

DESCRIPTION FOR THE GENERAL PUBLIC – EN

Methane plays an important role in many physical and chemical processes, both globally (as a greenhouse gas and energy source) and locally (indicates the way of organic matter decomposition and shapes environmental conditions in the bottom area of water bodies). Apart from its presence deep underground in older geological formations, it can also occur in surface sediments of lakes, seas and oceans. It was recognized that sediments of shallow shelf seas are a significant place for the production of methane due to the increase of human pressure and eutrophication (enrichment in nutrients).

Despite the research on methane carried out in sediments of other regions of the Baltic Sea (Eckernförde Bay - Germany, Danish Straits, Gotland Deep, etc.), the studies undertaken in the Polish area of the Baltic Sea (Gulf of Gdańsk) may turn out to be innovative at least on the European scale because: preliminary studies showed the presence of methane production zones in sediments of different regions of the Gdańsk Basin already at depths of 10-15 centimeters below the bottom (much shallower in comparison with other areas of the Baltic Sea), which can significantly affect the environment of the bottom area, and the existence of a unique site in the Baltic Sea (central part of the Gulf of Gdańsk) where constant flow of gas into the water column was observed.

Therefore, the **main objective of the project** is to determine the impact of geochemical processes associated with decomposition of organic matter and physical processes (mixing of water masses, temperature increase – as a result of climate change, inflow of saline/fresh waters) on methane concentrations and depth of its occurrence in sediments and its transport into the water column from sediments of the Gulf of Gdansk. In addition, it is planned to examine the impact of physical and geochemical parameters on the variability in methane emission into the water column, with a particular emphasis on the site of its constant outflow. We plan to achieve the aim of the project by combining geochemical (sampling cores, measurements of chemical and geological parameters of sediments and/or pore waters and near-bottom waters) and acoustic (active and passive methods of bottom investigation) methods, and by detailed recognition of short- and long-term variations in the distribution and evolution of the gas-bearing sediments, considering them as indicators of anaerobic decomposition of organic matter caused by eutrophication of the marine environment.

Driven by the need to acquire new knowledge, **pursuing basic research** on the functioning (geochemical approach) of eutrophic marine environments, changes in the carbon cycle induced by the presence of methane, effects of the gas outflow into the water column and the factors controlling its occurrence in sediments and emission from sediments, we plan to focus in this project on:

- estimation of short-term (spring/summer/fall) and long-term changes in spatial distribution of gas-bearing sediments in the Gulf of Gdańsk,
- determination the extent to which the processes related to physical factors (temperature and salinity changes as a consequence of climate change) affect the change in gas content in sediments,
- observation of the “special” sites of gas outflows and gas emission from sediments to the water column and the estimation of changes in the range of these outflows and emission
- investigation of the geochemical parameters associated with the process of decomposition of organic matter in sediments, with particular emphasis on the depth of occurrence of the methane production zone, and determination of their variability depending on the season (spring/summer/fall) and potential independent events (e.g. inflows of saline waters to the southern Baltic from the North Sea or excessive amounts of riverine fresh water discharge due to flood events),
- determination of the origin of gas ("old" - fossil vs. "young" - shallow, microbiological) in sediments and the processes leading to its occurrence – stable isotope analysis.

The reason for choosing the above research topic is primarily to broaden the knowledge on the occurrence of methane in the environment of the Baltic Sea sediments by investigation of the issues which have not yet been undertaken by other research centers: geochemical and acoustic research of the unique site of constant outflow of gas from the sediments (Gulf of Gdańsk), changes in the marine environment of bottom areas caused by the occurrence of methane in high concentrations in very shallow sediment layers and changes in methane concentration caused by the influence of physical factors/processes (inflows of saline water into the Baltic Sea, excessive runoff of fresh water, temperature changes). It should be noticed that European research projects concerning methane in sediments (METROL, BALTICGAS), carried in the XXI century, were mainly based on the spatial approach. In contrast, the issues that are included in this project practically have not been investigated in earlier projects. The implementation of this project would undoubtedly influence the development of the knowledge in the field of environmental consequences of marine eutrophication leading to the release of the greenhouse gas (methane) into the atmosphere.