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Plastics and microplastics – A future marker to reconstruct floodplain chronology (Opinion)

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After approximately two decades of plastic research in freshwater environments, plastics and especially microplastics (d < 5 mm) have entered the scientific consciousness as an anthropogenic pollutant. Even if this pollutant shows certain comparability with heavy metal pollution in soils and sediments, it should be seen as a purely anthropogenic material without geochemical or natural background loads, which leads to the assumption that it might also be a potential marker of the Anthropocene. Regarding the global plastic cycle within the environment, rivers act as main transport paths from land-to-sea. As rivers are embedded into landscapes, accumulation of plastics within riverine (e.g. sediment temporary sink) and accompanied terrestrial environments (e.g., floodplain storage for deposited plastics) has been proven in initial studies.

In contrast to other natural or anthropogenic pollutants, the approximate time since plastics and microplastic can be introduced into the environment starts in the 1950's with increasing global plastic production and consumption. A steady increase of possible plastic loads with the rising plastic production, probably decreasing with beginning environmental responsibility (approx. 2010 or beyond) leads to the fact, that plastic contents mainly occur in sediments and soils over a period of the last 70 years. This circumstance in connection with the general known sink function of soils and sediments, especially floodplains, nutrients as well as pollutants, allows the consideration of plastic deposits for dating purposes. As different dating methods reach their limits regarding comparatively young sediments, the connection between plastic deposition depth and temporal entry provides a basis for dating recent sediment layers. Possible detailed age differentiations in dependence on the identification of polymer types and additives, particle surface appearance (e.g., fresh/weathered) or spectroscopic criteria (e.g., surface weathering determination) are thinkable.

The opinion presented here, aims to address this new opportunity on the basis of own research findings within floodplains as well as other studies and highlights two main requirements: The first requirement for a sufficient dating implementation of plastic particles is the particle size: Detection and application for dating purposes is relatively easy to apply for macro- and mesoplastic particles (□5 mm), due to size and less mobility in soils or sediments (e.g., plastic films embedded in sediment structure). In contrast for particles in the microplastic size class (□ 5mm

down to 1 µm) we recommend only the consideration of coarse microplastics (2mm) as smaller particles could easily shift in soils and sediments (e.g., bioturbation, preferential flow). Additionally, the selection of a suitable sampling site as a second requirement depends on the appropriate localization within the floodplain area and surface morphology, sampling depth, flood history and anthropogenic influences.

Apart from the numerous potential environmental risks of plastics, their purely anthropogenic production and their respectively features, can turn them into a useful dating tool in river and floodplain sediments and thus enabling, besides the detection alone, a further application. This approach could also be transferred to marine or lacustrine sediments in future.