



The National Centre  
for Research and Development



# CLISED

## Climate Change Impact on Ecosystem Health - Marine Sediment Indicators

(02/2014 - 01/2017)

[www.iopan.gda.pl/clised](http://www.iopan.gda.pl/clised)



## Project Promoter and partners



### Project promoter

**Institute of Oceanology Polish Academy of Sciences, Sopot, Poland**  
***Coordinator: prof. Grażyna Kowalewska (Kowalewska@iopan.gda.pl)***



### Project partner 1

**University of Gdańsk (UG), Gdańsk, Poland**  
***Contact: prof. Hanna Mazur-Marzec (biohm@univ.gda.pl)***



### Project partner 2

**Norwegian Geotechnical Institute (NGI), Oslo, Norway**  
***Contact: prof. Gijs D. Breedveld (Gijs.Breedveld@ngi.no)***

NTNU



### Project partner 3

**Norwegian University of Science and Technology (NTNU), Trondheim, Norway**  
***Contact: dr. Tomasz Maciej Ciesielski (tomasz.m.ciesielski@ntnu.no)***

## Aim

- ✓ Comparison of the **Gulf of Gdańsk** (Baltic Sea) with **Norwegian fjords** – the **environmental state & climate change** over millennia based on sediment studies



Current environmental state concerns

such phenomena like:

- primary production
- eutrophication effects
- pollution
- toxic algae blooms.



The climate indicators will characterize climate-driven environmental phenomena in the past, like:

- high primary production
- temperature & salinity changes
- oxygen depletion.

## Implementation

- **sediment collection** at carefully selected sites
  - recent sediments (0–30 cm)
  - old sediments (up to 500 cm)
- **in-situ measurements** in water column and the near-bottom water:  
dissolved oxygen, temperature, salinity
- **sub-sampling** of the collected sediments
- sample **storage** (-20°C, -80°C)
- **analyses** of the sediment samples using different modern techniques  
(phytoplankton pigments, inorganic indicators, pollution indicators,  
geological proxies, biotoxins, toxicity)

## Cruises

1. Gulf of Gdańsk, 11-17.04.2014  
r/v Oceania, IO PAN, Sopot
2. Oslofjord/Drammensfjord, 7-12.06.2014  
r/v Oceania, IO PAN, Sopot
3. Gulf of Gdańsk, 10.04.2015  
r/v IMOR, IM, Gdańsk
4. Trondheimsfjord, 26.08.2015  
r/v Gunnerus, NTNU, Trondheim
5. Oslofjord, 14.09.2015  
f/f Trygve Braarud, OU, Oslo
6. Balsfjord (Troms), 3.10.2015  
f/f Helmer Hanssen, TU, Tromsø

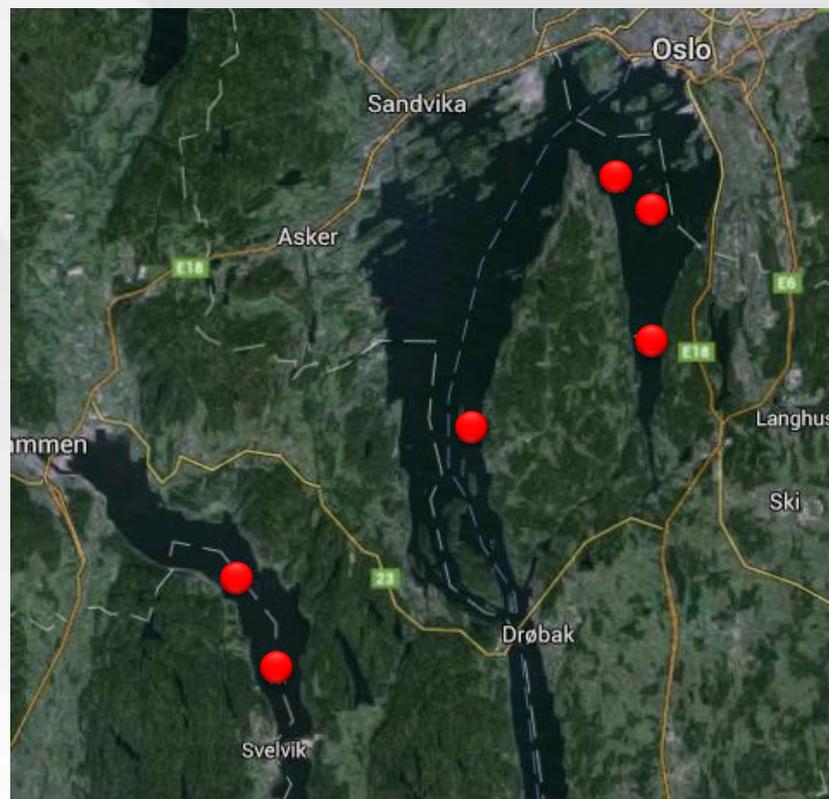


## Sampling sites – recent sediments (0-30 cm)

### 1. Gulf of Gdańsk



### 2. Oslofjord/Drammensfjord



## Sampling sites – old sediments (up to 500 cm)

1. Gulf of Gdańsk
2. Trondheimsfjord
3. Oslofjord
4. Balsfjord



## Sediment collection

### - recent sediments (0-30 cm)

(Niemistö core sampler, GEMAX twin-core sampler)



