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Time travel into the past of marginal seas: IOW expedition explores Canadian coastal waters

Why and how have coastal waters undergone environmental changes during the last decades and centuries? Is it possible to distinguish between natural processes and anthropogenic influences that drive these changes? Can the well-studied Baltic Sea serve as a model for other marginal seas? These questions are guiding the current expedition of the research vessel MARIA S. MERIAN under the lead of the Leibniz Institute for Baltic Sea Research Warnemünde (IOW), which started on August 25, 2015, from Halifax, Canada. It will take the scientific crew from the St. Lawrence Estuary into the Gulf of St. Lawrence and further on along the Labrador coast into the Hudson Strait.

15 of the 25 scientific participants are IOW researchers; another 10 come from Canadian and U. S. research institutions. The four-week expedition has been coordinated by Detlef Schulz-Bull, head of the IOW Marine Chemistry department. “We want to know more about the factors that drive environmental changes of coastal ecosystems: Is it the climate with its fluctuations, the local current dynamics or certain biogeochemical processes that are typical for marginal seas? And what is the role of human impact factors such as eutrophication and environmental pollution?” Schulz-Bull explains the general scientific focus of the cruise. “Our research program represents a kind of ‘time travel’, allowing us to distinguish between human and natural change drivers. On the one hand we aim at characterizing the current state of our study area, but we also want to explore its – by geological standards – recent past of the last 500 to 1000 years, which has left its traces in the deeper layers of the sea-bed. The East-Canadian coastal waters, which we are exploring for the first time, are especially interesting in this context as they are in parts comparable to intensively researched marginal seas like the Baltic Sea, while other parts are more strongly influenced by open ocean waters,” the marine chemist further explains.

The expedition’s scientific program includes an extensive sampling campaign at 28 stations, microbiological experiments directly on board as well as computer simulations to extrapolate the results from the stations for the entire Gulf of St. Lawrence. “Just like the Baltic Sea, the Gulf of St. Lawrence only has a narrow connection to the open North Atlantic with its high salinity. Hence, the gulf also exhibits salinity gradients typical for marginal seas: horizontally from the freshwater of the Lower St. Lawrence Estuary to the brackish areas further downstream to the higher salinities of the outer gulf, and vertically from the low-salinity of the surface waters to the deep saltwater layers, which rarely get mixed and therefore often are oxygen depleted,” says Detlef Schulz-Bull. On the cruise, water sampling and detailed CTD profiling will be used to characterize the properties und the structure of the water column as well as the gradients at each sampling station. “We are particularly interested to find out whether different organisms have adapted to the variability of salt and oxygen conditions and whether this has influenced species diversity,” Schulz-Bull elaborates. For this purpose, the scientists will perform various on-board experiments with microbial communities isolated from different sam-

pling sites and analyze the macrozoobenthos. Furthermore, nutrient and particulate matter analyses as well as satellite images will be used to get an overview of the spatial and temporal variability of primary production.

Schulz-Bull: "These investigations will provide us with a 'snapshot' of the current state of the study area, which gives us an impression of what makes the ecosystem St. Lawrence Gulf 'tick' at present. To understand its past, we additionally will take sediment cores at suitable sites. The chronologically layered deposits are like an archive, which allows us to reconstruct past environmental conditions." The history of anthropogenic pollution by pesticides, organochlorines and inorganic hazardous substances as mercury, for instance, can be traced through respective residues in the surface layers of the sea-bed. "Proxy investigations such as the analysis of microfossil diatoms and foraminifera in long sediment cores with lengths up to 18 meters, however, will help us to reconstruct climate and ocean circulation changes as long ago as 1000 years," the project coordinator explains. Comparable studies in the Baltic Sea have shown that the "climate engine" North Atlantic strongly influenced the environmental conditions, leading to several drastic changes over the last millennia. "Hopefully, the MERIAN expedition will provide the evidence whether the same processes shaped the Canadian marginal sea ecosystems," concludes Detlef Schulz-Bull on the scientific program of the cruise.

The expedition ends on September 25, 2015, in St. John on Newfoundland, where the scientific crew will leave the ship.

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