

# Influence of mineral and organic matrices on the thermal characterization of microplastics

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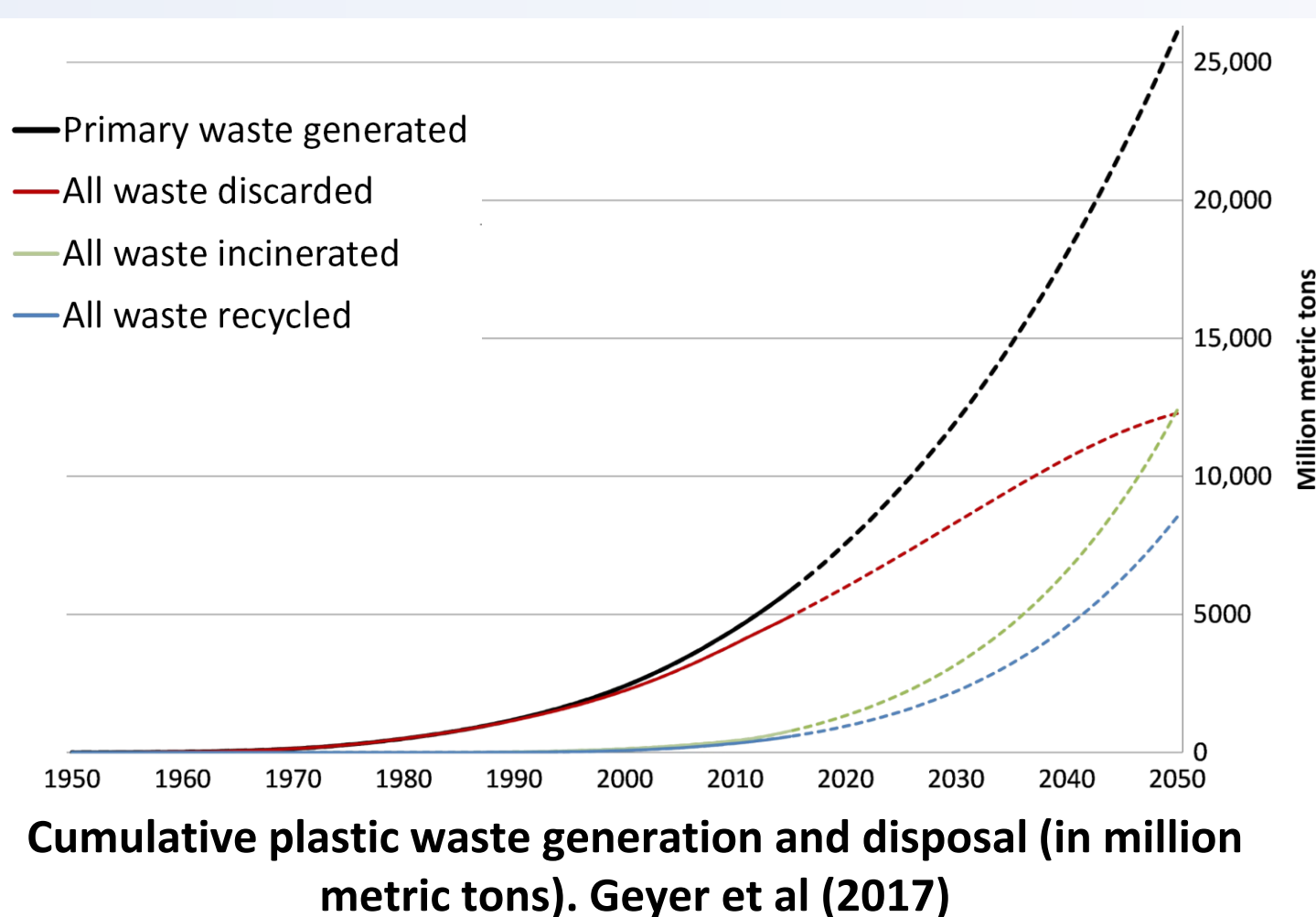
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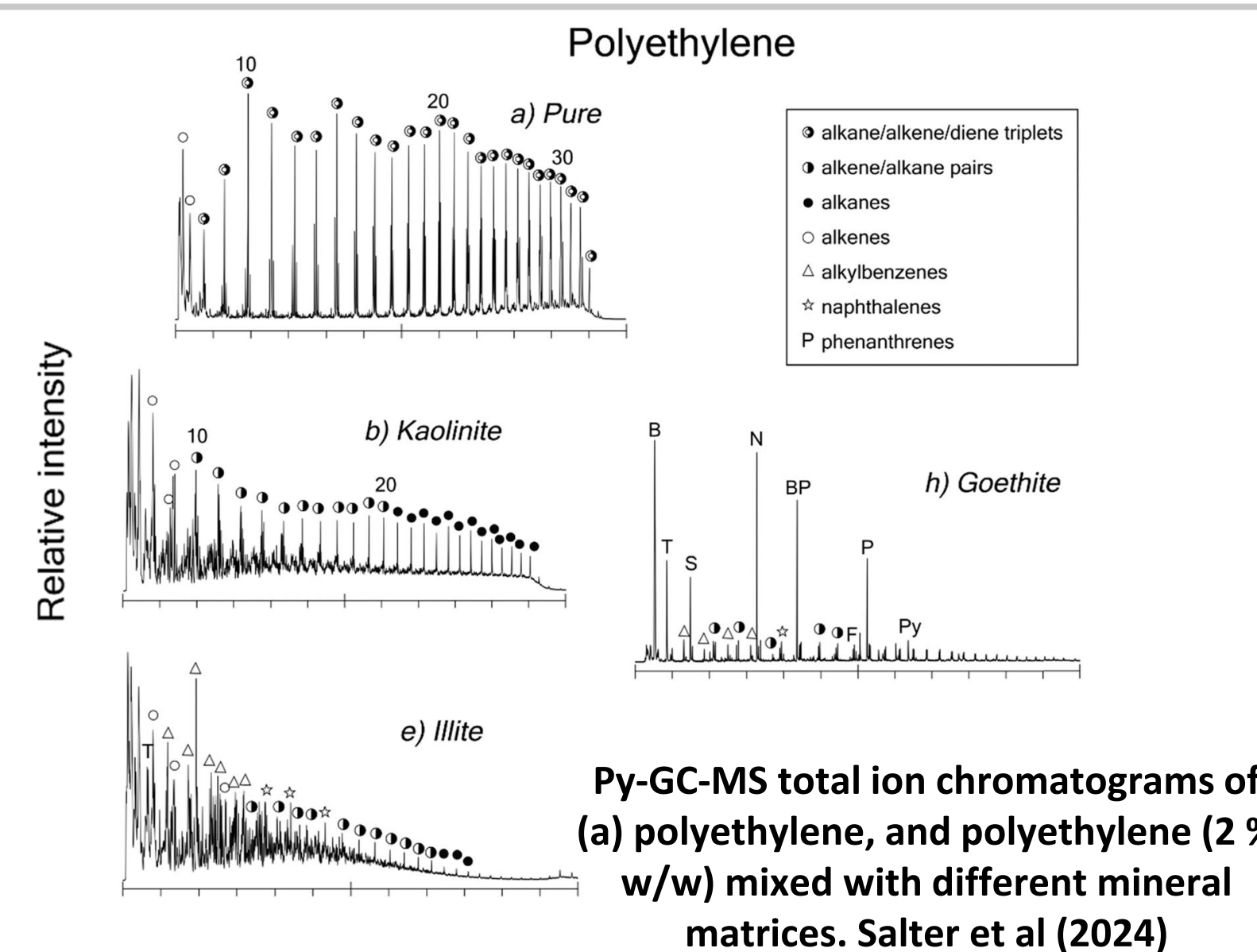


