Geophysical Research Abstracts
Vol. 19, EGU2017-2252, 2017
EGU General Assembly 2017

Development of Technosols in abandoned mine lands to reduce hazards to ecosystems and human health

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Mine tailings and residues dumped into the environment owing to mine ore processing activities have numerous restrictions affecting their development into natural soils, such as strong acidity, high concentrations and mobility of metals and metalloids, high salinity and extremely low organic matter content, which hinders the development of vegetation. This leads to the presence of bare surfaces which act as sources of water pollution and metal containing dusts, affecting natural ecosystems and populated areas in the surroundings. Therefore, there is a need to develop strategies to reduce the impact of tailings and mine residues spread on mine landscapes to reduce environmental and public health hazards and guarantee true land reclamation. One effective remediation option is the creation of Technosols by use of different materials, wastes and amendments derived from anthropogenic activities. For this purpose, the proper selection of materials is critical to convert metals to forms less soluble, mobile and toxic, so microorganisms, vegetation and animals can grow, and erosion rates are minimized so that metals do not reach populated areas. This goal can be achieved by applying materials with metal stabilization potential, to transform bioavailable metal species into geochemically stable forms. For this purpose, we have created Technosols in different mine tailings ponds located in SE Spain by use of different materials such as pig manure, pig slurry and marble waste. After 6 months of Technosol creation in field, seedlings from different native plant species were manually introduced for afforestation of the area. To monitor the evolution of soil quality and vegetation cover, four plots (10 m x 10 m) were established in each tailings pond, which were monitored every 6 months for 3 years. Results indicated that the created Technosol was efficient at significantly decreasing metal mobility by 90-99% depending on the metal. In addition, soil quality, fertility and structure increased, associated to increased microbial biomass and activity and development of vegetation. Vegetation cover at the end of the study was 65% of the total surface, with appearance of second generation individuals, suggesting the self-sustainability of the new ecosystem. Owing to the creation of a soil, metals are immobilized and soil particles are retained by increased soil aggregate stability and vegetation cover; so, the dispersion of metals to the surroundings by erosion and leaching is minimized, decreasing the hazards for human health and the environment.