

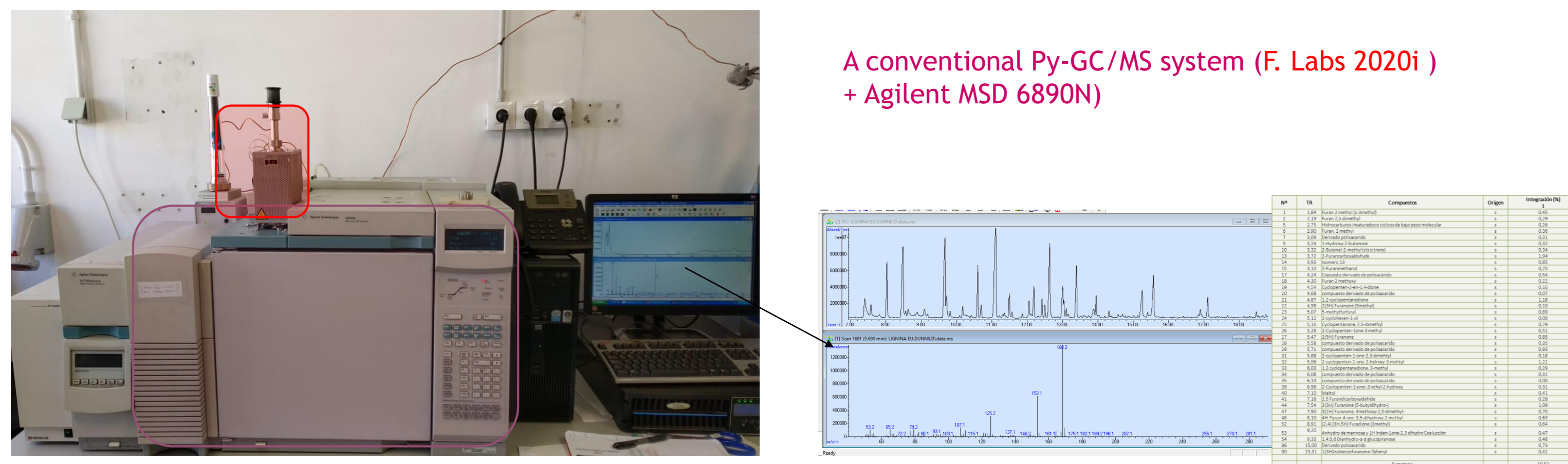
Pyrolysis-compound specific isotope analysis (Py-CSIA) is a relatively novel analytical technique able to provide identification of organic compounds in different complex matrices [1, 2]. This technique also offer additional valuable information about nature and origin of the materials based on their isotopic composition. With this technique it is possible to make direct isotopic measurements of major organic matter elements (i.e. $\delta^{13}C$, δD , $\delta^{15}N$ and also $\delta^{18}O$) of specific compounds.

1 BACKGROUND

- ▶ Cultural heritage hold an artistic, social and economic value.
- ▶ Isotopic analysis provide a better understanding of decay and deterioration.
- ▶ This information allows to design effective conservation methodologies, as well as ensure long-term management strategies.
- ▶ Accurate isotopic characterization of organic materials, including polymers and biopolymers used in the past as construction, supporting or protective materials, will help to ameliorate the conservation practices for controlling deterioration and preventing key and current issues such as pollution, climate change.

