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Editorial: Soil and Sediment Pollution, Processes and Remediation

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Editorial on the Research Topic

Soil and Sediment Pollution, Processes and Remediation

INTRODUCTION

Since the 20th century, human activities have generated a large amount of toxic organic and inorganic pollutants that have been released into earth surface environment, causing a number of environmental public health issues (Boente et al., 2017; Song et al., 2017; Sun et al., 2020; Tang et al., 2015). Many pollutants from natural or anthropogenic sources can enter soils and sediments through spills, leaks, tank and pipeline ruptures, irrigation, atmospheric transport, and other disposal pathways (Zhang et al., 2008; He et al., 2019). These pollutants can accumulate in soil and sediment systems, posing potential threats to food security, ecological and human health. Moreover, abandoned industrial sites due to weak environmental management (insufficient management, legislation and enforcement) and adjustment of urban planning or industrial structure are increasing and causes severe contamination to adjacent soils and sediments (Zhao et al., 2015). The pollution process, migration, transformation, degradation, and accumulation of toxic pollutants in soil and sediment of industrial sites are not well understood and reuse of these sites requires some *in-situ* and *ex-situ* remediation.

Before remediation, it is crucial to control the source of pollutants and prevent pollutants from entering soil and sediment. The choice of remediation technologies of contaminated soil and sediment is strongly dependent upon the types of pollutants and degree of pollution (Khalid et al., 2016; Ye et al., 2017; Zhang et al., 2021). Through remediation and risk assessment, prime land in established locations can be reused (e.g., agricultural, residential, and commercial land), thereby lowering the pressure on green land. Therefore, studies on the biogeochemical processes of soil and sediment pollution, control, and remediation are urgently needed. Since soil and sediment remediation followed by redevelopment prevent degradation of the environment, it is a topic of enormous public interest.

This Research Topic focuses on new pollutants such as antibiotics, environmental hormones, antibiotics resistance genes, pathogens, and microplastics as well as traditional heavy metals, excess nutrient microelements, and pesticides. This Research Topic covers the following themes: (a) Sources, migration, and transformation of pollutants in soils and sediments; (b) Plant and microbe response and environmental effect in polluted soils; (c) Biogeochemistry processes of pollutants between the atmosphere, organisms, water and soil/sediment systems; (d) Safe use, risk assessment and control of contaminated soil and sediment; (e) Mitigation and remediation technologies; (f) Environmental modeling of the fate and biogeochemical process of pollutants.

Highlights from Publications Featured in this Research Topic

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Huang et al. investigated the spatial variation in Cd and Hg concentrations in farmland soils from the Poyang Lake Plain, China, and evaluated their potential ecological risks. The authors concluded that moderate pollution of Cd and Hg presented in these farmland soils where their comprehensive potential ecological risk level was generally low and mainly influenced by soil pH and total phosphorous.

Wang et al. focused on the spatial distribution of Antimony in paddy Soils from Hunan Province, China, and concluded that strong migration of antimony in horizontal direction and a decrease trend of antimony with the increase of profile depth, which was significantly affected by parent materials.

Kong and Zhang investigated the spatial distribution of five heavy metals in north of north China plain, and proposed a scheme for the regional division of the security of soil heavy metals based on the different evaluation methods.

Zou et al. investigated the effects of As and Pb on spatial variation of soil microbial community, and concluded that soil pH, total As and Pb, bioavailable As and Pb, nitrate-nitrogen (NO_3−-N) and ammonia-nitrogen (NH_4^+-N) were the most important factors in shaping the bacterial community structure.

Liu et al. predicted the transformation of Cd from soil to potato in Karst soil and discovered soil pH was the key factor influencing Cd uptake by potatoes.

Abakumov et al. quantitatively and qualitatively evaluated the priority polycyclic aromatic hydrocarbons (PAHs) and heavy metals (Cu, Pb, Zn, Cd, Ni, and Cr) is soils and cryoconites on "St. Kliment Ohridski" Antarctic station territory and its vicinities, and their results suggested that there was no significant effect of anthropogenic activities on the environmental components of the landscapes.

Risk control and security utilization of the contaminated soils and sediments is crucial for ecological remediation. Some traditional methods including chemical leaching, vitrification, land farming, and soil covering are constrained by processing duration, geological problems, economical impracticality and negative impacts on soil properties (Gong et al., 2018; Purkis et al., 2021; Rajendran et al., 2021). Chemical stabilization is widely used in farmlands contaminated with heavy metals because of its low cost and high efficiency for reducing the migration and bioavailability (Lin et al., 2019; Shen et al., 2019). Based on the Superfund Remedy Report in USA, the stabilization/solidification is still the most popular *in-situ* remediation technology, which accounted for nine out of 35 total decision documents between 2015 and 2017 (US EPA, 2020). However, the long-term sustainability of the technology and the potential impact factors weaken the remediation effect are still not fully known, which limited the large-scale utilization of the technology (Wang et al., 2021). Phytoremediation is an environmental-friendly and economical strategy, but it is time-consuming and strong dependence on contaminant types, plant species, and soil types (Marques et al., 2009; Cui et al., 2016; Ashraf et al., 2019). Particularly, most hyperaccumulator is low biomass and the total removal of heavy metals is in low level (Marques et al., 2009). Therefore, some metal-tolerant plants with large biomass are recommended for phytoremediation (Cui et al., 2016). For example, Zhang et al. reviewed the application of giant reed in the field of phytoremediation of heavy metals and discussed the potential application of giant reed combined with advanced remediation technologies in ecological remediation.

Xu et al. reported the combination of lime immobilization and four Cu-tolerance plants can effectively decrease water-soluble can exchangeable Cu and Cd, which can significantly decrease the environmental risk of the contaminated area.

Future Research

This *Research Topic collection* advances our understanding on the spatial distribution of contaminants and their effects on plants and microbial community structure. Moreover, this Research Topic also highlights the phytoremediation with large biomass plants in heavy metals contaminated soils. Nevertheless, great challenges on the soil and sediment pollution, process and remediation needs more attentions. Therefore, the following aspects need further attention to support the environmental management and security utilization for soils and sediments: 1) Effectively identify the sources of the pollutants in the soils and sediments; 2) The mechanism of pollutant fate and biogeochemistry processes in the soils and sediments environment; 3) Efficient strategies of degrading and/or removing pollutants from soils; 4) More environmental-friendly bioremediation and combination of multiple measures; 5) Engineering technologies urgently needed in the field. 6) Sustainable green remediation materials and technologies; 7) Scientific assessment methods for the sites after remediation; 8) The influences of global climate change induced by human activities on the fate, transformation, and transportation of the pollutants.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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