Soil development from industrial waste

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Abstract:
Phytoremediation is primarily used to remove contaminants from a substrate and to reduce the risk for humans and environment. Less attention is given to the direct modifications of the substrate induced by the plants used for phytoremediation. In other words, can vegetation turn waste into soil? So our work focuses on the modifications of structural characteristics occurring at the surface and along the profile of industrial waste when it is colonized by vegetation. The disposed materials in the study site derived from the different industrial processes of several chemical factories and had accumulated for more than 60 years. We evaluated the influence of different plant types: woody plants, without any external aid such as compost addiction or tillage, and agricultural crops. The wood was formed by vegetation that had been running wild on the site surface since the waste disposal had been stopped. Prevalent species in the woody area included: Field Elms (Ulmus minor Mill.), Black Poplars (Populus nigra L.), Common Dogwoods (Cornus sanguinea L.), Oleasters (Eleagnus angustifolia L.), Elderberries (Sambucus nigra L.), and Blackberries (Rubus fruticosus L.). The agricultural crop was sunflower, sowed after the waste substrate had been tilled to a depth of 30 cm. Micromorphological observations of thin sections of undisturbed soil samples showed that all samples taken from the surface layer (0-5 cm) of the woody area looked similar to samples from natural forest soil abundant in organic matter and with an open and crumby structure rich in pores. In some samples the substrate alteration was still evident at a depth of 20-25 cm. Total porosity decreased along the profile from about 30 % to less than 5 %. Elongated pores were the most abundant in the majority of samples, and the intermediate size class (0.2-1.0 mm) was the most representative. Good structural properties were also confirmed by the cracking patterns of artificially dried surface soil samples, which showed a network of fine cracks. Thin sections deriving from all three sampling sites in the field area showed a striking difference from those of the wood area and shared some common features with each other: i) no presence of visible organic matter even at the surface; ii) a clear effect of agricultural practices, which made the distribution of clods and smaller fragments of the original substrate homogeneous throughout the profile; iii) a gradual disappearance of porosity created by tillage at increasing depths due to the compression of the layers above. The possible side effects, in the whole remediation process, induced by plant cultivation on the physical properties of the newly forming soil, as shown in this specific site, should be taken into account when considering the use of natural attenuation processes as an alternative technological approach to phytoremediation. Findings from this and from other similar studies could also lead to the consideration of the transformation of waste into 'soil' without external intervention in an assessment of the economic value of phytoremediation.

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