Quantification of Microplastics by Pyr-GC-MS in Sediments: Challenges and Implications

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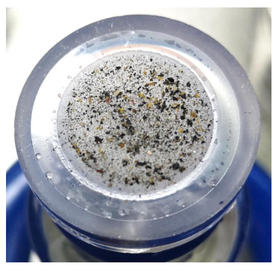
Introduction The conventionally used protocols of density separation followed by digestion of organic matter do not allow for complete isolation of MP from the associated organic and mineral matter. This effect is important to consider when using Pyr-GC/MS for the **quantification** of MP in sediment samples because it can generate interferences.

Treatment steps efficiency on a sediment sample?

Density separation + organic matter digestion

10 g dried sediment



Residue analyzed by **FT-IR imaging**

2% of particles identified as a plastic polymer

⚠ interferences

Organic matter may release the same pyrolysis products as the targeted polymers

Mineral fraction could adsorb pyrolysis products during pyrolysis

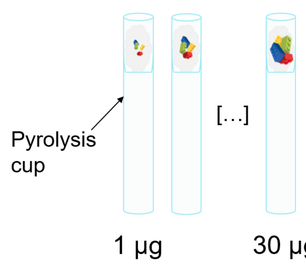
Method

① Indicator compounds for PP, PS, PET and PVC reviewed and selected[1] taking into account potential interactions with substances present in the residue after treatment

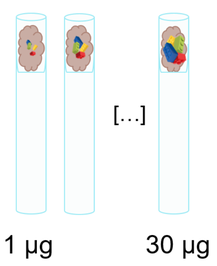
② Matrix effect in Pyr-GC-MS

Pyrolysis cups for calibration curves prepared by weighing polymer particles from 1 to 30 µg and adding inert matrix or sediment matrix

Polymer particles **+ inert matrix**

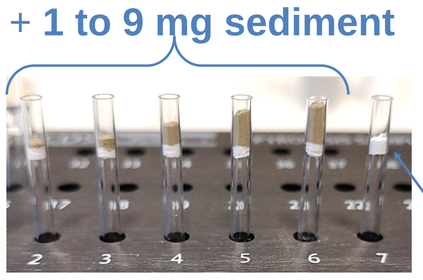


Polymer particles **+ sediment matrix**



Additional pyrolysis cups were prepared with fixed amount of polymer particles and increasing amount of matrix sediment

20 µg of polymer particles + **1 to 9 mg sediment**



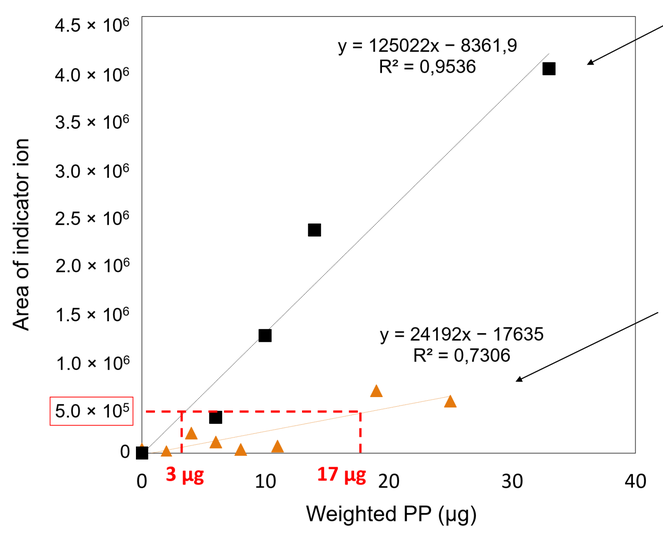
Polymer particles + quartz wool

Matrix effects depend on the matrix mass?

Results

PP indicator compound

2,4-dimethyl-1-hept-1-ene m/z 70



PP particles **+ inert matrix**

PP particles **+ sediment matrix**

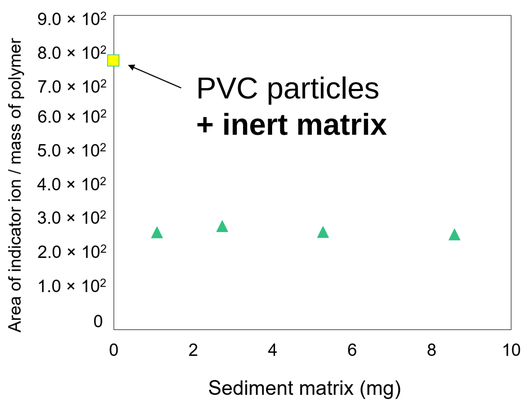
Attenuation factor of 5

⚠ external calibration curves: Underestimation of PP mass

The attenuation reflects the adsorption of the pyrolysis product onto or within clay sheets, as reported in the literature[2,3].

PVC indicator compound

chlorobenzene m/z 112



Constant attenuation indicating that the matrix effect does not depend on the amount of matrix

Conclusion The establishment of calibration curves in the presence of a sediment matrix has highlighted an attenuation of the signal for PP, PS, and PVC. Because of potential interferences with residual organic matter and mineral matrix effects, the use of an **internal standard** is emerging as a prerequisite for the quantification of plastic polymers in complex environmental samples such as sediments.

Literature cited

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3. Espitalie, J.; Madec, M.; Tissot, B. Role of Mineral Matrix in Kerogen Pyrolysis: Influence on Petroleum Generation and Migration. AAPG Bull. 1980, 64, 59–66.

Acknowledgments

This study was carried out in the framework of the Sedi-Plast research program funded by the French Research Agency (ANR-19-CE34-0012).

Sedi-PLAST