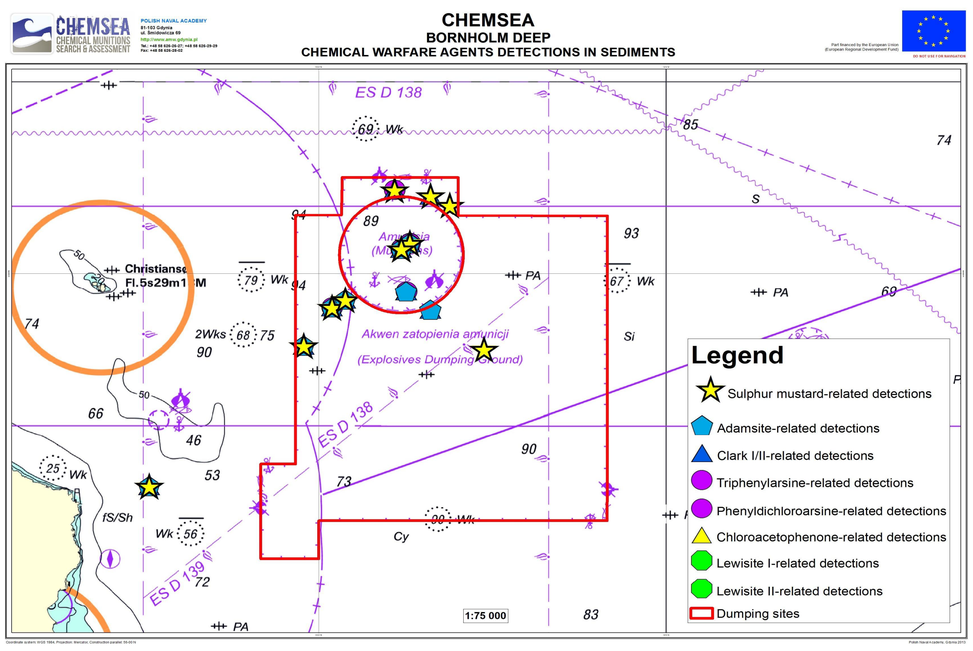
Overview of the results of the monitoring campaigns for analysis of Baltic Sea sediment samples for sea-dumped chemical warfare agents

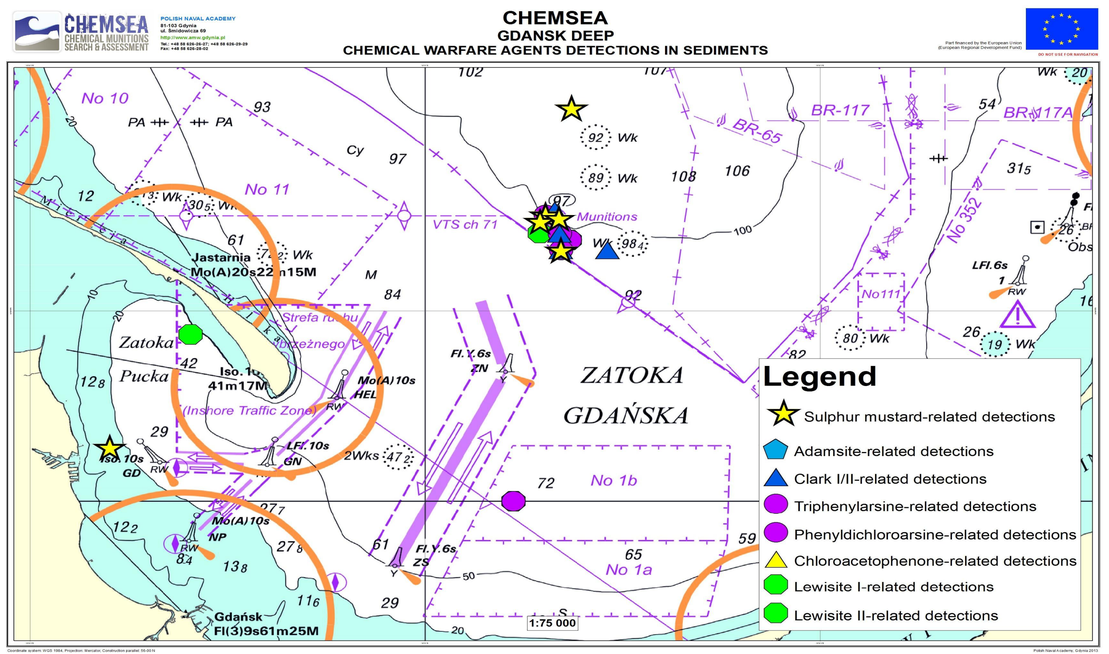
Paula Vanninen[1], Hanna Lignell[1], Stanisław Popiel[2], Jacub Nawała[2], Galina Garnaga[3], Pączek Bartłomieje[4], John Tørnes[5], Marta Szubska[6], Jacek Bełdowski[6]

[1]VERIFIN , Department of Chemistry, University of Helsinki, Finland
[2]Military University of Technology, Poland
[3]Environmental Protection Agency, Lithuania
[4]Polish Naval Academy, Poland
[5]Norwegian Defence Research Establishment
[6]Institute of Oceanology of the Polish Academy of Sciences, Poland

After the Second World War, large amounts of chemical munitions containing chemical warfare agents (CWAs) were dumped into the Baltic Sea. In 2006-2018, Bornholm, Gotland deep, Skagerrak, and Gdansk deep dumpsites were studied in many projects firstly in the EU FP6 project *Modelling of Ecological Risks Related to Sea-Dumped Chemical Weapons (MERCW)*. This project was later amended by Baltic Sea Region Interreg Project *Chemical Munitions, Search and Assessment (CHEMSEA)*, NATO SPS project *Towards the Monitoring of Dumped Munition Threats (MODUM)* and a joint EU project *Decision Aid for Marine Munitions (DAIMON)*.



