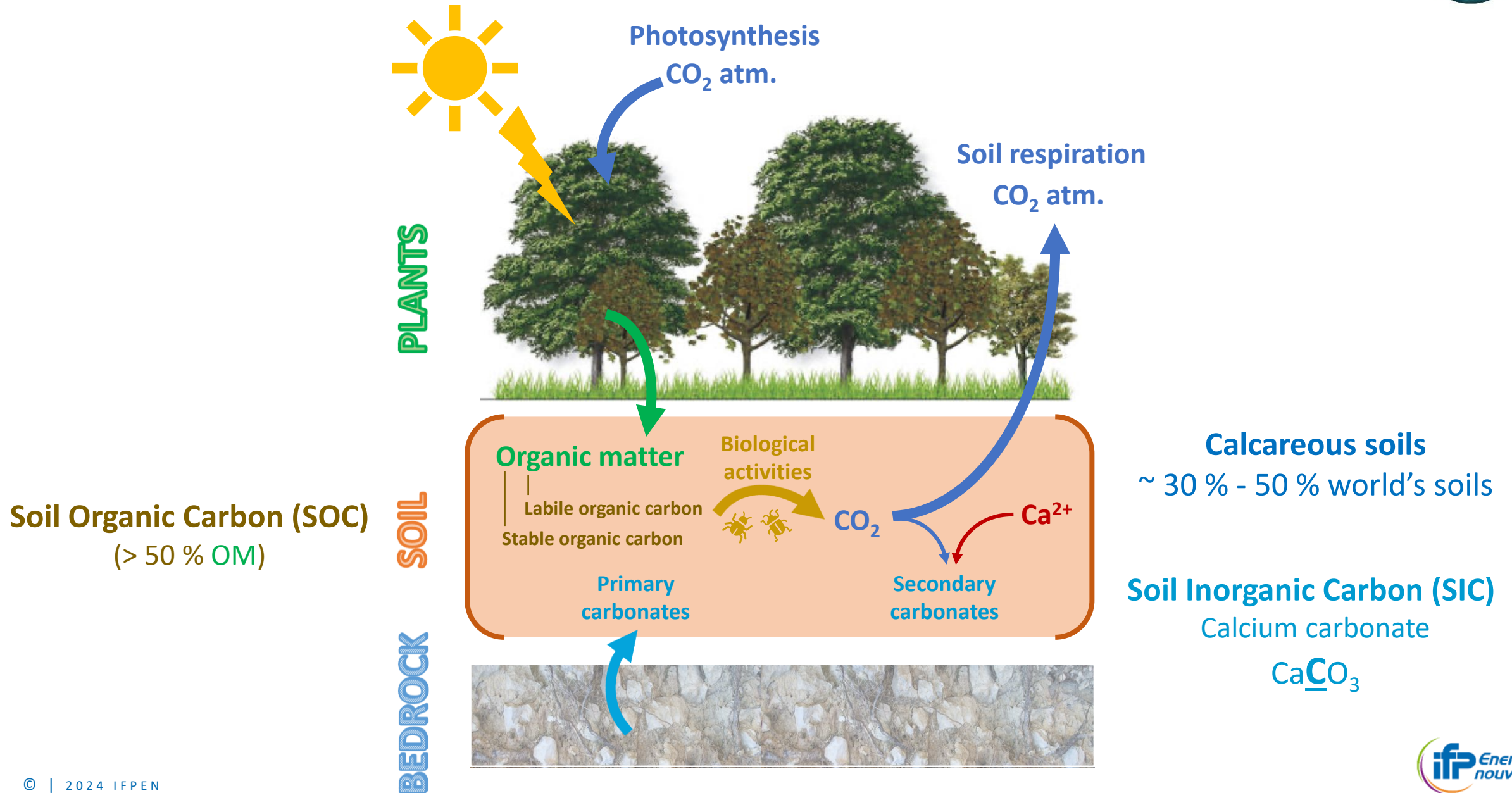
Affiliations

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(2) University of Lausanne, Institute of Earth Surface Dynamics, 1015 Lausanne, Swiss

(3) Eco&Sols, University of Montpellier, CIRAD, Institut Agro Montpellier, INRAE, IRD, Montpellier, France

