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Interim Report of the Working Group on Marine Sediments in Relation to Pollution (WGMS)

2–6 March 2015

Koblenz, Germany

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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Executive summary

The Working Group on Marine Sediments in Relation to Pollution (WGMS) met for the first meeting of its new three year term of reference on 2–6 March 2015, in Koblenz, Germany. The meeting was attended by ten members from 8 countries, with additional relevant presentations received from staff of the host institute.

WGMS has six Terms of Reference, with all of them being due for completion in 2017. These terms of reference require the Group to (1) respond to requests for advice; (2) report to ICES on research using passive sampling, review the suitability of different passive sampling methods for monitoring contaminants in sediments, to produce guidelines for sediment monitoring using passive samplers, to produce criteria to assess passive sampling monitoring data; (3) to report on the applicability of modelling to explain the distribution of sediment-associated contaminants in relation to potential sources; (4) to advise on deep sea sediment monitoring protocols; (5) to investigate/review the potential for release of contaminants from marine renewable energy activities; (6) to review emerging issues such as microplastics and deep sea mining as potential risks of environmental contamination by hazardous substances.

In 2015, good progress was made on five of the ToRs, whilst (ToR 5) was not worked on as the most interested member could not attend the meeting. The Group were due to produce a review in 2015 on methods for passive sampling of sediments. However, whilst significant progress was made with respect to reviewing methods of passive sampling for metallic contaminants and a review for hydrophobic contaminants was brought to the meeting, the final review document could not be finalised at the meeting and completion of this (ToR 2a) will be done as part of the final report of the group's three year term. A literature database was established and begun to be populated with reports suitable for deriving assessment criteria. Reports on modelling approaches were received and reviewed. Existing protocols and guidelines on sediment monitoring were reviewed for applicability to the deep sea. Reports from other working groups with interests in microplastics and deep sea mining were reviewed, and further information presented on work being done in these areas. Work to further progress the ToRs was agreed and will be taken forward at the next meeting of WGMS, which will take place in Ostend, Belgium during 14–18 March 2016.

1 Administrative details

Working Group name:

Working Group on Marine Sediments in Relation to Pollution (WGMS)

Year of Appointment:

2015

Reporting year within current cycle (1, 2 or 3):

Year 1

Chair(s)

Celine Tixier, France

Craig Robinson, UK

Meeting venue

Koblenz, Germany

Meeting dates

2–6 March 2015

2 Terms of Reference a) – z)

1	**Respond to requests for advice from Regional Seas Conventions** (e.g. OSPAR, EU) as required.
2	**Passive sampling (PS) in sediment** 2a - Review of existing methods dealing with PS in sediment 2b – Complete Guidelines for monitoring with PS in sediments for hydrophobic organic contaminants / produce guidelines for PS of metals 2c - Improve the understanding of the relation between data obtained by passive sampling in sediment and environmental quality (biota data, toxicity data, EACs) 2d- Review on on-going or future projects with PS
3	**Explore the suitability / possibility of modelling to explain spatial distribution patterns of contaminants in sediment and inform on sources and hence possible MSFD measures**
4	**Deep sea sediment monitoring** To provide advice on sediment monitoring in the wider oceans as required for MSFD
5	**Impact of renewable energy devices (e.g. wind mill,…)** To explore the potential risk impact in terms of release of contaminants (corrosion, anti-corrosion agents…)
6	**Emerging issues:** To assess the relevance and the potential risk impact of these issues and follow up outcomes

	of other expert groups working in areas of interest to WGMS - Microplastics in sediment - Deep sea mining - "new" priority substances to be considered under the MSFD - Emerging contaminants (flame retardants, pharmaceuticals, etc.)

3 Summary of Work plan

Year 1	Respond to requests under ToR 1 Complete review of techniques for passive sampling of marine sedments (ToR 2a) Progress work towards completion of the remaining ToRs
Year 2	Repond to requests under ToR 1 Progress work towards completion of the remaining ToRs
Year 3	Repond to requests under ToR 1 Report on ToRs 2-5

4 List of Outcomes and Achievements of the WG in this delivery period

ToR 1

- No specific requests for advice received;
- Feedback received from WGMS members serving on OSPAR and EU working groups.

ToR 2

- Review on passive sampling methods underway, intend to complete in 2016;
- People identified to undertake further work on the draft guidelines on passive sampling of sediments;
- Literature database established to help with the development of assessment criteria;
- Discussion and information exchange on current passive-sampling projects.

ToR 3

- Good progress made on reviewing possible methods for modelling sediment contaminant distribution patterns and source identification.

ToR 4

- Existing monitoring guidelines reviewed and considered fit for use in deep sea. However, WGMS will seek confirmation of this from colleagues not present.

ToR 5

- In the absence of key group members, very limited progress was made on this ToR.

ToR 6

- The output of OSPAR and EU Working Groups regarding microplastics monitoring was reviewed. Guidelines on measuring the abundance of different microplastics have been developed and assessment methodologies are in development. The group has an interest in the role of microplastics as contaminant vectors and will continue to monitor developments in this area of research;
- Work being done on deep sea mining by ICES WGEXT and ICES/NAFO WGDEC was reviewed to understand potential issues of mutual interest;
- An in-depth, French-language, report on potential environmental impacts of deep sea mining was received and will be reviewed for the 2016 meeting.

