

Chemical contamination from underwater munitions

Monitoring munitions chemicals in the Baltic Sea: Munitions in the sea have been recognized as a potential ecological disaster for many decades. However, most efforts by military and civil researchers to detect chemical release from munitions in the environment have found only limited and fragmented evidence for environmental spread of munitions-related chemicals such as explosive compounds. This lack of information severely limits our ability to understand how dumped munitions may affect the environment. In 2017, we adapted established methods from the chemical oceanography field to develop a highly sensitive method for detecting explosive compounds in marine samples. This technique relies on extraction of explosive chemicals from water, sediments, or organism tissues, and is now established as a routine method for monitoring underwater munitions.

Since 2018, GEOMAR has been running large-scale research cruises, in collaboration with other CONMAR partners, to characterize and understand the spread of munition chemicals throughout the German Baltic Sea. The sampling locations are shown in Fig. 1, and include 2018 (Cruise POS530), 2020 (AL548), 2021 (AL567), 2022 (AL583), and 2023 (AL603).

This monitoring requires an enormous amount of effort, but produces valuable data. It is clear that chemical release of explosives is highest in munitions dumpsites.

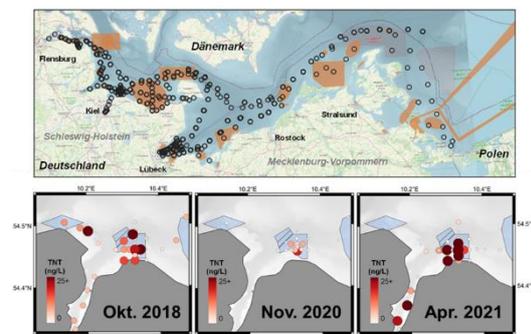


Fig 1. Upper panel shows water sampling locations between 2018 and 2023. Orange regions are known to be contaminated with munitions. Lower panels show the distribution of dissolved TNT in deep waters of the Kieler Bucht. Munitions-contaminated regions are colored in blue.

The Kolberger Heide dumpsite (Kieler Bucht) and the Lübecker Bucht are both known to have exposed explosive material, and those locations consistently show the highest concentrations of e.g., TNT. Repeated sampling shows substantial interannual variability. As shown in Fig. 1, TNT concentrations in the Kieler Bucht were high in 2018, low in 2020, and very high in 2021. We cannot say yet what caused these

GEFÖRDERT VOM

differences, but it clearly shows the importance of repeated sampling to monitor changes.

Measuring munition chemicals on ships at sea: Current methods for measuring munition chemicals such as TNT in marine samples are extremely time- and labor-intensive. Delays of weeks to months are typical between sample collection and laboratory analysis, and analyses require expensive and sensitive instruments. We developed a novel shipboard lab-in-a-box system, the “Xplotector” (Fig. 2), during the ExPloTect project (EU EMFF; 2019-2022), which is now being deployed in the CONMAR project. The Xplotector automates sample processing and analysis, and is robust enough to take on board research ships. Each sample is analyzed in less than 15 minutes, providing immediate information about chemical contamination spread. The mass spectrometer in the Xplotector was upgraded as part of the VAMOS project (BMBF), and can now detect TNT concentrations in seawater as low as 0.1 ng/L. The upgraded Xplotector was tested in

October 2023 on the CONMAR-led research cruise AL603. Results showed very low TNT concentrations in the Little and Great Belts (Fig. 2), suggesting that the high contamination found in the Kieler Bucht (Fig. 1) and Lübecker Bucht comes from local munitions, not from more distant sources.

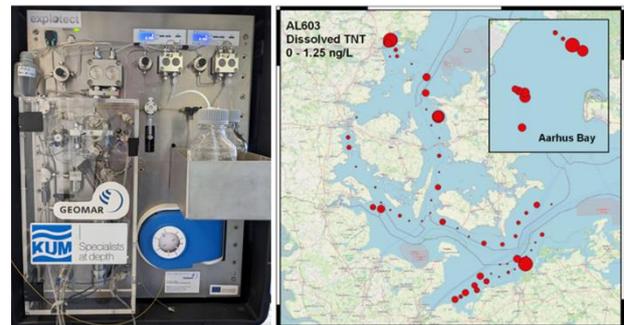


Fig 2. Left panel shows the prototype Xplotector system at sea on AL603. Right panel shows TNT concentrations in deep water along the ship track, measured shipboard with the Xplotector.

Contact: Aaron Beck, Kenneth Arinaitwe, Eric Achterberg
ajbeck@geomar.de*

CONMAR 2nd Annual Meeting Isle of Vilm

The 2nd annual meeting of CONMAR took place from 12-14 February 2024 at the International Academy for Nature Conservation on the island of Vilm that belongs to the German Federal Agency for Nature Conservation BfN. Representatives of various interest groups were also invited to the meeting to provide them with information of the current status of munition research in CONMAR and to present the activities planned in CONMAR for the clearance activities, which will start in 2024.



Fig. 3 Participants at the 2nd CONMAR annual meeting on Vilm

Contact: Daniela Henkel dhenkel@geomar.de