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Heavy metal adsorption and desorption by a Eutric Regosol and a Distric Regosol

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Heavy-metal adsorption reactions, in a competitive system, are important to determine heavy-metal availability to plants and their mobility throughout the soil. It is now well established that the free metal ion concentration, which is of relevance in metal bioavailability and toxicity studies, is often controlled by metal ion binding to natural organic matter (Kinniburgh et al., 1990). The objective of this work was to evaluate heavy metal sorption capacity of two subsurface horizons from an Eutric Regosol (ER) and a Distric Regosol (DR).

Ten solutions of mixtures of Cd, Cr, Cu, Ni, Pb, and Zn nitrates (between 10 and 400 mg L^{-1}) were prepared to obtain adsorption isotherms. Twelve grams of soil samples were treated with 200 mL of solution and shaken for 24 hours at 25ºC (Gomes et al., 2001). After centrifugation, metal in solution was determined by ICP-OES (Perkin Elmer Optima 4300 DV). Desorption experiments were performed using the pellets resulting from adsorption experiments (Madrid and Diez, 1992). Each sample was treated with 200 mL of an acetic acid (0.02M) and sodium acetate (0.02M) solution, buffered at pH 4.5 and shaken for 24 hours at 25ºC. All of the experiments were performed in triplicate. K_{d100} was used to establish the adsorption and retention selectivity sequences of the heavy metals (Covelo et al., 2004) by these soils.

Both studied Regosols have low organic matter contents (5.3 and 19.29 g kg^{-1} in RD and RE respectively) and low cation exchange capacity (1.08 and 0.38 $cmol_{(+)}$ kg^{-1} in RD and RE respectively). The clay proportion in soils mineral fraction is 21.94% in Distric Regosol and 26.29% in Eutric Regosol.

Kaolinite is the most frequent mineral in RD clay fraction ($>$50%) whereas in RE is between 10 and 30% in their clay fraction. RD has low mineralogical variety and

oxides content than RE.

Pb > Zn > Cd > Cr > Ni > Cu is the adsorption selectivity sequence obtained in RE. Their retention selectivity sequence is Cr > Zn > Pb > Ni > Cd > Cu.

Selectivity sequences obtained in DR are Pb > Zn > Cr > Cd > Ni > Cu (after adsorption experiments) and Cr > Zn > Ni > Pb > Cd > Cu (after desorption ones).

Cu is the metal adsorbed and retained in lesser amounts in both studied soils. This fact is attributable to their low organic matter content because this soil property presents high affinity to Cu sorption and retention.

Both retention selectivity sequences are very similar. Only third and fourth positions change, Pb is retained in higher amounts than Ni by RE whereas RD retains higher amounts of Ni than Pb. RE mineralogical variety influences the high Pb retention of this soil.

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