5 Progress report on ToRs and workplan

ToR 1

1	Respond to requests for advice from Regional Seas Conventions (e.g. OSPAR, EU) as required.	3 years	Requested advice

There were no specific requests for WGMS advice this year. However, several members of WGMS are also members of OSPAR and EU Working Groups and the following updates were provided to inform WGMS of activities within those, including the response of OSPAR to the Advice that ICES provided on spatial sediment monitoring and which WGMS had worked on during the 2012–2014 meetings.

OSPAR Working Groups on Monitoring and on Trends and Effects of Substances in the Marine Environment (MIME)

After discussion at WGMS 2014, a drafting group within OSPAR MIME 2014 reviewed and started to further revise a first draft revision of the Joint Assessment and Monitoring Programme (JAMP) Guidelines for Monitoring Contaminants in Sediments, that had been produced by MIME 2013 (Annex 13, Appendix 2 to MIME 13/8/1-E). Recommendations compiled by WGMS 2014 and ICES Advice Drafting Group were taken into account during the MIME review and the revision process during which MIME 2014 came to the conclusion that the monitoring programme should not differentiate between regional based monitoring for MSFD purposes and OSPAR spatial monitoring, as both should represent the spatial distribution of contamination. MIME 2014 agreed to the updated revised draft JAMP sediment guidelines that should be submitted to the Hazardous Substances and Eutrophication Committee (HASEC 2015) by the lead country (the Netherlands).

Intersessionally, the drafting group revised Technical Annex 5 to the OSPAR guidelines, as Spain found discrepancies between the main text of the Sediment Guidelines and this Annex. Some paragraphs that were not related to normalisation and that were already covered by the Sediment Guidelines or the CEMP agreement were deleted. Furthermore, a few minor corrections were made. The draft revised Technical Annex 5 was submitted to OSPAR HASEC 2015 for approval, too.

MSFD Expert Network on Contaminants

In 2014 the European Commission began a process to review the Commission Decision document on criteria and methodological standards on good environmental status of marine waters (2010/477/EU). For Descriptors 8 (Concentrations of contaminants are at levels not giving rise to pollution effects) and 9 (Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards) this review process was led by the Joint Research Centre in Ispra, with support from the Expert Network on Contaminants. The output of the review should be a new Decision document that is clearer and simpler than the existing one that includes minimum requirements, and is coherent with other Community Legislation. Following the first meeting of the Expert Network (July 2014), draft report templates for D8 and D9 were circulated for Expert Network comments before the JRC presented progress to the EU Working Group on Good Environmental Status (WG-GES) in October 2014. A second Expert Network meeting was held in February 2015 and following a further round of comments the JRC will submit its final report to WG-GES by end March 2015. Progress is communicated within the Expert Network using CIRCABC and with the public via the MSFD Competence Centre website (mcc.jrc.ec.europa.eu). The public website hosts the MSFD Task Group reports, the in depth assessments and other related documents; it includes links to EU funded projects of relevance to each of the MSFD Descriptors. At the February 2015 network meeting the following points were agreed:

- The substances to be monitored for D8 are the WFD Priority Substances, except any that are not relevant to the marine environment, with the possible addition of Marine Specific Pollutants, to be guided by the Regional Seas Conventions. A minimum list of substances should not be specified, rather a common de-selection mechanism is required in order to harmonise approaches between different Regions;
- Water is not recommended as a monitoring matrix; rather, monitoring should take place using sediment and biota;
- Biological Effects should be considered for D8, within the Regional Sea Conventions approach;
- Radionuclide assessments will be required for D8;
- The minimum requirement for monitoring under D9 are those substances listed in the EC Food Regulations; pathogens (e.g. E. coli) should not be considered under D9.

Any subsequent revision of the Commission Decision document will have long-term implications, and will affect the next round of MSFD monitoring plans, not the current (2014–2020) reporting cycle.

ToR 2: Passive sampling

ToR 2a

2a - Review of existing methods dealing with PS in sediment	Follow-up on the work of ICES WKPSPD	Year 1	Recommendation based on current status

A review of existing passive sampling methods (PSMs) to measure metals in sediments has been carried out. Limitations and advantages of these methods are highlighted. Based on the findings of the review, the use of well-developed PSMs for routine monitoring alongside conventional approaches is recommended for metals. These techniques provide excellent information on the bioavailability and potential toxicity of metals in sediments. However further studies are encouraged to demonstrate PSMs as a robust tool for assessing metal bioavailability-toxicity, and thus to assess the good environmental status of the marine environment under MSFD Descriptor 8.

A forthcoming international conference on passive sampling of trace metals by the diffusive gradients in thin films technique (DGT Conference 2015, Donostia-San Sebastián, Spain) aims to discuss the use of DGTs as tools for risk assessment, links between DGT-derived information and toxicity, the development of assessment criteria, and the method's limitations and uncertainties. Feedback from the conference will be used to inform the WGMS review on passive sampling of metals in sediments.