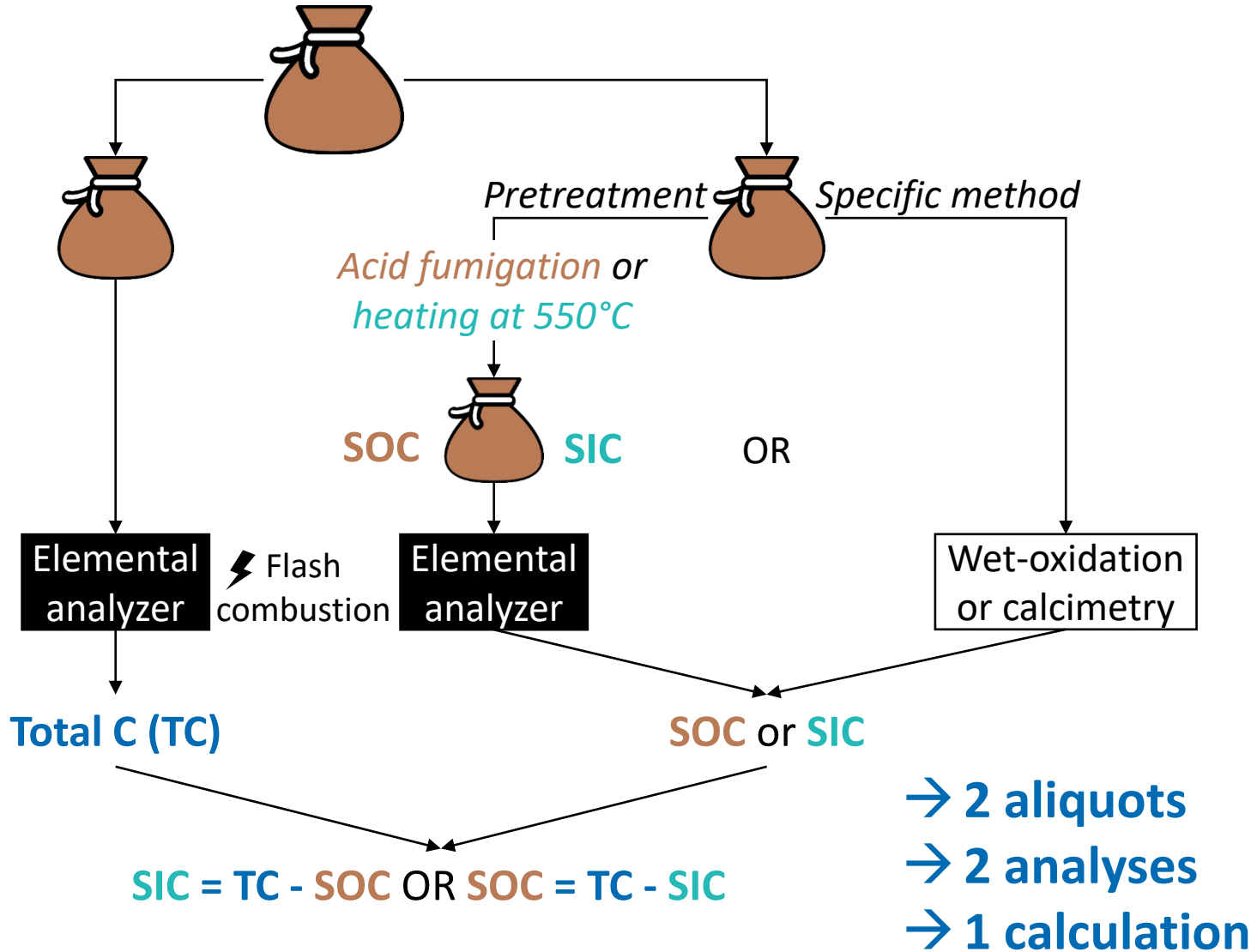
SOIL ORGANIC AND INORGANIC CARBON



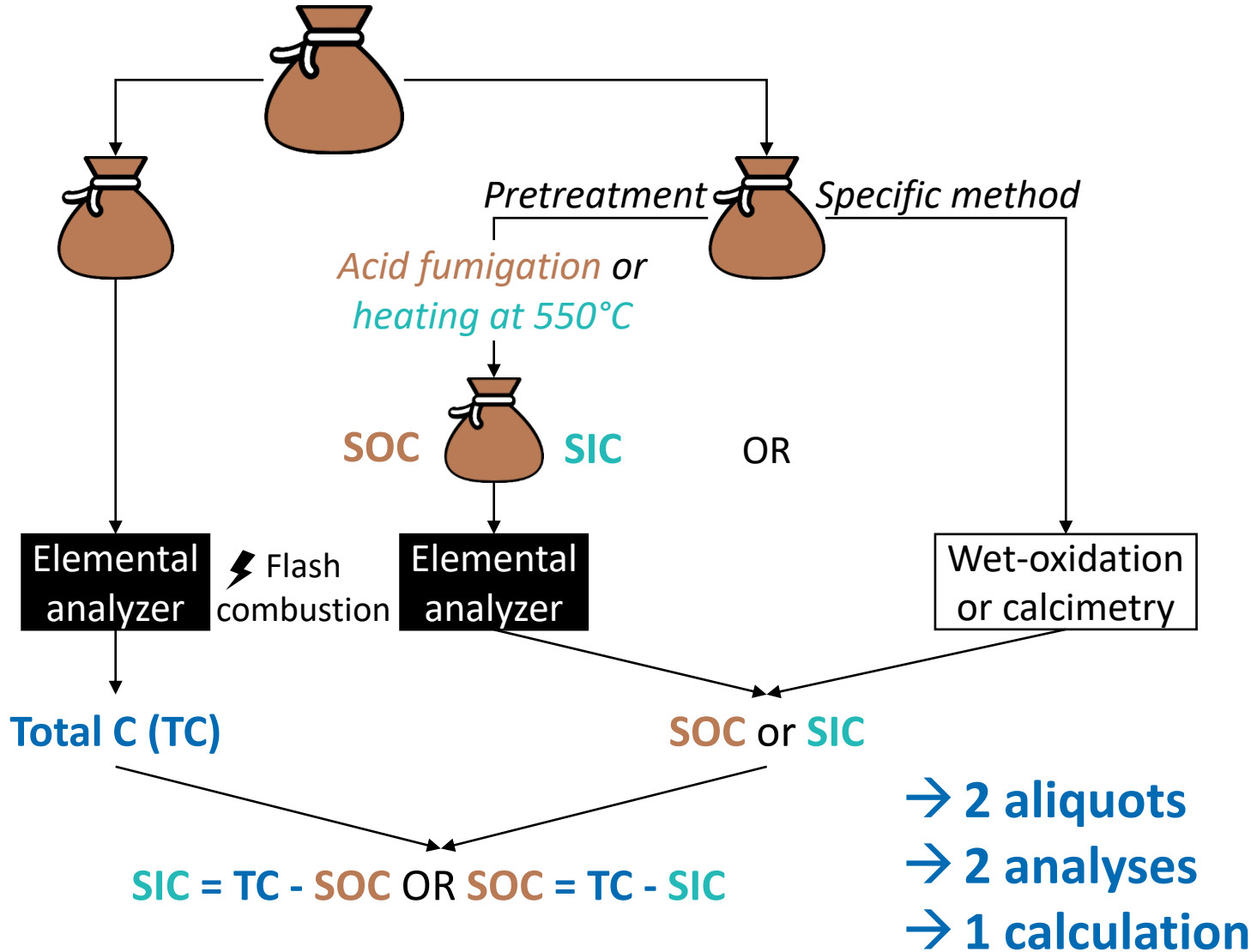
SOC & SIC QUANTIFICATIONS



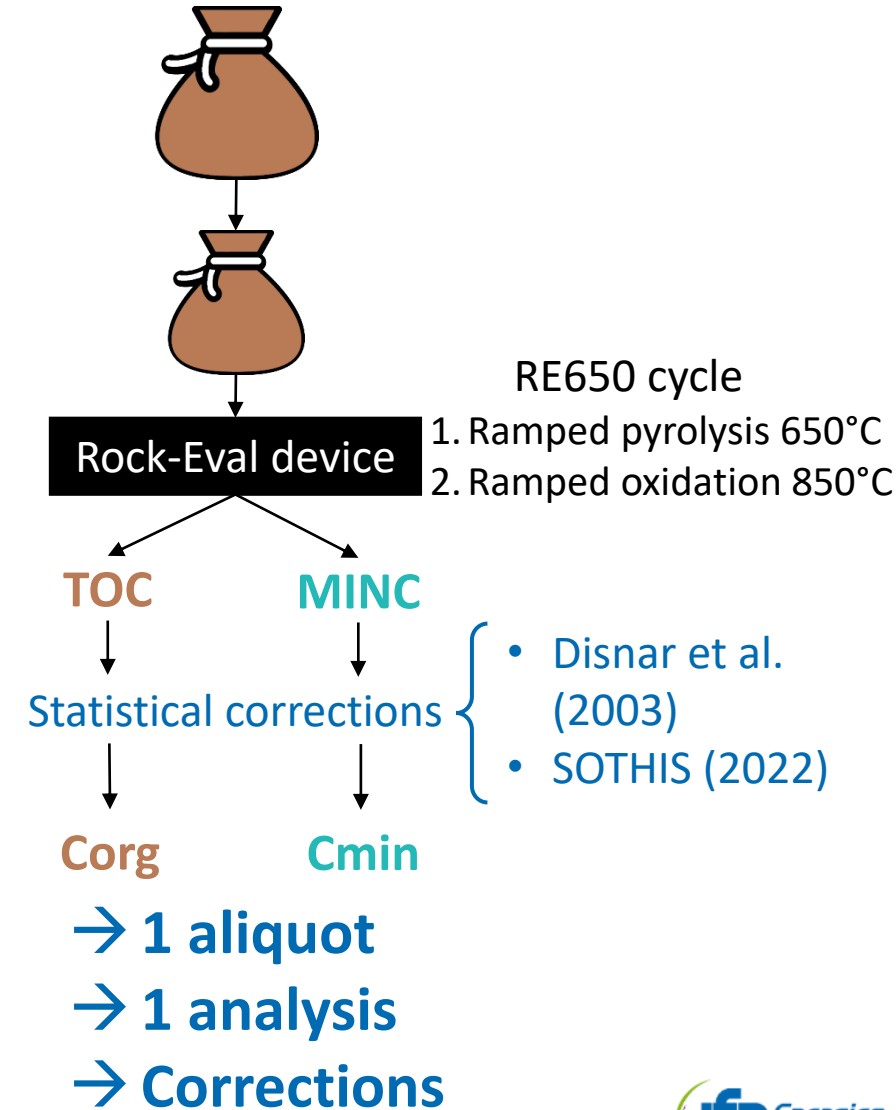
Classic method



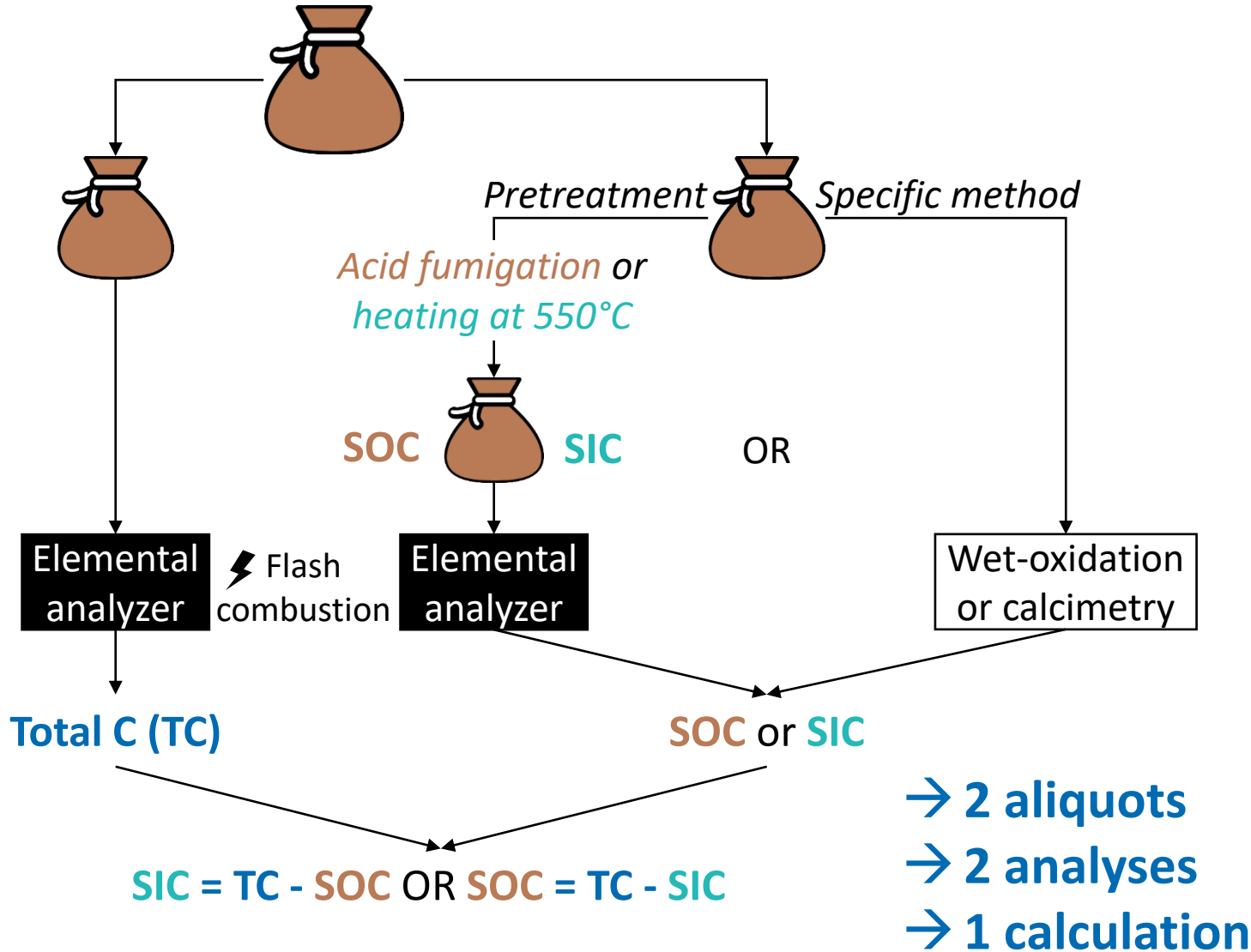
Classic method



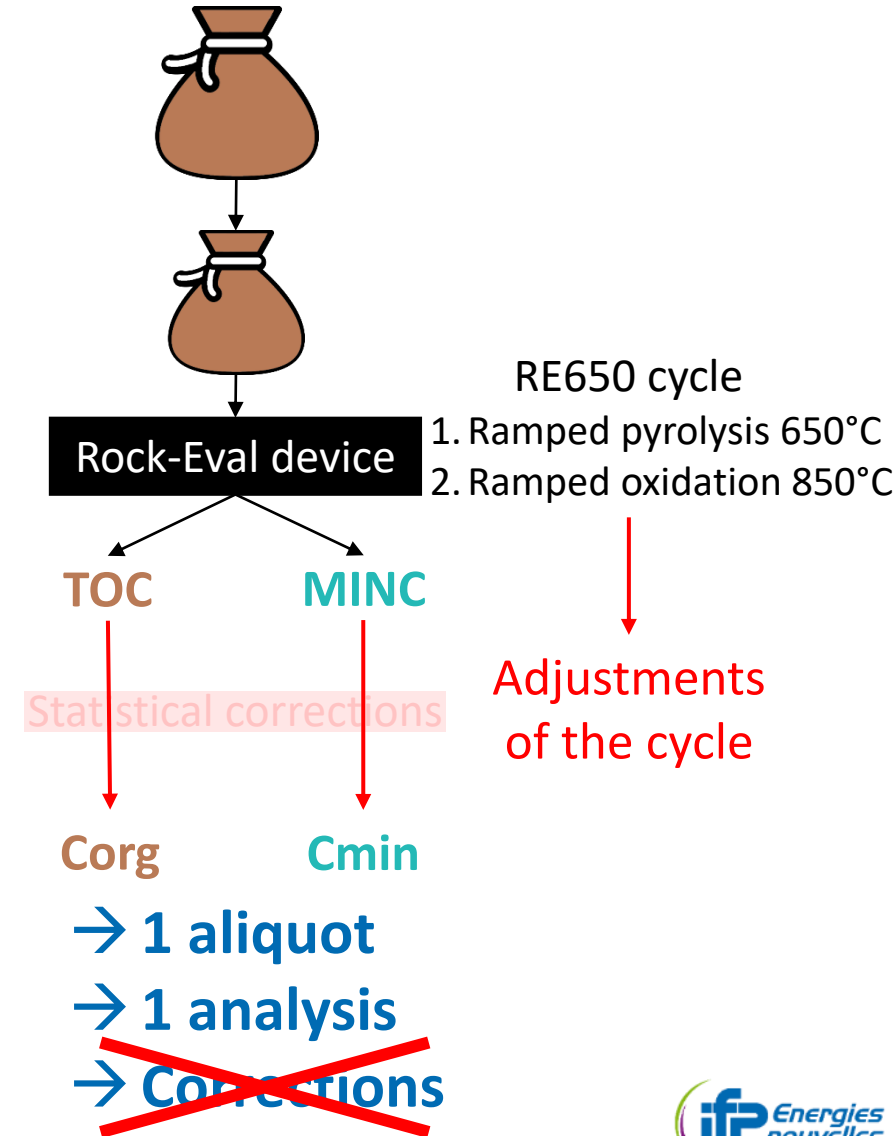
Rock-Eval® analysis (RE)



