International Council for the
Exploration of the Sea

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# *REPORTS OF MEETINGS OF THE SUB-GROUP ON BALTIC SEDIMENTS (UNDER THE WORKING GROUP ON THE BALTIC MARINE ENVIRONMENT)*

Tallinn, USSR 13-15 September 1988
Sopot, Poland 10-11 April 1989

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*General Secretary
ICES
Palægade 2-4
DK-1261 Copenhagen K
DENMARK

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1st Meeting



2nd Meeting

ICES/BME
Subgroup on Baltic Sediments
10.-11.4.89 Sopot

# R E P O R T

## 1. Opening of the meeting and adoption of the agenda

The meeting was opened on 10.4.89 at 9.00 by the chairman of the subgroup, Dr. Perttilä. The absence of specialists from Sweden, Denmark and Federal Republic of Germany was regretted. The group was welcomed by the disrector of the host organization, Dr. Joanna Zachowicz, and Prof. Jozef Mojski. The draft agenda, with minor modifications, was accepted for the basis of discussions.

## 2. Review of the Table of Contents of the Critical Review

The chairman introduced this item by recalling the agreements in the previous meeting in Tallinn September 1988. The contents of the Critical Review (Annex 2) were considered to give a good basis for the work. It was pointed out, however, that the Gdansk Bay as an important net sedimentation basin, should be included into the list of sea areas to be discussed in the Review. The Polish scientists present agreed to contribute to this effect.

## 3. The present situation of the Critical Review

## 4. Identification of data sources for the preparation of the sedimentation maps of the Baltic Sea

## 5. Possible re-assignment of the authors of the Critical Review

These three items were discussed partly together. The intersessional developments were reviewed by the chairman. For the chapter 2 (Description of the sedimentation areas in the Baltic Sea), descriptions covering the Gulf of Bothnia, Gulf of Riga and to a certain extent also the Baltic Proper basins had been written before the meeting, though to a varying degree of completeness. Accounts for the Gulf of Finland and the western Baltic Proper were submitted during the meeting. Dr. Emelyanov, who had agreed to account for the general description of the central Baltic Proper basins, was not present. According to

informal information, his contribution should be ready. Dr. Jankovski agreed to check with him as soon as possible. As for the Kattegatt area, Dr. Larsen, who had been asked to contribute, had not been able to confirm his participation in the work, but it was reminded that an earlier publication of Dr. Larsen could possibly be used to this effect. The chairman agreed to write a chapter on the basis of this paper, and submit it to the acceptance of Dr. Larsen.

As agreed at the Tallinn meeting, the chairman had approached Dr. Hallberg for him to consider contributing to this chapter. In answer, a manuscript of the title "Environmental implications of metal distribution in Baltic Sea sediments" was received, without any comments. The manuscript contains a large amount of trace element data from the central Baltic Proper, and a statistical treatment indicating that atmospheric pollution is a dominating factor. The data and results can probably be used, if a permission is given by Dr. Hallberg. However, it was still left open whether the manuscript contains enough material for a justification of an entire chapter, or should its content be incorporated into the review of sediment studies in the Baltic Proper.

Chapter 3 (Sensitivity of sediments to environmental changes) is covered by a manuscript of a corresponding title by Larsen and Anders Jensen. It was stressed that this kind of model work would be of utmost importance in the justification of monitoring of substances in the sediments.

Chapter 5 (Experimental methods) had been covered by Dr. Brügmann. Only methods of monitoring radioactive elements was found lacking. It was agreed that these methods should not be included in the Review, as generally approved methods are already in use by the MORS group.

Dr. Brügmann has covered the situation for trace elements in all the internationally accessible areas. Dr. Gordeev has included in his report (above) a full review of the studies in the Riga Bay.

For the Gulf of Finland, Drs. Punning and Jankovski are preparing a manuscript containing new data on 13-16 stations.

Drs. Tervo and Niemistö are preparing a manuscript on 5-6 stations in the Gulf on Finland and in the Gulf of Bothnia. The data will be published at the next ICES Statutory meeting and can thus be included already now in the Critical Review.