A Dutch document (Smedes, 2014) on passive sampling of hydrophobic contaminants in sediments was presented to the group by its author, who suggested that this could form the basis of the passive sampling review for these compounds. Foppe Smedes requested that an edited version of his report be published in the scientific literature before the document be presented to ICES within a WGMS report. Therefore, WGMS will work intersessionally with Foppe Smedes to produce this publication and, consequently, the report to complete ToR 2a is not completed in year 1 as planned, but will now be completed during year's 2 and 3, and will include both metals and hydrophobic contaminants.

Reference

Smedes, F. 2014. Monitoring Environmental Quality of Marine Sediment. A Quest for the Best. Deltares report 1209377-004-ZKS-0001; Deltares, Utrecht, The Netherlands. 57pp.

ToR 2b

2b - Complete Guidelines for monitoring with PS in sediments for hydrophobic organic contaminants / produce guidelines for PS of metals	Guidelines required for technique to be acceptable for monitoring purposes.	3 years	Working with MCWG experts, produce TIMES paper(s) on the use of PS in sediments

This ToR relates to the other passive sampling ToRs in that the Foppe Smedes document mentioned under ToR 2a recommends that the passive sampling of sediments is highly suitable for monitoring of hydrophobic contaminants, with many advantages over traditional sediment monitoring approaches and that it should be proposed for addition to the OSPAR pre-CEMP (voluntary). However, before passive sampling of sediments for hydrophobic contaminants can be used in mandatory monitoring programmes (e.g. OSPAR

CEMP) there are a number of operational requirements, including the publication of guidelines on how to undertake the technique (e.g. an ICES TIMES paper). Experts from the ICES Marine Chemistry Working Group (MCWG) and WGMS have already published an ICES TIMES paper for the passive sampling of waters using silicone rubber (ICES TIMES no. 52) and are progressing with an ICES paper describing how to determine the partition coefficients that are required for use in passive sampling. In 2008, WGMS had begun to prepare a guideline document on passive sampling of sediments using silicone rubber, and it is this document that is being completed under ToR 2b. However, with the work being undertaken on ToR 2a this year, we were not able to progress with the guidelines. People able to work on the Guideline have been identified and we will progress with this ToR during the 2016 meeting. Guidelines for PS of metals in sediments are also required, however at the 2015 meeting the work on metals focussed on the review under ToR 2a and the guidelines will be worked on in 2016 and 2017.

ToR 2c

2	**Passive sampling (PS) in sediment** 2c - Improve the understanding of the relation between data obtained by passive sampling in sediment and environmental quality (biota data, toxicity data, EACs)	Assessment criteria suitable to assess GES in sediments are lacking / require improvement. WGMS will work with WGBEC to attempt to close this knowledge gap	3 years	Dataset and advice to OSPAR on progress as passive sampling, which ICES WKPSPD have recommended the approach go on the pre-CEMP.

As an initial step towards generating a dataset suitable for use in deriving assessment criteria, an account for WGMS was established on the web-based citation manager www.mendeley.com. This allows members to add citations containing toxicity data to develop a library of papers for subsequent data mining in developing assessment criteria such as OSPAR Background Assessment Criteria and Environmental Assessment Criteria. WGMS recommends that the ICES Working Group on Biological Effects of Contaminants (WGBEC) and the Marine Chemistry Working Group (MCWG) help to populate this database. WGMS members were asked to encourage colleagues in WGBEC and MCWG to do so and the WGMS co-chair will highlight the database to the 2015 and 2016 meetings of WGBEC.

ToR 2d

2	**Passive sampling (PS) in sediment** 2d - Review on-going or future projects with PS		Each year	Report to ICES

The following information on projects in Belgium was provided by Els Monteyne to update on current passive sampling work being undertaken by group members (ToR 2d).

After World War I an estimated 35 000 tons of war material was dumped on the 'Paardenmarkt', a shallow sand flat just off the Belgian coast. Probably about one third consists of chemical munitions. The dumping site extends over 3 km^2, ranging in water depth between 1.5 and 5.5 m. The munition has been sagging and is largely covered under accumulating fine-grained sediments, mainly due to the construction of the outer port of Zeebrugge. The munitions are most likely not too heavily corroded; complete corrosion could take hundreds of years. The most important threats seem to be related to mechanical disturbance of the munition shells (e.g. due to vessel grounding) and direct contact (with Yperite lumps). The total amount of TNT on the Paardenmarkt is estimated to be at least 2500 tons. To make sure that TNT is not leaking out of the bomb shells to the surrounding sediments a Belgian project started in 2015 with the aim to develop a passive sampling method allowing to trace low concentrations of TNT or transformation products in the sediment. Sediments of the site will be sampled and ex-situ passive sampling will be performed on these sediments. A dispersion model of TNT leakage was made by F. Francken in a previous project. The dispersion model will be validated and further refined in case positive TNT samples were found.

Maria Belzunce announced to WGMS that in September 2015 she is co-hosting an international conference on passive sampling of trace metals by the diffusive gradients in thin films (DGTs) technique. The aim of the conference is to present the latest advances in DGT techniques, to discuss their advantages as new tools for risk assessment, links to toxicity and the development of assessment criteria, and to highlight limitations and uncertainties. All are invited and encouraged to participate.

