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A grand measuring journey across the Atlantic SONNE Expedition SO287-CONNECT tracks biogeochemical cycles

13.12.2021/Las Palmas de Gran Canaria/Kiel. Across the Atlantic Ocean, a large current carries seawater from Africa across the Atlantic into the Sargasso Sea and all the way to the Caribbean. The biogeochemical processes that take place along the way have hardly been researched so far. An international team led by GEOMAR Helmholtz Centre for Ocean Research Kiel therefore crosses the Atlantic on the expedition “SO287-CONNECT” with the German research vessel SONNE, taking thousands of measurements – also to clarify how these processes are linked to climate change. In addition, they will also investigate how much plastic waste and shipping traffic pollute the Atlantic.

Although the Atlantic is several thousand kilometres wide, the water masses in the west and east of this large ocean are closely connected. Off West Africa, nutrient-rich water rises from the depths and supports the growth of tiny plants and animals as well as fish at the ocean surface. A large current – the North Equatorial Current – moves some of the water to the Gulf of Mexico and the Caribbean. This water mass transport is important because it carries large amounts of organic material into the open ocean. For microorganisms such as bacteria, this represents an elixir of life. But how these nutrient-rich leftovers of algae and other substances are processed by microorganisms, biochemically transformed, decomposed and respired to carbon dioxide, has so far been researched incompletely. Therefore, on 11 December 2021, an international team set off from Las Palmas de Gran Canaria for a four-week Atlantic crossing with the German research vessel SONNE to take water samples at many locations along the way and measure trace substances in the atmosphere. The group will celebrate Christmas with researchers from twelve nations in the middle of the Atlantic. After passing through the Panama Canal, the SONNE will reach its destination in the Ecuadorian port of Guayaquil on 11 January 2022.

“Our route is unique because we do not sail from east to west in a straight line like most other ships, but make a detour north into the Sargasso Sea far off Florida,” says Dr. Birgit Quack. The biogeochemist from GEOMAR Helmholtz Centre for Ocean Research Kiel is the Chief Scientist of the expedition “SO287-CONNECT”. The Sargasso Sea is famous for its Sargassum sea weed, which floats on the water surface over thousands of square kilometres. It is an important habitat for many marine creatures. The SONNE cruise will provide new details about the transformation of substances in the sea and especially about the large cycles of carbon and nitrogen. How are biogeochemical and ecological processes interconnected over large distances? And how large are the quantities of substances exchanged between the ocean and the atmosphere?

In all of these questions, the experts focus on the impacts of climate change. For example, it has been known for a long time that certain iodine compounds and other trace gases from the sea, which can promote the formation of clouds, influence the climate. Dr. Birgit Quack and her team now want to find out, among other things, how much iodine and halogenated hydrocarbons the Sargassum releases into the atmosphere. In addition, bromine and iodine compounds are emitted naturally from the sea into the atmosphere and partly reach the stratosphere, where they contribute to ozone depletion. The scientists therefore want to measure exactly how much of these compounds are released at which locations and how they are transformed in the sea and in the atmosphere. To do this, they will measure the trace substances in seawater samples on board using state-of-the-art

technology. In addition, they will investigate the influence of various natural parameters such as temperature and solar radiation on the biogeochemical transformation processes in storage experiments in order to better understand the influence of climate change on the processes.

The group is also interested in how the busy shipping traffic on the Atlantic influences the material cycles in the sea. For example, large quantities of nitrogen oxides are introduced into the water via ship exhaust. It is unclear to what extent these affect the natural nitrogen cycle. Many ships today are equipped with emission control systems that wash sulphur compounds out of the exhaust gases. The resulting sulphurous, acidic and dirty water may be pumped overboard. The influence of this method on organisms and biochemical processes in the sea is also being investigated.

In addition, the team is taking the opportunity to record and study plastic pollution in the sea. The ocean current around the Sargasso Sea is one of the large patches in the world's ocean where huge amounts of floating plastic aggregate. The SONNE is equipped with a fishing sledge that can be used to rake the flotsam from the surface of the sea. The researchers will examine both the larger plastic pieces and the tiny microplastics.

With this cruise, the research vessel SONNE will finally reach one of its most important areas of operation again – the Pacific Ocean – after a long forced break due to the Corona pandemic. Dr. Birgit Quack is looking forward to this unusual expedition, which gives the team the opportunity to explore very fundamental questions in detail. Throughout the trip, water samples will be taken regularly at noon at the highest position of the sun and in the middle of the night. "It will be particularly interesting to compare the data from midday and at night, because solar radiation influences many biogeochemical processes," says Birgit Quack. Iodine compounds emitted from the sea, for example, are immediately broken down by sunlight during the day. At night, on the other hand, they can be transported into the atmosphere unhindered.

The fact that she will be on the road over Christmas does not bother her, given the unique opportunity for this expedition, says Dr. Birgit Quack. "Because it is a special time of year, some colleagues were not able to join. However, many students have used the opportunity for their Master's theses and are looking forward to celebrate Christmas in the Sargasso Sea and New Year's Eve in the Caribbean, which promises a short relaxation to the round-the-clock work on the expedition."

Links:

www.geomar.de GEOMAR Helmholtz Centre for Ocean Research Kiel

<https://www.geomar.de/forschen/expeditionen/detailansicht/exp/359780?cHash=e6871cf655f2ceede775d0edf4840bea> SO287-Connect expedition details

<https://www.oceanblogs.org/connect> the SO287-CONNECT Blog

<https://www.lfd.uni-hamburg.de/sonne/wochenberichte.html> Weekly cruise reports from RV SONNE

Images:

Images are available for download at <http://www.geomar.de/n8226-e>

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