## Introduction

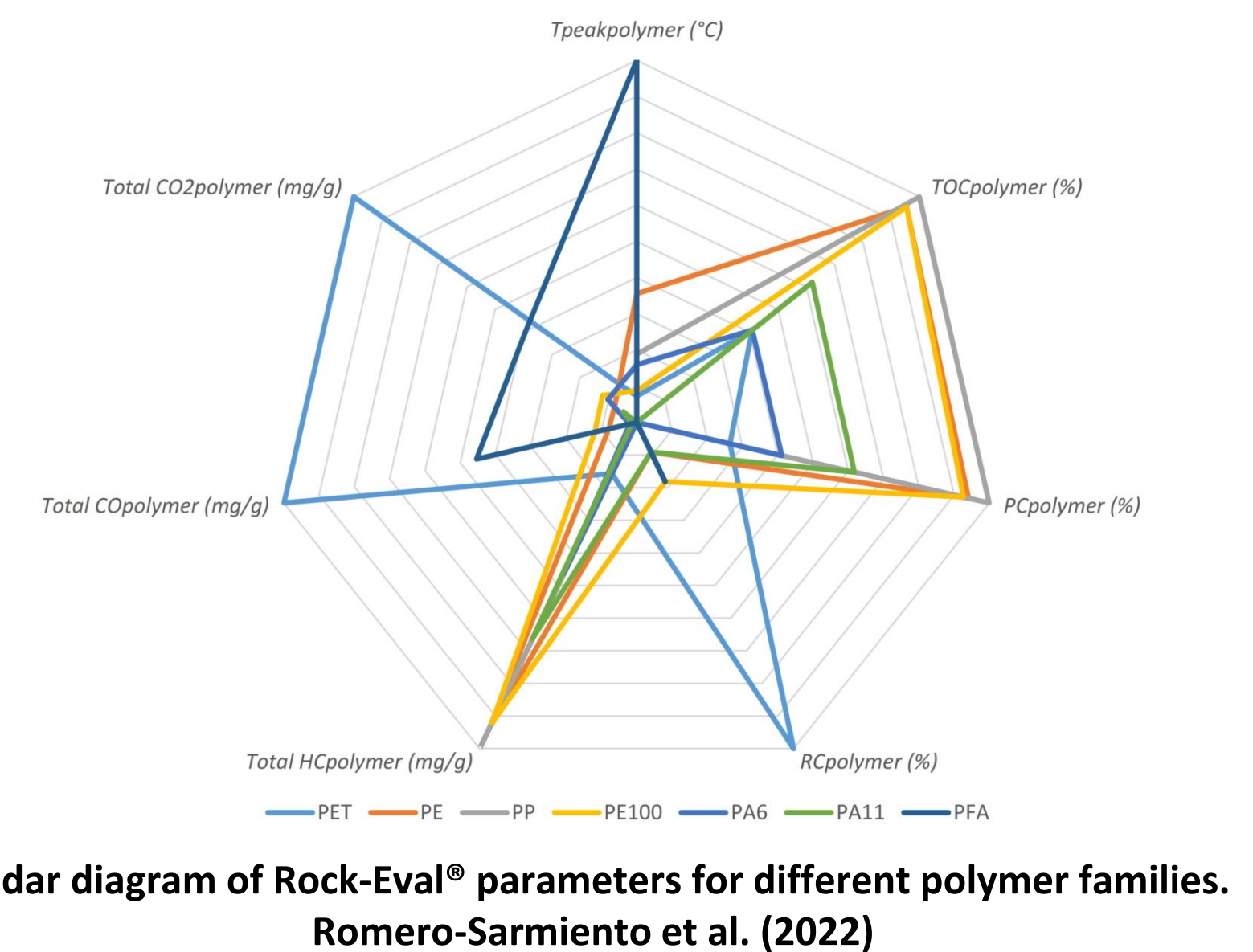
- Global plastic production:
  - from 2 million tons (Mt) in 1950<sup>1</sup>
  - to 460 Mt in 2020
- Around 3% of plastic production ends up in the oceans<sup>2</sup>.
- Wide variety of methods used to assess and quantify plastic pollution<sup>3</sup>.
- Methods often fastidious and expensive.