Classic method



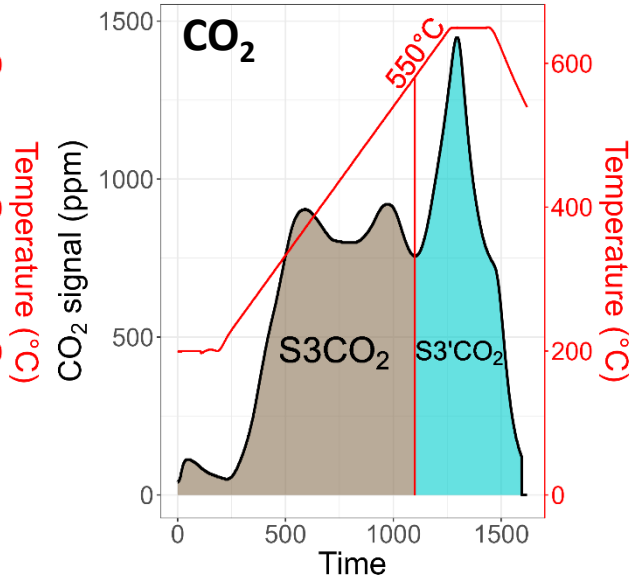
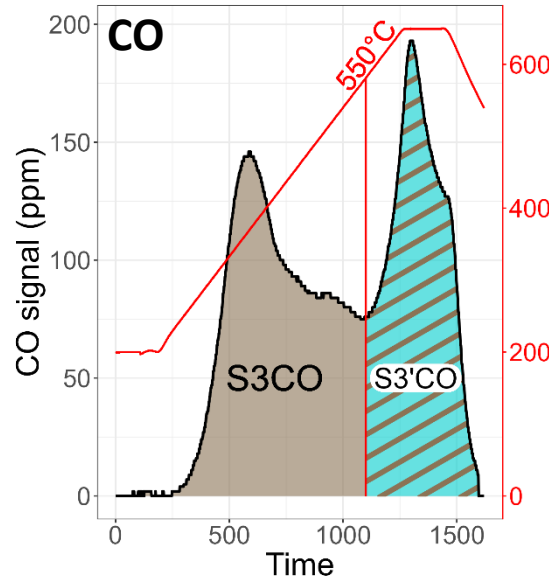
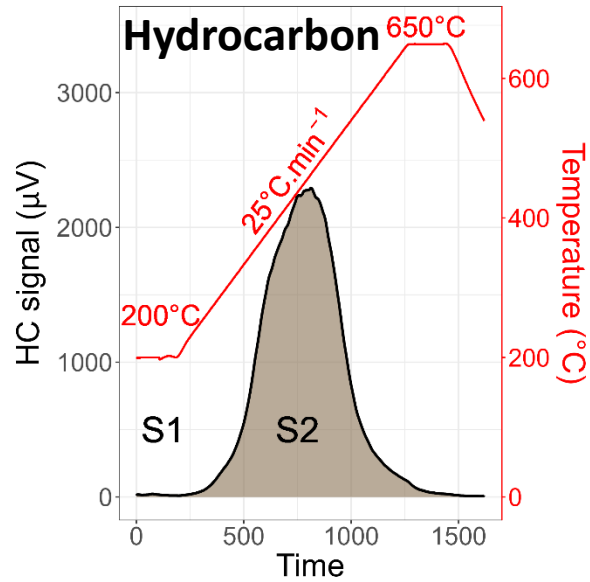
Rock-Eval® analysis (RE)



THE ROCK-EVAL® THERMAL ANALYSIS – STANDARD CYCLE (RE650)



PYROLYSIS

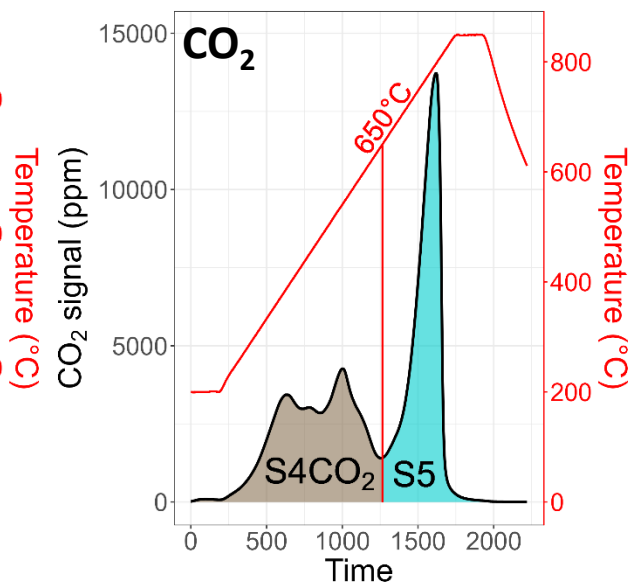
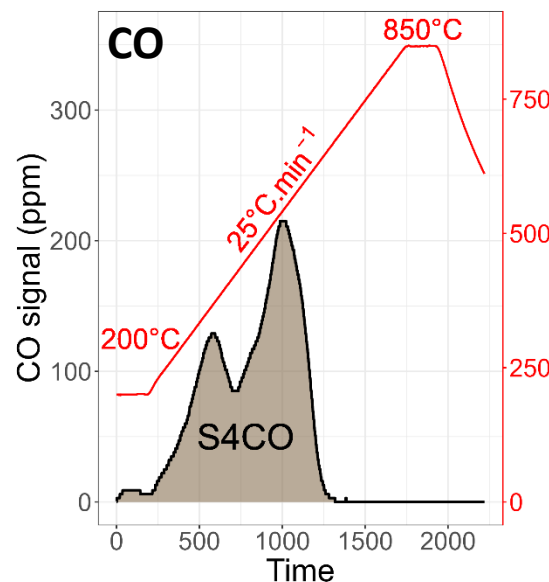


TOC = S1 + S2 + S3CO + ½ S3'CO + S3CO₂ + S4CO + S4CO₂

MINC = ½ S3'CO + S3'CO₂ + S5

TOC & MINC

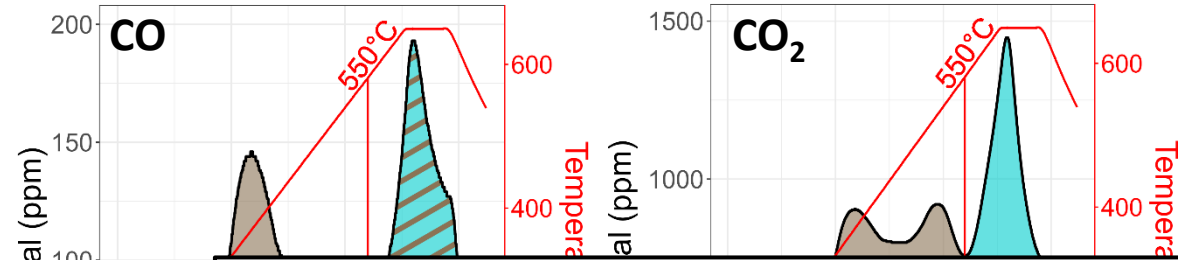
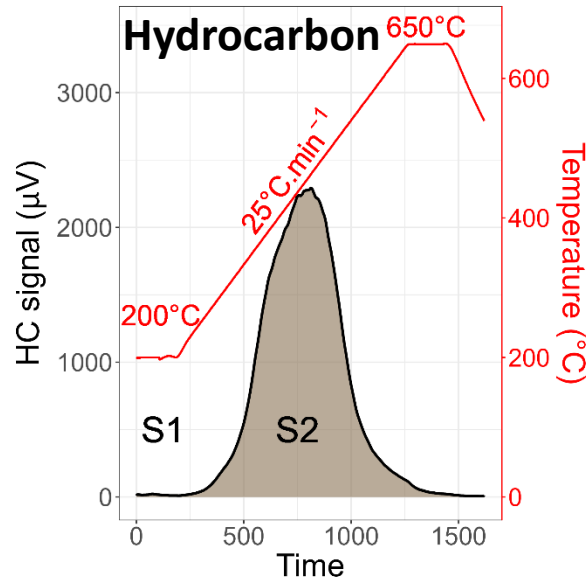
OXIDATION



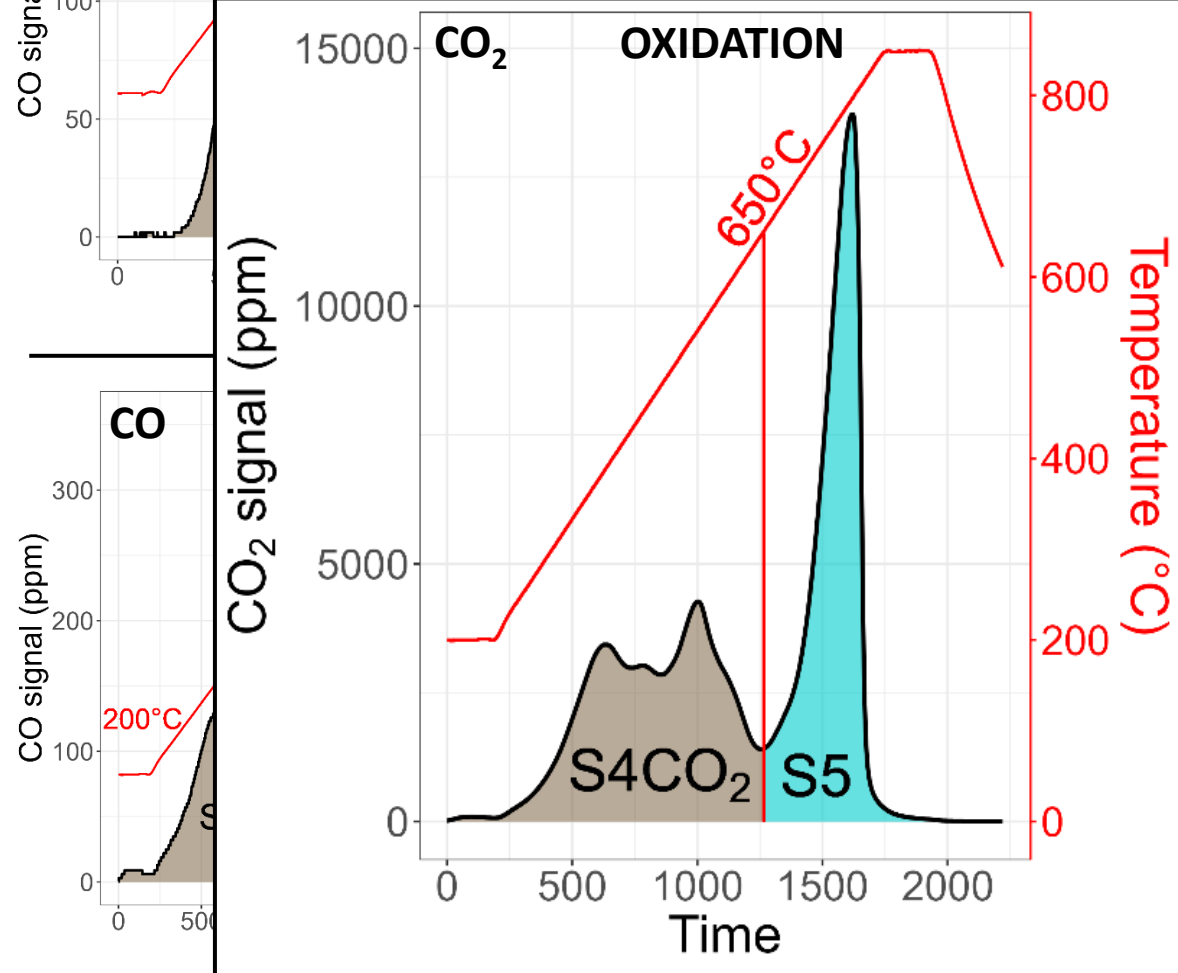
THE ROCK-EVAL® THERMAL ANALYSIS – STANDARD CYCLE (RE650)



