Title: How mineralogical factors can affect distribution and concentration of microplastics in soils and geological matrices

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Research program

Plastic represents one of the most widespread anthropogenic matrices of the last decades and its use is exponentially growing since the second half of the 20th century. In 2018 a world production higher than 310 million tons was estimated. In Europe the demand of plastic matter is among the highest in the world and Italy is within the Countries with the largest of thermoplastics, polyurethanes, thermosetting and other synthetic polymers. Measures to fight pandemic COVID-19 have inexorably intensified the use of disposable materials, where plastic is often one of the main components.

Despite the plastic waste abandoned in nature has always been a great clamor from an ethical and media point of view, little attention has been paid to the negative effects of smaller plastic particles (the so-called microplastics, <5mm) on the environmental matrices water, air, soil and subsoil. However, in recent years the scientific community has developed the right awareness of this problem and many researches seems to be oriented towards a solution.

Microplastics are essentially produced by the gradual degradation of synthetic polymers such as polyethylene and polypropene, following prolonged exposure to ultraviolet radiation and mechanical abrasion. Most microplastics tend to bypass the filtration systems of urban waste water treatment plants and reach marine water through traditional surface drainage systems. However, a part of these materials contaminates also the solid matrices in aerial or subaerial conditions (soil and subsoil) inevitably conditioning the quality of the ecosystems and having easy access to the chain food.

The research program will deal with the identification and the characterization both of microplastics and the inorganic matrices carrying them, by means of an implementation of the analytical techniques typical of the chemical and mineralogical analyses. A particular attention will be focused on the role of the mineralogical component of soils and geological materials, on the distribution and concentration of microplastics in the ecosystems. Great emphasis will be also devoted to the characterization of the chemical-physical properties of the most adsorbing or cation exchangeable minerals such as clay minerals and zeolites.

Proposal for a PhD position

The PhD student will be entrusted with highly interdisciplinary tasks, aimed at an exhaustive characterization of the inorganic matrices and of the plastic materials contained in them. The PhD student will evidence the correlations existing between the geological-mineralogical phenomena typical of the investigated matrices and the anthropic effects of the pollution by microplastics. The investigation will focus on natural matrices, carefully sampled in selected and characterized sites, but will also consider laboratory simulations on matrices appropriately formulated.

The PhD student will develop technical-scientific competencies proper of the chemical and minero-petrographic analyses. A particular emphasis will be given to optical and electronic microscopy, Raman and FTIR vibrational spectroscopy, X-ray diffractometry and fluorescence, UV-Vis

spectrophotometry, TG/DSC simultaneous thermal analyses along with Evolution Gas Analysis (EGA), mass spectrometry and gaschromatography. Collaborations with research institutions, both Italian and foreign, will be also envisaged.