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INTRODUCTION



Global warming:

- Increase in global average temperature
- Rise in average sea level
- Increase in greenhouse gas emissions (GHG)
- Higher frequency of extreme weather events
- Loss of biodiversity

variable climatic conditions



Study of the **compatibility of thermal energy storage (TES) material** with the climate zone

allows

Climate-adapted TES

materiales for energy conservation, reduction of GHG emissions, and adaptation to and mitigation of climate change

for

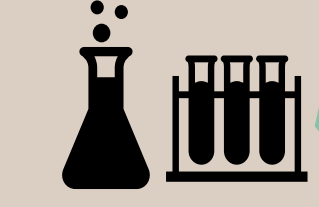
Applications:

- Comfort in buildings and vehicles
- Refrigeration for transport.
- Greenhouses.
- Waste heat recovery

CLIMATE-ADAPTED THERMAL STORAGE MATERIALS THESIS PHASES:



1 Historical and future climate analysis for the appropriate selection of TES materials by climate zone



2 Development of new formulations for PCMs: encapsulation, addition of additives such as enhancing agents to improve their thermophysical properties



3 Characterization of new materials for thermal energy storage from waste and natural products

METHODOLOGY

1 Historical and future climate analysis for the appropriate selection of TES materials by climate zone

Data collection and processing
Database used: IPCC AR6 Scenarios PNACC
Available period: 1950-2100

Variables studied: Tmin, Tmax, Tavg.
Indices studied: Heating Degree Days (HDD), Cooling Degree Days (CDD)

Thermal climate clustering

Selection of TES materials by zone

Visualisation and analysis: maps, trends...

2 Development of new formulations for PCMs: shape stabilized PCMs (SS-PCMs) by Cold Sintering Process (CSP)

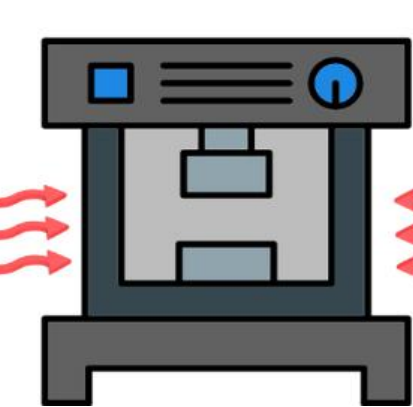
PCM: Tetradecylamine (TDA)



Matrix: Al₂O₃ or MgO

CSP

SS-PCM



Characterisation:

TGA
DSC
XRD
FTIR
LFA
SEM

3 Characterisation of new materials for thermal energy storage from natural products: vegetable oils (VOs):



VOs analysed: sunflower, corn, linseed, sacha inchi, sesame, soya bean, olive oils