ToR 3

3	**Explore the suitability / possibility of modelling to explain spatial distribution patterns of contaminants in sediment and inform on sources and hence possible MSFD measures**	3 years	Report to OSPAR via ACOM

The group was able to make good progress on this ToR during the 2015 meeting and a series of presentations was given on this topic by various WGMS members (See Annex 3 for abstracts). Federico Spagnoli described how conservative tracers such as aluminium and rare earth elements have been used in multivariate statistical modelling (Davis, 1986) to explain the distribution of contaminants in the Adriatic Sea resulting from inputs from the River Po (Spagnoli *et al.*, 2014). Birgit Schubert and Nicole Brennholt reported on the use of hydrodynamic and morphodynamic modelling to produce sediment transport models of the German Bight and German North Sea estuaries (BAW 2013; Heyer and Schott, 2013), including the Elbe (Seiffert *et al.*, 2014; Fricke, 2012). Back-modelling to source has provided support to a theory that pathogenic bacteria observed in the German Bight in 2010 originated from an outbreak in the Ems estuary. These studies suggest that modelling may be able to inform on sources of marine contaminants, and thus inform on measures under the MSFD and WFD. Taking a different approach, Mário Mil-Homens showed how the use of stable lead isotopes and ratios of Pb/Al concentrations inform on the extent of anthropogenic Pb input from the River Tagus to the deeper areas of the Portuguese Atlantic margin (Mil-Homens, *et al.*, 2013). Further work is required to investigate the limitations of the modelling approach to identifying the source of contaminants.

The 2016 meeting of WGMS will be hosted by a Belgian institute with much expertise in mathematical hydrographic modelling, and their experts will be invited to contribute to this ToR. All WGMS members are asked to consult within their home institutes and research networks for relevant information that they could bring to support the group's work on this ToR.

References

BAW – Bundesanstalt für Wasserbau (2013): Nordsee-Basismodell – Teil II: Modellsystem UnTRIM-SediMorph, Hydrodynamic (UnTRIM-SediMorph), UnTRIM Basismodell, BAW-report (http://www.baw.de/methoden/index.php5/Validierungs-studien_Nordsee)

Davis, J.C., 1986. Statistics and data analysis in geology. Second edition. Wiley, NY, USA. 550 pp.

Fricke, B. and Weilbeer, H. (2012): Modellierung von feststoffgebundenen Schadstoffen am Beispiel der Tideelbe. In: Bundesanstalt für Gewässerkunde: Partikuläre Stoffströme in Flusseinzugsgebieten. Kolloquium am 20./21. September 2011 in Koblenz. – Veranstaltungen 1/2012, Koblenz, Februar 2012, 88 S.; DOI: 10.5675/BfG_Veranstalt_2012.1

Heyer, H. and Schottke, K. 2013. Aufbau von integrierten Modellsystemen zur Analyse der langfristigen Morphodynamik in der Deutschen Bucht – AufMod (03KIS082-03KIS088). Gemeinsamer Abschlussbericht für das Gesamtprojekt mit Beiträgen aus allen 7 Teilprojekten, 292 S.

Martinez-Carreras, N, Gallart, F, Iffly, J F, Pfister, L, Walling, D E, Krein, A (2008): Uncertainty assessment in suspended sediment fingerprinting based on tracer mixing models: a case study from Luxembourg. Sediment Dynamics in Changing Environments, vol 325 (Proceedings of a symposium held in Christchurch, New Zealand), 94-104.

Mil-Homens, M., Caetano, M., Costa, A.M., Lebreiro, S., Richter, T., de Stigter, H., Trancoso, M.A., Brito, P., 2013. Temporal evolution of lead isotope ratios in sediments of the Central Portuguese Margin: A fingerprint of human activities. Marine Pollution Bulletin, 74, 274-284.

Seiffert, R., Hesser, F., Büscher, A., Fricke, B., Holzwarth, I., Rudolph, E., Sehili, A., Seiß, G., Winkel, N. 2014. Auswirkungen des Klimawandels auf die deutsche Küste und die Ästuare. Mögliche Betroffenheiten der Seeschifffahrtsstraßen und Anpassungsoptionen hinsichtlich der veränderten Hydrodynamik und des Salz- und Schwebstofftransports. Schlussbericht KLIWAS-Projekt 2.04/3.02. KLIWAS-36/2014. DOI: 10.5675/Kliwas_36/2014_3.02

Spagnoli, F. *et al.* 2014. Sedimentological, biogeochemical and mineralogical facies of Northern and Central Western Adriatic Sea. Journal of Marine Systems, 139, 183–203.

Walling, D.E. 2005. Tracing suspended sediment sources in catchments and river systems. Science of the Total Environment, 344, 159-184.