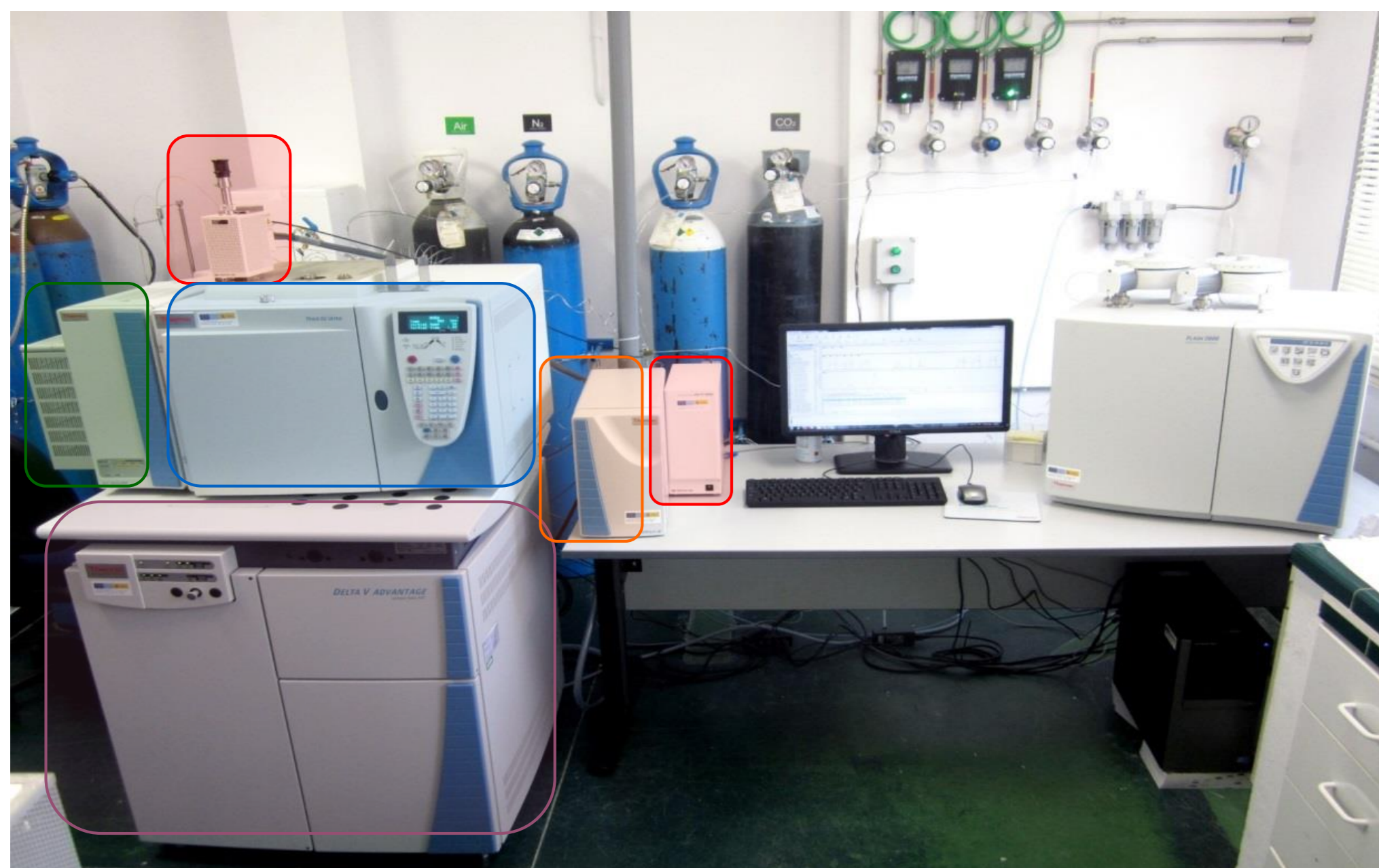
2 METHODOLOGY: OUR INSTRUMENTS

Py-GC/MS: provides structural information



A conventional Py-GC/MS system (F. Labs 2020i) + Agilent MSD 6890N

Py-GC-C/TC-IRMS: provides isotopic information ($\delta^{13}C$ δD $\delta^{18}O$ $\delta^{15}N$)



