Lab Journal: analysis of an Atlantic clay sediment sample near the Canary Islands

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I. INTRODUCTION

First, we shall discuss the points we are to research before starting our research plan. In literature, we shall attempt to find:

1. the precipitation rate for this portion of the Atlantic, to determine the time resolution in our sample;
2. perturbation of the ocean floor through natural or human mechanisms;
3. concentration of microplastics, as an indication of the increase in nanoplastic concentration;
4. amounts of detritus, and whether this would contaminate the measurement;
5. protocols for extraction of the plastics from the clay.

From this, we shall construct a protocol for our measurements and from there, we shall find the tools we may need to acquire.
In general we split these into three categories: items 1 and 2 (to be researched by Joost) describe the context of the samples, items 3 and 4 (to be researched by Has) describe the contaminants, and item 5 (to be researched by Eva) describes the practical steps to be taken.

I.i. Question Answers

I.i.1.

I.i.2.

I.i.3.

I.i.4.

I.i.5. Existing Protocols

There exists research on the filtration, dialysis, and ultrafiltration retention rates using polystyrene nanospheres between 1000 and 50 nm.[1]
From this research, we get several takeaways:
Polymer membranes are not recommended, with retention rates far too high.
"there was always retention even if the porosity was up to 50 times larger than the beads diameter. This implies that for pre-filtration, in the view to NP quantification in a real sample, the recoveries would be insufficient and very difficult to rationalize because of the high particle heterogeneity."
Dialysis led to important losses of 50% after 48h and 70% after 72h.
Ultrafiltration had losses of 35-40%

Next, I found a publication which determined metal fractionation of a marine sediment core from Antarctica.[2]
Again, there were several takeaways:
Stainless steel was used to sample the core. It was subsampled using a Teflon blade. Only the inner part was analysed.
To determine moisture content, a subsample was dried at 105° C until the mass was constant.

The storage containers were cleaned extensively. They used a clean room (Class-100.000 / ISO 8, the "dirtiest" clean room[3]).

Next, I analysed section 2 ('Materials and method') of a publication in which a cire sample was analysed from the Indian Ocea.[4] In this, they used acetic acid to remove inorganic carbon contents of the sediment, and hydrogen peroxide to remove organic carbon contents. After this, they were washed with deionized water to remove remaining aces, peroxide, and salt.

Finally, I read a paper of the PASADO core processing strategy, which appeared to have been made to allow several disciplines to perform research on the same core. Still, I extracted some points that I thought might be useful.
Namely, the idea of leaving one half of the core (if split lengthways) for archiving purposes, if we have enough of the core to do that. Secondly, the idea to use a cutting tool with the right shape to not take the sides of the core, as those might be contaminated.

In summary:
We should try to avoid any filtering with porosity less than two orders of magnitude above 1 m. If needed, stainless steel grids with cut off at 5 or 10 m are preferred, with 15-20% retention.
We should use steel and glass tools wherever possible, as to not contaminate the sample. We clean the bottles using temperature. Verify if we can get a glovebox.
Peroxide can be used to remove organic carbon contents, acetic acid can be used to remove inorganic carbon contents.
A D-shaped cutter is useful as not to incorporate plastics from the storage medium. Furthermore, to use only one half of the sample may be a good idea for insurance's sake.

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[1] Albignac, M., Maria, E., De Oliveira, T., Roux, C., Goudouneche, D., Mingotaud, A. F., Bordeau, G., & ter Halle, A. (2023). *Assessment of nanoplastic extraction from natural samples for quantification purposes.* Environmental Nanotechnology, Monitoring & Management, 20. https://doi.org/10.1016/j.enmm.2023.100862

[2] Burgay, F., Abollino, O., Buoso, S., Costa, E., Giacomino, A., La Gioia, C., Garofalo, S. F., Pecoraro, G., & Malandrino, M. (2020). *Geochemical characterization of a marine sediment core from the Joides Basin, Ross Sea, Antarctica.* Marine Geology, 428. https://doi.org/10.1016/j.margeo.2020.106286

[3] American Cleanroom Systems. (2024, September 4). *Clean room Classifications & ISO Standards | American Cleanrooms Systems.* https://www.americancleanrooms.com/cleanroom-classifications/

[4] Sensarma, S., Gupta, S.M., Banerjee, R. et al. *Change of lithofacies in marine sediment core from Quaternary to Pre-Quaternary: A case study from the Central Indian Ocean* Basin. J Earth Syst Sci 129, 54 (2020). https://doi.org/10.1007/s12040-019-1318-z

[5] Ohlendorf, C., Gebhardt, C., Hahn, A., Kliem, P., & Zolitschka, B. (2011). *The PASADO core processing strategy — A proposed new protocol for sediment core treatment in multidisciplinary lake drilling projects.* Sedimentary Geology, 239(1-2), 104–115. https://doi.org/10.1016/j.sedgeo.2011.06.007