ToR 4

4	**Deep sea sediment monitoring** To provide advice on sediment monitoring in the wider oceans as required for MSFD	Monitoring of the deep sea is required for the MSFD. Tehcnically this is more difficult than for shallow seas and advice should be developed	3 years	Advice to OSPAR via ACOM on deep sea sediment monitoring

Sampling procedures/techniques in the deep sea are similar to those developed for shallow marine sediments that are well described in the OSPAR JAMP Guidelines for Monitoring Contaminants in Sediments, originally developed by OSPAR Working Groups on Monitoring and on Trends and Effects of Substances in the Marine Environment (MIME) and currently under review by the OSPAR Hazardous Substances and Eutrophication Committee (HASEC). However, major differences exist between the deep sea and shallower marine environments. These differences are related to the relatively low sediment accumulation rates, absence of direct pollution sources (excepting in the cases of aggregates, mining and oil/ gas extractions) and the dominance of diffusive contamination sources (e.g., atmosphere, oceanographic transport) in the deep sea areas. Other differences are the technical conditions of sampling recovery in the deep sea that are critical and have specific requirements (e.g., pressure resistant equipment, larger vessels, corers, winches and cables), and also the time necessary for collecting each sample in deep waters. Therefore, the financial costs associated with each sample collection increases significantly in deep seas, even where these are relatively nearshore. For minimizing the costs to setup the sampling strategy a good knowledge of bottom morphology and sedimentological processes that occur in the survey area is needed. Additionally, it will be recommended to use a risk-based monitoring strategy based on the identification of the targets (issues) to be studied before, during and after the operation. Based on this, it will be possible to choose each station as representative of the widest area. In this way, the description of the sea-bottom can be carried out with the minimum number of samples. In order to optimize the sampling strategy in deep-sea environments it is then recommended to:

1) Compile bibliographic information available for the area concerning: bottom sediment features, hydrodynamic knowledge, other available geochemical/sedimentological data;

2) Characterize the morphology and sedimentology of the sea-bottom through the use of geophysical surveys (e.g., side-scan sonar, multi-beam and seismic).

Furthermore, the sampling frequency and sampling depth need to be decided on the basis of knowledge of sedimentation rates, mixing rates and the aims of the monitoring program. Given the cost of obtaining deep sea samples, considerations should be given to archiving and storage of samples for future use (e.g. analyses of emerging contaminants, determination of baselines…).

The existing OSPAR guidelines on monitoring contaminants in sediments were considered by WGMS members present at the 2015 meeting to be adequate for deep sea monitoring and WGMS will seek confirmation of this from colleagues not present.

ToR 5

5	**Impact of renewable energy devices (e.g. wind mill,…)** To explore the potential risk impact in terms of release of contaminants (corrosion, anti-corrosion agents…)	Many hundreds of renewable energy devices are being placed in the marine environment. Resultant changes in hydrodynamics may release sediment-bound contaminants, there may be inputs of contaminants from their installation, operation and decommissioning.	3 years	Report to ICES (with recommendations, as appropriate)

Whilst the use of sacrificial anodes to protect metallic structures from galvanic current corrosion was recognised as a potential source of contaminants, limited progress was made on this ToR. Group members are requested to bring to the next meeting information from expert colleagues that may be suitable for use in this ToR.

ToR 6

6	**Emerging issues:** To assess the relevance and the potential risk impact of these isuues Follow up of outcomes of other expert groups		3 years	Report to ICES
	6a - Microplastics in sediment	Microplastics are of emerging concern and may be a vector for contaminant transfer to sediments, or from sediments to biota		Develop link-ups to relevent expert groups on marine litter
	6b - Deep sea mining	Mineral mining is a likely future source of anthropogenic disturbance to the deep sea and could result in the release of contaminants into otherwise relatively pristine environments		Link-up with WGEXT who have a ToR to report to produce a summary paper concerning deep sea mining (What is being mined, where this is occurring, techniques being developed etc).

ToR 6a: Marine Litter

A number of Working Groups in other organisations are providing advice and information regarding the abundance of microplastics in the marine environment, including sediments. WGMS reviewed outputs of the OSPAR Intercessional Correspondence Group on Marine Litter (ICG-ML) and the European MSFD Technical Subgroup on Marine Litter (TSG-D10). The latter has produced a document "Guidance on Monitoring of Marine Litter in European Seas" that includes comprehensive and sensible advice on monitoring microplastics in marine sediments, the former are currently developing Common Indicators for sea bed marine litter and for ingestion of microplastics.

N. Brennholt (BfG, Koblenz, Germany) provided information concerning a 3 year project on "Microplastics in inland waterways and coastal waters – origin, fate, impact" that was launched on 1 January 2015 (cf Annex 3).

WGMS will keep informed and report on work/project dealing with the occurrence of microplastics in sediments and their impact on aquatic systems, particularly as regards their potential as vectors for contaminants. The outcomes of the working groups mentioned above, and international fora such as (Micro2014 Workshop, Brest, France; Micro2015 seminar, Piran, Slovenia) shall be reviewed along with the progress made on microplastics achieved by MCWG and WGBEC.

ToR 6b: Deep sea mining

The scarcity of mineral resources on land deposits together with the continuous and growing demand for metals and rare earth elements motivates a future exploitation of all these resources in deep sea areas. Certain target areas, such as, hydrothermal vent fields, Fe-Mn crust deposits are good examples. Mining activities threaten to disturb wide areas of deep-sea environments that until now have been maintained untouched by human activities. The exploitation of these resources can affect extensive areas of the seafloor (including areas distant from the exploitation area) and the overlying water column (e.g. by releasing plumes of material). The environmental costs can be extremely high, being an urgent need to identify and assess potential impacts of these activities. Before starting the resources exploitation it is necessary to proceed to a correct evaluation of mineral reserves and also to an environmental characterization of these sensitive environments. Under the Framework 7 program, the European Commission funded research projects such as MIDAS (http://eu-midas.net/) and BLUEMINING (http://www.bluemining.eu) in order to study environmental impacts of extracting mineral and energy resources from the deep-sea environments and also to raise the technological and environmental challenges of the mineral exploitation in extreme conditions such as that existing in deep-sea environments.

On request of the French Ministry of Ecology and of the Scientific Council on Natural Heritage and Biodiversity (CSPNB), the environmental risks of deep sea mining were investigated in an Expertise report (Dyment *et al.*, 2014.). This report, elaborated by French expert researchers, presents the available knowledge on marine mineral resources, their exploration, and possible exploitation techniques to provide a consistent approach of their impacts. The report also identifies a set of knowledge gaps and how these can be addressed, stressing the importance of acquiring fundamental scientific knowledge that requires great investment in researchers (people), technical resources and long-term financing. A more in-depth review of this extensive, French-language, document will be undertaken for the 2016 meeting.

The ICES Working Group on Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT) has a ToR to study the implications of deep sea mining for them (legislative/environmental/geological). In their 2014 report, WGEXT summarized the main types of potential mining interests and indicated that commercial development of these resources is not likely in the near to medium term. WGEXT also identified that the ocean floor outside of National waters are regulated by the International Seabed Authority (ISA; www.isa.org.jm) which has regulations for prospecting and exploration, whilst its code for exploitation of deep sea mineral resources is under development. WGMS will attempt to investigate the extent to which this developing code addresses the input and impact of contaminants arising from such activities on the marine environment.

Another expert group with interest in deep sea mining is the the ICES/NAFO Joint Working Group on Deep-water Ecology (WGDEC). WGDEC met in February 2015 identified the different types of deep sea mining as outlined above and identified a number of potential impacts, including removal of substrate / loss of habitat, introduction of energy (noise, light), introduction of non-native species, smothering by sediment plumes, nutrient (Fe) enrichment altering plankton communities, and toxicity from introduced contaminants released incidentally (e.g. oil spills, sewage, flocculants) or as by-products of mining activities (e.g. release of toxic metals & radionuclides). WGDEC noted that the ISA have authorised exploration licences in regions of seafloor massive sulphides of the Mid-Atlantic Ridge (14-26° N), potential commercial interest in waters of the Azores and between Norway and Greenland, and that deep sea mining is planned to commence in the territory of Papua New Guinea in 2018.

ToR 6c: other emerging issues (e.g. "new" priority substances, pharmaceuticals, novel flame retardants, etc.)

It was suggested that the group may wish to add this new sub-ToR in order to inform itself and report to ICES on emerging scientific and policy issues such as monitoring of the "new" priority substances under European Directive 2013/39/EU, and emerging contaminants (pharmaceuticals, novel flame retardants, etc.).

References

J. Dyment, F. Lallier, N. Le Bris, O. Rouxel, P.-M. Sarradin, S. Lamare, C. Coumert, M. Morineaux, J. Tourolle, 2014. Les impacts environnementaux de l'exploitation des ressources minerals marines profondes. Expertise scientifique collective. (Environmental impacts of deep sea mining. Collective scientific expertise). Rapport d'expertise (Expertise report), CNRS - Ifremer, France. 930 pp. Available (in French, with an Executive Summary in English) from http://www.developpement-durable.gouv.fr/Impacts-environnementaux-de-l.html

6 Revisions to the work plan and justification

Revision to the timing of ToR 2a and addition of a sub-ToR 6c are proposed:

i) to delay the output of ToR 2a (review and recommendation on passive sampling of sediments) to year 3 in order to allow prior publication of a supporting piece of work

ii) to add a sub-ToR (6c) in order to inform the Group, and report to ICES, on emerging scientific and policy issues such as monitoring of the "new" priority substances under European Directive 2013/39/EU, and emerging contaminants (pharmaceuticals, novel flame retardants, etc.).

7 Next meetings

WGMS will hold the second meeting in Ostend, Belgium 14–18 March 2016.

Annex 1: Annex 1: List of participants

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Annex 2: Recommendations

Recommendation	Addressed to
1. WGMS recommends that members of WGBEC and MCWG assist in the development of a database for reports publishing toxicity data expressed as freely dissolved concentrations. This will be used to develop assessment criteria for passive sampling data. An online database has been established and details on accessing it will be passed to the Chairs of WGBEC and MCWG, or can be made available to individuals upon request to WGMS co-chairs.	ICES Working Group on Biological Effects of Contaminants (WGBEC) ICES Marine Chemistry Working Group (MCWG)

Annex 3: Presentation abstracts

Several WGMS members gave presentations related to the different topics discussed within the meeting; abstracts from these are reproduced here.

Federico Spagnoli (ISMAR–CNR, Italy) Sedimentological, biogeochemical and mineralogical facies of Northern and Central Western Adriatic Sea

The aim of this work was to identify sedimentary facies, i.e. facies having similar biogeochemical, mineralogical and sedimentological properties, in present and recent fine sediments of the Northern and Central Adriatic Sea with their spatial and temporal variations. Further aims were to identify the transportation, dispersion and sedimentation processes and provenance areas of sediments belonging to the facies. A Q-mode factor analysis of mineralogical, granulometric, geochemical (major and trace elements) and biochemical (organic carbon and total nitrogen) properties of surficial and sub-surficial sediments sampled in the PRISMA 1 Project has been used to identify the sedimentary facies. On the whole, four facies were identified: 1) Padanic Facies, made up of fine siliciclastic sediments which reach the Adriatic Sea mainly from the Po River and are distributed by the Adriatic hydrodynamic in a parallel belt off the Italian coast. Southward, this facies gradually mixes with sediments from the Apennine rivers and with biogenic autochthonous particulate; 2) Dolomitic Facies, made up of dolomitic sediments coming from the eastern Alps. This facies is predominant north of the Po River outfalls and it mixes with Padanic Facies sediments in front of the Po River delta; 3) Mn-carbonate facies, made up of very fine sediments, rich in coccolithophores and secondary Mn-oxy-hydroxides resulting from the reworking of surficial fine sediments in shallow areas and subsequent deposition in deeper areas; 4) Residual facies, made up of coarse siliciclastic sediments and heavy minerals resulting from the action of waves and coastal currents; this facies is present mainly in inshore areas.

Reference

Spagnoli, F., Dinelli, E., Giordano, P., Marcaccio, M., Zaffagnini, F. and Frascari, F. 2014. Sedimentological, biogeochemical and mineralogical facies of Northern and Central Western Adriatic Sea. Journal of Marine Systems, 139, 183–203.

Mário Mil-Homens (IPMA, Portugal): Stable Pb isotopes in marine sediments as a tool to trace the transfer of metal contamination from shelf areas to deeper part of the Portuguese Margin

M. Mil-Homens (IPMA, Portugal) gave a presentation on the temporal characterisation of stable Pb isotopes ($^{206}Pb/^{207}Pb$, $^{208}Pb/^{206}Pb$) in sediment cores of the Portuguese Margin to assess the Pb contamination throughout the last 200 years. Independently of their locations, all cores are characterized by increasing Pb/Al trends not related to grain-size changes. Conversely, decreasing trends of $^{206}Pb/^{207}Pb$ were found towards the Present. This tendency suggests a change in Pb sources reflecting an increased proportion derived from anthropogenic activities. The highest anthropogenic Pb inventories for sediments younger than 1950s were found in the two shallowest cores of Cascais and Lisboa submarine canyons, reflecting the proximity of the Tagus estuary. Lead isotope signatures also help demonstrate that sediments contaminated with Pb are not constrained to estuarine-coastal areas and upper parts of submarine canyons, but are also transferred to a lesser extent to deeper parts of the Portuguese Margin.

Reference

Mil-Homens, M., Caetano, M., Costa, A.M., Lebreiro, S., Richter, T., de Stigter, H., Trancoso, M.A., Brito, P., 2013. Temporal evolution of lead isotope ratios in sediments of the Central Portuguese Margin: A fingerprint of human activities. Marine Pollution Bulletin, 74(1): 274-284.

B. Schubert (BfG, Germany): Modelling sediment transport in the German Bight and North Sea Estuaries

A model system consisting of hydrodynamic modelling with UnTRIM and morphodynamic modelling with SediMorph was developed by the Federal Waterways Engineering and Research Institute, Hamburg (BAW) (BAW, 2013; Heyer and Schott, 2013) for modelling sediment transport in the German Bight and German North Sea Estuaries. SediMorph (Malcherek, 2005) facilitates a 2D or 3D simulation of fractionated sediment transport processes within the bottom and at the bottom surface. The model system was also applied to model contaminant transport associated with particulate suspended matter in the Elbe Estuary (Seiffert *et al.*, 2014; Fricke, 2012). It was assumed that contaminants behave conservatively and are associated with the fine-grained fraction <20 µm. Data on the distribution of contaminants in bottom sediments and contaminant input to the Elbe Estuary were taken in consideration in the model.

References

BAW – Bundesanstalt für Wasserbau (2013): Nordsee-Basismodell – Teil II: Modellsystem UnTRIM-SediMorph , Hydrodynamic (UnTRIM-SediMorph), UnTRIM Basismodell, BAW-report (http://www.baw.de/methoden/index.php5/ Validierungsstudien_Nordsee)

Heyer, H. und K. Schottke (2013): Aufbau von integrierten Modellsystemen zur Analyse der langfristigen Morphodynamik in der Deutschen Bucht – AufMod (03KIS082-03KIS088). Gemeinsamer Abschlussbericht für das Gesamtprojekt mit Beiträgen aus allen 7 Teilprojekten, 292 S.

N. Brennholt (Bundesanstalt für Gewässerkunde, Koblenz, Germany): Particle transport model as a tool to determine the source of the human pathogenic bacteria Vibrio vulnificus that was detected in an non-typical habitat at the island Borkum in the German Bight

V. vulnificus belongs to bacteria of the genus Vibrio occurring in estuarine and sea water environments worlwide. Vibrios can cause e.g. food poisoning, gastroenteritis, wound and ear infections. In Germany, severe Vibrio-related human infections after contact with sea water have been reported in 1994 and sporadically since then. Within the framework of the German departmental research programme KLIWAS, *V. vulnificus* was found exclusively at the mesohaline estuaries of the rivers Weser and Ems at salinities of 0.5 and 23. These findings were consistent with literature, where the main habitat of *V. vulnificus* is described as brackish water environments. However, in September 2010, a positive sediment sample had been detected at Borkum that belongs to the euhalin open coastal waters with high salinity of approx. 30 and thus does not provide a typical habitat for *V. vulnificus*.

A particle transport model, which was developed and applied for drift simulations at the German Federal Maritime and Hydrographic Agency, Hamburg (BSH) was used by Frank Janssen (BSH) in order to check a possible drift of *V. vulnificus* from the Ems Estuary, where it had been detected one month earlier, to the island of Borkum. The model that considered current and wind regimes in this area during late summer 2010 confirmed the assumption that *V. vulnificus* detected at Borkum may have had its origin in the Ems Estuary, suggesting that these bacteria can be transported over long distances.

In Boer *et al.* (2013) the model is described: "The 3D baroclinic regional ocean circulation model BSHcmode calculates the 3D current field, water level, temperature, salinity and ice cover in the North Sea and the Baltic Sea with an overall horizontal resolution of 5.5 km and 900 m resolution in the German Bight and the western Baltic Sea. The model includes tidal and meteorological forcing, as well as baroclinic effects due to temperature changes and varying river discharge. Based on archived results from BSHcmod, the drift of particles is calculated by the particle transport model BSHdmodL. Both model components make use of meteorological forcing data provided by the weather prediction models of the National Meteorological Service of Germany, Offenbach (DWD)."

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Microplastics

N. Brennholt (BfG, Germany): "Microplastics in inland waterways and coastal waters – origin, fate, impact"

N. Brennholt presented the objectives and methodological approach of a 3 years project on "Microplastics in inland waterways and coastal waters – origin, fate, impact" that was launched on 1 January 2015. The project is intended to establish a scientific basis for the assessment, monitoring and regulation of microplastics (MP) in the aquatic environment, i.e. in water and sediments. In a first step, it will quantify the occurrence of microplastics (<5 mm) in inland waterways and assess their quality. Then the quantitative and qualitative input in waterways and coastal waters shall be evaluated. Furthermore, the potential of microplastics to adsorb contaminants and the potential of their uptake by aquatic organisms as well as their biological effects will be investigated. Finally, the project aims at a risk assessment for aquatic organisms and the aquatic environment.

First results on the occurrence of microplastics in limnic sediments had already been achieved prior to the beginning of the project and varied from 32–64 MP particles/kg (for comparison: in literature 0.3–165 MP particles/kg were described for marine sediments). Generally, quantification of the MP fragments that may have different shapes, is achieved by separating them from sediments by hand or by sieving or by a density separation. Currently, different researchers use different separation fluids for density separation. But not all these approaches/separation fluids match the density especially of highly dense polymers like PVC. For reliable assessments and to get comparable data, standardised methods to quantify the amount of MP in sediments are required. For the BfG project, a reproduction of the Munich Plastic Sediment Separator developed by Imhof *et al.* (2012) will be applied for quantifying the amount of microplastics in sediment samples. These analyses will be performed by the University of Frankfurt, a partner of the project. For separating MP from sediments, this method uses a saturated $ZnCl_2$-solution that allows to separate MP particles of different size classes (1 to 5 mm (L-MPP) and < 1 mm (S-MPP) in a stirring chamber with a recovery rate of more than 95 % compared to 40 to 55 % with other methods). Separation efficiency for silty samples may be lower. The use of $ZnCl_2$ allows also to separate high density polymers like PVC. For sandy sediments, about 2.5 kg samples were used, for silty sediments, samples may be smaller.

The project partner at the University of Frankfurt also exposed freshwater invertebrates (*Daphnia magna, Gammarus pulex, Chironomus riparius, Lumbriculus variegatus, Physella acuta, Sphaerium corneum*) to MP in order to study ingestion of MP. Particles of 1 μm and 10 μm could be detected in the gastrointestinal tract of all these organisms, after exposure to MP, however, they also will excrete MP to a certain extent. Particles of 90 μm could only be detected in *Gammarus pulex, Chironomus riparius, Lumbriculus variegatus* and *Physella acuta*. In the presence of food or sand ingestion rates decreased. Summing up, the results show clearly that freshwater invertebrates have the capacity to ingest and accumulate high amounts of MPs. The ingestion was thereby determined by the size of the particles as well as the feeding behaviour, the stage of development and the size of the organisms. Further studies are needed to assess the biological effects of MPs and to understand the interaction between MPs and biological systems. In particular research is required to assess the impact of contaminated MP on aquatic organisms and to assess the contribution of contaminated MP to bioaccumulation compared to direct uptake of contaminants via the water phase. First laboratory experiments e.g. showed that the exposure of algae to MP reduced contaminant uptake by algae as a result of competitive adsorption of contaminants by MP.