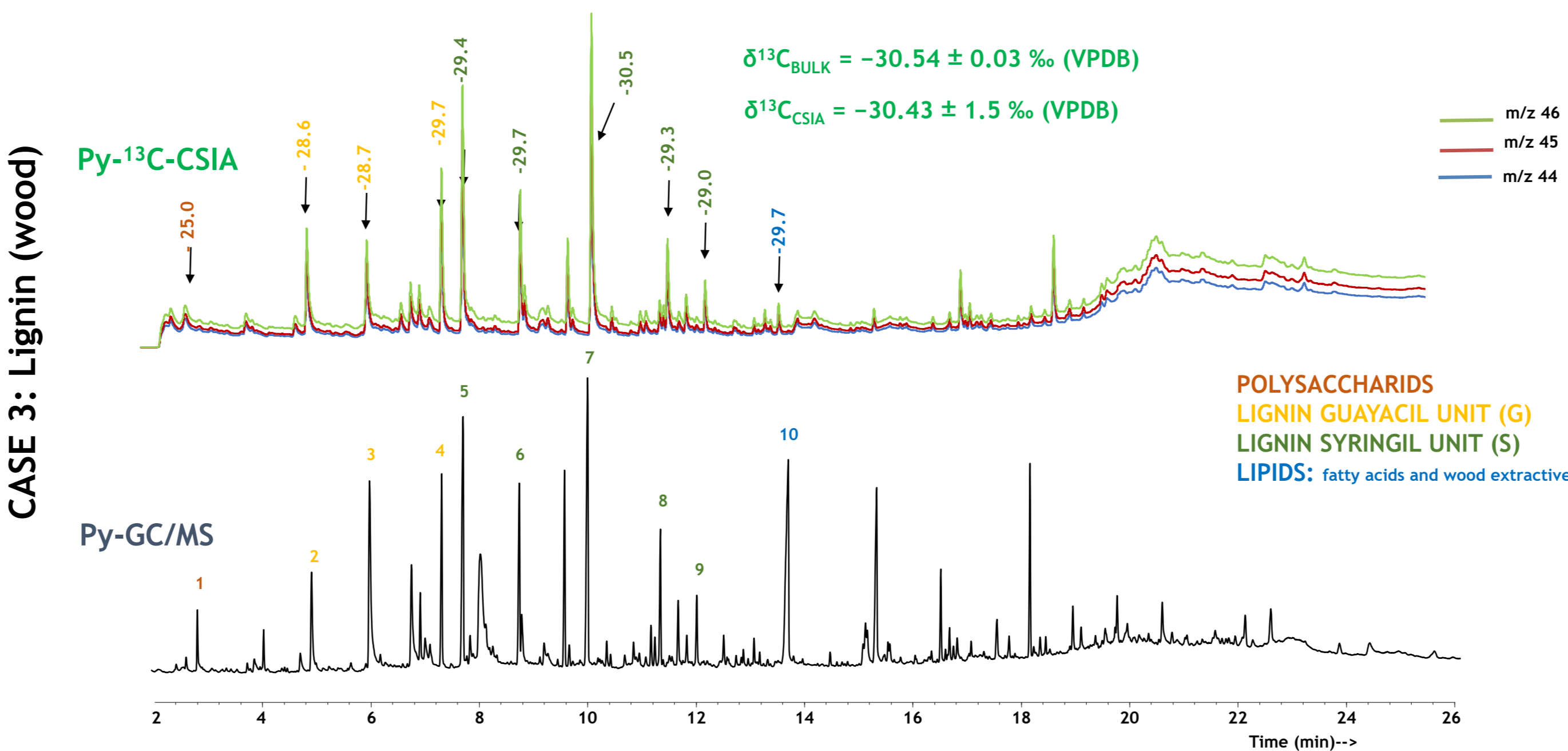
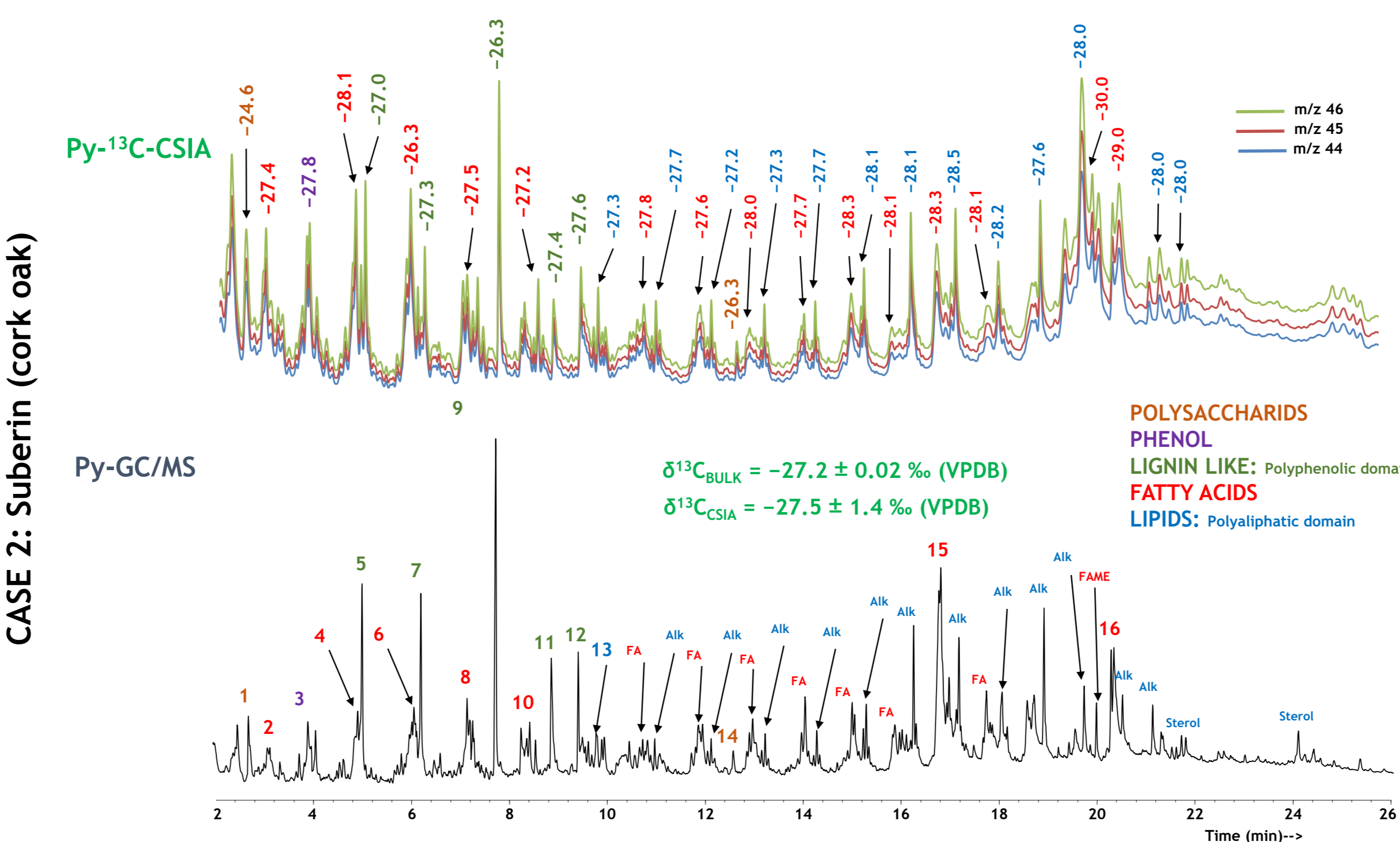
