

# **Distribution of Pollutants in the Odra River System Part I. General Description of the International Odra Project (IOP)**

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## **Abstract**

Part I describes the organization and objectives of the International Odra Project (IOP) for the 1997 – 2001. Scientific teams from Germany and Poland took part in the project. The main objective of the IOP program was to describe the status, trend dynamics and metabolic pathways of all types of pollution in the Odra river basin. A scientific task realized by the team from Gdańsk University of Technology (GUT) was to assess the pollution level of organic compounds in water and sediments from the Odra river catchment area. Parts II and III will present the results obtained by the GUT team, which consist of determinations of organic pollutants in water and sediments.

The assessment of heavy metals contamination and its mobilisation in water, suspended matter and bottom sediments of the upper and middle Odra river was the main task of the research group from the University of Mining and Metallurgy in Krakow. The obtained results are presented in Parts IV and V.

**Keywords:** Odra river ecosystem, pollution level, organic pollutants, heavy metals, sediments, suspended matter.

## **Introduction**

Scientific investigations conducted within the framework of the International Odra Project (IOP) began in 1997. Eleven scientific teams from Germany and Poland participated in the program. The teams were affiliated with universities or included the employees of national agencies.

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The financial means for the project were obtained from the German Federal Ministry of Education and Research. In addition, Polish teams received substantial funds from the Foundation for Polish-German Cooperation.

The main objectives of the IOP are shown schematically in Figure 1 [1].

The main objective of the IOP program – a program which should serve as an example of a developing integration in the field of scientific research - was to describe the

status, trend dynamics and metabolic pathways of all types of pollution in the Odra river basin. On the basis of the obtained results it was possible to:

- Define a modern monitoring system which comprises all toxicologically relevant pollutants.
- Provide arguments for sanitation measures.
- Develop quality criteria for several regions (settlement and industrial areas, areas used for abstraction of drinking water, regions for protection of nature and landscape).

In the framework of the IOP the following regionally differentiated activities were carried out:

- Quantitative determination of inorganic and organic pollutants in all compartments (biota, water, suspended matter, sediments as well as flood sediments) of the Odra river. Thereby, the search of totally new, until now unidentified pollutants by non-target screening is included.
- Characterization of synergistic and toxic effects.
- Description of the transport and conversion pathways of pollutants.
- Determination and characterization of sources and sinks of the pollutants as well as parameters influencing their transport and metabolic pathways.

These investigations contributed to the evaluation of the amount of pollutants reaching the Baltic Sea via Szczecin Lagoon, as well as to the characterization of pollution sources.

#### The Participation of Polish Teams in the Realization of the IOP Project Objectives.

Six Polish teams took part in the scientific investigations conducted within the framework of the IOP program.

Scientific investigations were conducted within the framework of two programs, i.e. basic and extended programs. The essential information concerning these tasks is given below.

| Institution   | Team Leader                               |
|---|---|
| University of Mining and Metallurgy (UMM) (Faculty of Geology, Geophysics and Environmental Protection) | Prof. E. Helios - Rybicka                 |
| University of Wrocław (UW) (Institute of Geological Sciences)   | Dr. L. Poprawski                          |
| Institute of Meteorology and Water Management (IMWM) - Wrocław  | Prof. A. Dubicki<br>Dr. J. Błachuta       |
| Institute of Meteorology and Water Management (IMWM) - Gdańsk   | Dr. E. Niemirydz                          |
| Agricultural University of Szczecin (AU)  | Prof. M. Protasowicki                     |
| Gdańsk University of Technology (GUT) (Chemical Faculty)  | Prof. J. Namieśnik<br>Prof. J. F. Biernat |

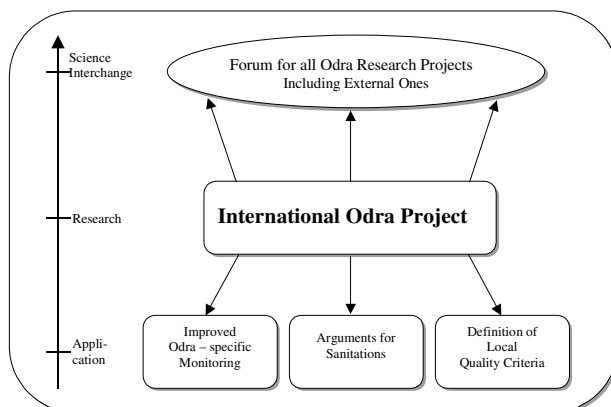


Fig.1. Objectives of the IOP [1].

#### Scientific Tasks Realized by the Chemical Faculty Team from GUT Within the Framework of the IOP

##### Basic measuring program

1. Investigation of water and sediment pollution in the Odra river basin with the following organic compounds [2-8, 12]:

- selected Cl-, P-, and N-organic pesticides;
- aliphatic and aromatic hydrocarbons;
- volatile and semivolatile chloroorganic compounds;
- selected volatile S-organic compounds;
- polycyclic aromatic hydrocarbons (PAHs);
- polychlorinated biphenyls (PCBs);
- chlorobenzenes (CBs).

The above-mentioned organic compounds were analysed in the water and sediment samples from seven sampling campaigns by the team from the Department of Analytical Chemistry of the Gdańsk University of Technology (GUT) (Table 1).

2. Interlaboratory studies of the developed method for PAH and PCB determination in sediments.
3. Collecting information on possible point and area emission sources of toxic substances in the Odra river basin.
4. Assessment of water and sediment pollution of the Odra river basin with target organic compounds.
5. Preliminary studies on the pollution trends in Odra river system.