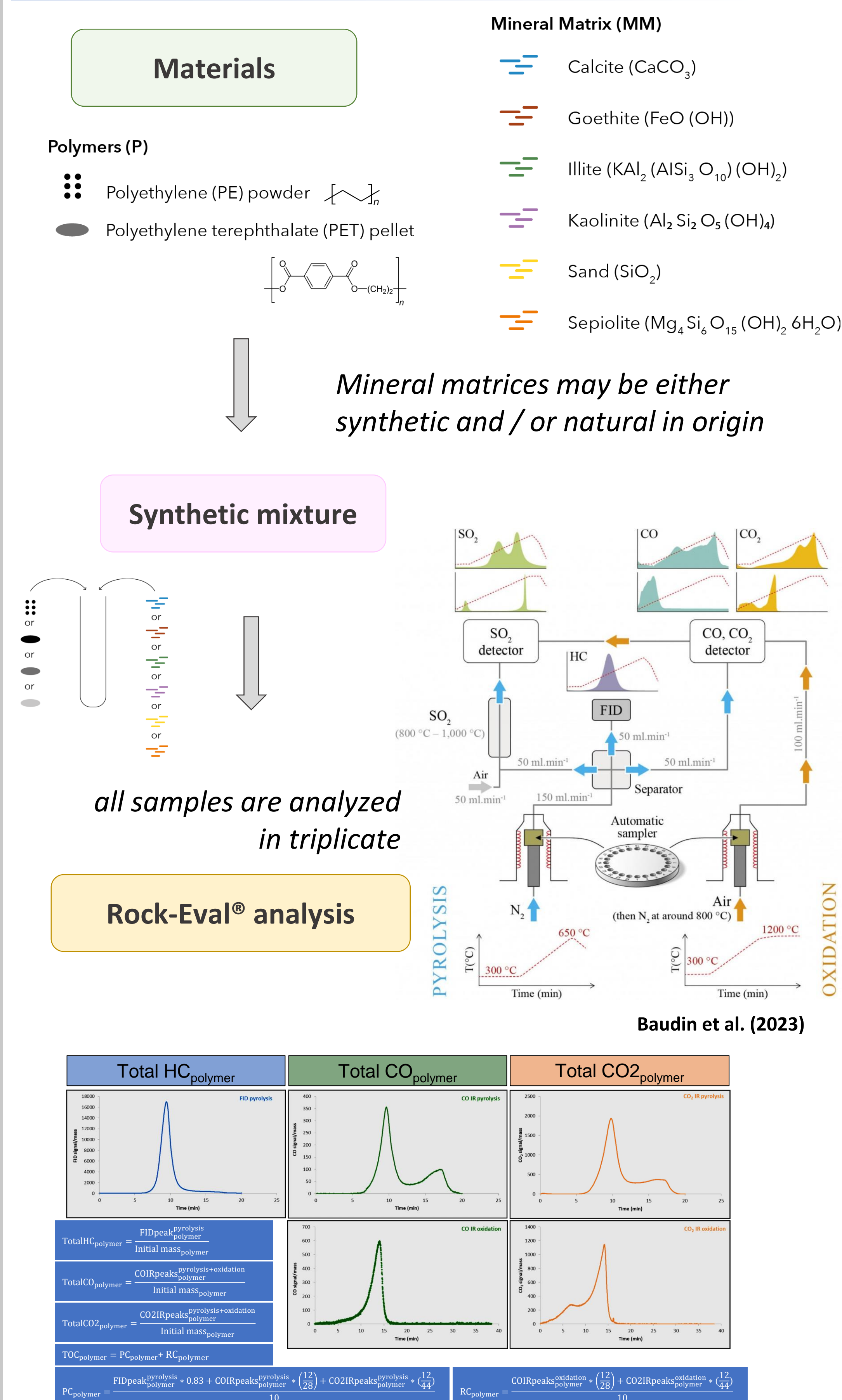
- Thermal methods such as Py-GC/MS are increasingly used for polymer identification and quantification.
- The composition and intensity of the released compounds vary depending on the associated mineral matrix.
- Such matrix effects may limit the reliability of this technique for identifying polymers in sediment sample.