Organochlorines have not yet been covered (Dr. Perttilä).

Petroleum hydrocarbons have not yet been covered (Andrulewicz).

Artificial radioactive elements: Dr. Niess has responded, indicating that the Helcom/MORS data are confidential and can be obtained only through a permission from the Helcom Secretariat. While this is true, Dr. Niess was in fact asked to give an overview on published studies of radioactive elements

in the Baltic Sea sediments. As radioactive elements are already monitored in the Helcom programm, it was questioned if the data (or even the overview) would be needed. However, it was agreed that as the radioactive elements are the only ones at present monitored in sediments, they should be covered in the Review at least for the sake of an example. It was agreed that Dr. Niess should be approached again for an extended abstract on recent radionuclide data in sediments contained in a report prepared for the MORS/HELCOM. It was further agreed that this part should be annexed to chapter "4" instead to chapter "6" because it was more meant as a methodological guidance and support than a "review of radioactive contamination of Baltic Sea sediments in general".

Nutrients (Larsen, Cato). The chairman has not been able to contact directly with Dr. Larsen. There is no promise from his part. Dr. Cato has promised to look for the possibilities, but no firm confirmation has been given. It was decided that an earlier publication of Dr. Larsen could be used as a basis for a preliminary phosphorus overview. The chairman agreed approach to Dr. Cato again, and also Dr. Frederik Wulff for an account for the nitrogen studies.

Drs. Pempkowiak and Uscinovicz agreed to write the necessary contributions on the Gdansk Bay, including the general description,an overview of published literature, and a compilation of representative data.

**Agenda item 6 - Consideration of a possible tentative recommendation to Helcom on the monitoring of harmful substances in sediments**

The main reason for the Critical Review is to give background support for Helcom to decide whether or not to start the monitoring of harmful substances in marine sediments. While radioactive elements are already now being monitored in the sediments, trace elements and organochlorines are followed only in biota (obligatory basis), and petroleum hydrocarbons in sea water. Sediments might give an insight on the development of the concentrations. Also, concentrations in sediments are necessary information for mathematical models which are used to predict trends and the effects of environmental measures. Sediments also provide an excellent integrating capacity for many contaminants, not disturbed by short-term fluctuations. An intercalibration has been run to assess methodological capability of the Baltic Sea laboratories.

It was, however, noted that the slow rate of accumulation and the mixing of the sediment through bioturbation and, in several places, the mechanical disturbance by trawling make it impracticable to start monitoring the sediments on an annual basis. A longer interval, perhaps 5 years, would increase the chances to detect environmental changes, and in addition allow a proper preparation time for the extensive work involved with sediment sampling and analysis, and also give sufficient time for assessing the results. This would imply the starting of baseline studies on a regular, long-interval basis.

Accordingly, the group decided to forward a tentative recommendation to the Helsinki Commission, through its parent body, to start a "repeated extensive baseline study" (Annex 1).

**7. Tentative timetable**

The texts and representative data on the sea areas should be sent to the chairman by the end of August. The chairman will then compile and distribute the draft review, together with the sedimentation maps, to the members by the end of December 1989. The final draft could be presented at the ICES/BME 1990 meeting. Thus it was considered not necessary for the group to meet again until in connection to the next BME meeting.

The meeting was closed on 11.4.89 at 9.30.

Subgroup on Baltic Sediments
Sopot 10.-11.89
Annex 1

**Tentative Recommendation**

The following recommendation reflects - on a "consensus level"- those opinions expressed from the participants of the meetings of the ICES/BME-Sub-Group on Baltic Sediments held in Tallinn/September 1988 and in Sopot/April 1989. In addition, the preliminary outcome of draft chapters and working papers prepared for the "Critical -Baltic Sea Sediment- Review" is taken into account.

