Experimental report

15/02/2021

Proposal: UGA-114 **Council:** 4/2020

Title: Detection of microplastic particles in self-constructed and undistrubed sediment samples by combined neutron and x-ray imaging

Research area:

This proposal is a new proposal

Main proposer: Christian TOTZKE

Experimental team:

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Samples: SiO2 sand
CH2=CHCl plastic

Instrument	Requested days	Allocated days	From	To
D50 T	1	1	13/09/2020	14/09/2020

Abstract:

Detection of microplastic particles in self-constructed and undisturbed sediment samples by combined neutron and x-ray imaging

Experimental Report

Scientific Background

Microplastics have become a ubiquitous pollutant that seriously affects aquatic and terrestrial ecosystems. Common methods for analyzing microplastic pollution in soil or sediments are based on destructive sampling or involve destructive sample processing. Thus, substantial information about local distribution of microplastics is inevitably lost. Tomographic methods can overcome this limitation, however, their capability has not yet been fully exploited for detection of environmental microplastics. In a first pilot study, the unique potential of neutrons to sense and localize microplastic particles in sandy sediment was demonstrated. The complementary application of X-rays allows mineral grains to be discriminated from microplastic particles.(Tötzke *et al.*, 2021). In the experiment UGA-114, we increased the complexity of sediment samples by adding remnants of plants, to mimic natural soil samples containing organic components. Furthermore, we tested the detection capacity for fragments of plastic foils in soil used for asparagus cultivation. These tests were considered important steps in method development for the analysis of natural soil and sediment samples.

Samples, imaging conditions and preliminary results

A total of 8 sediment samples were prepared using cylindrical quartz glass vessels with a diameter of 20 mm and a height of 100 mm as sample containers. The containers y were filled either with soil from an asparagus field or with sand that contained microplastic particles as well as organic additives such as peat, bark mulch or charcoal.

Samples were scanned with neutrons and X-rays at spatial resolutions chosen according to the size of the microplastics to be detected: 16 µm/pix in the case of the plastic film and 46 µm/pix in the case of the microplastic particles. The image registration and further processing is still in progress. The aim is the unambiguous localization and identification of microplastics present in the in the soil sample. The post-processing and analysis of the complementary imaging data is being performed in a similar way as it is described in (Tötzke *et al.*, 2021). For image registration, the software "spam" is being be used (Roubin *et al.*, 2019). Figure 1 shows the basic setup of the sample as well as a neutron radiograph region at the middle height of the sample.

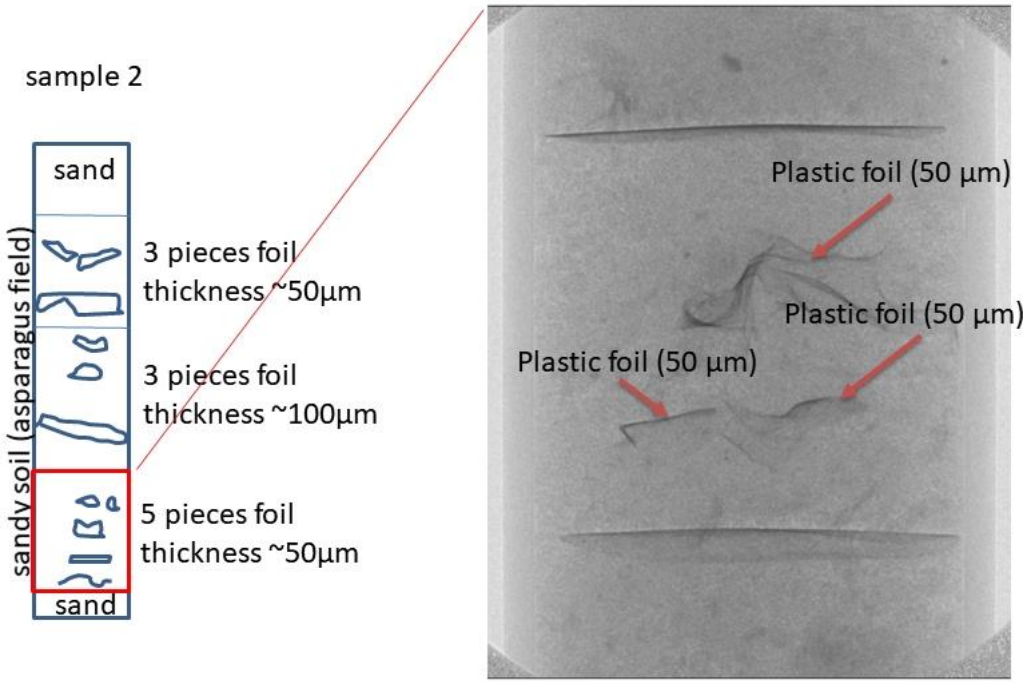

Figure: Detektion of microplastic foils by neutron tomography. Left: principal design of the sediment sample. Right: High resolution neutron image of the lower sample compartment.

Roubin E, Andò E, Roux S. 2019. The colours of concrete as seen by X-rays and neutrons. Cement and Concrete Composites **104**, 103336.
Tötzke C, Oswald SE, Hilger A, Kardjilov N. 2021. Non-invasive detection and localization of microplastic particles in a sandy sediment by complementary neutron and X-ray tomography. Journal of Soils and Sediments.