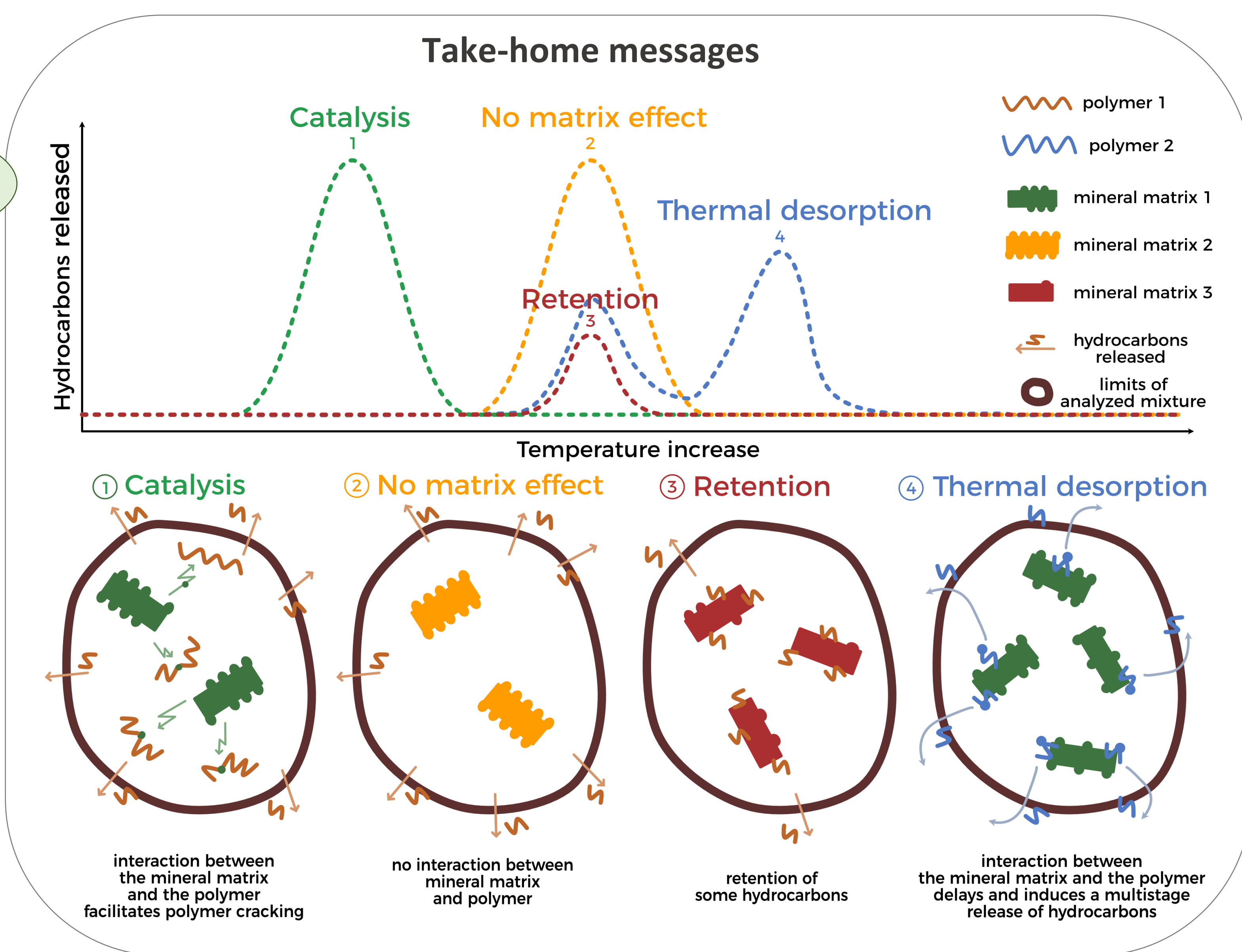
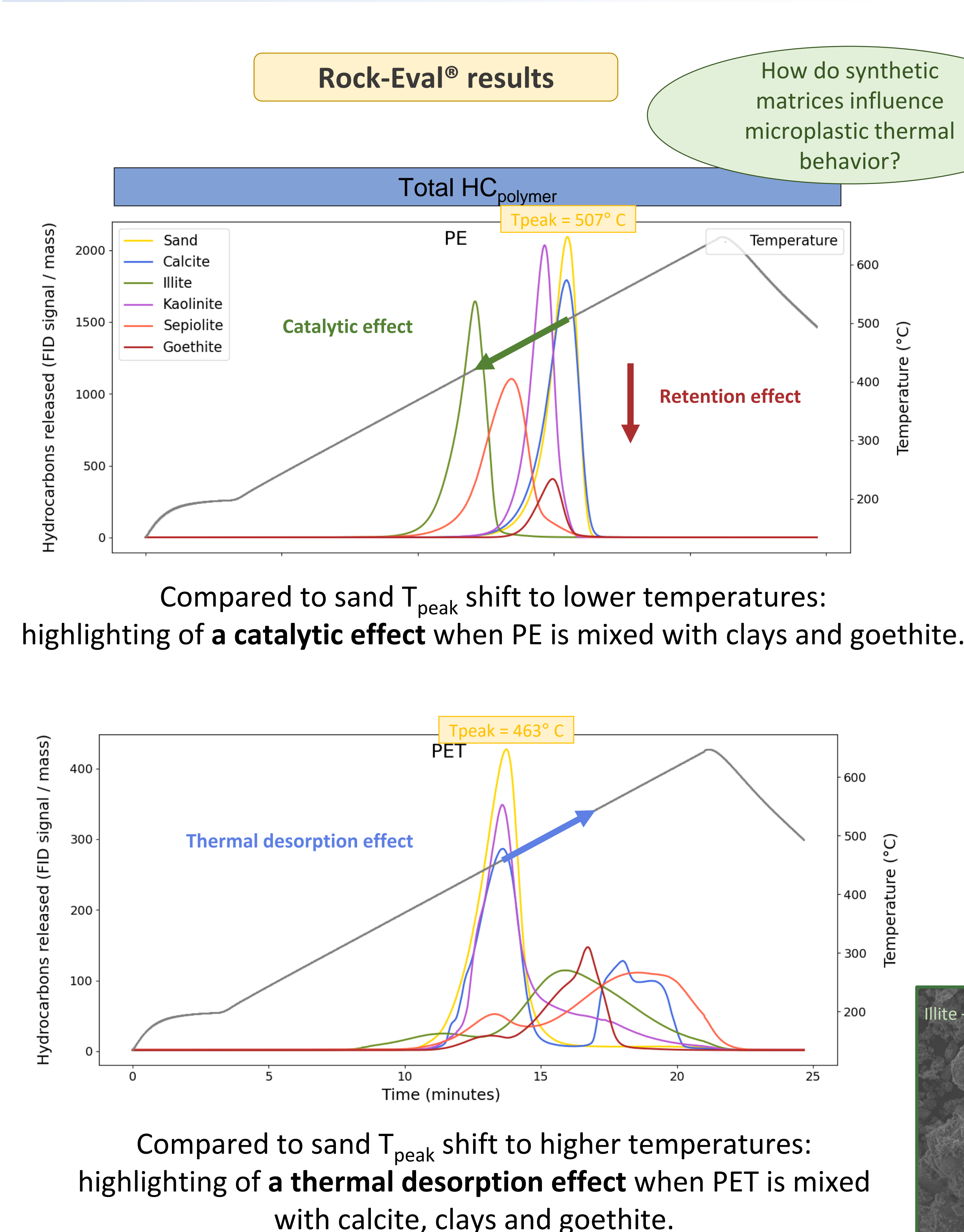
- Proposition of the Rock-Eval<sup>®</sup> method (a based-pyrolysis and oxidation thermal method) by Romero-Sarmiento et al. (2022) as a rapid and low-cost tool to identify polymers<sup>4</sup>. Nevertheless, this needs to:
  - Understand the influence of matrix effects on Rock-Eval<sup>®</sup> signals
  - Develop an improved method considering these matrix effects to quantify microplastic pollution in natural samples