Sediments are considered a useful medium to study the contamination of the Baltic Sea environment with respect to many compounds introduced significantly by anthropogenic activities. Information on the distribution patterns and chronological development of those contaminants -together with certain parameters describing the sedimentation conditions- is deemed necessary
- to quantify changes in contaminant contents caused by accidental and/or long-term chronic inputs,
- to assess possible effects on the ecosystem, and, possibly,
- to use in models to predict contaminant trends and to evaluate theoretically the effects of environmental regulations.

At least for some contaminants, the comparability of earlier data from different sources is such that a joint effort of laboratories from countries bordering the Baltic Sea may be recommended.

The proposed studies should not be a "monitoring" in the common sense. Instead, "repeated extensive baseline studies" should be organized starting not before 1993 and with at least 5 years intervals.

All significant net-sedimentation areas of the Baltic Sea should be covered. Statistically sound sampling should be performed around the pre-selected " representative site" taking into account the "sediment patchiness" known or expected for the respective area.

In the first phase, at least some metals (Hg, Cd, Pb, Cu, Zn), phosphorus and nitrogen compounds should be included; selected organochlorines and petroleum hydrocarbons on a tentative basis. Together with the contaminants, an as broad as possible range of background parameters should be included.

Combined "pilot studies/intercalibration exercises" may be organized in advance of the proposed baseline studies to optimize the sampling and analytical procedures. A Steering Group should be convened with representatives from all sevem countries.

Subgroup on Baltic Sediments
10.-11.4.89 Sopot
Annex 2

# A G E N D A

1. Adoption of the agenda

2. Review of the Table of Contents of the Critical Review

3. The present situation of the Critical Review

4. Identification of data sources for the preparation of the sedimentation maps of the Baltic Sea

5. Possible re-assignment of the authors of the Critical Review

6. Tentative timetable

7. Closing the meeting

Subgroup on Baltic Sediments
Sopot 10.-11.4.89
Annex 3

**List of participants**

Eugeniusz Andrulewicz
Institute of Meteorology and Water Management -
Maritime Branch
Waszyngtona 42
81-342 Gdynia
Poland

Lutz Brügmann
Institute of Marine Research
Seestrasse 15
DDR-2530 Rostock - Warnemünde
DDR

Leonard Falkowski
Institute of Oceanology
Polish Academy of Sciences
Powstancow Warzawa 55
81-967 Sopot
Poland

Harri Jankovski
Institute of Thermo- and Electrophysics of the
Academy of Sciences of Estonia
Paldiski Street 1
200031 Tallinn
Estonia

Regina Kramarska
Geological Survey of Poland
Branch of Marine Geology
Kombatantow No. 62
81-740 Sopot
Poland

Malgorzata Maslowska
Geological Survey of Poland
Branch of Marine Geology
Kombatantow No. 62
81-740 Sopot
Poland

Josef E. Mojski
Geological Survey of Poland
Branch of Marine Geology
Kombatantow No. 62
81-740 Sopot
Poland

Janusz Pempkowiak
Institute of Oceanology
Polish Academy of Sciences
Powstancow Warzawa 55
81-967 Sopot
Poland

Matti Perttilä
Finnish Institute of Marine Research
PO Box 33
SF-00931 Helsinki
Finland

Matti Punning
Institute of Thermo- and Electrophysics of the
Academy of Sciences of Estonia
Paldiski Street 1
200031 Tallinn
Estonia

Teresa Szczepanska
Geological Survey of Poland
Branch of Marine Geology
Kombatantow No. 62
81-740 Sopot
Poland

Anna Trozinska
Institute of Meteorology and Water Management -
Maritime Branch
Waszyngtona 42
81-342 Gdynia
Poland

Szymon Uscinovicz
Geological Survey of Poland
Branch of Marine Geology
Kombatantow No. 62
81-740 Sopot
Poland

Joanna Zachowicz
Geological Survey of Poland
Branch of Marine Geology
Kombatantow No. 62
81-740 Sopot
Poland

Subgroup on sediments in the Baltic Sea (Subgroup of the ICES WG on Baltic Marine Environment)

Subgroup meeting in Tallinn 13.-15.9.88

# R E P O R T

## 1. Opening of the meeting

The chairman of the subgroup, Dr. Matti Perttilä, opened the meeting and welcomed the participants. Prof. Raukas from the Estonian Academy of Sciences then welcomed the participants stating in a few words the importance of sedimentological work in his country. The chairman then described the targets of the study group as defined in its terms of reference, that is the compilation of a Critical Review on contamination studies carried out in the Baltic Sea sediments, the compilation of maps describing the areas in the Baltic Sea suitable for contamination monitoring studies in the sediments, and finally the consideration of the possibilities of starting a pilot monitoring program. This meeting was convened because of a necessity to discuss and agree on the contents and authors of the Review and the maps.