PYROLYSIS



OXIDATION



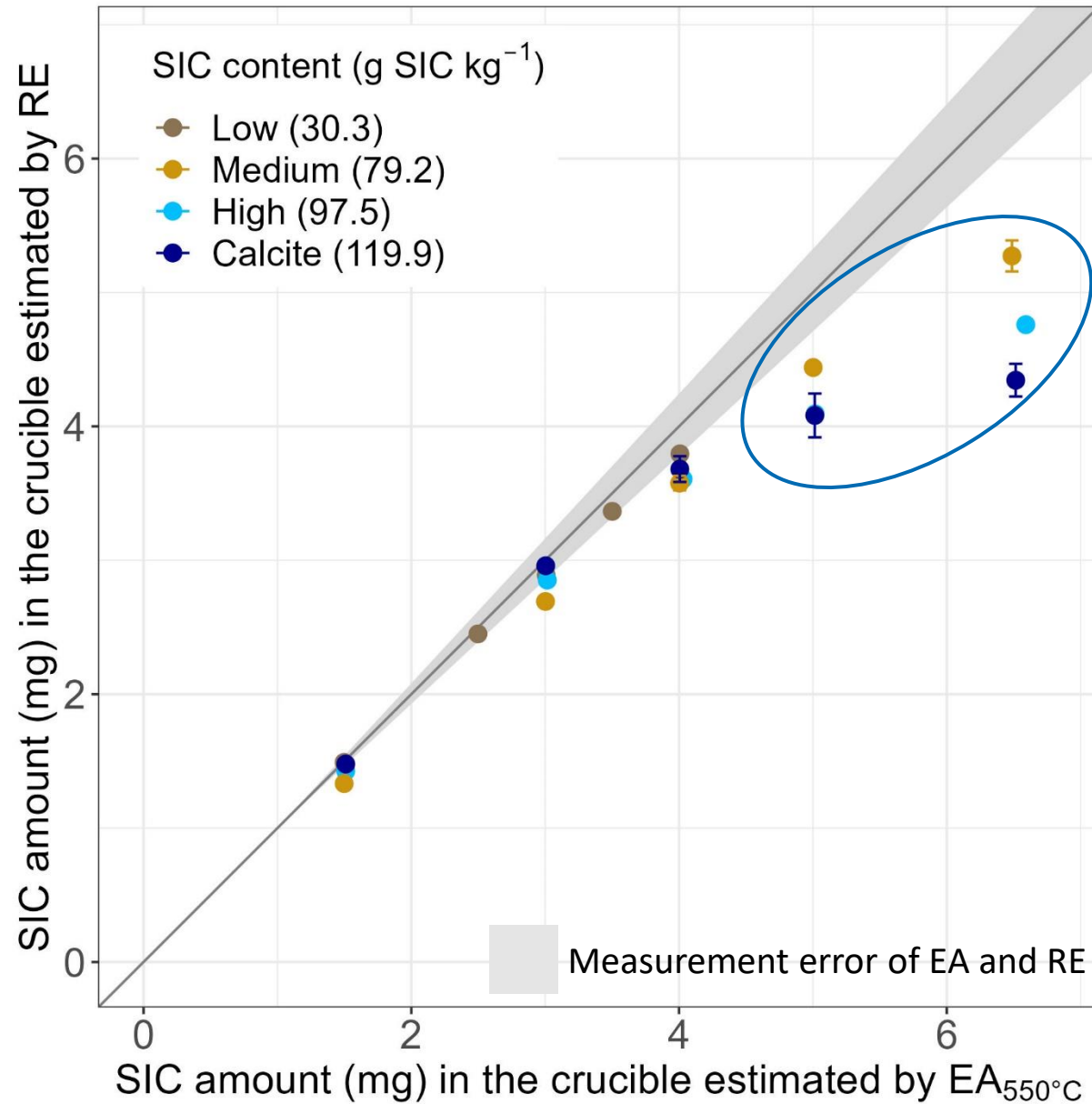
TOC = S1 + S2 + S3CO + ½ S3'CO + S3CO₂ + S4CO + S4CO₂

MINC = ½ S3'CO + S3'CO₂ + S5

TOC & MINC

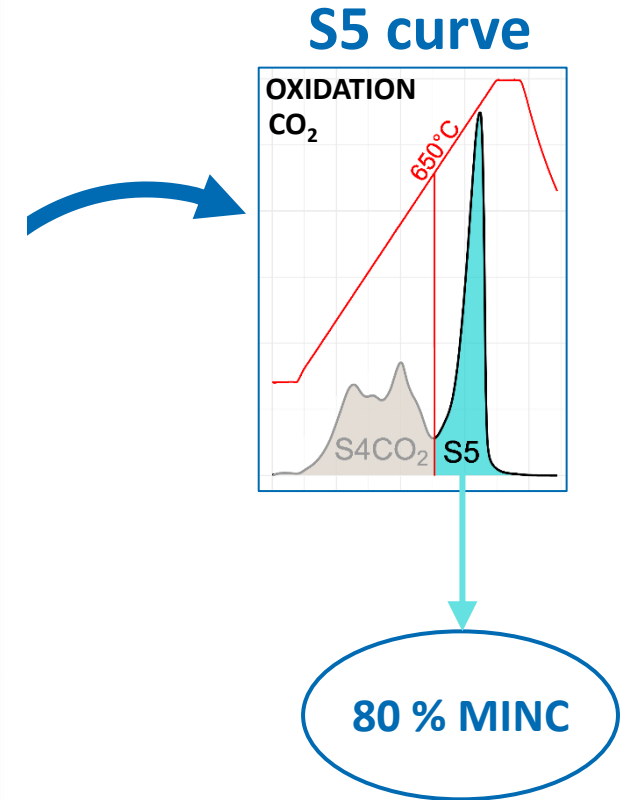
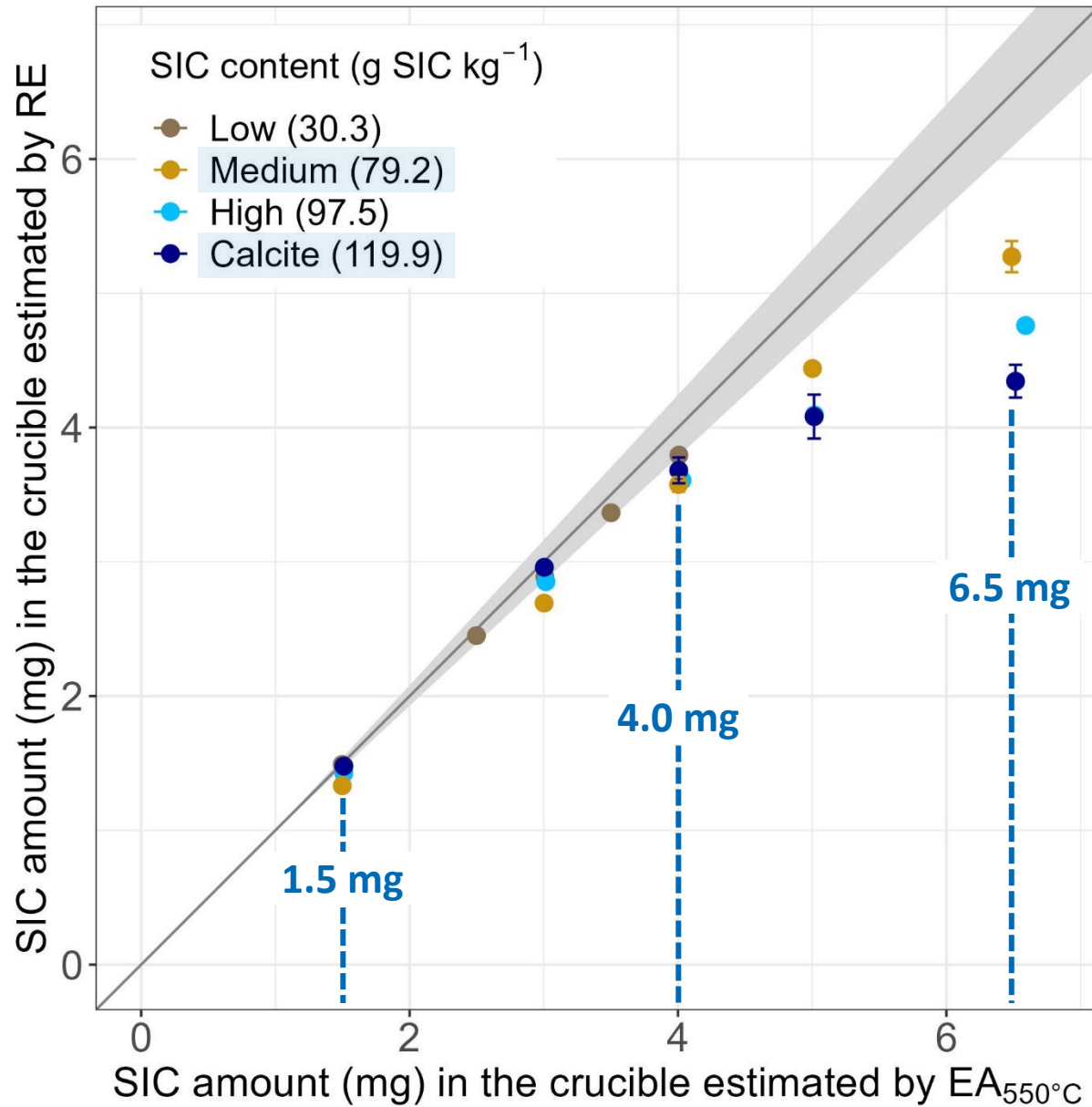
Problem of SIC quantification during oxidation