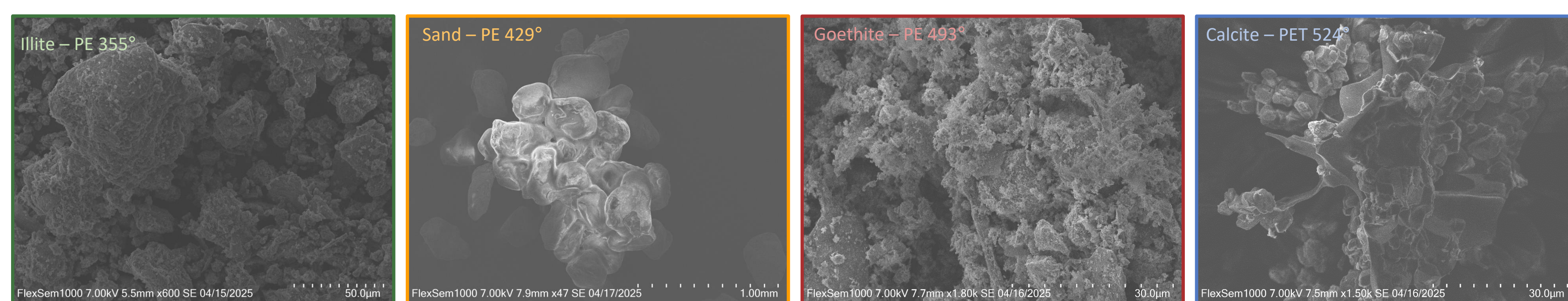
## Materials & Methods



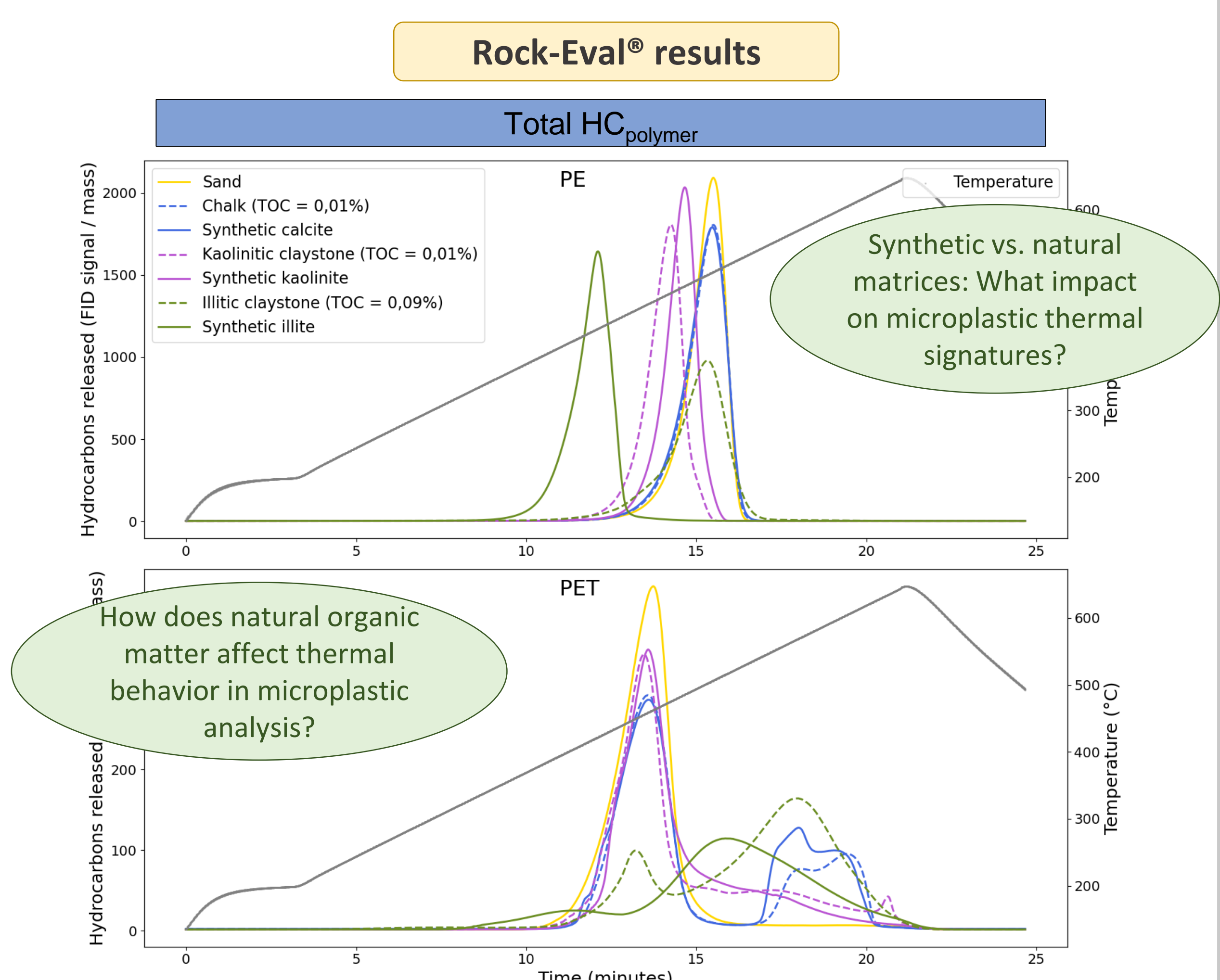
## Results & Discussion



## Scanning Electron Microscope observations

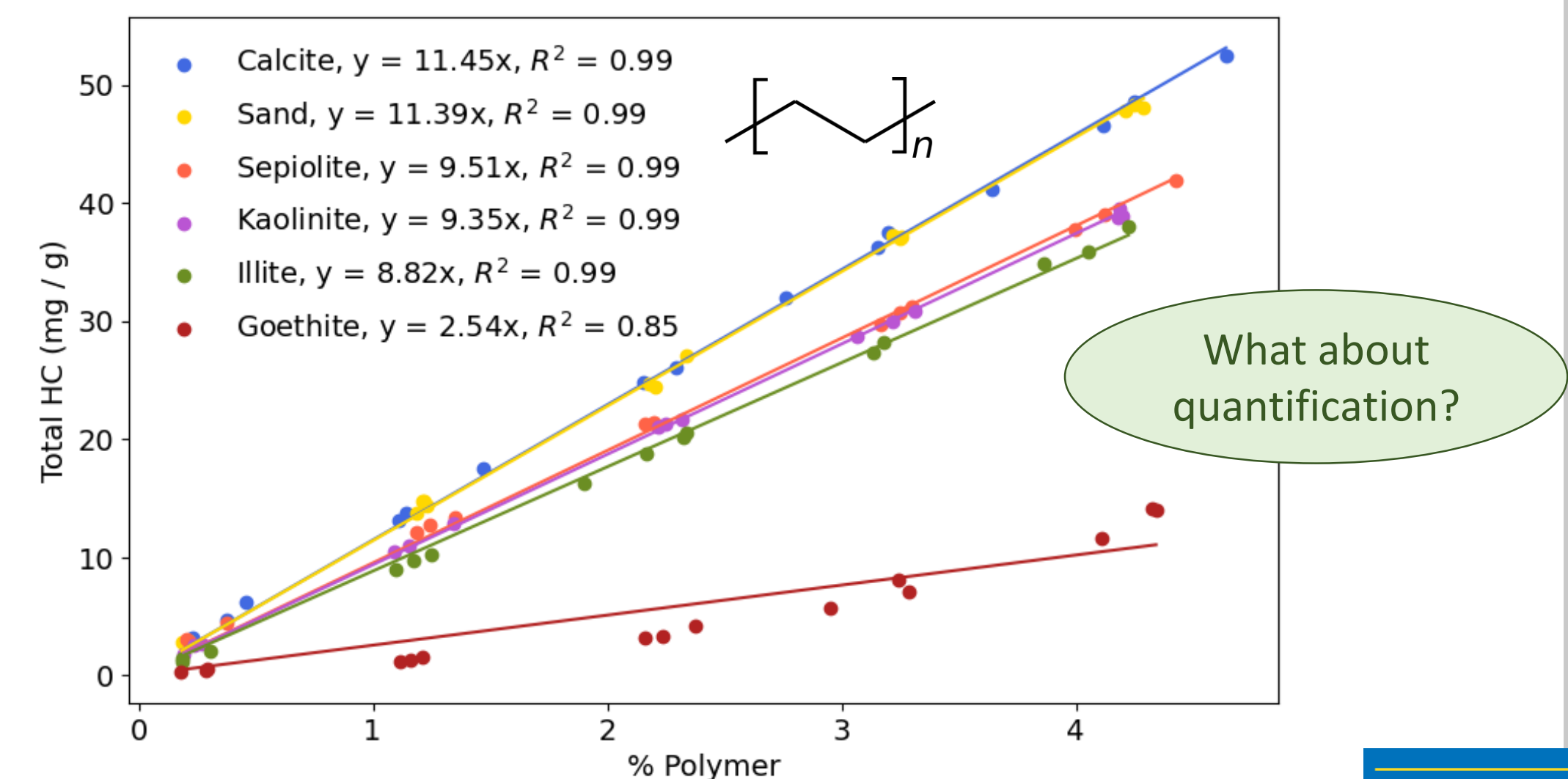


Mineralogical observations using SEM also allow the monitoring of polymer evolution at different temperatures with various mineral matrices. These images confirm that the polymer remains clearly visible in the absence of interaction (Sand – PE), as well as in cases of thermal desorption during the successive releases of hydrocarbons (Calcite – PET).



Natural matrices with negligible total organic carbon (TOC) exhibit **matrix effects comparable** to those observed in synthetic matrices.

The presence of organic matter in natural matrices appears to **attenuate, or even suppress, the matrix effects** typically observed with synthetic matrices.



## Perspectives

- Investigate the evolution of microplastic thermal signatures in relation to varying mineral matrices.
- Continue evaluating the applicability of the Rock-Eval<sup>®</sup> method in natural mineral matrices.
- Initiate testing on microplastics in natural sediment samples.
