Geophysical Research Abstracts,
Vol. 11, EGU2009-11993, 2009
EGU General Assembly 2009

Atmospheric Deposition of Heavy Metals in Soil Affected by Different Soil Uses of Southern Spain

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Heavy metals are a natural constituent of rocks, sediments and soils. However, the heavy metal content of top soils is also dependent on other sources than weathering of the indigenous minerals; input from atmospheric deposition seems to be an important pathway. Atmospheric deposition is defined as the process by which atmospheric pollutants are transferred to terrestrial and aquatic surfaces and is commonly classified as either dry or wet. The interest in atmospheric deposition has increased over the past decade due to concerns about the effects of deposited materials on the environment. Dry deposition provides a significant mechanism for the removal of particles from the atmosphere and is an important pathway for the loading of heavy metals into the soil ecosystem. Within the last decade, an intensive effort has been made to determine the atmospheric heavy metal deposition in both urban and rural areas.

The main objective of this study was to identification of atmospheric heavy metals deposition in soil affected by different soil uses.

Study area is located in Murcia Province (southeast of Spain), in the surroundings of Murcia City. The climate is typically semiarid Mediterranean with an annual average temperature of 18ºC and precipitation of 350 mm. In order to determine heavy metals atmospheric deposition a sampling at different depths (0-1 cm, 1-5 cm, 5-15 cm and 15-30 cm) was carried out in 7 sites including agricultural soils, two industrial areas and natural sites. The samples were taken to the laboratory where, dried, passed through a 2 mm sieve, and grinded. For the determination of the moisture the samples were weighed and oven dried at 105 °C for 24 h. The total amounts of metals (Pb, Cu, Pb, Zn, Cd, Mn, Ni and Cr) were determined by digesting the samples with nitric/perchoric acids and measuring with ICP-MS.

Results showed that zinc contamination in some samples of industrial areas was detected, even this contamination reaches 30 cm depth; thus it is not possible to conclude that the actual contamination by zinc is due to atmospheric deposition or spill. However, some samples in this same area present lightly higher zinc concentration in topsoil than in subsoil indicating a cursory atmospheric deposition. Regarding to lead, one of the industrial areas showed a very active atmospheric deposition, with concentrations higher than 900 mg/kg in topsoil decreasing until less than 10 mg/kg to 30 cm depth. Oppositely, the lead concentration in natural soil is constant in the profile. On the other hand, the range of cadmium concentrations in the different depths of the profiles was, generally, low. Only one sample from the industrial area shows high concentration in the first centimetre of soil, decreasing quickly with the depth, supporting the hypothesis that the atmospheric deposition is the main pathway of cadmium contamination. Studding the copper concentration, only in agricultural soil atmospheric deposition is observed, probably due to application of pesticides. Oppositely to the rest of metals, manganese increases its concentration with the depth in natural soil, probably due to that the parent material (metamorphic rock) is rich in this metal. In the case of chromium has not been detected atmospheric deposition in any sampling point. Finally, only one sample located at the industrial area, nickel concentration shows a higher level in topsoil than subsoil, indicating atmospheric deposition.

Acknowledgements: to “Fundación Séneca” of “Comunidad Autónoma de Murcia” for its financial support