ADJUSTMENT OF THE OXIDATION PHASE



High SIC amounts systematically underestimated with the standard cycle

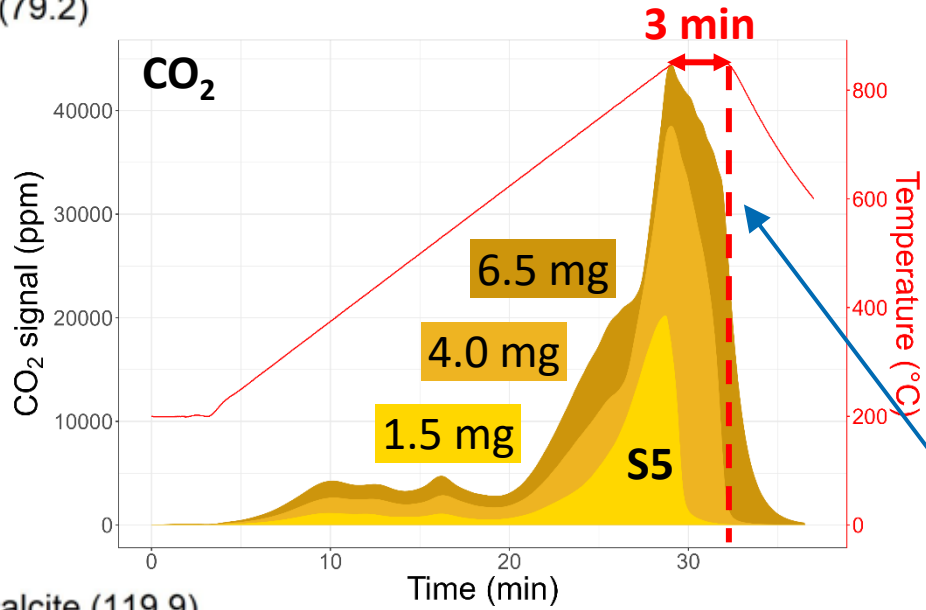
ADJUSTMENT OF THE OXIDATION PHASE



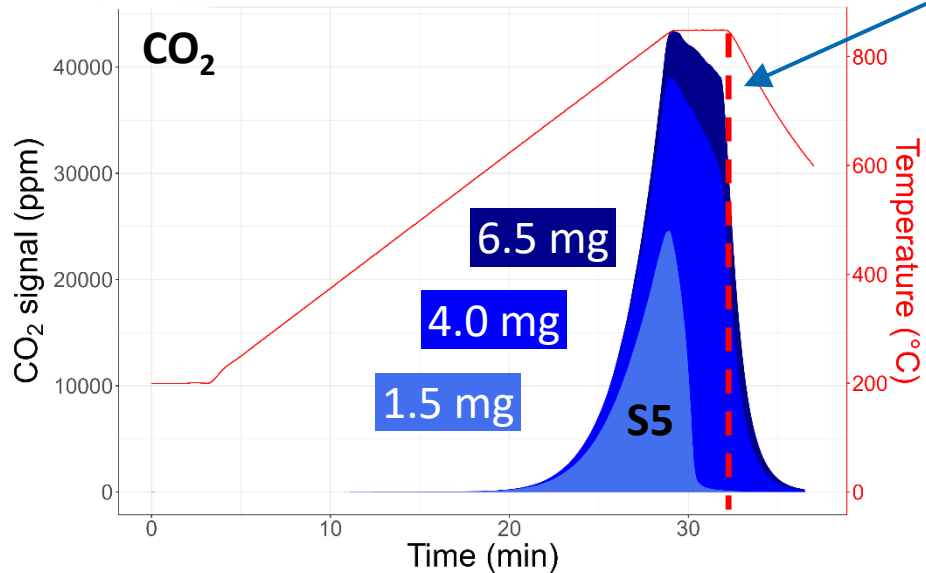
ADJUSTMENT OF THE OXIDATION PHASE



● Medium (79.2)



● Natural calcite (119.9)



Sudden drop of the CO₂ signal linked to the temperature decrease



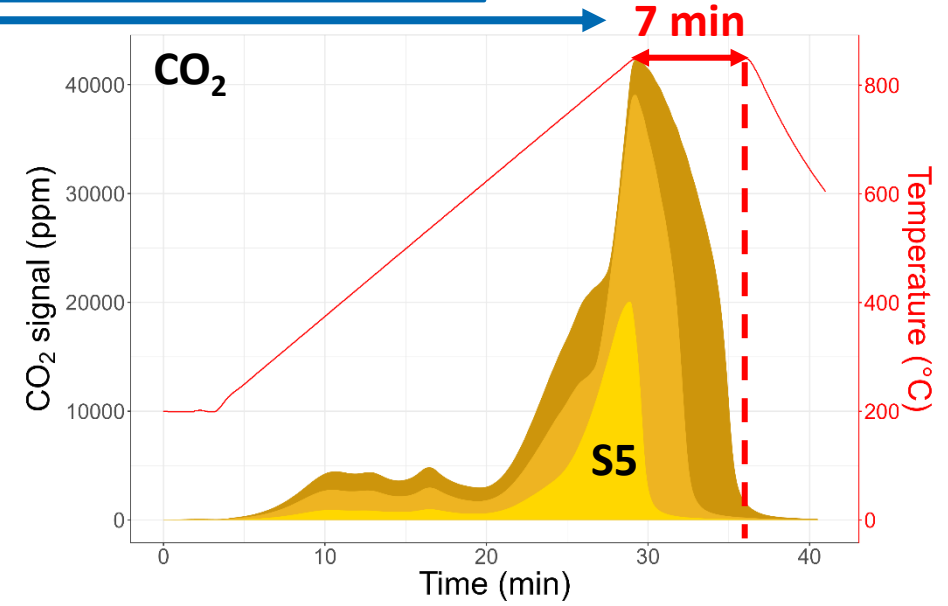
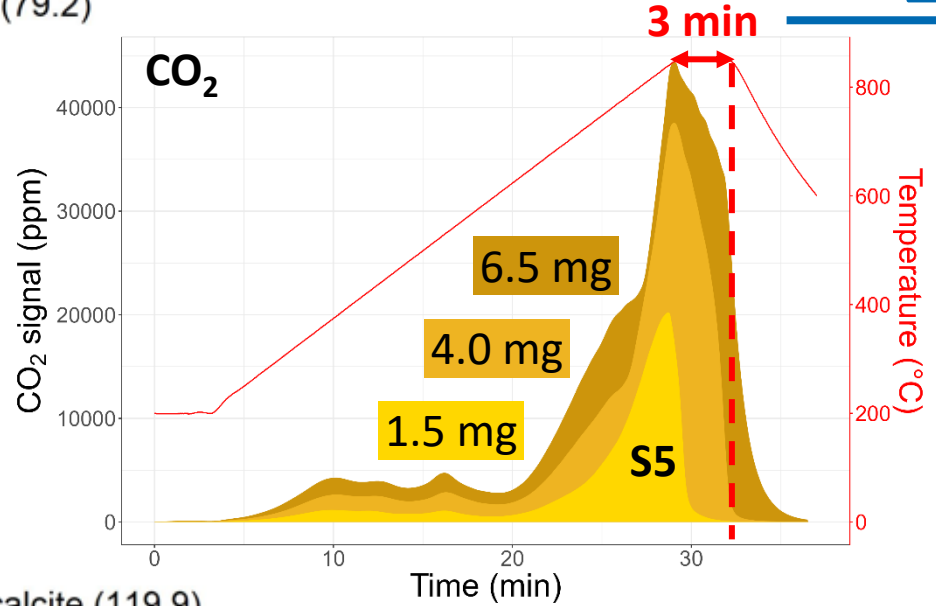
Incomplete SIC thermal decomposition

ADJUSTMENT OF THE OXIDATION PHASE

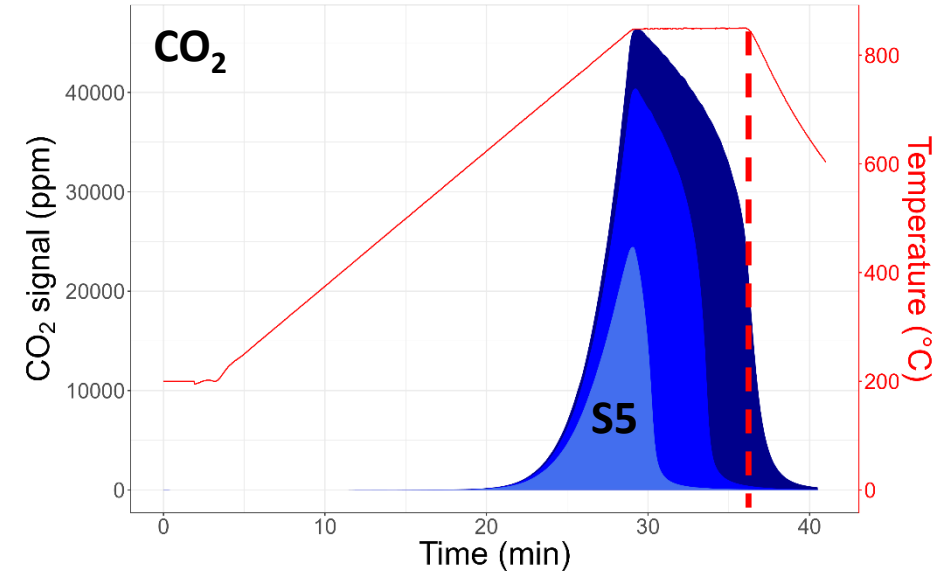
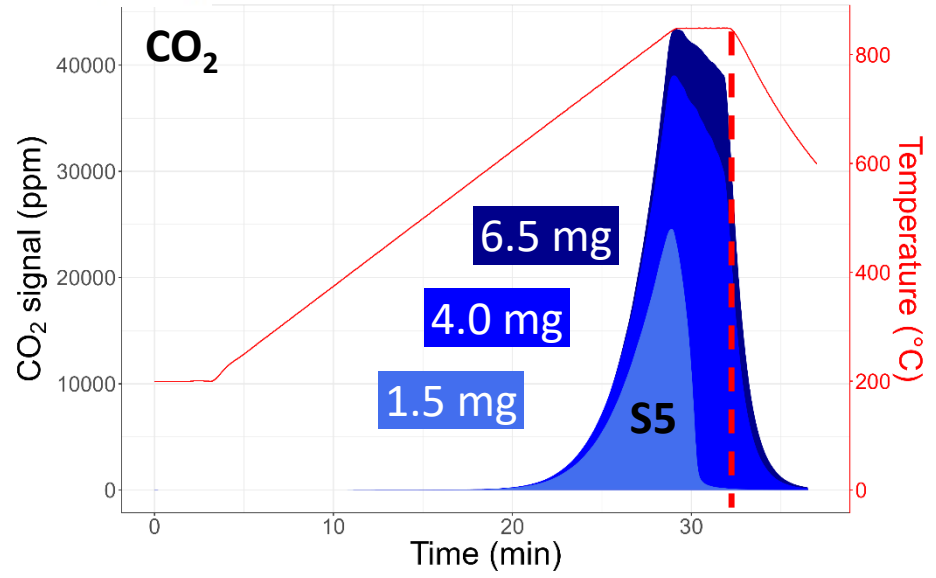


Extension of the final isotherm

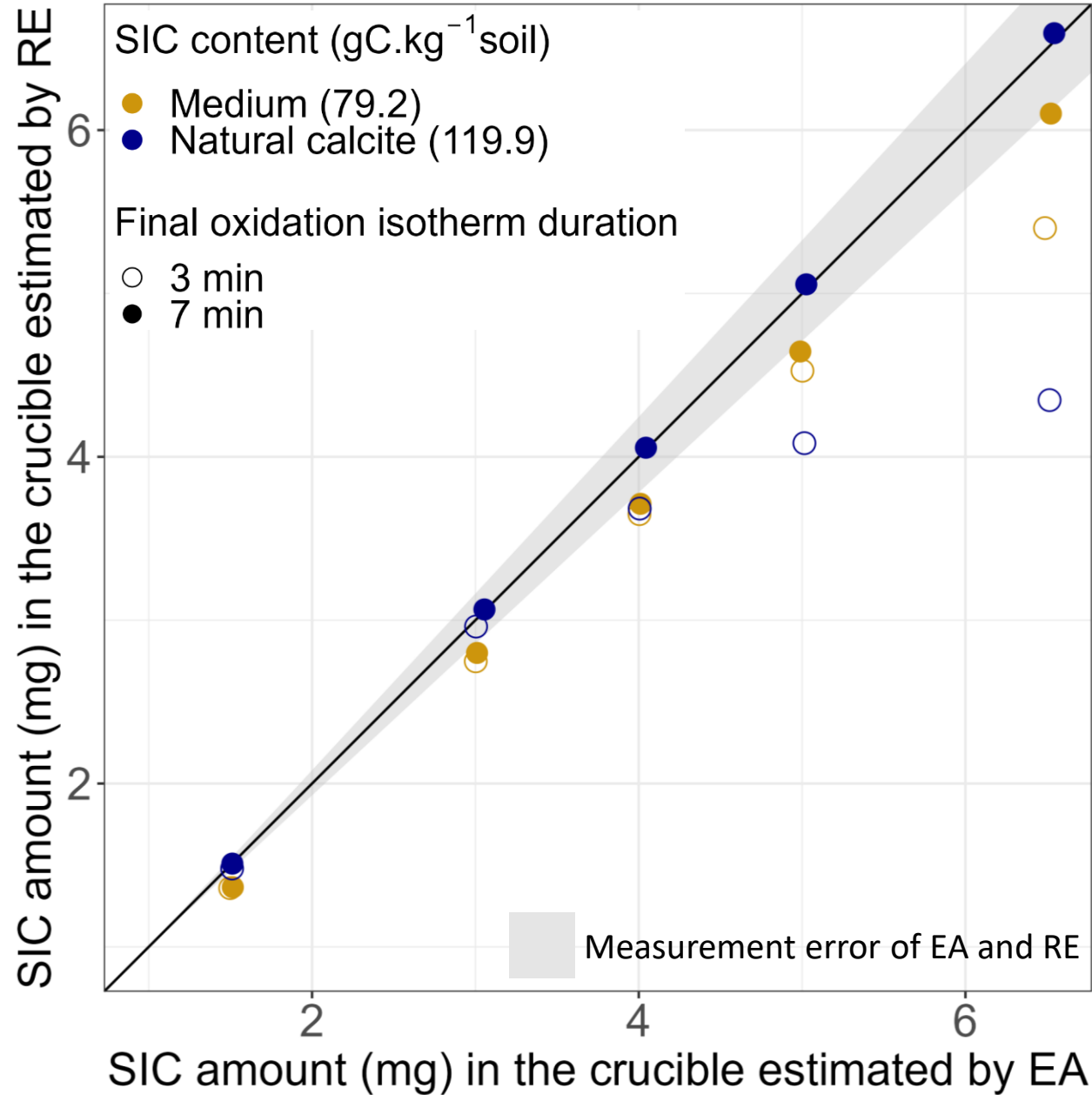
● Medium (79.2)