- Develop a standardized analytical procedure to qualify and quantify microplastic contamination in natural samples with diverse mineralogical compositions.

## References:

- Geyer, R., Jambeck, J. R., Law, K. L., « Production, Use, and Fate of All Plastics Ever Made », Science Advances 3, no 7 (7 July 2017): e1700782.
- Jambeck, J. R., et al., « Plastic Waste Inputs from Land into the Ocean », Science 347, no 6223 (13 February 2015): 768-71.
- Hidalgo-Ruz, V., et al., « Microplastics in the Marine Environment: A Review of the Methods Used for Identification and Quantification », Environmental Science & Technology 46, no 6 (20 March 2012): 3060-75.
- Romero-Sarmiento, M. F., et al., « Polymer Quantification Using the Rock-Eval<sup>®</sup> Device for Identification of Plastics in Sediments », Science of The Total Environment 807 (February 2022): 151068.
- François Baudin. The Rock-Eval Method. ISTE-Wiley, pp.304, 2023, 978-1-78945-153-5. (hal-04390257)
- Tara L. Salter, Jonathan S. Watson, Mark A. Sephton, The effects of some common inorganic soil components on the pyrolytic analysis of plastics, Journal of Analytical and Applied Pyrolysis, Volume 182, 2024, 106694, ISSN 0165-2370.