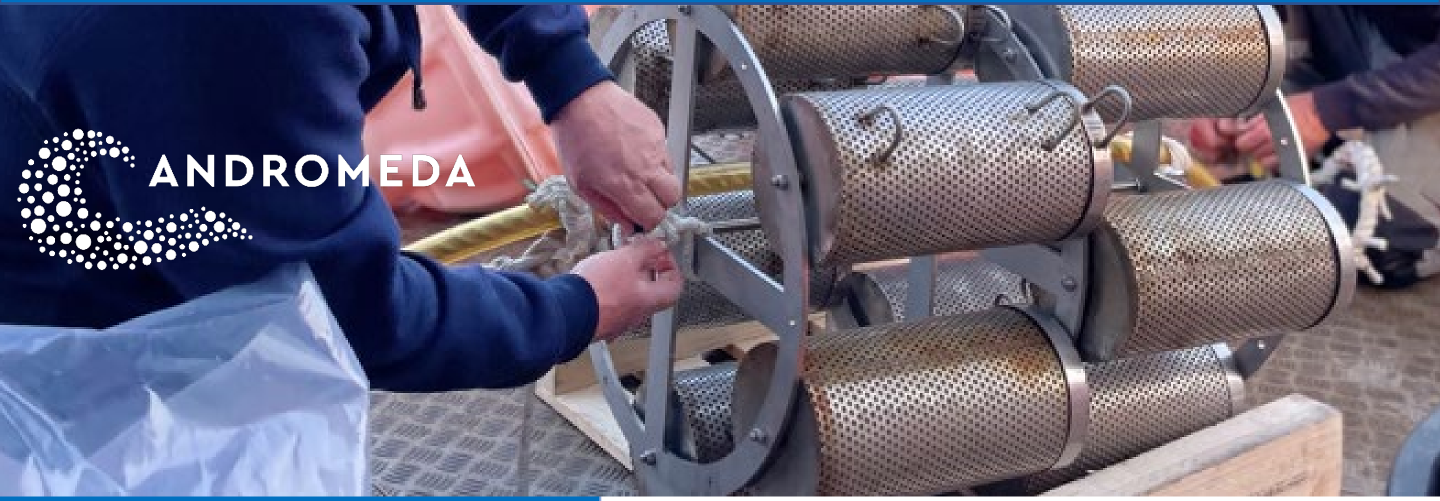
February 2022 | Issue 1




## IN THIS ISSUE



# ANDROMEDA Newsletter Issue No. 1

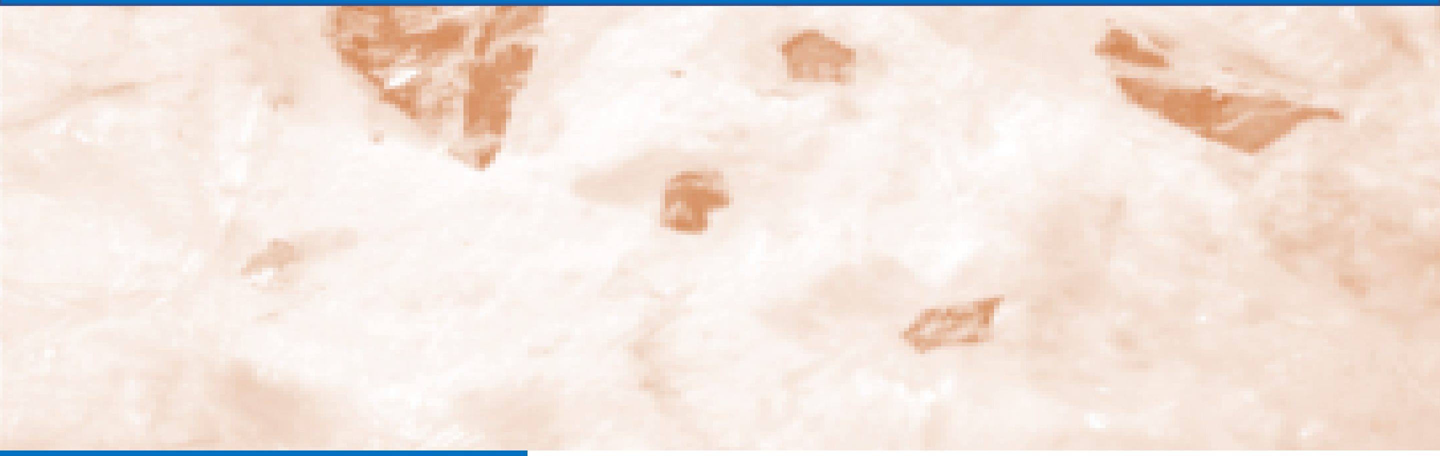
We are delighted to be bringing you ANDROMEDA's very first newsletter which covers our project activities to date. As you can imagine, some of our best laid plans were reimagined in light of the global pandemic, however our team has continued to undertake in-field surveys, publish papers, and has participated in a number of digital events across Europe.

