TITLE: Soil and sludge exposures induce measurable morphology and stable isotopic changes in plastics

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ABSTRACT: Microplastics (typically under 5mm in size) have become an emerging issue in marine and freshwater systems. The current consensus, however, suggests that terrestrial systems receive as much or more plastic pollution as their aqueous counterparts. Yet in comparison, the presence, and environmental interactions of microplastics in soil systems have been understudied. The fate of microplastics in soils is presently debated, but they are presumed to negatively impact animal/human health, damage plants, and alter soil microbial communities. More recent studies have indicated that the presence of plastics in soil may affect the ecosystem cycling of carbon. In this study, the degradation of low-density polyethylene (LDPE), high-density polyethylene (HDPE), and polyethylene terephthalate (PETE) was evaluated using controlled soil and sludge microcosm experiments. Microplastics were analyzed using a combination of microscopy and isotope mass spectrometry techniques to assess their breakdown after a 30-day incubation period. Images obtained with scanning electron microscopy showed the development of different morphological characteristics for all three microcosm exposed plastics, including pitting and cracking. Imaging also showed the presence and attachment of biofilm and bacterial colonies. Discernable differences in the bulk stable carbon isotopic composition of HDPE and PET were observed, but isotopic changes were not observed for LDPE. Overall, we consider these determinations as 'test-positive' indicators for more rigorous future characterizations of microplastics in soil systems.