Geophysical Research Abstracts
Vol. 21, EGU2019-16240, 2019
EGU General Assembly 2019

Tracing microplastic in environmental samples – offline pyrolysis – a new method

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As plastics have been used in an increasing amount within the past century, the resulting pollution of oceans, rivers and terrestrial environments with plastics and increasing amount of microplastics, has been observed. However, the study of microplastic pollution in sedimentary environmental systems is at a preliminary stage to date. This is related to lacking methods displaying unambiguously the pollution of microplastics in sediments in a qualitative and quantitative manner. As not all critical environments are polluted to an extent observed for macro-plastics, knowledge about pollution of these environments also on lower concentration levels is of great interest.
We present a new approach analyzing sediments for their microplastic pollution using offline pyrolysis. Six of the polymers (PS, PP, PE, PMMA, PVC, PET) most frequently used in everyday life were selected. For later recovery of these polymers in sediments, first blank samples were treated for analysis. Samples were pyrolyzed in an oxygen-free atmosphere, the pyrolysates were dried over sodium sulfate and fractionated using organic solvents of different polarity. Subsequently, the analyses were performed by gas chromatography-mass spectrometry. The determination of polymer residues was based on the identification of specific pyrolysis products for each polymer to identify and quantify the original polymer pollution.
In a second step, polymers were added to extra pure sea sand to simulate natural environments polluted with microplastics. These spiked samples were again treated with the described analytical procedure.
Preliminary results show that the detection of the prior characterized pyrolysis products of the six most common polymers is possible also in samples representing natural environments. Further on, an evaluation of the minimum total pollution by microplastics is possible via the detected concentrations in the sediments. However, results show as well that concentrations remain very low adjoining the detection-limit, showing that the analysis of microplastics in natural environments by pyrolysis methods is possible but remains more challenging than the more present macro-plastic pollution.