##### Extended program

1. Development of methods for determining target organic compounds in environmental matrices [9-11].
2. Non-target screening of samples from the collections in June and November 2000.
3. Physical speciation of PAH and PCB in the river environment [13-15].
4. Studies on toxicity of Odra river water (bioassay test) [7].
5. Studies on the new sorbents for isolation of phenols from aqueous matrices [16].

Table 1. Sampling campaigns and sample numbers of water and sediments.

|      | Sample collection                   |   |
|------|-------------------------------------|---|
| I    | post flood                          | 72 sediment samples   |
| II   | 18-28.08.1997                       | 79 sediment and 11 water samples  |
| III  | 12-19.11.1997                       | 25 sediment and 15 water samples  |
| IV   | 05-15.05.1998                       | 14 sediment and 12 water samples  |
| V    | 02-13.11.1998                       | 14 sediment and 15 water samples  |
| VI   | 15-19.06.1999                       | 18 sediment and 24 water samples<br>AQA: 3 sediment and 3 water samples |
| VII  | 22-26.05.2000                       | 26 sediment and 27 water samples<br>AQA: 4 sediment and 3 water samples |
| VIII | 17-22.10.2000<br>(profile sampling) | 15 sediment and 27 water samples  |

Scientific Tasks Realized by the Faculty of Geology, Geophysics and Environmental Protection Team from University of Mining and Metallurgy Within the Framework of the IOP

#### Basic measuring program

1. Investigation of concentration of heavy metals in the flood sediments of the upper and middle Odra river system [17, 18, 19].
2. Study of heavy metal distribution in water of the Odra river and its tributaries; assessment of river water quality [20, 21].
3. Investigation of heavy metal distribution in the suspended matter and sediments of the upper and middle Odra river and its tributaries [22, 23].
4. Sediment and Suspended Matter Assessment in the upper and middle Odra river and its tributaries [24, 25, 26, 27, 28].
5. Investigation of the metal content in the cross profile samples of Odra river water and suspended matter.

The above-mentioned investigations were carried out by the team from Faculty of Geology, Geophysics and Environmental Protection, for the water, suspended matter and sediment samples from sampling campaigns listed in Table 2.

#### Extended program

1. Investigation of mobility and chemical forms of heavy metals in the flood sediments of the upper and middle Odra river system [18, 19].
2. Study of sediment buffer capacity and metals mobility

Table 2. Sampling campaigns and sample numbers of the water, suspended matter (SPM) and sediments (nm - not measured).

| Sampling campaign | Water | Sediment | SPM |
|-------------------|-------|----------|-----|
| August 1997       | nm    | 72       | nm  |
| November 1997     | nm    | 26       | 25  |
| May 1998          | 33    | 37       | 34  |
| November 1998     | 37    | 35       | 35  |
| June 1999         | 39    | 37       | 39  |
| May 2000          | 38    | 34       | 37  |
| October 2000      | 40    | nm       | nm  |

in the sediments of the upper and middle Odra river system [25, 28, 29, 30].

3. Study of metal distribution among main substrates of suspended matter and sediments [25, 31].
4. Study of chemical or mineralogical forms of metals in the suspended matter and sediments using scanning electron microscopy (SEM-EDX) method [31].
5. Assessment of Odra river contamination with heavy metals - past, present and future [32, 33].

Figure 2 shows a map of sampling sites of water and bottom sediments for six sampling campaigns conducted in the years 1997-2000.

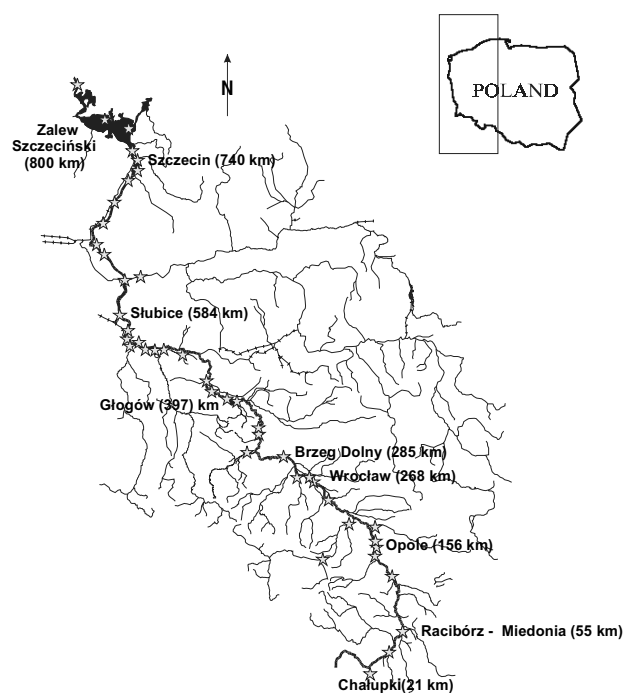


Fig. 2. A map of sampling sites in IOP sampling collections.

## Summary

Based on the results of conducted investigations, new analytical procedures have been elaborated which were later used to collect water and sediment samples. Two publications (see Part II and Part III) will contain the results obtained from the identification of a wide spectrum of organic compounds in river water and bottom sediments. The results of heavy metals in the upper and middle Odra river are presented in Part IV, while the heavy metal situation in suspended matter and bottom sediments are discussed in Part V (this issue).

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