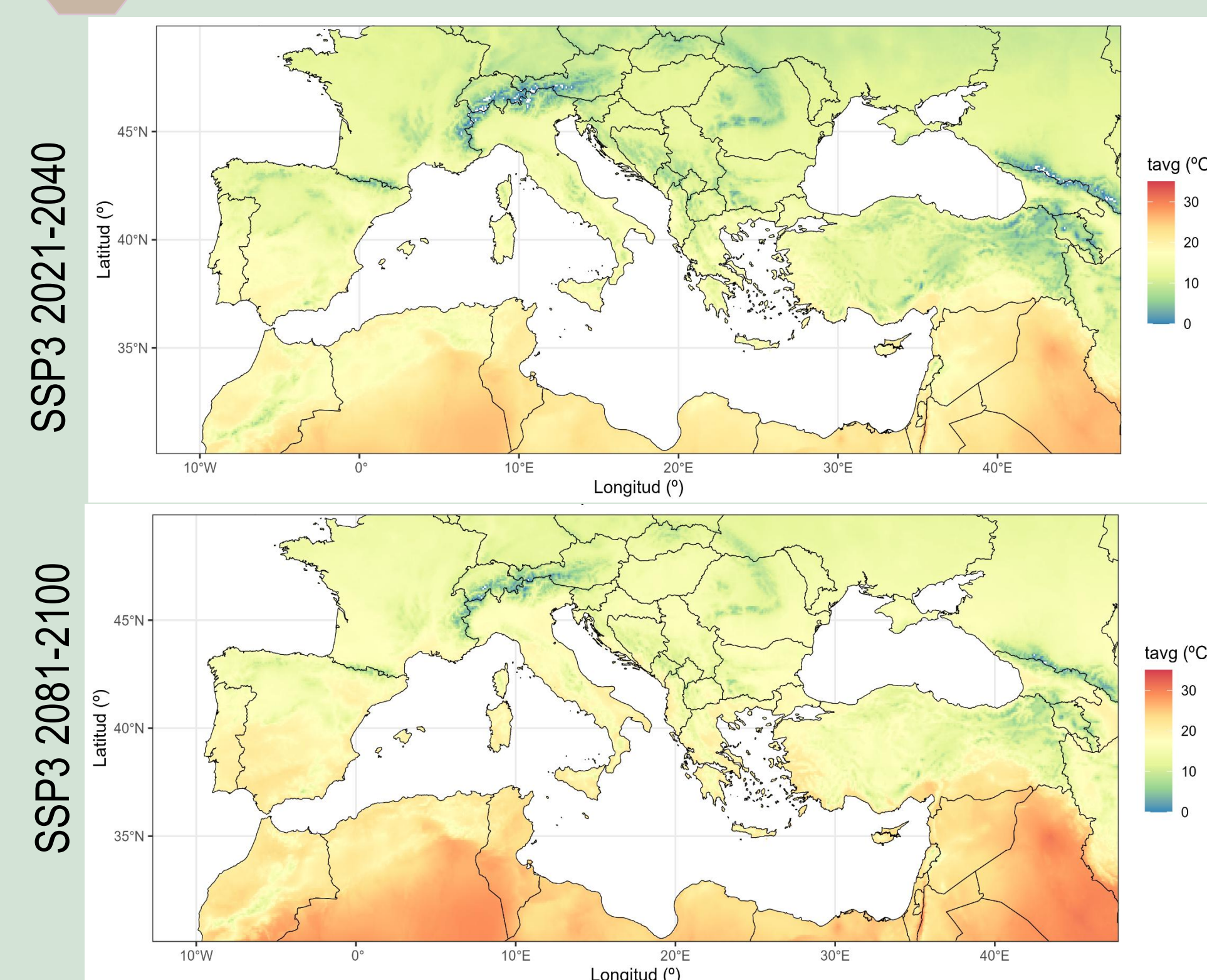
Composition analysis: FTIR (400-4000 cm⁻¹) and gas chromatography (prior to the methylation process)

Thermogravimetric analysis and degradation