A



B



C



D



E

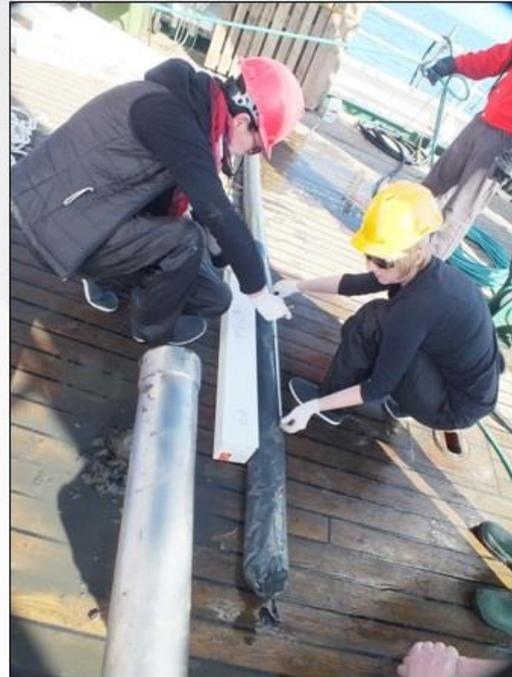


F



## Sediment collection

- **old sediments (up to 500 cm)**  
(vibro-corer, gravity corer)



## Sediment collection - sub-sampling



## Sampling summary

- 1st year – 2014: **recent sediments** (0-30 cm)

12 stations

120 sediment cores

640 sediment layers

**672 sub-samples**

- 2nd year – 2015: **old sediments** (up to 500 cm)

4 stations

9 long sediment cores

1504 sediment layers

**4080 sub-samples**

- Total: ca. **5000** cm of cores,  $\emptyset = 10$  cm, **4752 sub-samples**



## Analyses

grain-size & humidity

Pb-210 dating / C-14 dating

C<sub>org</sub>, N<sub>tot</sub>, black carbon,  $\delta^{15}\text{N}/^{14}\text{N}$ ,  $\delta^{13}\text{C}/^{12}\text{C}$  - EA/IRMS

phytoplankton pigments; HPLC-DAD, FL

contaminants (PAHs, OTs, NPs) - GC-MS

Elements (69 & their forms) - HR-ICP-MS

Biotoxins – DNA analyses, LC-MS/MS

Diatoms (geological proxies)

genotoxicity, mutagenicity, endocrine-disrupting activity  
- CALUX assays



## Results

➤ **scientific paper (*submitted for publication*)**

'Pigments in recent sediments as environmental indicators – comparison of the Gulf of Gdańsk (southern Baltic) and the Oslofjord/Drammensfjord (Norway)',

authors: M.Szymczak-Żyła, M.Lawręc, A.Winogradow, A.Zaborska, G.D.Breedveld, G.Kowalewska\*

➤ **scientific conferences**

**9th International SedNet conference (*oral presentation*),  
Kraków 23-26.09.2015**

'Marine sediment indicators in the Gulf of Gdańsk and Oslofjord - a comparison of climate change impacts on the ecosystem'

authors: G.Kowalewska, H.Mazur-Marzec, G.D.Breedveld, T.Ciesielski, A.Filipkowska, M.Szymczak-Żyła, L.Lubecki, M.Lawręc, A.Oen

**- 31st IAS Meeting, 22-25.06.2015 (*poster*), Kraków  
(International Association of Sedimentologists)**

'Chloropigment in deep marine sediments as proxies of climate change - driven eutrophication'

authors: M.Szymczak-Żyła, G.Kowalewska, G.D.Breedveld

**- ECSA 55 Conference, 6-9.09.2015 (*poster*), London  
(Estuarine Coastal Sciences Association)**

'Chloropigments proxies in recent sediments – comparison of the Gulf of Gdańsk (Poland) and Drammen/Oslofjord (Norway)'

authors: M.Szymczak-Żyła, G.Kowalewska, A.Filipkowska, L.Lubecki, M.Lawręć, A.Zaborska, A.Winogradow