● Natural calcite (119.9)

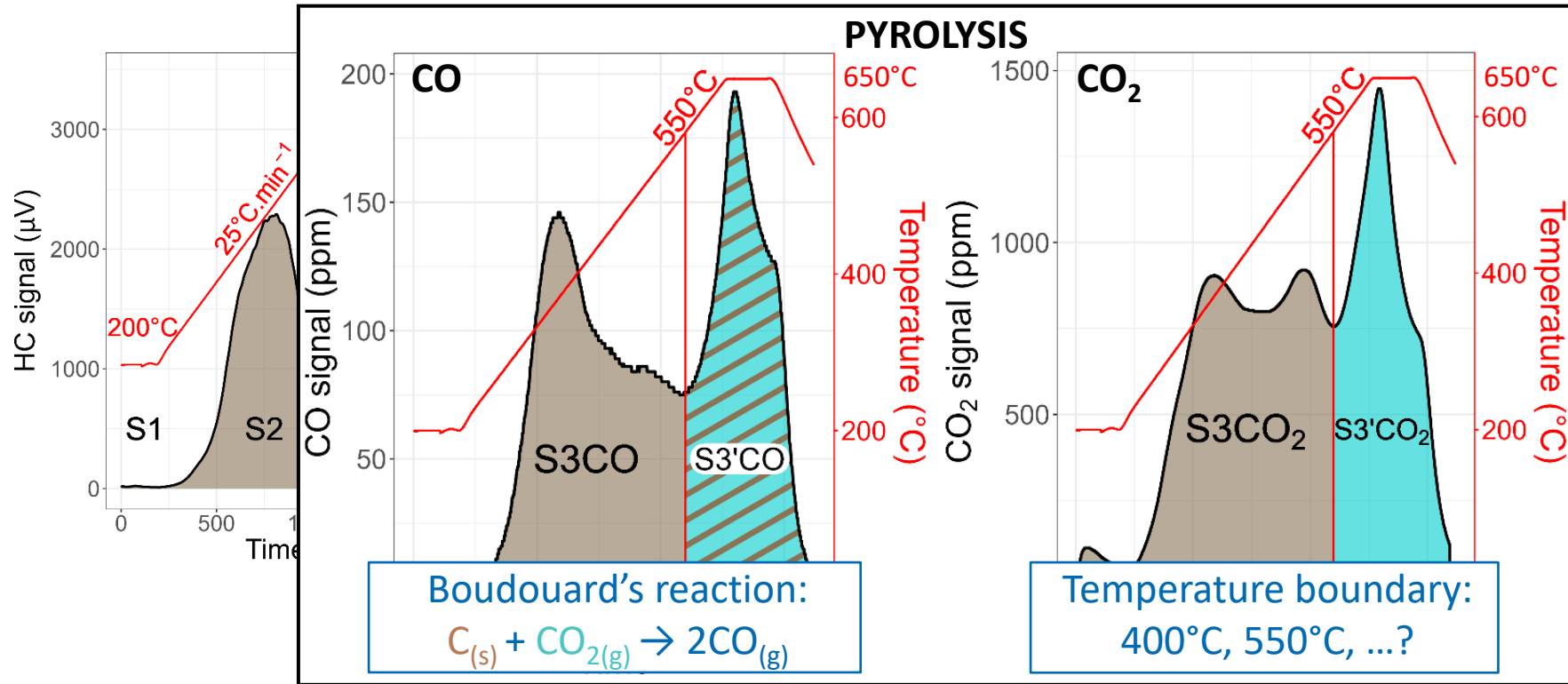


ADJUSTMENT OF THE OXIDATION PHASE



Completion of the SIC thermal decomposition

THE ROCK-EVAL® THERMAL ANALYSIS – STANDARD CYCLE (RE650)



Inaccuracies in SOC/SIC characterization during pyrolysis

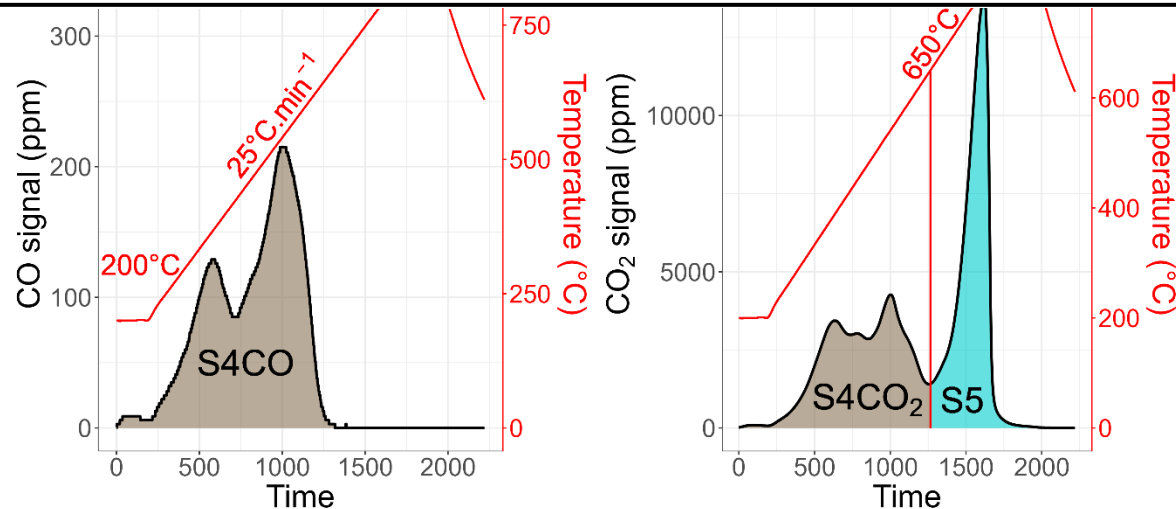
SOTHIS

$C_{org} = TOC + \alpha TOC$
 $C_{min} = MINC - \alpha TOC$

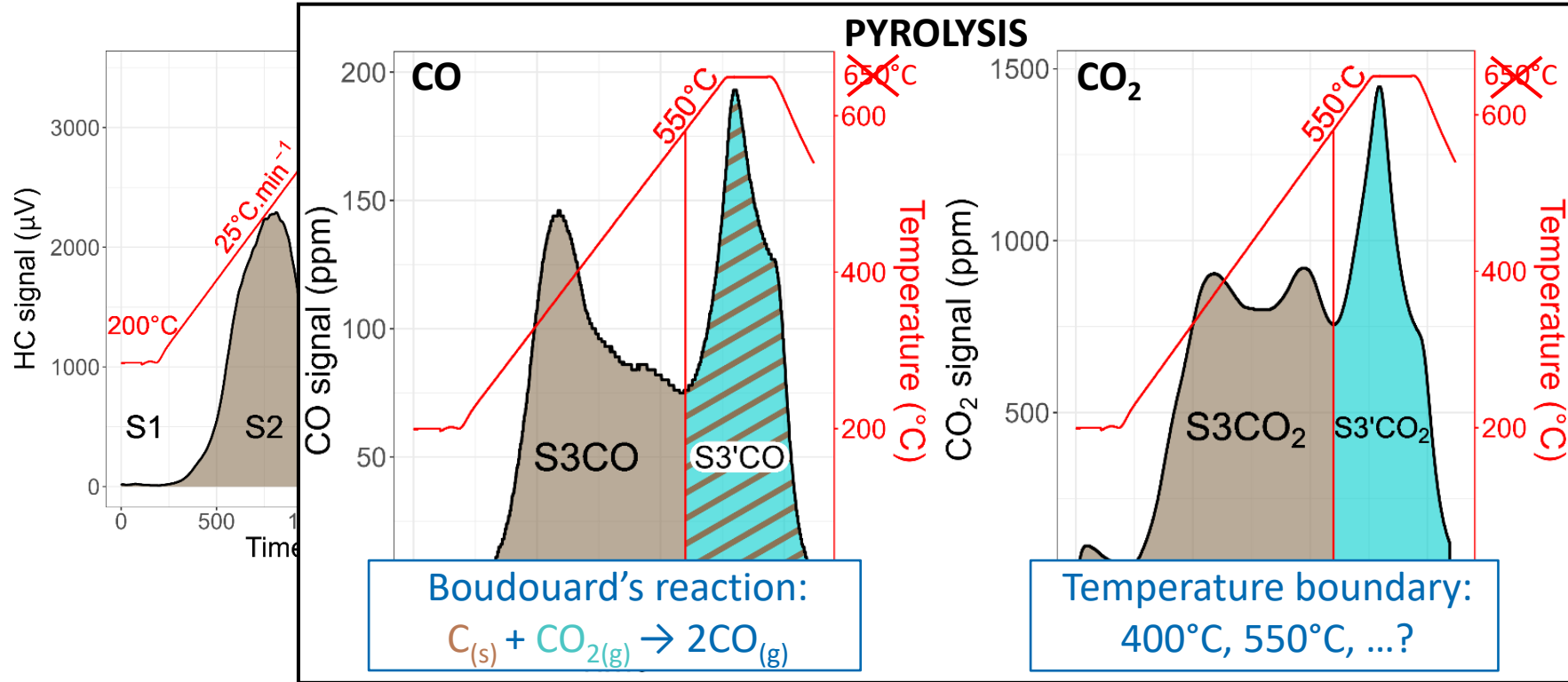
$TOC = S1 + S2 + S3CO + \frac{1}{2} S3'CO + S3CO_2 + S4CO + S4CO_2$

$MINC = \frac{1}{2} S3'CO + S3'CO_2 + S5$

TOC & MINC



THE ROCK-EVAL® THERMAL ANALYSIS – STANDARD CYCLE (RE650)

