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Stratigraphic relevance of macro- and microplastics in alluvial sediments – a first assessment

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Today it seems that we are living in the “plastic age”. But plastics as an anthropogenic material element and environmental pollutant has only been in widespread use for about seven decades. The occurrence of both macro- and microplastics in different marine and terrestrial environments provides the possibility to consider plastics as stratigraphic markers. The young age of plastic polymers, the global increase in plastic production since the 1950s and their resistance against environmental degradation, could turn plastics to a useful stratal component. This applies for stratigraphic consideration and also for geoarchaeological issues.

First results from the “Microplastics in floodplain soils” (MiFS) project, investigating the spatial dynamics of microplastic in floodplain soils, allow know a first assessment about the stratigraphic relevance of plastics in alluvial sediments. Alluvial sediments in floodplain areas are known as dynamic chemical and physical sinks as well as spatial transport corridors for sediments and pollutants. Therefore, floodplain soils could also act as an accumulation area for macro- and microplastics.

Four transects in the floodplain cross section distributed in the catchment area of the Lahn river, located in the central German low mountain range, were sampled to a depth of two meters. Samples were dried, sieved and the fractions 2 mm were analyzed visually using a stereomicroscope and identification criteria. In order to prevent an overestimation, the supposed plastic objects were analyzed using ATR-FTIR spectroscope. The larger microplastic fraction analyzed here seems to be particularly suitable for stratigraphic considerations, since this fraction is less suitable for in-situ displacements by natural processes. The macro- and microplastic data was compared with sediment ages and sedimentation rates from a literature enquiry.

The results of macroplastics (5 mm) and larger microplastic (2 mm) contents show that plastic is detectable down to a depth of 70 cm. Common polymer types like PE-LD, PE-HD, PP, PS, PMMA, PVC, PET and others could be identified. At the surface and topsoils, macroplastic accumulations are found on a) river banks (superficial in vegetation or young sandy river bank depositions) and on b) fields under agricultural use. In subsoil samples 75,75 % of identified plastic particles are found in near channel samples located at the river embankment.

Comparing the distribution of macro- and larger microplastics in floodplain soils with sediment

ages, sedimentation rates and floodplain morphology, it can be concluded that a deposition of the plastic particles in the natural sedimentation process could only be expected for near channel embankments. In other areas of the floodplain, an in-situ vertical displacement of the plastic particles by tillage or natural processes appears most probable, as the sediments must be significantly older. The application of plastics and especially microplastics as a stratal component in alluvial sediments must therefore be further discussed and investigated.