products: STA-FTIR (25-700 °C, 10 °C/min; N₂ Flow)

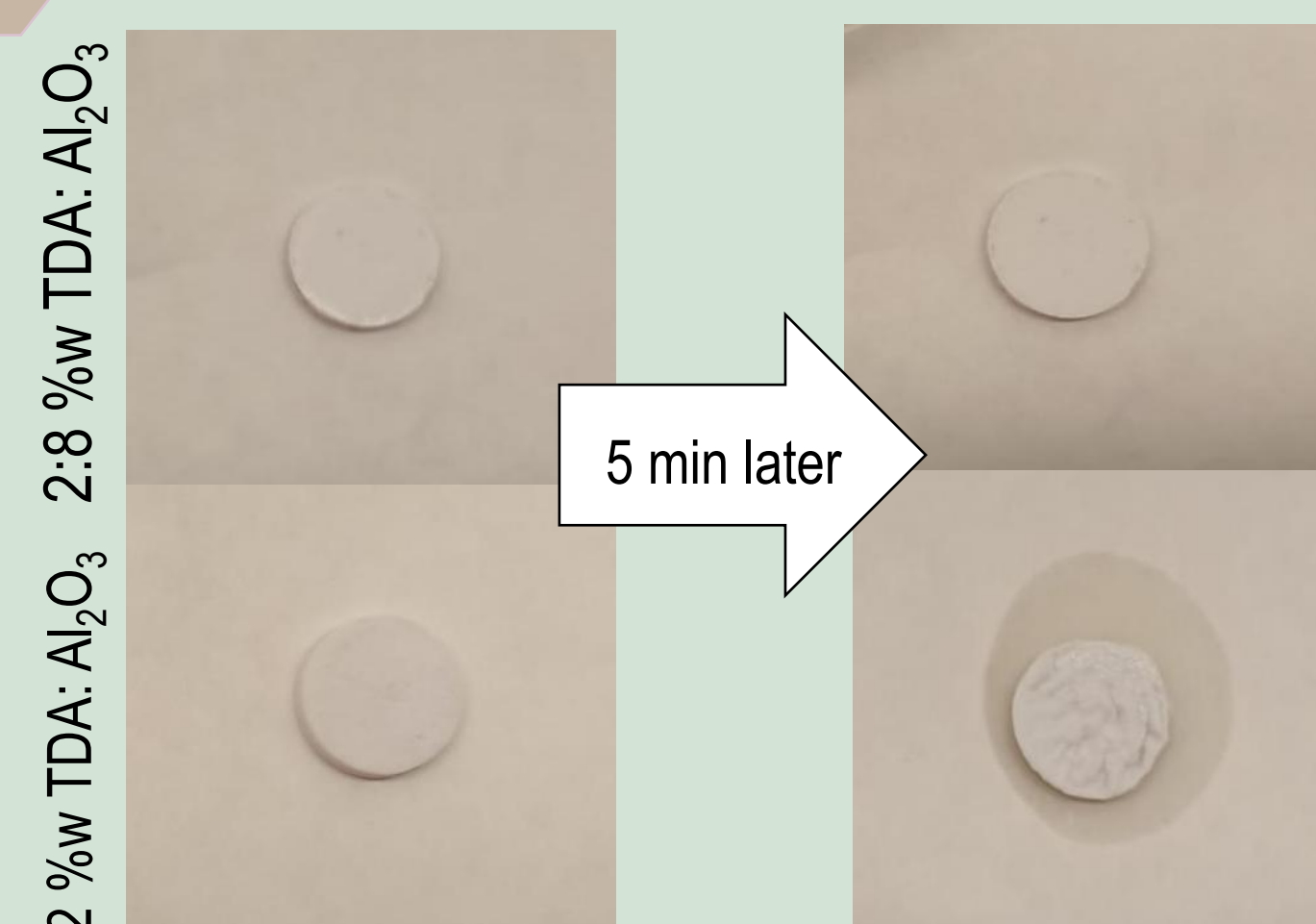
Thermal properties: DSC (-70 to 20 °C, 5 °C/min; N₂ Flow) and LFA (at 0, 5, 10, 20°C)