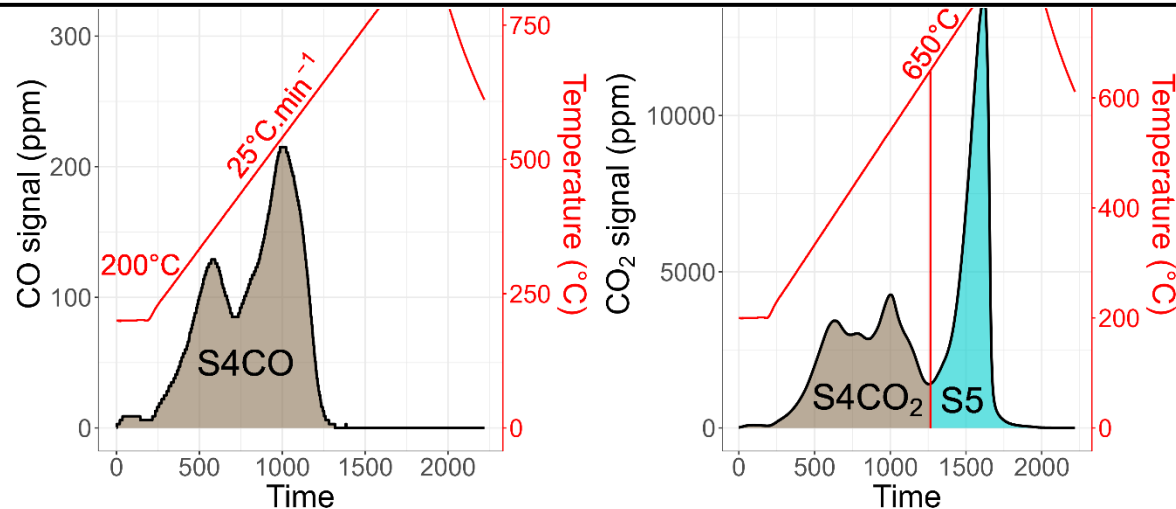


Inaccuracies in SOC/SIC characterization during pyrolysis

TOC = S1 + S2 + S3CO + $\frac{1}{2}$ S3'CO + S3CO₂ + S4CO + S4CO₂

MINC = $\frac{1}{2}$ S3'CO + S3'CO₂ + S5

TOC & MINC



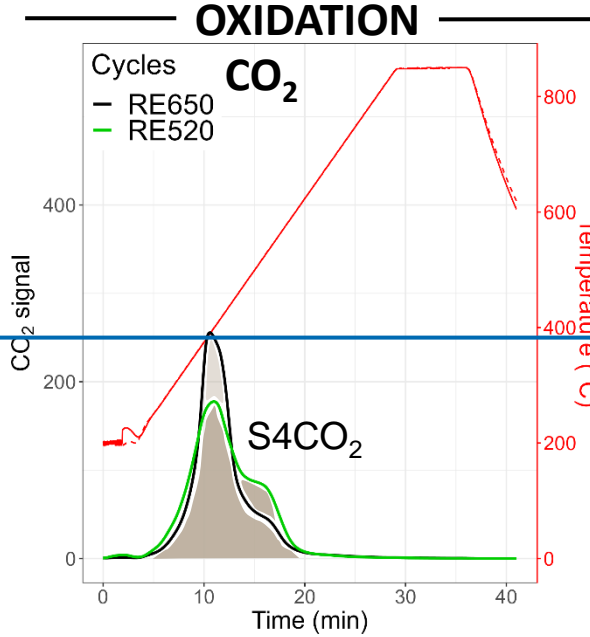
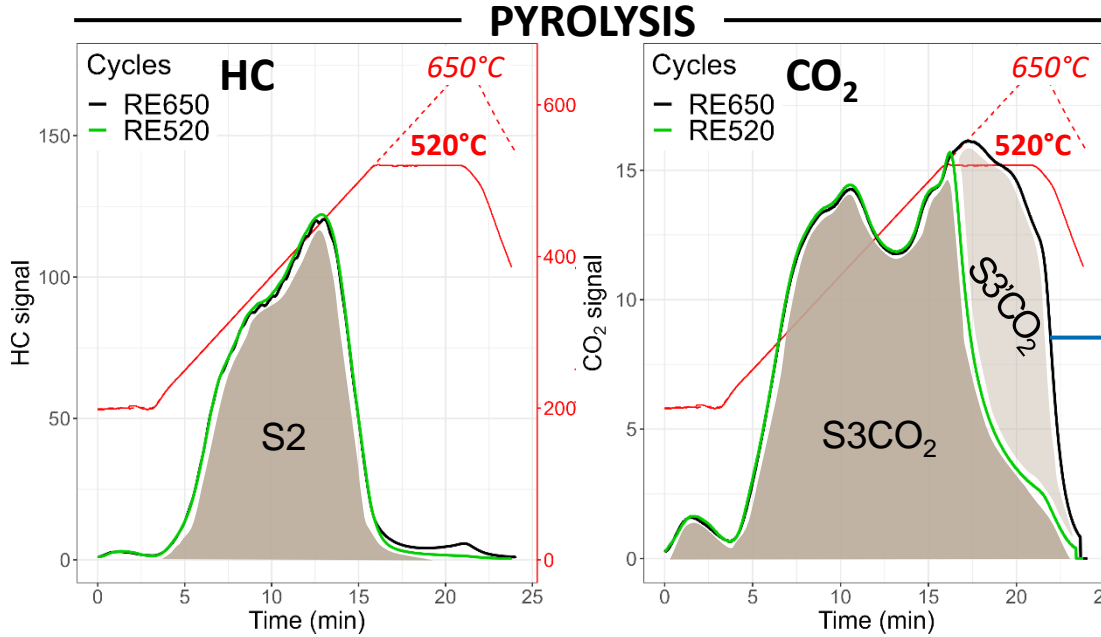
~~SOTHIS~~
~~C_{org} = TOC + α TOC~~
~~C_{min} = MINC + α TOC~~

520°C

ADJUSTMENT OF THE PYROLYSIS PHASE

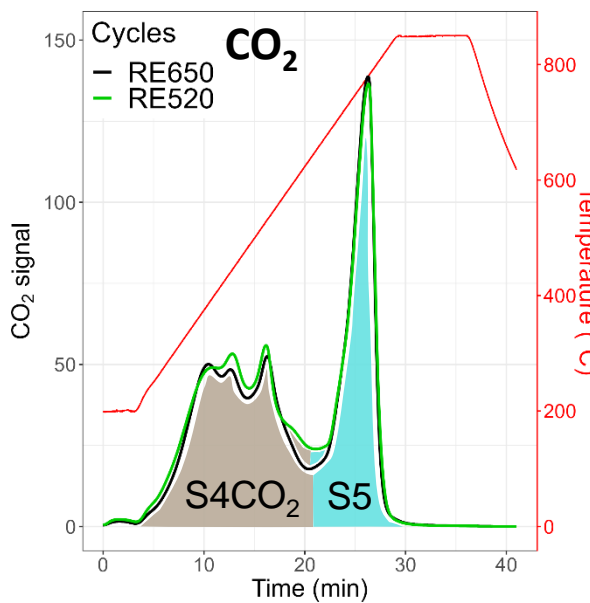
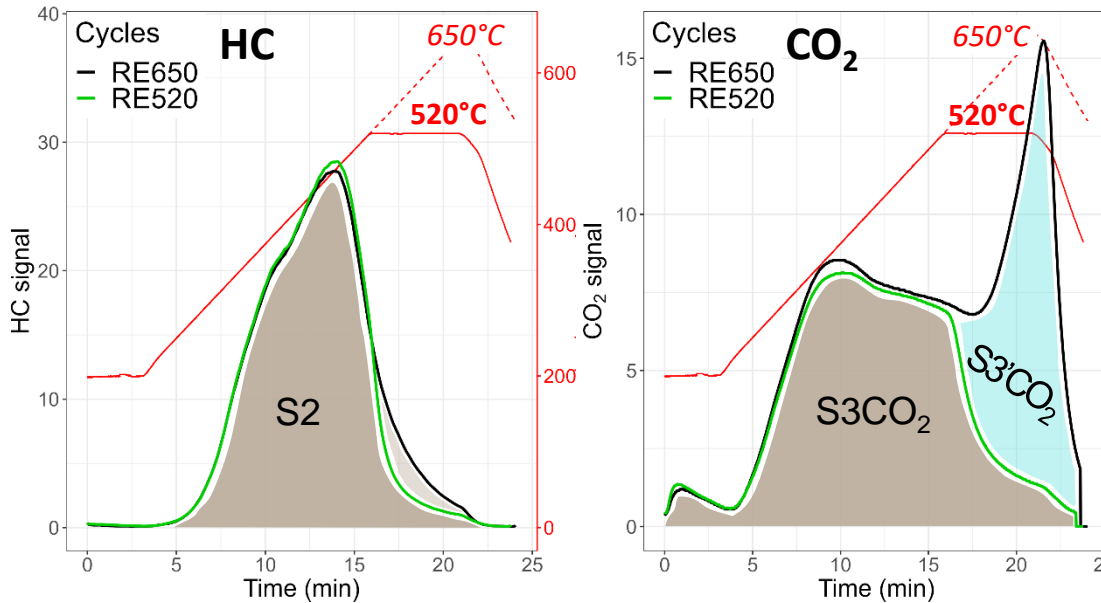