In this newsletter you will find the highlights of the year including links to papers, presentations, and other activities of interest!

## The ANDROMEDA team.

The **ANDROMEDA** project is supported through the Joint Programming Initiative: Healthy and Productive Seas and Oceans (JPI Oceans).

JPI OCEANS



## OBJECTIVES

**ACHIEVE** cost-effective analysis of microplastics by in-situ methods and low-cost laboratory analysis, including efficient sampling.

**DEVELOP & OPTIMISE** advanced techniques to measure and quantify small and challenging types of microplastic particles.

**INVESTIGATE** the degradation and fragmentation mechanisms of plastic into micro- and nanoplastic particles.

**STUDY** the release of additive chemicals during plastic fragmentation and degradation processes.

**DISSEMINATE** project results and developed protocols to a range of audiences, including public authorities, the private sector, academia, and the general public

## About ANDROMEDA

The JPI Oceans funded **ANDROMEDA** project brings together a multidisciplinary consortium of 15 international partners in 9 European countries to improve the quantification of nanoplastics and microplastics in our oceans and seas.

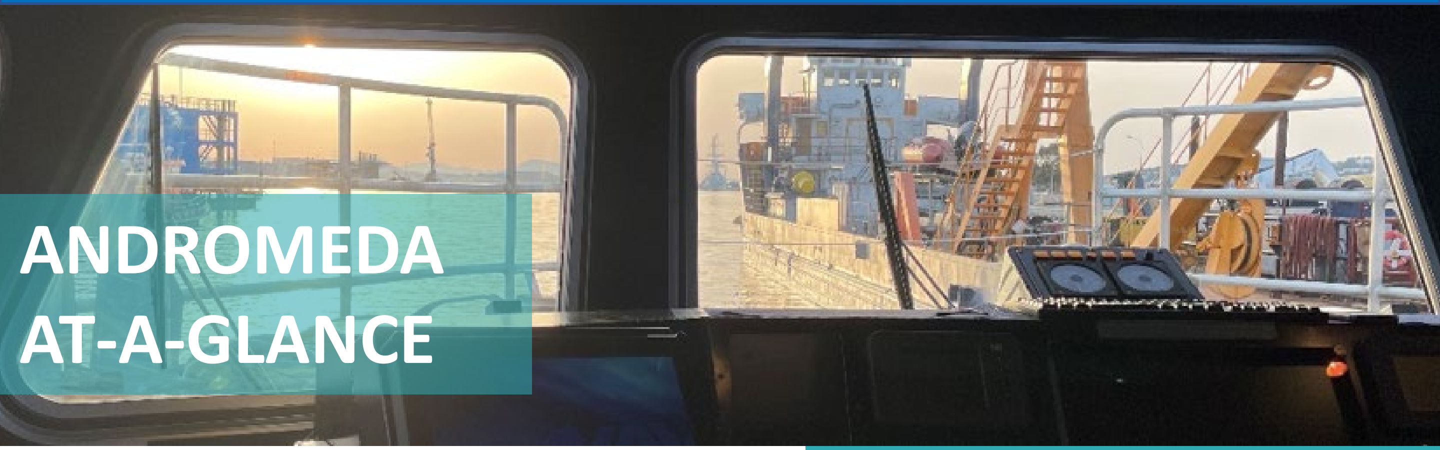
The project will develop new sampling and advanced analysis methodologies that focus on smaller microplastic (< 10 µm) and nanoplastic (< 0.2 µm) particles to enable improved risk assessment of plastic pollution, along with *in situ* techniques and cost-effective measurement methods for improving the efficacy and efficiency of microplastic monitoring.