RESULTS

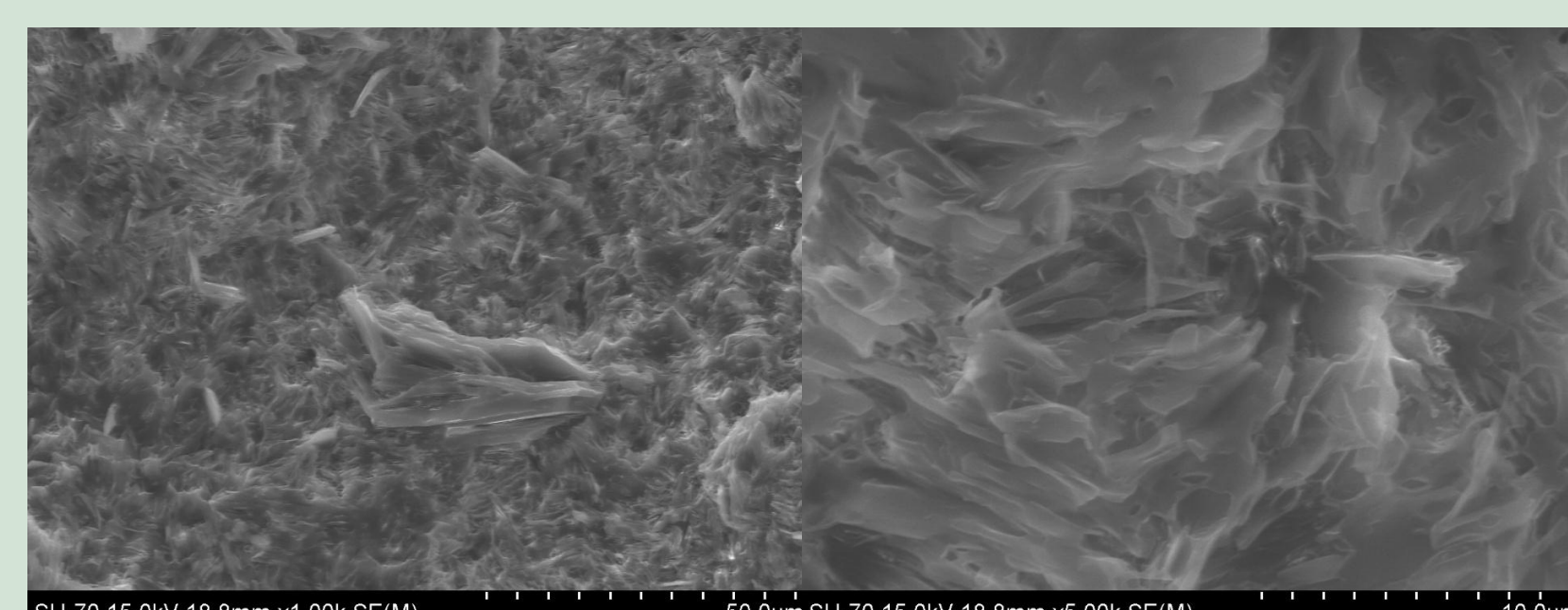
1 Climate data processing



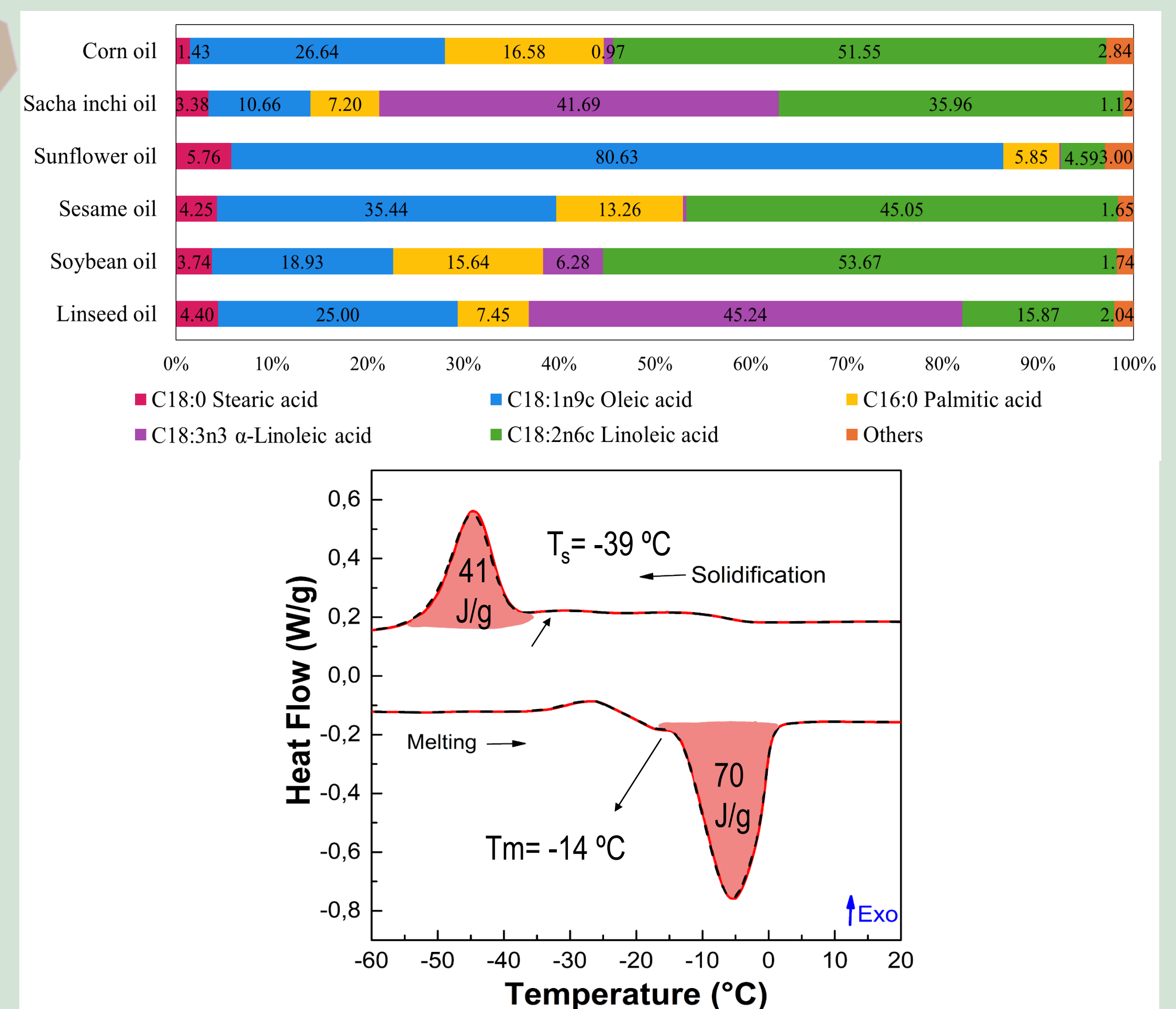
2 Leakage test SS-PCM: TDA: Al₂O₃



SEM images SS-PCM: 8:2 %w TDA: MgO



3



CONCLUSIONS

1. Assessing climatic conditions allows for a more efficient and strategic selection of thermal energy storage materials.
2. SS-PCM tetradecylamine: ceramic prevents PCM leakage during melting.
3. The main components of these vegetable oils are: linoleic acid, α-linolenic acid, oleic acid and palmitic acid. Sunflower oil stood out as a natural eutectic mixture of these fatty acids. These vegetable oils could be used for cold thermal energy storage.

References

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