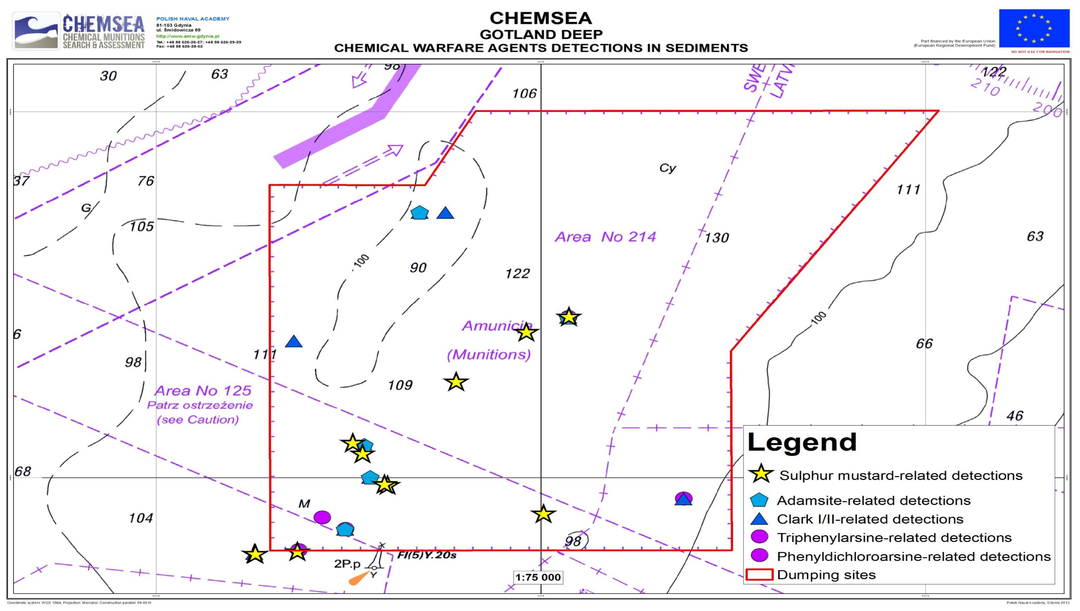
CWA measurement in the Bornholm deep (Chemsea Data)



CWA measurement in the Gdansk deep (CHEMSEA Data)

Key observations

- The presence of various CWAs was studied.
- The results indicate a widespread contamination reaching far beyond the dumpsite boundaries. CWA degradation products were detected in most of the sediment samples taken from and outside the dumpsites.
- The contamination is mostly related to arsenic containing compounds like Clark I/II, Adamsite, arsenic oil, and inorganic arsenic up to mg/kg concentrations levels.
- Some samples also indicated the presence of sulfur mustard and its degradation products.
- Overall results proves that the sea-dumped munitions are leaking and contaminating seafloor sediments.
- The analysis data is loaded into a Decision Support System (DSS) produced in the DAIMON project. It provides risk assessment and decision aid related to operations in the contaminated areas.



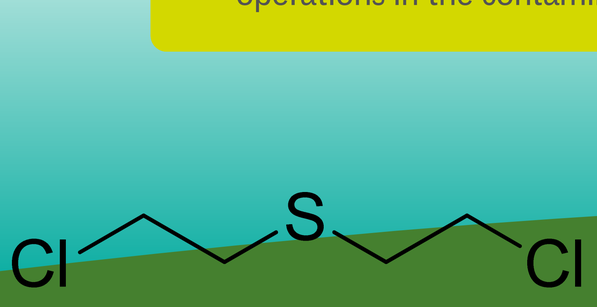
CWA measurement in the Gotland deep deep (Chemsea Data)

Sediment sampling

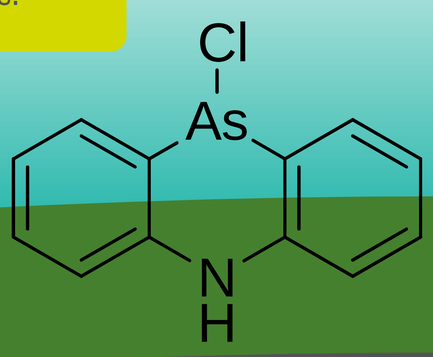
Sediment analysis

Evaluaton of contamination

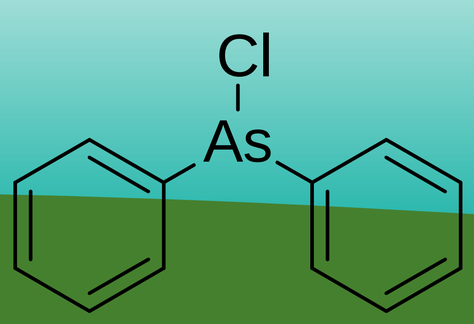
Risk assessment



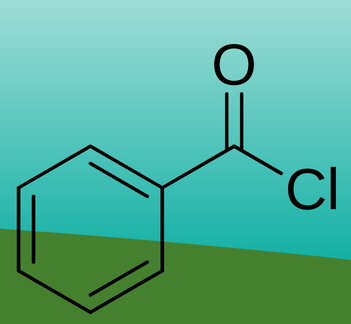
Mustard gas (H)
~ 7 000 tons



Adamsite (DM)
~ 1 500 tons



Clark I (DA)
~1 000 tons



α-Chloroasetofenoni
~ 500 tons