

From macroplastic to microplastics – weathering and biodegradation of synthetic polymers in the mountain river basin

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Microplastics (MPs) are an emerging pollutant penetrating different environments. A majority of MPs present in the environment is of secondary origin – they originate from the degradation processes of macroplastics. Plastic is widely used in infrastructure, clothing, agriculture and other spheres of human activity, thus it is prone to entering the environment.

There is a lack of understanding of the mechanisms and pace at which plastic disintegrates into microplastics under environmental conditions. There is also a need for further study of the presence and concentration of other pollutants attached to the surfaces of plastics in sediments.

The scope of the present study is a multilevel analysis of synthetic polymers collected in the mountain river basin (roads in arable fields and pastures, forest roads, streams, and river beds). The collected polymer fragments were exposed to sunlight to varying degrees, washing by rainwater, development of vegetation and mechanical fragmentation. These polymer fragments occur usually singly, often exhibiting disintegration into narrow ribbons or irregular fragments. Several pieces were brittle and broke down into fragments of different sizes. In and along the river beds, different conglomerates of plastic, plant debris and stones were found. The polymers were identified (domination of polyethylene) and the degree of oxidative degradation was assessed by means of infrared spectroscopy (ATR-FTIR). Oxidative degradation is assumed to be the main process of polymer fragments weathering. The degree and forms of disintegration of polymers surfaces and the presence of microorganisms were observed using scanning electron microscopy with energy dispersive spectrometry (SEM-EDS).

The oxidation and development of the plastisphere, accumulation of metal-rich particles, changes of mechanical properties (friability) are intertwined and the explaining of the connections between them requires detailed testing of samples collected in different environments and experimental ones.

The obtained results are important for the assessment of potential dangers and further study of microplastic origin in environmental conditions and mutual interactions between the plastisphere, geosphere and biosphere. In the geological context, the recognition of processes of degradation or conservation of synthetic polymers in the soil, is important, as plastic is