### ANDROMEDA is analysing challenging types of microplastics including:

Tyre Wear Particles

Microfibers

Paint Particles



# ANDROMEDA AT-A-GLANCE

## Activities Timeline

**Virtual Kickoff**
*May 2020*

The ANDROMEDA project had a successful virtual kick-off meeting on the 18th & 19th of May, with attendance from all 15 partners.

**Online Presence**
*June 2020*

The ANDROMEDA project launches its official website and Twitter account.

**Coastal Deployment**
*February 2021*

Dorte Herzke & Guttorm Christensen successfully deploy our Norwegian subsurface weathering samples.

**Ferrybox Development & Testing**
*March 2021*

First impressions of the ferrybox prototype developed under T2.1 are presented at the *High Frequency Radar and FerryBox Joint Workshop.*

**Deep-Sea Deployment**
*April 2021*

Our research team successfully deploys microplastic samples in deep sea conditions off the coast of Toulon, France.

**Project Brochure**
*June 2021*

The ANDROMEDA project brochure is created and published on our project website.

**Research Methods**
*June 2021*

Microplastic analysis & degradation methodologies are published on the ANDROMEDA project website, giving an overview of the state-of-the-art at the start of the project.

**Common Cruise**
*September 2021*

Our first research sampling cruise takes place from the 14th - 17th of September!

**Publication Milestone**
*February 2022*

Our seventh peer reviewed paper is accepted for publication!

## Key Deliverables

**DEVELOP** an instrument platform for *in situ* and cost-effective analysis of microplastics

**ADVANCE** characterisation of nanoplastics and microplastic materials and for accelerated microplastic degradation, and

**CHARACTERISE** microplastic degradation.

## Milestones

**10** project presentations

**7** peer reviewed publications

**3** field sampling activities

## PROJECT ACTIVITIES

### + Research Methodologies

ANDROMEDA is focusing on the development and optimisation of methodologies for microplastic analysis and microplastic degradation methods. As part of this work our team has created a series of resources that give an overview of the state-of-the-art at the start of the project that you can now access on our project website.

Click on the icon below to learn more!

### + ANDROMEDA Brochure

To increase the visibility of the project we will be producing a number of factsheets for a range of different audiences. The first of these is an A5 project brochure that provides an at-a-glance overview of the key project aims and objectives.

Download your copy here!


## PUBLICATIONS

Sarno, A., Olafsen, K., Kubowicz, S., Karimov, F., Sait, S.T.L., Sørensen, L. and Booth, A., 2020. Accelerated hydrolysis method for producing partially degraded polyester microplastic fiber reference materials. *Environmental Science and Technology Letters*. Volume 8, Issue 3.

READ MORE

Phuong, N.N., Fauvelle, V., Grenz, C., Ourgaud, M., Schmidt, N., Strady, E. and Sempéré, R., 2021. Highlights from a review of microplastics in marine sediments. *Science of the Total Environment*. Volume 777, 146225.

READ MORE

Carretero, O., Gago, J., Filgueiras,A.V. and Viñas L., 2021. The seasonal cycle of micro and meso-plastics in surface waters in a coastal environment (Ría de Vigo, NW Spain). *Science of the Total Environment*. Volume 803.

READ MORE

Alimi, O.S., Claveau-Mallet, D., Kurusu, R.S., Lapointe, M., Bayen, S. and Tufenkji, N., 2021. Weathering pathways and protocols for environmentally relevant microplastics and nanoplastics: What are we missing? *Journal of Hazardous Materials*. Volume 423, Part A.

READ MORE

## + Twilitter App Launch

In September 2021, Jesús Gago of Spanish Institute of Oceanography contributed to a new data visualisation application called “Twilitter”, an interactive tool that highlights key Twitter users, hashtags, and cities contributing to the discussion of marine plastic pollution. This tool accompanies the publication ‘Twitter Data Analysis to Assess the Interest of Citizens on the Impact of Marine Plastic Pollution’ by Pablo Otero, Jesus Gago, and Patricia Quintas, which was funded by ANDROMEDA and CleanAtlantic.

The paper describes key concerns around marine plastic pollution identified through users’ tweets, and highlights ways in which marine and environmental organisations can adjust their communication plans to contribute better to the social media discussion around marine litter.

You can access our paper in the below panel, and explore the Twilitter web data here.

Otero, P., Gago, J. and Quintas, P., 2021. Twitter Data Analysis to Assess the Interest of Citizens on the Impact of Marine Plastic Pollution. *Marine Pollution Bulletin*. Volume 170.

READ MORE

# Media & Outreach

Andy Booth participated in an interview with Lisbeth Sørensen for *Gemini.no,* where they discussed the impacts of microplastics in our environment and the work being undertaken by the ANDROMEDA project. Click on the icon below to learn more!

Andy Booth participated in a *Teknisk Ukeblad* article where he discussed nanoplastics and their impacts on our marine environment. Click on the icon below to learn more!

Pablo Otero participated in a number of media activities in 2021 to promote his work with Jesús Gago and Patricia Quintas on their recent Twilitter publication and web application. Click on the icons below to learn more!

## PRESENTATIONS & EVENTS

**Micro2020**
*23-27 November 2020*

**SHAREMED – First Capitalisation Workshop**
*14-15 December 2020*

**VLIZ Marine Science Day**
*3rd March 2021*

**High Frequency Radar and Ferrybox Workshop**
*18th March 2021*

**Norwegian Environment Agency Seminar**
*7th April*

**Blue Research and Innovation Days**
*19th April 2021*

**SETAC Europe 2021**
*5th May 2021*

**Protect Our Oceans: The challenge of Europe's Global Leadership**
*16th June 2021*

**International Council for Exploration of the Seas, Annual Science Conference**
*6th September 2021*

**Planète Plastique**
*25th September 2021*

## Polymer Identification Techniques

*Karin Mattsson, University of Gothenburg*

Vibrational spectroscopy techniques such as FTIR and Raman spectroscopy are widely used methodologies for polymer identification, with best spectra quality being achieved through the optimization of measurement-specific parameters including:

- Spectral resolution
- Focus, and
- The number of scans taken.

In general, measuring for longer periods of time can result in higher spectral quality, however, optimizing all parameters will positively impact the analysis time employed per sample.

As part of the ANDROMEDA project, our research team employed a deep-learning methodology to remove instrumental noise and unwanted spectral artifacts from samples. By using a simple autoencoding neural net for reconstructing complex spectra distortions, the constructed network was able to remove all unwanted artifacts in a single pass and with high computational efficiency.

The results of this study have been published in the recent edition of *Analytical Chemistry* and are available for download in the link below!

Brandt, J., Mattsson, K. and Hassellöv, M., 2021. Deep Learning for Reconstructing Low-Quality FTIR and Raman Spectra – A Case Study in Microplastic Analyses. *Analytical Chemistry*. Volume 93, Issue 49, pp.16360–16368.

READ MORE

+

# Optimised Analysis of Microfibres

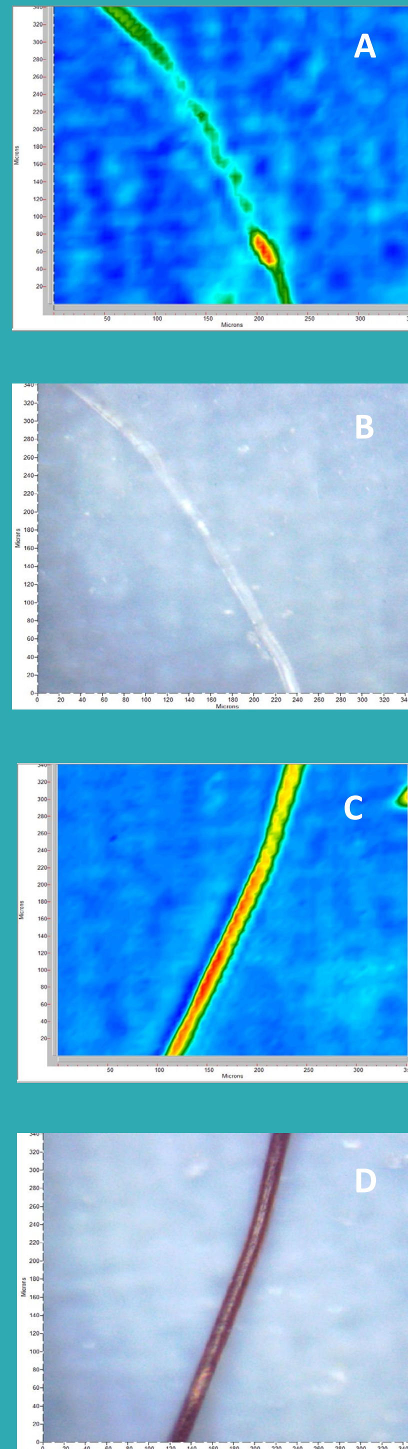
*Andy Booth & Stephan Kubowicz,*
*SINTEF Ocean AS*

Microscopy-based microplastic analysis techniques can encounter problems with microplastic fibres not sitting uniformly in the focal plane. This can result in a single fibre being identified as multiple microplastic particles. To address this issue, SINTEF has collaborated with the instrument manufacturer Agilent, in the possible development and testing of 'cover slides' for microscopy-based instrumentation (e.g. µFTIR and LDIR).

$CaF_2$ slides of an appropriate size and shape were sourced and tested at Agilent (LDIR) and SINTEF (µFTIR), using a series of reference microplastic fibres produced by SINTEF. Tests with the LDIR instrument show that this system can handle fibres well without the need for the cover slide, effectively allowing for the identification and quantification of microplastic fibres.

This is a new type of instrument and the analysis technique differs from that of µFTIR, allowing it to overcome this limitation. However, the instrument is not currently used widely within the microplastics research community.

The $CaF_2$ slide was not found to be effective at overcoming the issues of microplastic fibre analysis by µFTIR, resulting in poor spectra and reduced image resolution. Two different $BaF_2$ slides have been ordered and in the final step of this task SINTEF will assess these slides for microplastic fibre analysis on the µFTIR instrument.




*µFTIR image (A) and microscopy image (B) showing a polyester microplastic fibre that does not lie fully in the focal plane, where it can be interpreted as multiple microplastics. µFTIR image (C) and microscopy image (D) showing a polyester microplastic fibre that lies fully in the focal plane. The absorbance in the µFTIR images is measured at 1720 cm$^{-1}$, which corresponds to the ester bond in polyester (Image Credit: Stephan Kubowicz).*

# An Innovative Approach for Microplastic Analysis

*Nelle Meyers, Flanders Research Institute for Agriculture, Fisheries and Food (ILVO), and Flanders Marine Institute (VLIZ)*

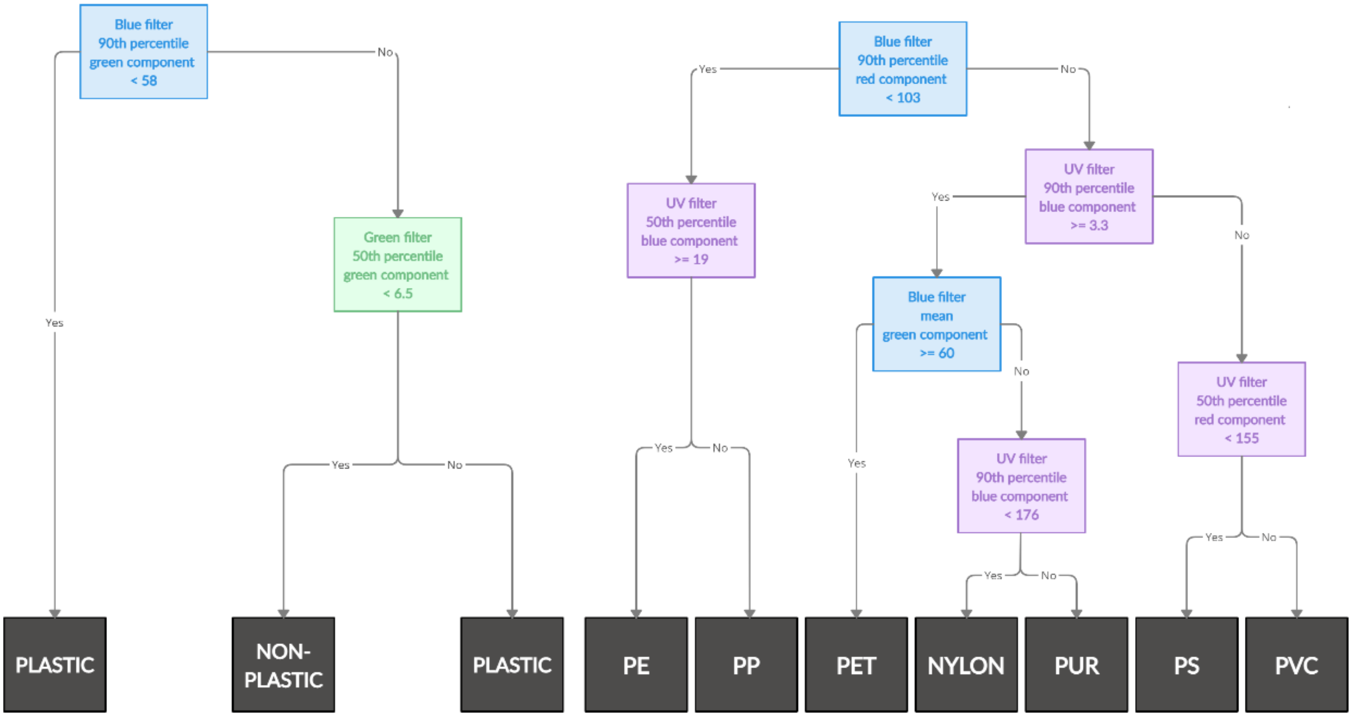
VLIZ and ILVO have developed an innovative approach for microplastic analysis where they combined the advantages of both high-throughput screening and automation. This method combines RGB-colour quantification of emitted fluorescence of Nile red (NR)-tagged particles, with a simplified supervised machine learning classification model, which has been developed in an open-source environment.

This approach further enhanced the Nile red technique for the fast detection of microplastics and included the identification of the polymer types. Both developed models (see accompanying illustration for detail) make use of recursive binary splits through simple decision rules inferred from emission spectra features.

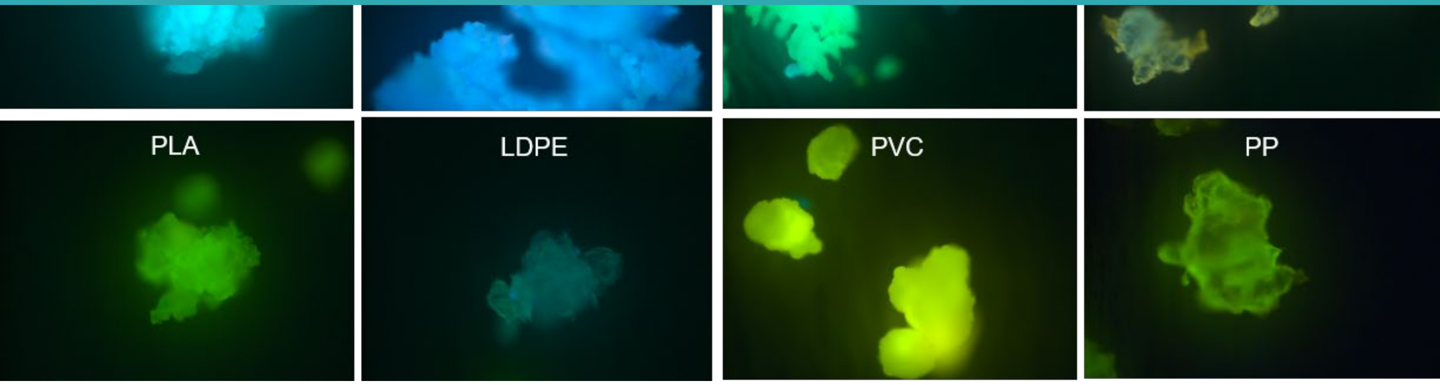
The first model (Plastic Detection Model – PDM) can predict with high accuracy whether a particle is plastic or of natural origin, while the second model (Polymer Identification Model – PIM) allows to identify the polymer type of microplastics.

Both models use RGB colour data, extracted from the stained particles photographed through a fluorescence microscope under blue, green, and UV filters, and were trained and validated using stained reference MPs.

We also developed a sample processing procedure suitable for this sample analysis approach that involves a double digestion step (alkaline and oxidative digestion) to remove any contaminating material (Continued on page 9).




*The PDM (left) and the PIM (right), two decision tree models based on RGB-coloration of particles following staining with Nile red. The models can be used to predict the plastic or organic nature of particles, and to identify the polymer type of a microplastic particle (Image Credit: Nelle Meyers).*




## An Innovative Approach for Microplastic Analysis

*continued from previous page*

This way, the method can be used for microplastic analysis in biota. At present, the efficiency and suitability of our approach is being validated for mussel and fish gastrointestinal samples, taking into account various validation parameters such as accuracy, precision, limit of quantification, selectivity, specificity, and robustness.