## 31st IAS, Kraków 2015, 23-26.09

## 55 ECSA, London 2015, 6-9.09

31st IAS Meeting of Sedimentology - Kraków (23-26.09.2015)

### Chloropigments in deep marine sediments as proxies of climate change-driven eutrophication

Małgorzata Szymczak-Zyła<sup>1</sup>, Grażyna Kowalewska<sup>2</sup>, Gjørd D. Brendevold<sup>3</sup>

<sup>1</sup>Institute of Oceanology PAN, Sopot, Poland  
<sup>2</sup>Norwegian Geotechnical Institute, Oslo, Norway

**Previous studies**

Chlorophyll *a* derivatives in sediments have been an object of studies in Marine Pollution Laboratory of IO PAN since almost twenty years. Discovery of undecomposed chlorophyll *a* in deep BSiL sediments (Baltic Sea, Gdansk Basin and Bornholm Deep), together with the good evidence for occurrence in prehistoric times compared to a warm sea eutrophication that had advanced recently. Relations between the BSiL, BSiL and BSiL in some cores reveals in deep sediments from the Gdansk Basin suggested that the high pigment preservation of Holocene sediments.

**Abstract**

Analysis of chloropigments in deep-sea (BSiL) cores (long core) from the Gdansk Basin (Gdansk Basin BSiL) confirmed previous results for Gdansk Basin. BSiL sediments cores that show greater quantities of chloropigments - in the deeper horizons than in the upper horizons - were observed. Studies on BSiL cores indicated that there were periods of very high primary production and chlorophyll *a* derivatives preserved in the BSiL in the past. The BSiL cores indicated that there were periods of very high primary production and chlorophyll *a* derivatives preserved in the BSiL in the past. The BSiL cores indicated that there were periods of very high primary production and chlorophyll *a* derivatives preserved in the BSiL in the past.

**Gdansk Deep**  
SAP75 (pre-1900-1900)

**Gdansk Deep** (London 1710)  
September 2005

**CLISED project**

The CLISED (Climate Change Impact on Ecosystem Health - Marine Pollution Indicator) 2014-2017, No. 2014/01/2015/01/01 is a project of Polish-Norwegian Research Programme supported by the National Centre for Research and Development. One of the Work Package (WP) is focused on assessing of the biological indicators of climate change in the BSiL in terms of sediment pigments, primary production, oxygen depletion and eutrophication. One of the main objectives of the project is to study the BSiL in the Gdansk Basin and Bornholm Deep (BSiL) in the Baltic Sea (BSiL) and Gdansk Basin (BSiL) in the Baltic Sea (BSiL) and Gdansk Basin (BSiL) in the Baltic Sea (BSiL).

**deep sediment core collection**

Coastal waters of the Gdansk Basin (BSiL) are characterized by high primary production and chlorophyll *a* derivatives preserved in the BSiL in the past. The BSiL cores indicated that there were periods of very high primary production and chlorophyll *a* derivatives preserved in the BSiL in the past.

**Abstract**

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**Sediment cores**

**Pigment concentrations**

**% Chloropigments-a**

**Cluster analysis**

**Conclusions**

High primary production and chlorophyll *a* derivatives preserved in the BSiL in the past. The BSiL cores indicated that there were periods of very high primary production and chlorophyll *a* derivatives preserved in the BSiL in the past.

**Logos: Norway Grants, Polish Research Programme, BR, CLISED**

\*This project is funded from Norway Grants in the Polish-Norwegian Research Programme operated by the National Centre for Research and Development (No. 2014/01/2015/01/01).

55 ECSA - London, UK (06-09 September 2015)

### Chloropigment proxies in recent sediments - comparison of the Gulf of Gdańsk (Poland) and Drammen/Oslofjord (Norway)

M. Szymczak-Zyła<sup>1</sup>, G. Kowalewska<sup>2</sup>, A. Filipińska<sup>3</sup>, L. Lubecka<sup>4</sup>, M. Lawrecz<sup>1,5</sup>, A. Zaborska<sup>6</sup>, A. Winogrodow<sup>7</sup>

<sup>1</sup>Institute of Oceanology, Polish Academy of Sciences, Sopot, Poland  
<sup>2</sup>KOPAN Centre for Polar Studies (KOPAN)  
<sup>3</sup>ipm.pau.edu.pl

**Abstract**

Chloropigments in deep-sea (BSiL) cores (long core) from the Gdansk Basin (Gdansk Basin BSiL) confirmed previous results for Gdansk Basin. BSiL sediments cores that show greater quantities of chloropigments - in the deeper horizons than in the upper horizons - were observed. Studies on BSiL cores indicated that there were periods of very high primary production and chlorophyll *a* derivatives preserved in the BSiL in the past. The BSiL cores indicated that there were periods of very high primary production and chlorophyll *a* derivatives preserved in the BSiL in the past.