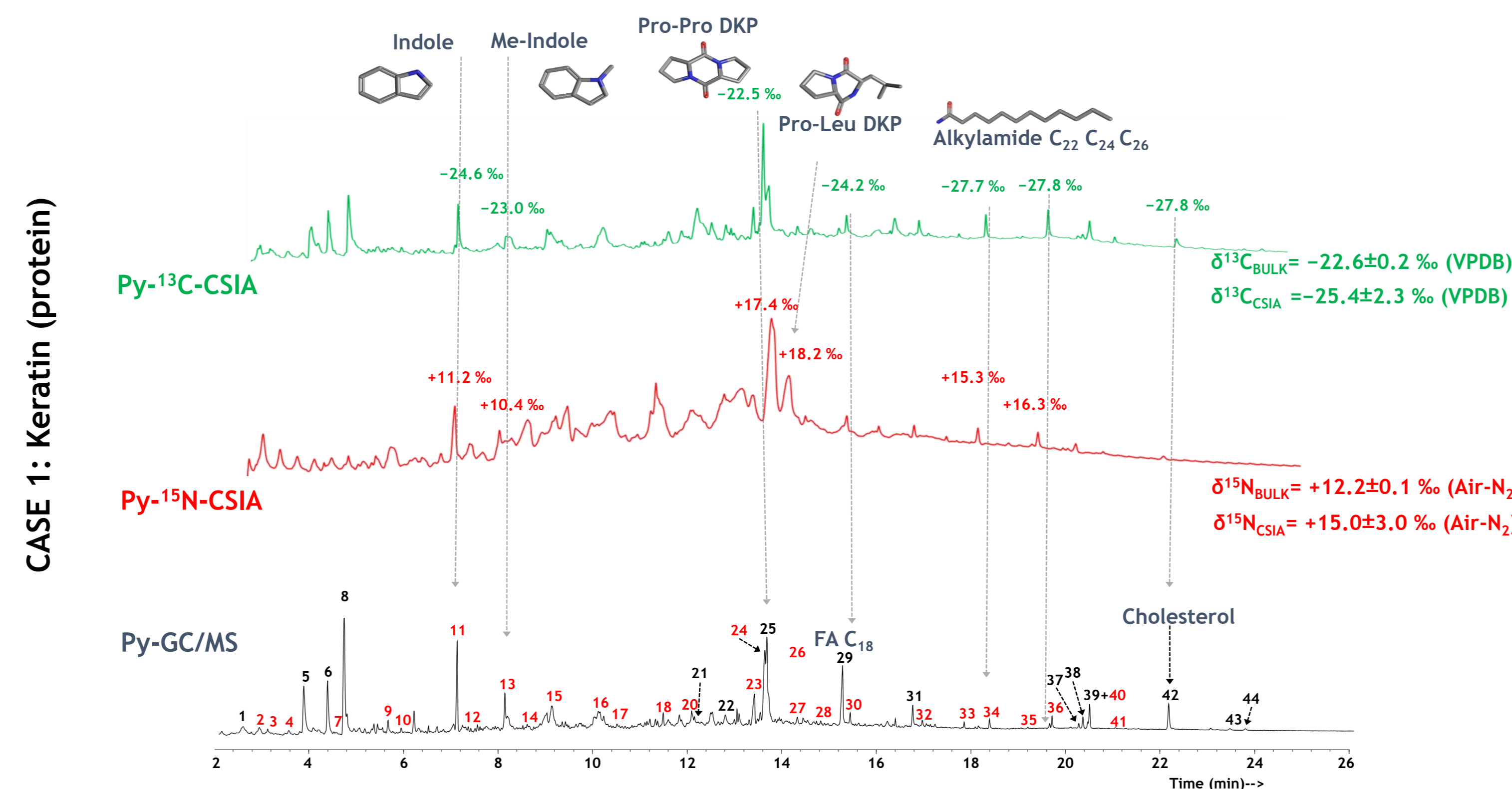
A double-shot/micro-furnace pyrolyzer (Frontier Laboratories, model 3030D).

