Corrosion protection of offshore wind farms: An emerging inorganic contamination source for the marine environment?

A. REESE[1,2]*, N. VOIGT[1], T. ZIMMERMANN[1,2], T. KIRCHGEORG[3], I. WEINBERG[3], J. IRRGEHER[4], D. PRÖFROCK[1]

[1]Helmholtz-Zentrum Geesthacht, 21502 Geesthacht, Germany (*corresepondence: anna.reese@hzg.de)
[2]Universität Hamburg, 20146 Hamburg, Germany
[3]Federal Maritime and Hydrographic Agency, 22589 Hamburg, Germany
[4]Montanuniversität Leoben, 8700 Leoben, Austria

Offshore wind energy is a steadily growing sector contributing to the worldwide energy production. The impact of these offshore constructions on the marine environment, however, remains unclear in many aspects. In fact, little is known about potential emissions from corrosion protection systems such as galvanic anodes composed of Al and Zn alloys, used to protect offshore structures. To close this gap of knowledge the joint project "OffChEm" was initiated. The presented study focusses on the analysis of potential inorganic contaminants released from galvanic anodes that are wideley used. Those anodes are designed to be *sacrificed* instead of the structural steel, resulting in the continouse emssion of metals (e.g. > 250 kg Al-anode material per pile and year) into the marine environment. In order to systematically evaluate the emission load and the fate of potential contaminants (a) suitable tracers have to be identified and (b) reliable analytical methods for their detection and quantification in marine compartments need to be developed and applied. In this study, Al and Zn anodes from several manufacturers were analysed using inductively coupled plasma mass spectrometry (ICP-MS) based techniques. High mass fractions of rare and/or technology- and environmentally-critical elements such as In (≤ 230 mg/kg), Ga (≤ 130 mg/kg), Cd (≤ 700 mg/kg), and Pb (≤ 20 mg/kg) were found. Furthermore, Al and Zn anodes can be clearly differentiated by their Pb isotopic composition ($2.0619 \leq n(^{208}Pb)/n(^{206}Pb) \leq 2.1263$), bearing the potential to differentiate between contamination sources (e.g. offshore wind farms vs. shipping). ICP-MS-based techniques were developed for the quantification of these new tracer analytes, such as In and Ga, and applied to water, sediment and biota (*Mytilidae*) samples in and around offshore wind farms located in the German North Sea. First results on spatial and temporal trends in elemental concentrations in the anlysed compartments will be presented and discussed.