



PhD course in Sustainable Development and Climate Change University School



for Advanced Studies IUSS Pavia - 38° cycle

Biogeochemical fate of emerging Anthropogenic pollutants in the sedimentary Record

Elisa Costanzi

Supervisor: Prof. Anna Sabbatini

Laboratory of Stratigraphy, Sedimentology and Paleoecology, DiSVA

INTRODUCTION

Marine debris is a global environmental issue. Chemistry of water and sediments, thus environmental quality and eventually the trophic chain, are affected by dispersal of pollutants. Smoked cigarette butts (CB) and their chemicals are the predominant human coastal litter item together with plastic debris and associated substances that can be bioaccumulated and could cause negative impacts on marine organisms.



OBJECTIVE

The purpose of my project is to investigate the impact of (1) littered smoked CBs and its associated toxicant (nicotine) and (2) organic molecules contained in plastics (PAEs-DEHP) on benthic foraminifera by evaluating the effect they cause on their shells, which leave a trace over time, considering them as an index of anthropogenic pollution on the marine environment.

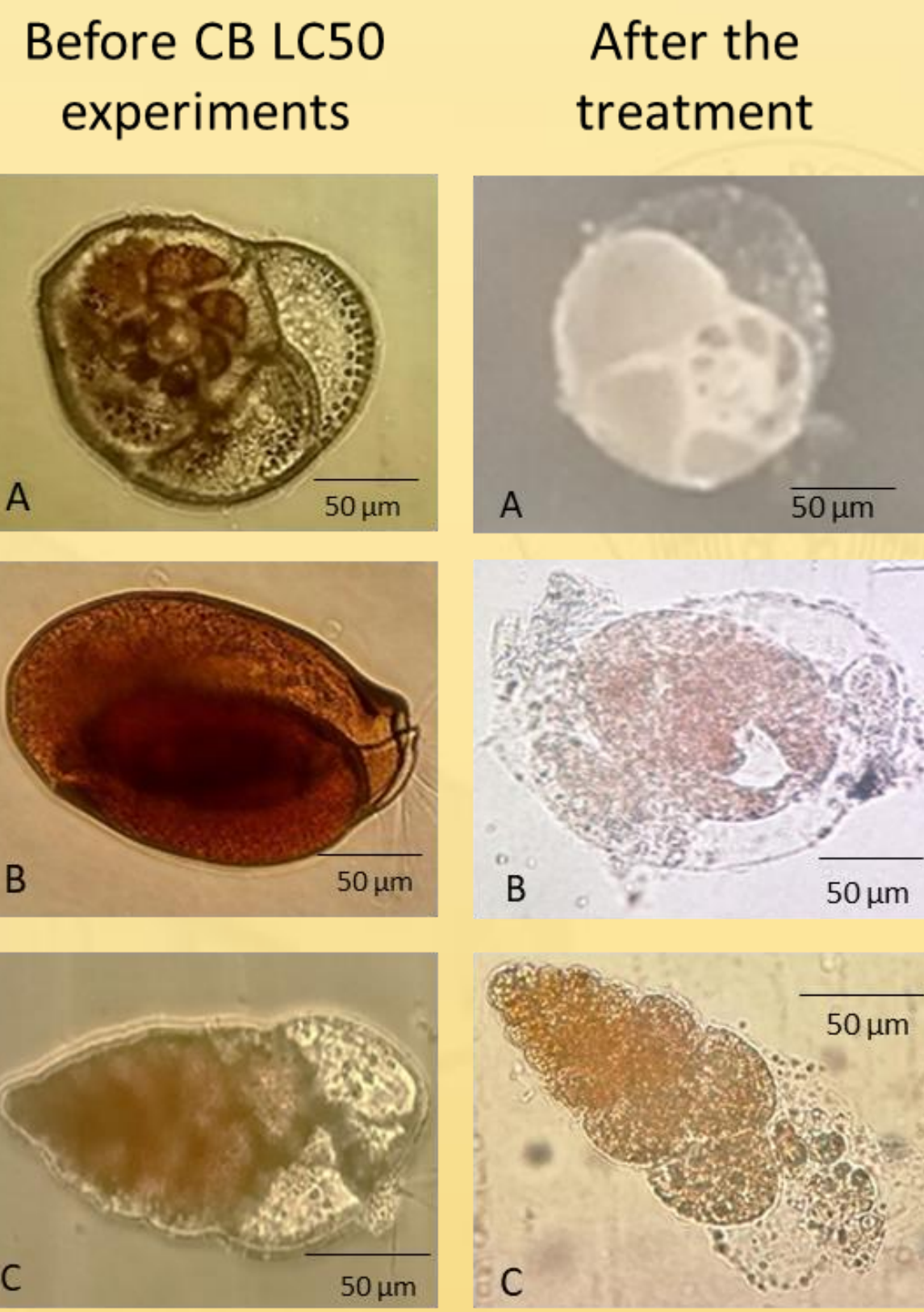
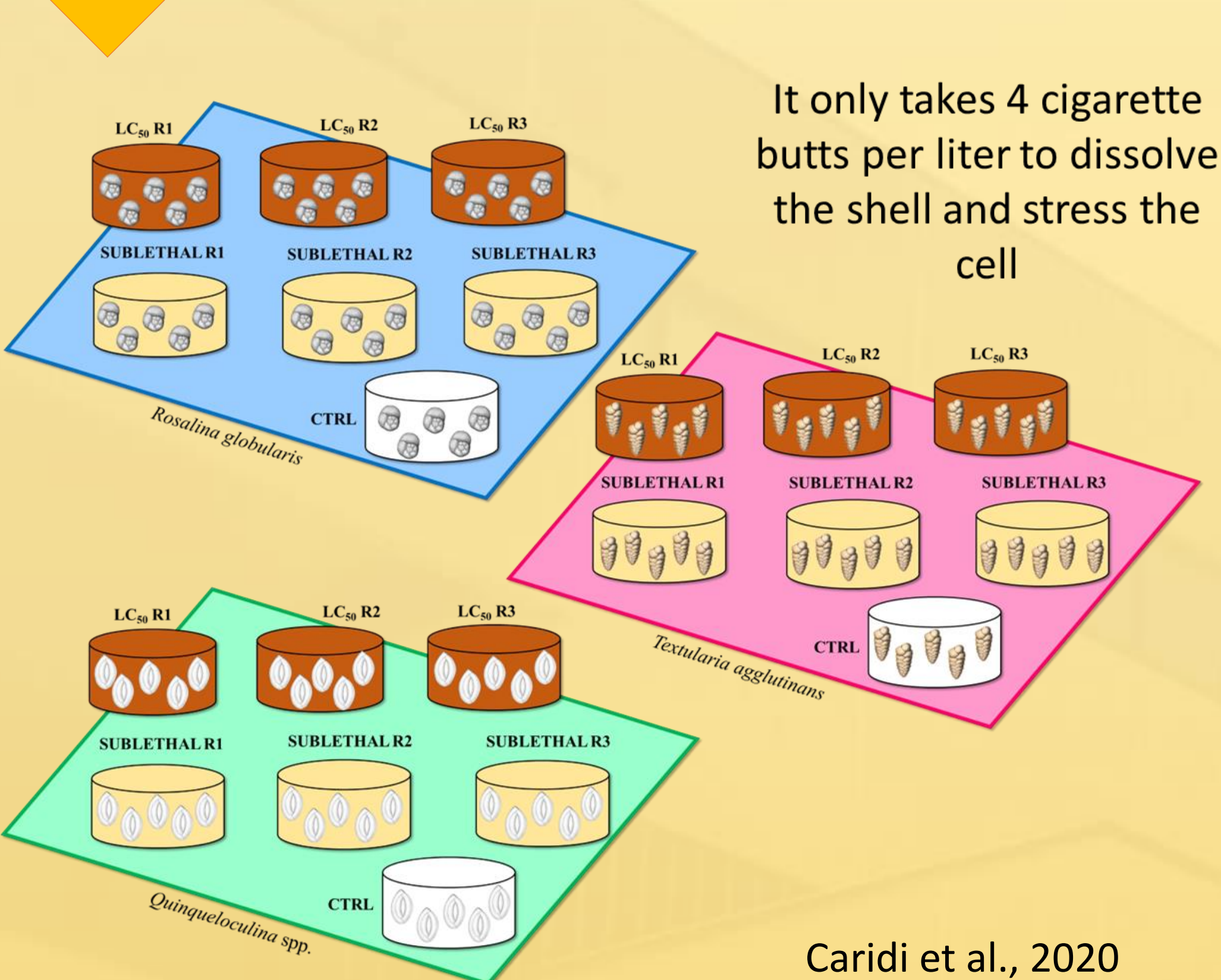
MATERIALS AND METHODS

- Acute toxicity test on benthic Foraminifera (CBs-nicotine)
- Chronic toxicity test on benthic Foraminifera (nicotine-DEHP)

Is it possible to use the foraminiferal shell as an indicator of the accumulation of these pollutants over time, and detect them in environmental matrices?