Gas chromatograph (Trace Ultra GC system).

Coupled to isotope ratio mass spectrometer, IRMS (Thermo Delta V Advantage) via a ConFlo IV universal interface unit.

Individual volatile pyrolysis products separated by GC are directed to GC-Isotink System with combustion (C and N) and pyrolysis (H or O) micro-furnaces.

3 Py-CSIA BIOPOLYMERS: FINGERPRINTINGS



4 APPLICATIONS

- $\delta^{13}C$**
 - Diet for humans and nutritional ecology [3].
 - Trace of ancient pottery: degraded lipids preserved [4].
 - Paleoenvironment and climate changes: e.g. dendrology.
 - Identification of dominant mode of rock formation: e.g. origin of carbonates [5].
- $\delta^{15}N$**
 - Trophic levels.
 - Evaluations of both diet pattern and provenances [3].
 - Elucidate agricultural production means.
 - Pollution tracers (atmospheric contamination).
- $\delta^{2}H$ + $\delta^{18}O$**
 - Both elements are linked to water; therefore, they are complimentary.
 - Constraints on environmental processes: e.g. water scarcity in plants.
 - Migration among humans, animals and plants: biogeography.
 - Water uptake, which depends on altitude and latitude.
 - Thus, it can be used to trace a geographic origin of organic materials [6].
 - Paleo-thermometry.

5 HIGHLIGHTS

- ✓ Small sample size: only a few milligrams of a single sample are required for a determination.
- ✓ Time saving: no pre-treatment nor extraction procedures are generally needed.
- ✓ Less handling: avoid experimental errors.
- ✓ Good reproducibility.
- ✓ Complex materials or mixtures (including biopolymers), with varying structures and origins can be analyzed.
- ✓ By using Py-CSIA, key compounds of heritage material for their conservation can be characterized.
- ✓ Py-CSIA results in an innovative approach in heritage science, providing tools for decision-makers in this field.

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