Geophysical Research Abstracts
Vol. 15, EGU2013-4048, 2013
EGU General Assembly 2013

Sequential extraction of heavy metals in soils from a copper mine

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Metal mining produces a large amount of waste materials where mine soils can be formed. They use to have important limitations for plant development like extreme pH and low organic matter among others. On metal mines they usually have problems of pollution by heavy metals (Asensio et al., 2013) generally concerning more than one metal. At Touro (Galicia, Spain) copper was mining from 1973 to 1988. Nowadays, there are soils formed on the tailings formed with waste and thick materials coming from copper extraction and on the settling pond since it is emerged and dry. They are partly exposed to weathering and the iron, copper, sulphides and H+ can be released causing acid mine drainage and heavy metal solubilization. Since heavy metals can adsorb onto the soil, runoff into rivers or lakes or leach in the groundwater (Mulligan et al., 2001) it is very important to study the soils mechanisms involved in both retention and solubility of heavy metals. The sequential extraction procedures allow to better understand them since the chosen extractions attempt to minimize solubilization of other soil fractions even none of them is completely specific (Mulligan et al., 2001). At Touro mine, five soils were sampled and analysed for those properties known as heavy metal retention determiners. The distribution of Cr, Cu, Mn, Ni, Pb and Zn among geochemical soil phases was analysed following the modified sequential extraction technique of Shuman (1979, 1985). The concentration in the extractions was analysed by ICP-OES. The results show that most of the heavy metal content is associated to the residual fraction in all soils Cr (85-92%), Cu (53-81%), Mn (80-98%), Ni (86-96%), Pb (47-81%) and Zn (85-95%). The high crystalline Fe-oxides content also plays an important role, specially for Cu (18-22% of the total Cu). The amount of heavy metals associated to soil organic matter is very low (Pb and Cu: <3%, Zn, Ni, Mn and Cr: <0.5%) and the same happens with the exchangeable form (Cu: 1-8%, Mn and Ni: <3% Pb and Zn: 1.5% and Cr <0.01%). Therefore, most of heavy metal contents are strongly retained in low accessible soil fractions. Still, the high Cu content together with high soil acidity and low organic matter contents and endanger the environmental quality of the surroundings due to the possibility of leaching and run-off waters.

Acknowledgments

This research was supported by Project CGL2010-16765 (MICINN-FEDER). F.A. Vega and D. Arenas-Lago acknowledge the Ministry of Science and Innovation and the University of Vigo for the Ramón y Cajal and FPI-MICINN, respectively.

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