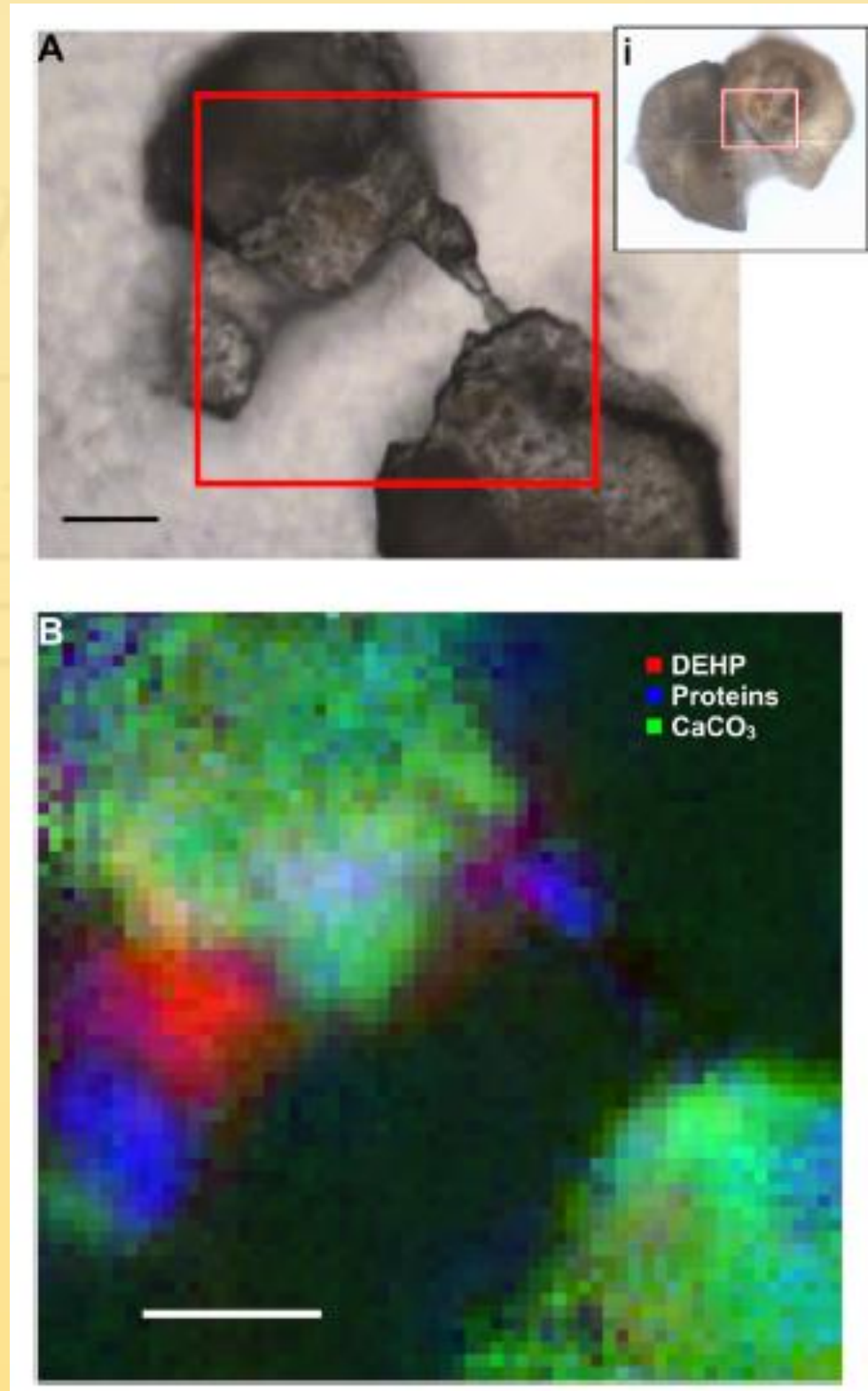


Toxicity assay



Recent studies have shown the accumulation of DEHP at the shell level in association with protein and CaCO₃, meaning that this pollutant becomes part of the sedimentary record.