NON-CALCAREOUS



Thermoresistant OM decomposition after 550°C

CALCAREOUS



✓ Negligible HC losses
✓ SIC decomposition avoided

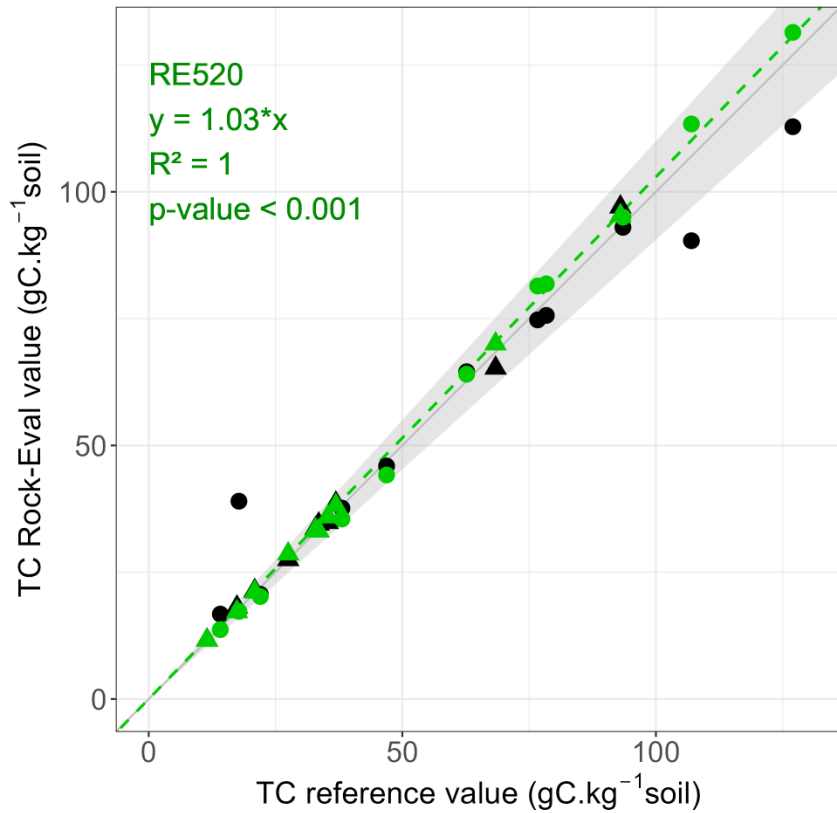
ADJUSTMENT OF THE PYROLYSIS PHASE



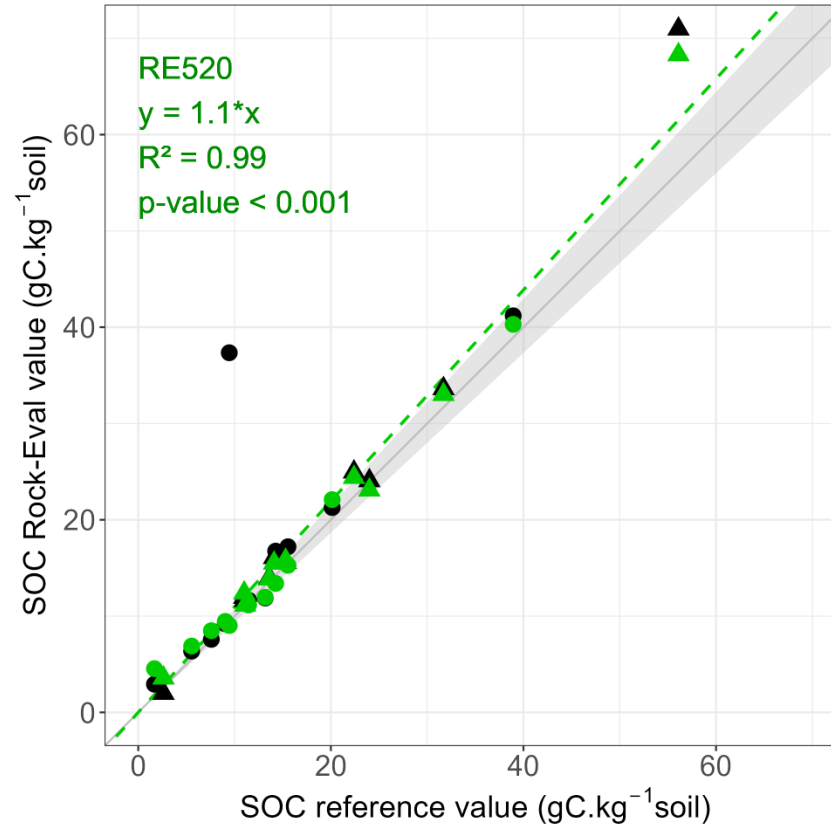
Parameters from **RE520** or **RE650** + statistical corrections vs reference values

▲ Geostandard samples, ● Soils

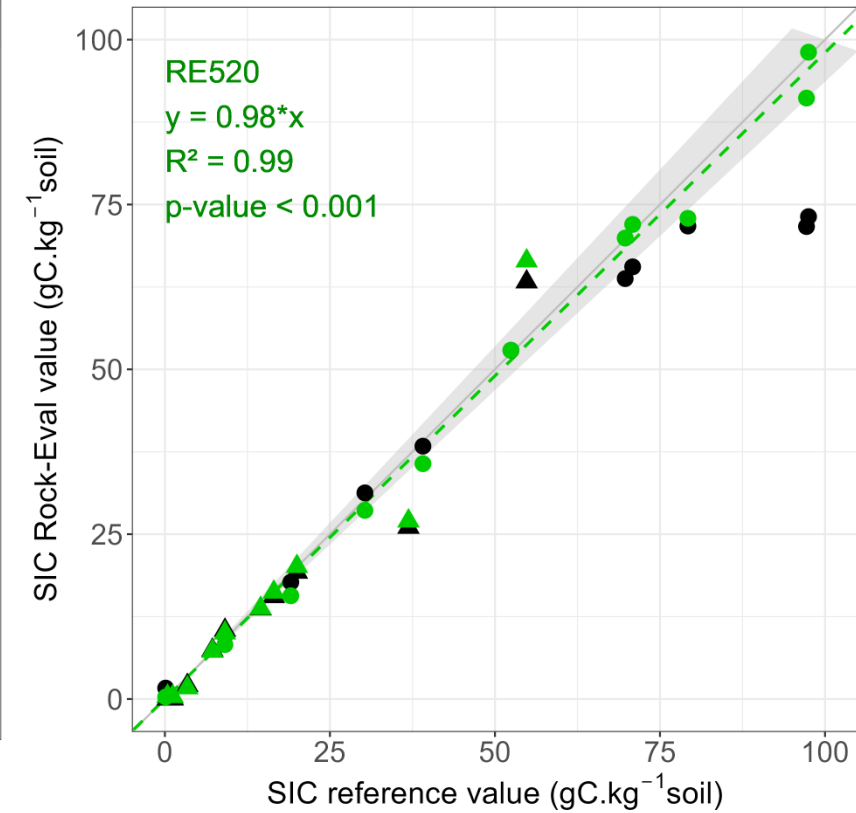
TC = TOC + MinC



TOC



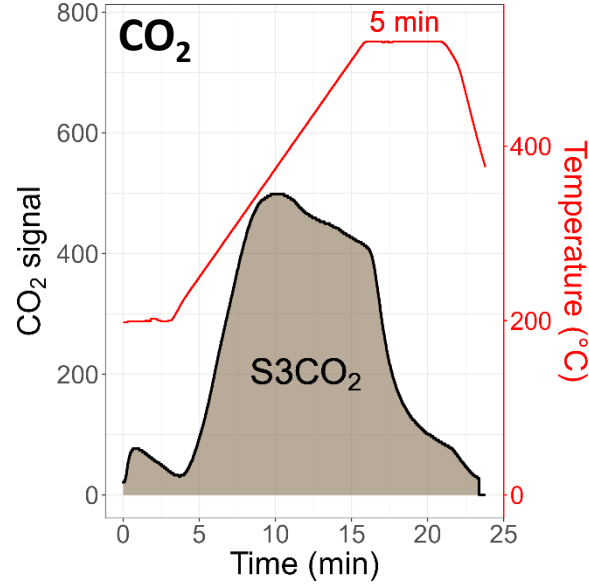
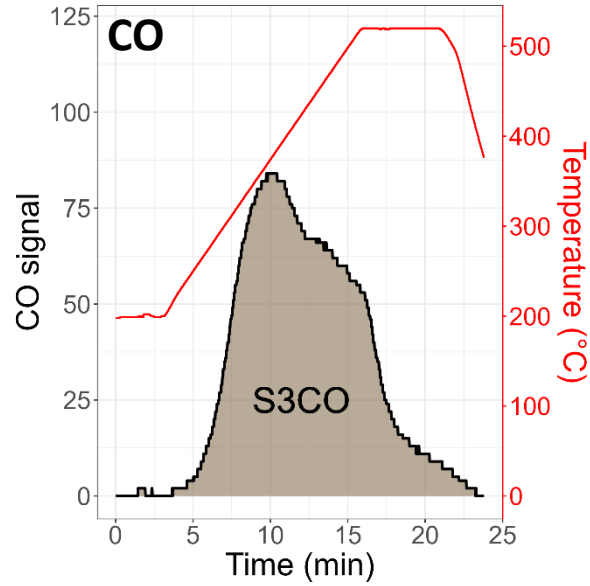
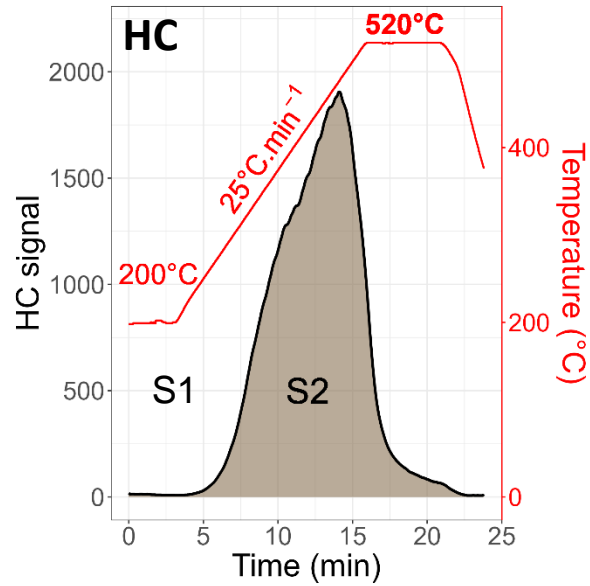
MINC



THE ROCK-EVAL® THERMAL ANALYSIS – NEW CYCLE (RE520)



PYROLYSIS

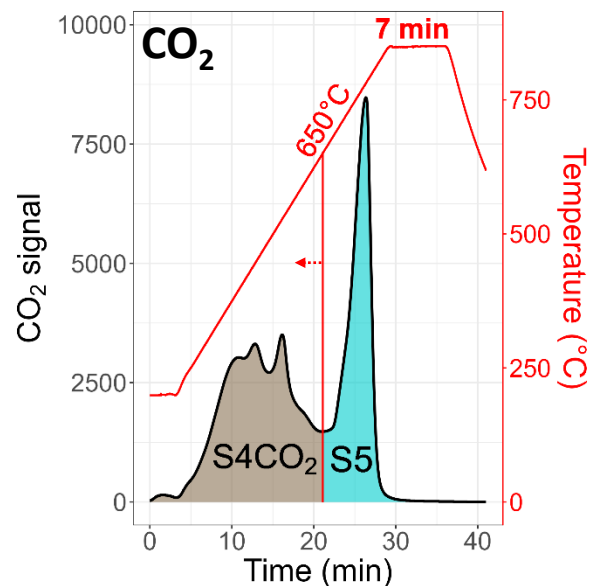
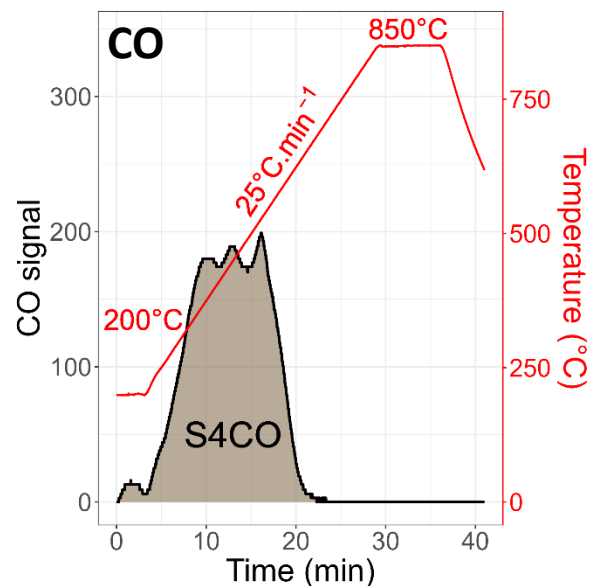


RE520

Low temperature pyrolysis



OXIDATION



Extended oxidation

TOC = S1 + S2 + S3CO + S3CO₂ + S4CO + S4CO₂

MINC = S5



Thank you for your attention!

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Poster: Romero-Sarmiento et al.: Rock-Eval[®] device for characterization of environmental samples: methods, insights, and applications.

Article: Hazera et al.: Adjustments of the Rock-Eval[®] thermal analysis for soil organic and inorganic carbon quantification, Biogeosciences, 2023

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