MONITOOL: New tools for monitoring the chemical status in transitional and coastal waters under the Water Framework Directive

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Introduction

Heavy metals, such as nickel, cadmium, and lead, can have toxic effects when accumulated within organisms. As such, the EU has designated these metals "priority substances" in revisions of the Water Framework Directive, and their monitoring in marine environments is essential. At present, the EU monitors these metals by biota sampling, a method which involves the killing of fish or other marine organisms to sample for presence of metals in body tissue. The MONITOOL Project aims to prove the effectiveness of passive sampling devices in the marine monitoring of priority metals. Devices called Diffusive Gradient in Thin Film (DGT) passive samplers allow for the accumulation of metals over time when immersed in solution, and have been applied in studies of metal contamination since their invention in 1995. The MONITOOL Project incorporates 17 partners from 8 European countries, performing DGT deployments along the North Atlantic coast at coastal and estuary sites for five days, alongside water sampling to compare results. The Project aims to redefine the EU regulations on priority metal sampling to allow the use of these passive sampling devices in place of biota sampling.

DGT Devices

DGTs continuously accumulate metals when immersed in solution. The binding layer draws metal into the device and binds them for subsequent analysis to determine time weighted average concentrations.

This layer is separated from solution by a diffusive layer to slow binding, and a membrane filter to prevent large particles entering the gel layers. These layers are encased in a hard non-leaching plastic to protect from abrasive damage of the gel.

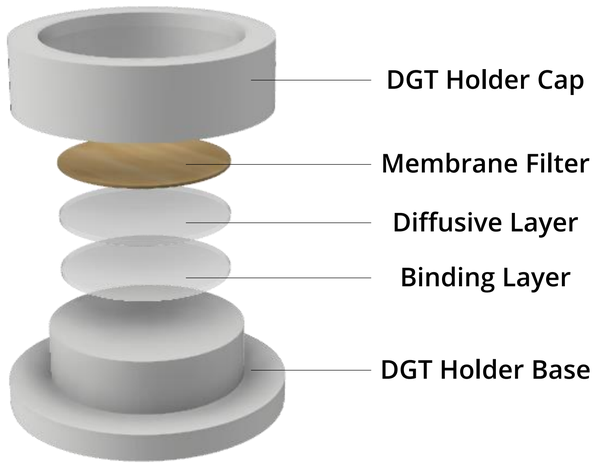


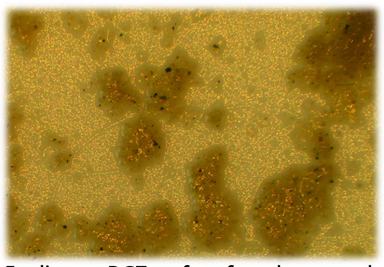
Diagram of the DGT's design.

DGTs before deployment in Perspex holder.

Analysis

The MONITOOL Project minimises variation in results by having a single project partner carry out specific work packages. The devices are sent to French laboratory IFREMER where the binding layer is isolated and the metals are removed by immersion in nitric acid, and this sample is then analysed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Spot water samples are analysed by two methods (ICP-MS and voltammetry) to validate the passive sampling method.

DCU analyses the devices for biofouling– the buildup of organisms on the surface of the membrane. This involves microscopy to identify individual primary fouling species, as well as protein and carbohydrate content analysis to estimate the extent of fouling.

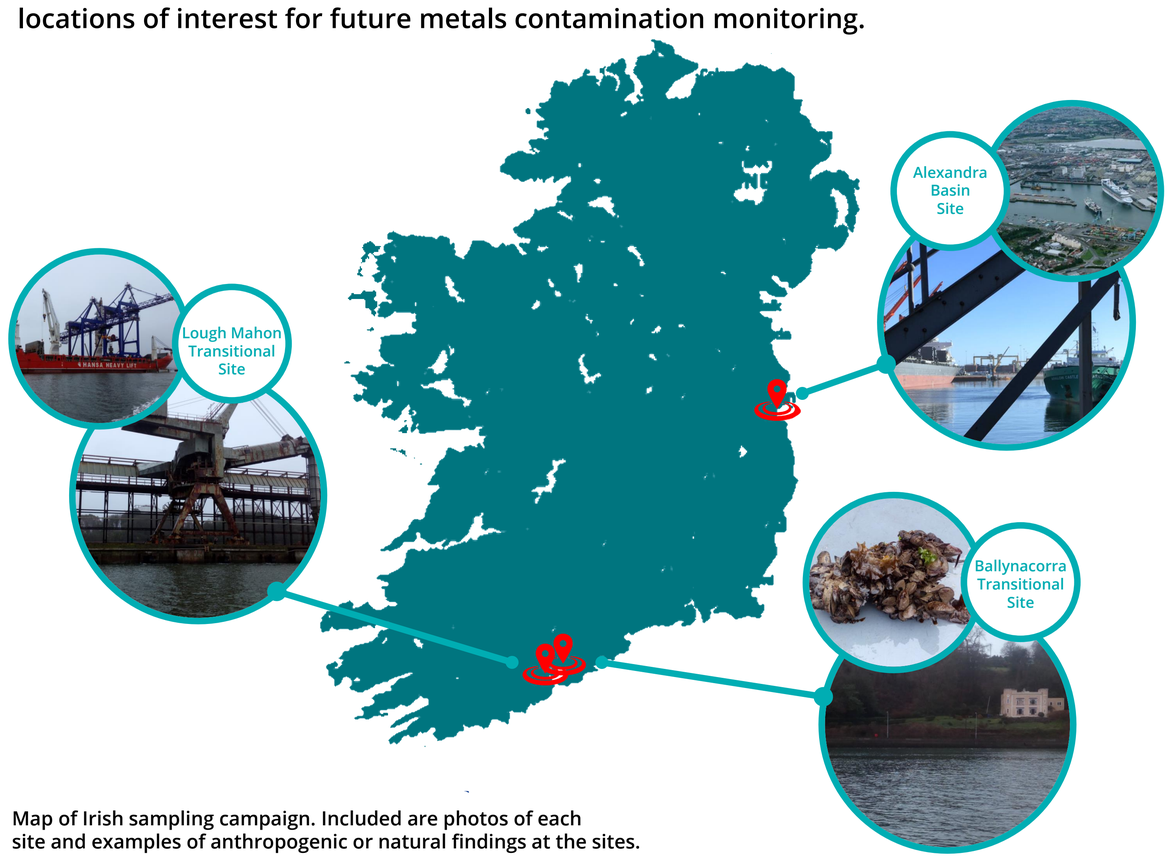


Fouling on DGT surface found on sample From Tagus River estuary, Portugal.

Deployments & Sampling

DGT devices were deployed at saltwater sites (coastal, transitional and estuary sites) in locations around Europe. In Ireland, two transitional sites (Cobh, Co. Cork) and one estuary site (Dublin Port Alexandra Basin) were chosen. Spot samples of the water and parameters such as temperature, pH and salinity are taken on-site regularly.

Both areas have had a history of industrial activity and potential sources of metal pollution (Haulbowline Island's steelworks dump at Cobh, and the export of lead and zinc at Alexandra Basin). These sites are undergoing redevelopment projects and are locations of interest for future metals contamination monitoring.



Map of Irish sampling campaign. Included are photos of each site and examples of anthropogenic or natural findings at the sites.

Project Goals

Through the tandem analysis of the DGT passive sampling devices and spot samples, the MONITOOL Project aims to define Environmental Quality Standards for the use of DGTs in Water Framework Directive compliance monitoring in the EU. Through interlaboratory exercises, the Project also aims to develop a network of laboratories in the Atlantic area proficient in analysis of these devices to support WFD monitoring.

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www.monitoolproject.eu

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