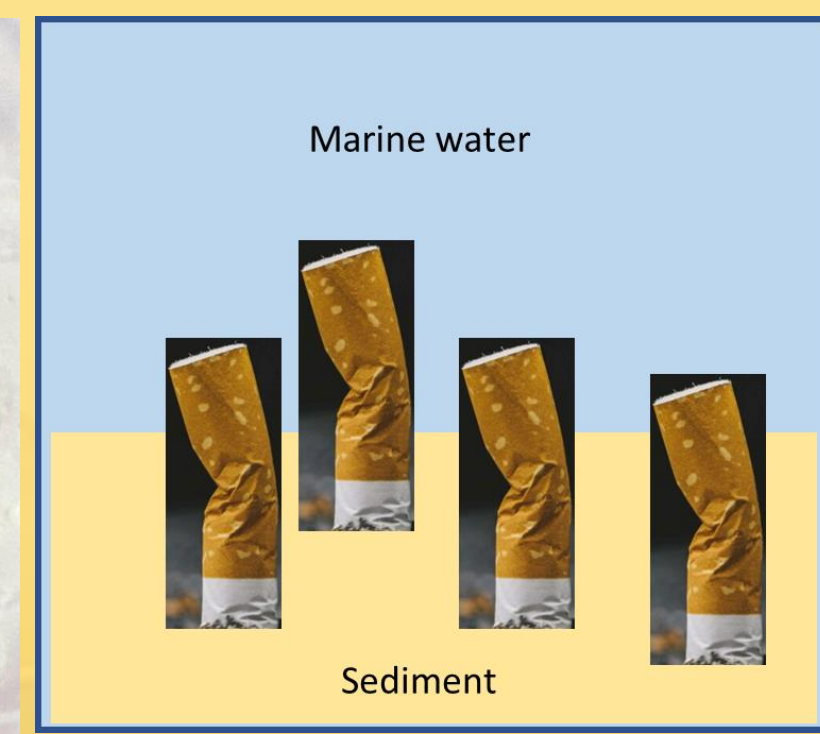
- DEHP
- Proteine
- CaCO₃



Mesocosms

- Mesocosms (nicotine)
- Mesocosms (CBs)

Mesocosm with nicotine for the evaluation of the density, biodiversity and taxonomic composition of foraminifera due to the presence of the pollutant.



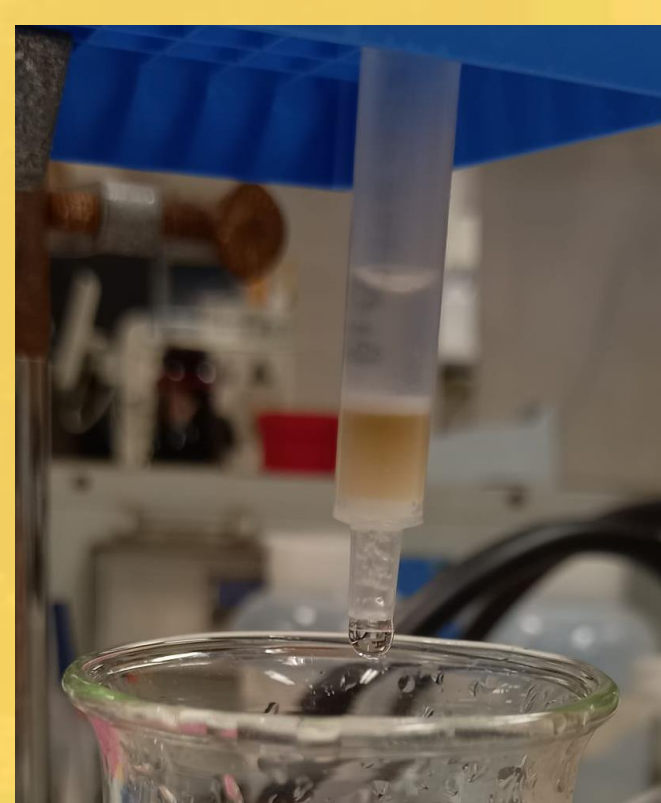
Mesocosm with CBs for the evaluation of the residence time of the pollutant in water and sediment.

In-situ analysis

- Pollutants (nicotine-DEHP) detection in water and sediment (in collaboration with DiSCO)
- Development of a pollutant dispersion model in coastal areas (in collaboration with oceanographic team of DiSVA)



We are setting up a protocol for the extraction of nicotine from water and marine sediment (Solid-phase extraction SPE-C18, HPLC).



Ultra-structural analysis

- Biominalisation studies to check the uptake of these pollutants in the shells

EXPECTED RESULTS AND IMPACT

Foraminifera as an index of anthropogenic pollution on the sedimentary record

Foraminifera could incorporate anthropogenic pollutants derived from littered cigarette butts and plastic additives into its shell and cell.

Because of the fossilizable shell, it could record in its shell the presence of the pollutants.

It may be able to trace the history of these anthropogenic pollutants over time.

Emerging pollutants in mesocosms:



Emerging pollutants in sedimentary record:

