



Międzynarodowa Środowiskowa Szkoła Doktorska
przy Centrum Studiów Polarnych
w Uniwersytecie Śląskim w Katowicach

ul. Bedzińska 60
41-200 Sosnowiec
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Title of PhD project: Climate change impact on mercury levels and bioavailability in the Arctic

The leading unit: Institut of Oceanology Polish Academy of Sciences

Requirements:

- 1) Master's degree in the field of Oceanography or similar.
- 2) Knowledge of research topics related to Marine Chemistry
- 3) Knowledge of issues related to the circulation of mercury in the marine environment, typical tools and methods used in trace analysis, with particular emphasis on mercury analysis
- 4) Knowledge of the English language enabling communication, reading and writing scientific papers

Tasks description:

1. Analysis of... samples of water, soil, sediment and organic material. in terms of mercury concentration and speciation;
2. Acquisition, processing and analysis of soil samples, permafrost, sea and river water, suspended solids and bottom sediments;
3. Preparation, organization and conducting of ... field research on the research unit and during land expeditions in the polar regions;
4. Preparation of scientific articles and conference presentations;
5. Regular reporting of work progress;
6. Assistance in everyday scientific and didactic tasks of the unit, including co-care of the measuring apparatus

Abstract:

Mercury is one of the most toxic metals. Its ability to biomagnify in the trophic chain means that even small concentrations in the natural environment can accumulate in living organisms, while the concentration increases significantly on subsequent levels of the food web. This causes a health-threatening accumulation of this metal, especially in predators. Mercury emitted by human activity in the Northern Hemisphere can be transported over long distances, up to thousands of kilometers. As a result of atmospheric changes and adsorption on aerosols, this metal is deposited in land and sea areas. Due to its high reactivity and volatility, mercury can be re-emitted to the atmosphere and



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transported further. This mechanism, known as the grasshopper effect, leads to the accumulation of mercury from industrialized areas in the Arctic Northern Hemisphere. In combination with the ability to bioaccumulate and biomagnify, this causes a dangerous accumulation of this element, especially in organisms with higher trophic levels, such as marine mammals or polar bears.

In the era of climate change and Arctic warming, melting glaciers and thawing permafrost are also an additional source of mercury. They contain both mercury from 20th century atmospheric emissions and natural resources of this metal. They come from volcanic emissions and weathering of mercury-containing rocks. Some areas of Spitsbergen contain geothermal rocks and rocks of the Precambrian formations (such as Hecla Hoek), which naturally contain high concentrations of heavy and trace metals, including mercury. They are subject to weathering caused by glacial processes, and the permafrost in this region contains numerous rock fragments with a high metal content. The process of thawing permafrost and melting glaciers releases not only the metals associated with them, but also the dissolved organic matter (DOM) they contain. After these compounds are released into the marine environment, mercury compounds may be transformed into more bioavailable forms, including the most toxic methylmercury, as a result of the activity of microorganisms.

The PhD Thesis 'Impact of climate change on mercury levels and bioavailability in the Arctic' aims to estimate how much mercury could be released into the environment as a result of climate change, to determine how much of it could be released into the marine environment, and to estimate how much mercury from these sources may prove to be bioavailable. It will be tested in multiple ways. First, soil, peat, water and permafrost samples will be collected. The samples will be collected in regions characterized by the presence of different types of parent rock and different due to the presence of faults and limestone formations that can be used to transport the smelting waters. Four land expeditions are foreseen in the Hornsund region, where metal-rich rocks from the Precambrian formations are present, in the Isfjord region, where human activity related to the presence of cities such as Barentsburg or Longyearbyen and mining activities continues, in the Bilefjorden region, characterized by a lot of faults and limestone formations and the Van Mijen fjorden away from them, covered with younger and less cracked rocks.

The project will also analyze the flow of mercury into nearby fjords by analyzing the flow of rivers, groundwater and calving glaciers. The data obtained for all processes will be confronted with climate change scenarios and the predicted melting of glaciers and thawing permafrost to determine the impact of climate change on the mercury cycle in the Arctic.



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Other information:

The work will be carried out under supervision of: prof. Jacek Bełdowski, hyron@iopan.pl,
Institute of Oceanology Polish Academy of Sciences and dr. Dominika Saniewska,
dominika.saniewska@ug.edu.pl, University of Gdańsk