Reference microplastics of varying polymer type, size and shape were spiked into mussel and fish GIT samples and following extraction the developed method was then assessed. Based on preliminary results so far this approach of high-throughput screening and machine learning automation proves to be promising for the cost- and time-effective routine analysis of microplastics in biota in a simple, yet reliable way.

The results of this work have been accepted for publication with *Science of the Total Environment* and will be available to access this month!

## Hyphenated Techniques for Nanoplastics

*Andy Booth, SINTEF Ocean AS*

Our research partners at SINTEF have started developing and optimising methods for pyrolysis GC-MS (pyGC-MS) analysis of polymers, focused towards small microplastic and nanoplastic particles.

This work is a collaborative effort with the EU Joint Research Centre. A field flow fractionation method has been developed to produce particle size fractions of narrow size distributions within the range of 10 nm - 10 µm. A method to isolate small microplastics and nanoplastic fractions from aqueous solution and prepare them for analysis by pyGC-MS is currently being developed and optimised.

At the same time, we have been developing and optimising pyGC-MS analysis and quantification methods for a range of common polymer types. Limits of detection and quantification are being determined and methods for the identification of multiple polymer types in the same sample will be developed, with this work continuing in 2022.

Meyers, N., Catarino, A. I., Declercq, A., Brenan, A., Devriese, L., Vandegehuchte, M., De Witte, B., Janssen, C. and Everaert, G., 2022. Microplastic detection and identification by Nile red staining: towards a semi-automated, cost- and time-effective technique. *Science of the Total Environment.*

READ MORE

# A New Microlitter Sampler

*Urmas Lips, Tallinn University of Technology*

During the course of the JPI Oceans ANDROMEDA project, a new and easy-to-use device for microlitter sampling from water was designed and developed. This device, which was built to specifications by Flydog Solutions in Estonia, is a stand-alone version of the sampling device used in connection to ferryboxes found onboard ships-of-opportunity (e.g. commercial ferries).

The sampler is comprised of a simple flow-through case that consists of a stainless-steel outer and inner container, with the latter containing three sieves with different mesh sizes that sit one on top of the other. The design makes sampling, changing sieves, and transportation of samples an easy procedure and subsequently avoids contamination of samples taken.

Microlitter sampling is done by pumping seawater through the device while an attached flowmeter records the water volume. Particles left on the sieves will reveal microlitter pollution in the sampled area as concentrations of particles in three different size classes.

This stand-alone microlitter sampler was first tested in August 2021 onboard the R/V Salme in the Gulf of Finland (the Baltic Sea). Extended testing was then conducted on board the R/V Antedon II in the Mediterranean Sea during our scheduled sampling campaign in September 2021 (see page 12 for details). This new flow-through method was tested in parallel with a surface trawl manta net, to compare these two methods.

Since the testing of the sampling device and the subsequent microlitter analyses has been very successful, more devices will be built and delivered to the partners of the ANDROMEDA consortium for use in other sampling activities. Furthermore, the device will be used during research cruises to polar regions in the near future.

Our next JPI Oceans ANDROMEDA surveys employing our microlitter sampler are planned for early 2023 in the Bay of Biscay so don't forget to follow our journey online!


*Pictured (from L-R) is the completed JPI Oceans ANDROMEDA microlitter sampling device, the device with the outer container opened, and the inner container with three ascending sieves (Image Credit: Urmas Lips).*

*Microplastics samples ready for deployment off the coast of Toulon, France (Image Credit:* Mélanie Ourgaud*)*

## + Microplastic Sample Deployments

*Natascha Schmidt,* Institut Méditerranéen d'Océanologie

The deep sea is seen as one of the key plastic sinks in the ocean, where plastic waste accumulates and its degradation is slowed due to the lack of UV oxidation processes. As a result, it is of considerable interest to the scientific community to study the weathering of microplastics under natural deep sea conditions as well as subsurface conditions. The ANDROMEDA project has therefore sought to address this by undertaking a number of anchorage deployments and field sampling activities in both shallow coastal and deep sea environments. In order to generate suitable samples for analysis, the microplastic samples will be exposed in the natural environment for a period of 12 months before being reclaimed for distribution to our ANDROMEDA research partners.