## 2. Adoption of the agenda

The draft agenda distributed earlier to the participants was adopted with a change of the order of the items. The final agenda is attached as Annex 1 and the list of participants as Annex 2.

## 3. Activities of interest to the Subgroup

The chairman of the ICES-WG on Baltic Marine Environment, Dr. Lutz Brügmann, summarized the relevant outcome of the 1988 meeting of the ICES-WG on Marine Sediments in Relation to Pollution (WGMS). The WG on Sediments has mainly concentrated on the sedimentological methodology, with important results concerning sampling, analytical and storage methods, intercalibrations, and suspended material, and on questions like "normalization techniques" and "bioavailability".

The chairman of the subgroup referred to the 1983 IOC/GIPME/GEMSI Report for a general representation of using sediments for pollution monitoring purposes. Prof. Raukas described the major effort started in the Soviet Union to map the geological quality of the Baltic Sea bottom, and indicated the need to wait for the results of this work. Dr. Anders Jensen described then the planned Danish study programme to investigate the importance of bioturbation in sedimentation studies. Dr. Emelyanov told the meeting about the ongoing Finnish-Soviet geological survey of the Baltic Sea bottom.

**4. Outline of the sediment maps of the Baltic Sea**

The chairman introduced this item by referring to draft maps, sent earlier to the participants of the Study Group. These include a map describing the soft bottom areas, most probably to be suitable for contamination studies, and a map showing the location of a few stations where contamination studies have been carried out already for a long time. The definition for a soft bottom was then discussed. From the geological point of view it was noted that there was a need to agree on the definition for different kinds of bottom quality. There followed a lively discussion on the inclusion of geological aspects into the Critical Review. It was, however, pointed out by the chairman that the main target for the group was to describe the Baltic Sea bottom from the point of view of contamination studies, and thus only areas with undisturbed sedimentation conditions and where a suitably thick recent sediment bed had been formed, should be included in the maps.

In order to give a uniform description to the sedimentation areas in question, following criteria were agreed on:

- -the majority of the sediment material should have a grain size <63um
- -fine sand content should not exceed 5%
- -dry matter content in the top 5 cm layer should not exceed 40%.

It was agreed that in most cases the soft bottom areas follow the bottom topography. Dr. Perttilä agreed to continue the compilation of these areas, with the help of experts from various countries, as listed in connection to the item 5.

The group decided to illustrate in the maps the distribution and concentration development for the following elements and compounds:

Trace elements: Zn, Cu, Cd, Pb, Hg
Organochlorines: tot-PCB, DDT, DDD, DDE, HCH,HCB
Petroleum hydrocarbons
Phosphorus and nitrogen
Total organic carbon

Data from the following stations/areas were decided to be included in the maps:

Bothnian Bay: F2/F2a, BO3/BO3a
Bothnian Sea: US5b, SR5 (or EB1), plus 1 - 3 stations according to the data collected by the Swedish scientists
Gulf of Finland: XV-1, possibly one of the stations on the LL-section, and later on data provided by the Soviet scientists for the eastern end of the Gulf
Baltic Proper: F81/BY15 (Gotland Deep), BY38, BY28, BY31 (Landsort Deep), BCSIII-15 (Gdansk Bay), BY5 (Bornholm Deep), Mecklenburg Bight, Arkona Deep, Kiel Bight, Riga Bay, Kattegat area

It was accepted that Dr. Perttilä would be responsible for compiling the data coming from various experts, and for the drafting of the maps. Responsibility for collecting and sending in the contaminant data for the above listed stations and areas was accepted by the following persons (main responsibility as underlined):

Gulf of Bothnia: Brügmann, Perttilä
Gulf of Finland: Perttilä, Jankovski
Riga Bay: Gordeev
Gotland Deep and the northern Baltic Proper: Brügmann, Perttilä, Emelyanov, Gordeev
Southern Baltic Proper: Brügmann, Emelyanov, Gordeev, Kuptsov
Western Baltic Sea and the Danish Straits: Brügmann, Jensen

It was further decided that, in order to get a better coverage of the areas, the chairman should approach to those members not present who would be likely to have access to additional data. This includes especially Ingemar Cato and Rolf Hallberg of Sweden, Birger Larsen of Denmark, and Janusz Pempkowiak and Eugen Andrulewicz of Poland. It was emphasized that preferably the most recent data should be used. In addition to the maps, also the original data sets, submitted to the chairman, should be distributed among the Study Group members. Should several data sets be submitted for a particular station, only one set should be used for the maps, but all data should be considered by the members. In areas where data are available for several close-lying stations, the data originators should consider of submitting only representative mean values. When available, data sets on cores divided into 1 cm slices should be submitted for all contaminants, including the nutrients. Data should be submitted on dry weight basis.

The utility of a further map, showing the linear sedimentation rates (mm/y) and mass accumulation rates in different parts of the Baltic Sea was then considered. On the basis of the presentations of Drs. Anders Jensen and Rainer Gellermann it became evident that this kind of description would be of great importance to the interpretation of results from sediment

studies. In addition, a presentation of "response times" should be provided (time before a change of about 30% in a specific contaminant content can be detected with 1 cm subsampling, provided the contaminant input increases by 100%).

## 5. Outline of the contents of the Critical Review

The draft list of the contents, distributed earlier to the participants, was introduced. The order of the items was found unsuitable and was changed. Moreover, the proposed chapter on mass balances was omitted, since mass balance considerations for the purpose of the work should be included in other chapters. Instead, on the basis of the introduction by Drs. Anders Jensen and Rainer Gellermann, a chapter on the sensitivity of sediments to environmental changes was considered necessary. The resulting table of contents is given in Annex 3.

## 6. Authors to the Critical Review

It was decided to ask the following persons to assume the responsibility for the writing of the items in the table of contents (main responsibility as underlined):

Chapter 1. (Introduction, general background)

This chapter will be written later on.

Chapter 2. (Description of sedimentation areas/stations)

-Gulf of Bothnia: Tulkki, Winterhalter
-Gulf of Finland: Punning, Niemistö, Winterhalter
-Riga Bay: Gordeev
-Baltic Proper: Emelyanov, Cato, Boström
-Western Baltic Proper: Lange, Larsen
-Kattegat: Larsen

For the Baltic Proper, the chairman was asked to approach several other experts for contributions on specific areas. Dr. Brügmann provided the meeting with a guiding list of items to be considered in the preparation of the descriptions (see Annex 4).

Chapter 3. (Geochemical implications)

It was decided that Dr. Hallberg would be asked to consider writing a general presentation on the geochemical effects in contamination studies in the Baltic Sea.

Chapter 4. (Sensitivity of sediments to environmental changes)

Drs. Anders Jensen and Rainer Gellerman accepted to write this chapter. It was agreed that the relevant data, specified in Annex 5, should be sent to Dr. Anders Jensen as soon as possible. The group identified at least the following persons who would probably have access to suitable data: Janusz Pempkowiak, Sergei Kuptsov, Anita Liehu, Matti Perttilä, and Dr. Erlenkeuser. The chairman of the Subgroup will approach them for cooperation.

Chapter 5. (Experimental methods)

This chapter will be written by Dr. Brügmann, by means of compiling methodological guidelines proposed by the ICES WGMS, except for methods to determine the redox potential, for which Dr. Niemistö will be asked to contribute.

Chapter 6. (Review of contamination studies in the sediments in the Baltic Sea)

The responsibility was divided in the following way (main responsibility as underlined:

Trace element studies: Brügmann, Jensen (organotins), Perttilä (arsenic)
Organochlorines: Perttilä
Petroleum hydrocarbons: Andrulewicz, Poutanen
Artificial radioactive elements: Nies
Nutrients: Larsen (phosphorus), Cato (nitrogen)
Others: detergents (Perttilä)

Chapter 7. (Conclusions)

The conclusions will be drafted when all drafts of the other chapters are available. Preferably, a draft Conclusions will be submitted to Helcom, via ICES, answering the main questions, ie. if and in which way a sediment monitoring programme should be recommended for the Baltic Sea.

The Group also considered the possible size of the final Report. A tentative allocation is given in Annex 6.

**7. Timetable**

It was decided that a draft review should be presented at the next ICES-WG on Baltic Marine Environment meeting in April 1989. For this, the contributions should be sent to Dr. Perttilä by the end of March 1989. However, data for the sedimentation maps should be sent to Dr. Perttilä by the end of December 1988. It was decided that the final version of the Critical Review should be presented at the 1990 meeting of the ICES-WG on BME.

Data needed for the response time assessment, as specified in Annex 5, should be sent to Dr. Anders Jensen as soon as possible.

**8. Pilot study on pollution monitoring in sediments**

As the consideration of a pilot study would depend on the outcome of the Review, this item was left for future discussions.

**9. Recommendations**

Noting that the sedimentation maps and the Critical Review will be prepared by the Subgroup due to the request of the Helsinki Commission to ICES, and being aware of the importance of the study in view of the monitoring of the Baltic Sea, and that the only way to achieve a satisfactory result is through full cooperation among the Baltic Sea countries, the group recommends that in all countries the authorities responsible for the Helcom work should give appropriate support to the participants of the subgroup.

**10. Closing the meeting**

The chairman reviewed the actions listed above. They were approved of by the meeting. It was also agreed that the Subgroup should meet in connection with the ICES-WG on BME in Gdynia, 10.-15.4.89.

The meeting was adjourned at 11.00 hours on 15 September.

Annex 1

Meeting of the Sediment Study Group

Tallinn 13.-15.9.88

# A G E N D A

1. Opening of the meeting
2. Adoption of the agenda
3. Outline of the sediment maps of the Baltic Sea
4. Outline of the contents of the Critical Review on Sediment Studies in Relation with Pollution
5. Decision of authors of the respective chapters
6. Timetable
7. Pilot study
8. Closing the meeting

Annex 2

**LIST OF PARTICIPANTS**

(Those marked with an asterisk were present during the whole period of the meeting)

Raukas, Anto
Presidium of Estonian Academy of Science (Institute of Geology)
Kohuto Stn. 6
200006 Tallin ESSR

Tavast, Elvi
Estonian Academy of Science (Institute of Geology)
Kohuto Stn. 6
200006 Tallin ESSR

Karukäp, Rut
Estonian Academy of Science (Institute of Geology)
Kohuto Stn. 6
200006 Tallin ESSR

Martin, Era
Estonian Academy of Science (Institute of Geology)
Kohuto Stn. 6
200006 Tallin ESSR

Kask, Juri
Estonian Academy of Science (Institute of Geology)
Kohuto Stn. 6
200006 Tallin ESSR

Orviku, Kaarel
Estonian Academy of Science (Institute of Geology)
Kohuto Stn. 6
200006 Tallin ESSR

Kaljo, Dimitri
Estonian Academy of Science (Institute of Geology)
Kohuto Stn. 6
200006 Tallin ESSR

* Punning, Jaan- Mati

Institute of Thermophysics and
Electrophysics Acad. Sci.
Paldiski St. 1
200031 Tallin ESSR

* Jankovski, Harri

Institute of Thermophysics and
Electrophysics Acad. Sci.
Paldiski St. 1
200031 Tallin ESSR

Piivi, Maire

Institute of Thermophysics and
Electrophysics Acad. Sci.
Paldiski St. 1
200031 Tallin ESSR

Emelyanov, Emil

Institute of Oceanography. Atlantic
Department.
Pr. Mira 1
Kaliningrad 236000 USSR

* Brügmann, Lutz

Institute für Meereskunde
Seestrasse 15
Rostock 2530 DDR

* Gellermann, Rainer

Bergakadamie Freiberg, Sektion
Physik.
Cottastrasse 4
Freiberg 9200 DDR

* Gordeev, Viacheslav

Institute of Oceanology Acad.Sci
Krasikova 23
117218 Moscow USSR

* Jensen, Anders

Danish Isotope Centre
Skelbaekgade 2
1717 Copenhagen Denmark
Telf. 1-21 41 31

* Perttilä, Matti

Finnish Institute of Marine
Research
PO. Box. 33
0931 Helsinki Finland
Telf. 0-33 10 44

* Herman, Magdalena

Finnish Institute of Marine
Research
PO. Box. 33
0931 Helsinki Finland
Telf. 0-33 10 44

Annex 3

**CRITICAL REVIEW OF POLLUTION STUDIES IN SEDIMENTS IN THE BALTIC SEA**

Table of contents (draft)

Annex 4

**Critical Review / item 2**

Proposed structure/content:

1. Short information on the geological history of the specific area

2. Short information -where possible- on main bottom currents (direction, speed), and on main characteristics of rivers draining into that area, and of their draining area (sources of transported material, anthropogenic influences etc).

3. Short description on bottom topography and bottom types resulting from 1. and 2., including, where appropriate, some maps, preferably not more than 2.

4. Short description on the condition of the bottom waters and on "surface" sediments (from 0 to about 20 cm), eg. in relation to the redox state and the density of the benthic organisms.

5. Summarizing 2. - 4., proposals should be made which stations would be favourable for future sediment studies (monitoring?). Criteria could be:

-places with net sedimentation of fine grained / soft material,

-central parts of basins, remote from local sources (hot spots)

-no or only low probability of disturbances due to dumping of dredge material, ground-net fishery and similar activities,

-low bioturbation and sediment mixing due to bottom circulation, advection etc.,

-"trapping characteristics" of the sediments (eg., that could mean permanent anoxic conditions)

-already existing knowledge from earlier studies and related to the Baltic Monitoring Programme BMP (ideally it would be a station already included in the BMP),

-finally, the above conditions should not only be restricted to a small spot but to an area extended over some 10 km2 for central parts, and about 4 km2 for marginal parts of the Baltic Sea.

Annex 5

**Pb- 210 data exchange**

Data from Pb-210 datings should consist of the following items:

Zm (mixing depth) cm and g/cm^2

A (unsurported Pb-210 in mmBq versus Mm (mass depth) g/cm^2

D (mixing coeff.) cm^2/a

R (accumulation rate) g/cm^2/a

w (liniar accumulation rate) cm/a (below Zm)

wo (liniar accumulationrate) cm/a (0-1 cm depth)

Flux of Pb-210 mmBq/cm^2/a

o dry density of sediment in the deepst part of core g/cm^3

oo dry density of sediment in 0-1 cm g/cm^3

surported Pb-210 mmBq

measured total Pb-210 in 0- 1 cm mmBq

Pb-210 halflife used in compilation

The data should be send to:

Anders Jensen
Danish Isotope Centre
Skelbaekgade 2
1717 Copenhagen
Denmark

Annex 6

**Tentative space allocation for the items to be discussed in the Critical Review**

| | | | |
|---|---|---|---|
| Item 1. | | | 10 pages |
| Item 2. | 10 pages each | | 60 pages |
| Item 3. | | | 15 pages |
| Item 4. | | | 15 pages |
| Item 5. | | | 25 pages |
| Item 6. | Trace elements | 20 | |
| | Organochlorines | 10 | |
| | Petroleum HC | 10 | |
| | Nutrients | 15 | |
| | Other | 5 | |
| | | | 75 pages |
| Item 7. | | | 5 pages |
| | | | 205 pages |

Sediment maps 5 - 10 pages