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## Project promotion

- leaflets
- **XI Conference of Marine Chemistry Section of the Polish Scientific Committee on Ocean Research, IO PAN, Sopot, 24.10.2014 (*poster*)**

'Indicators of environmental state – recent sediments of the Gulf of Gdańsk and the Oslo'

authors: G.Kowalewska, M.Szymczak-Żyła, A.Filipkowska, L.Lubecki, I.Złoch, A.Zaborska, A.Winogradow, H.Mazur-Marzec, A.Toruńska-Sitarz, A.Krakowiak, T.Ciesielski, M.Ardelan, G.D.Breedveld, A.Oen

- **VIII Sopot Day of Science, Sopot, 23.05.2015 (*poster*)**

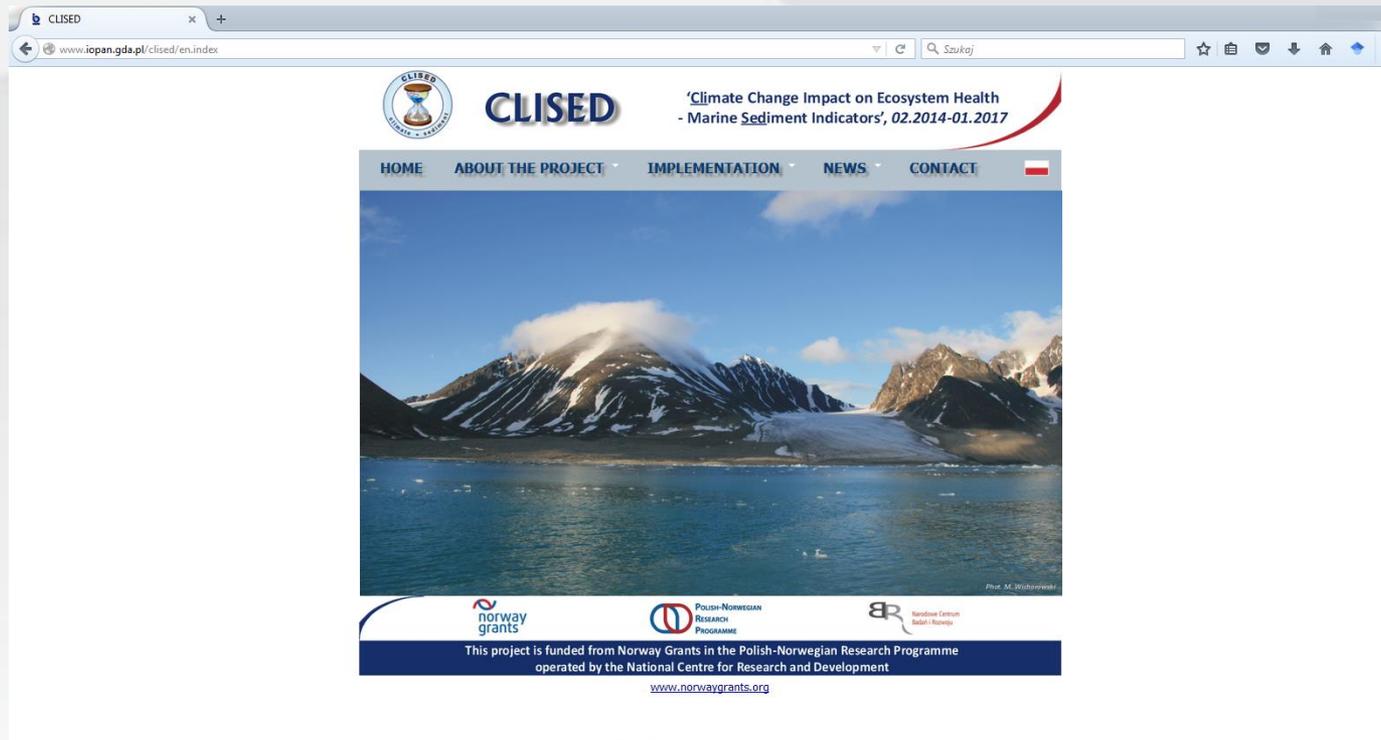
'Climate Change Impact on Ecosystem Health - Marine Sediment Indicators', 02.2014-01.2017



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- webpage (<http://www.iopan.gda.pl/clised/>)



Webpage