Our first microplastic samples were deployed by hand in February of 2021 in Norwegian shallow waters, by NILU research partners Dorte Herzke and Guttorm Christensen, with retrieval scheduled for the coming months.

Our second microplastic sample deployment took place in deep sea conditions on April 3rd, approximately 30km off the coast of Toulon, France, at a depth of 2380 m using an anchorage apparatus (see accompanying image for detail).

The anchorage mechanism is secured in situ by means of a mooring line fixed with 300kg of ballast. Several floats are then attached to the metallic cage housing the microplastic samples to prevent any potential damage, and to ensure the samples will float upon release, and facilitate collection.

In order to retrieve these microplastic samples, an acoustic signal is sent through the water column initiating a release mechanism on the anchorage apparatus underwater. A GPS and flash device which are also included in the anchorage system will ensure that the equipment can be detected once at the water's surface even in difficult sea conditions (i.e. low visibility).

# ANDROMEDA Research Cruise

*Francois Galgani - Ifremer*

The ANDROMEDA cross-validation campaign to develop simple, sensitive, and robust methods for quantifying microplastics was held on the ship Antedon (INSU) from 14th to 17th September 2021, and involved participants from five Andromeda research institutes (MIO, ILVO, VLIZ, TALTECH, IFREMER). The work was carried out along a radial path located in the south of Marseille, France.

The methods implemented on this reserach cruise concern the use of fluorescent polymer markers, which will be tested on surface microplastics and in sediments by relevant ANDROMEDA partners. These methods will be inter-calibrated between the different laboratories involved, allowing their limits to be specified. In addition to this, chemical characterization of microplastics (*FTIR*, *RAMAN*, micro *FTIR*, etc.) will be carried out by the different partners.

The aim of this work in the long term, is to strengthen the skills of all research laboratories (e.g. number of analyses, simplified implementation, automation) in carrying out cross-validation (harmonization, validation comparison and inter-calibration) in order to develop an optimized and automatable measurement protocol.

Additional experimental work was carried out on the samples in order to develop more sensitive and semi-automated methods, in particular the implementation of a ferrybox system (see Page 10 for more details) for continuous microplastic measurements. These automated and high-frequency measurements will be tested as a complement to more traditional methods (e.g. visual observations).

In the end, the data that is generated from this work will be used in the context of the institutional monitoring of the Marine Strategy Framework Directive.

*Three different types of sampling equipment were used on this research cruise including (from L-R), a manta trawl, the new ferrybox microlitter sampler, and a sediment corer (Image Credit: Francois Galgani).*

*Red paint sheet fragments (Image Credit: Olga Carretero)*

# UPCOMING FOR ANDROMEDA

## + Smartphone App Launch and Schools Outreach

As part of the ANDROMEDA project we have been developing a smartphone app that will allow citizens to submit standardized and geo-referenced photographs of mesoplastics and microplastics for identification and characterization.

Photographs submitted through the app will be analysed by a custom-built image analysis algorithm to identify key polymer attributes (i.e. size, colour, roughness) before being projected onto an online GIS platform that will be made available through our project website.

Our research team has been working hard behind the scenes to design this app and we are looking forward to launching it during our next project meeting in Malta this summer.

In order to facilitate the launch of this innovative smartphone application, ANDROMEDA will actively reach out to schools in partner countries to raise awareness about microplastics and facilitate their participation in microplastic recording events. This activity is foreseen to take place simultaneously in partner countries to allow local-level engagement to become directly part of a truly international activity!

## CONNECT WITH US

@andromeda_eu

andromedaproject.net

ANDROMEDA is funded by JPI Oceans through support by the following national funding agencies: Belgium: the Belgian Federal Science Policy Office (BELSPO), France: The National Research Agency (ANR), Estonia: Ministry of the Environment of the Estonian Republic (MoE) and the Estonian Research Council (ETag); Germany: Federal Ministry of Education and Research (BMBF), Ireland: Marine Institute, and the Dept of Housing, Planning, and Local Government (DHPLG); Malta: Malta Council for Science and Technology (MCST); Norway: The Research Council of Norway (RCN); Spain: Spanish State Research Agency (AEI); Sweden: the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS).