Phosphorus sorption in two Geric Ferralsols of New Caledonia
Rétention de phosphore dans deux sols ferrallitiques oxydiques de Nouvelle-Caledonie

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A large part of New Caledonia territory is covered by Geric Ferralsols. These soils are usually divided in two types, according to their mineralogy. "Ferritic" soils are characterized by a predominance of iron oxides and are located in the South of the main island of New Caledonia. On the other side, "Allitic" soils exhibit large amounts of both aluminium and iron oxides, and are found on Loyalty Islands. These soils, which are of great importance for the agricultural development of these two regions, are believed to have very large phosphorus sorption capacities that lead to a limited phosphorus availability to crops.

Sorption kinetics, sorption and desorption isotherms were built using batch equilibrium experiments for the two soil types. Phosphorus sorption data was analyzed using correlations between Langmuir sorption parameter Xmax and soil properties.

Geric Ferralsols of New Caledonia showed very large sorption capacities, and sorption appears to be governed by both organic and mineral components. Organic carbon and oxalate-extracted aluminium were the main soil properties that explained P sorption variations. An increase in shaking duration resulted in a sorption increase. The organic matter would act as a physical-chemical barrier, its role being however limited in time. Desorption data showed that the sorption-desorption process is highly irreversible.

The richness in aluminium and iron oxides combined to unusual large phosphorus sorption capacities make New Caledonian soils particularly interesting research materials.

Keywords: phosphorus, sorption, sorption kinetic, Geric Ferralsols, New Caledonia

Mots clés : adsorption, désorption, cinétique, Geric Ferralsols, Nouvelle-Calédonie

Adorsión de Zn y Cd en diferentes suelos
Adsorption du Zn et du Cd sur divers sols
Cadmium and Zinc sorption in different soils

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El objetivo de este trabajo es analizar el efecto de las propiedades del suelo sobre la adorsión y fijación de Zn y Cd, cuando se le añaden diferentes cantidades de cada uno de ellos y de la mezcla de ambos. Se utilizó el método de superficie total de varios suelos naturales de diferentes propiedades y que fueron caracterizados físicamente y químicamente: S.M.: 2-2,75%, Acrica: 10,83%, CIEc: 1,08 cmol/kg, porosidad: 44,4%. S2: M.O.: 3,29%, Acrica: 14,97%, CIEc: 1,42 cmol/kg, porosidad: 53,9%. S3: M.O.: 13,12%, Acrica: 21,33%, CIEc: 1,90 cmol/kg, porosidad: 65,7%. La experiencia se llevó a cabo en 63.16 cm3 de PVC, cerrados en su parte inferior con tela de lino y en los que se introdujeron 2 gr de cada suelo y se llevaron a capacidad de campo. En cada uno de ellos, en seis etapas y durante tres meses, se añadieron en disolución, y a un ritmo de 5 ml/min, distintas cantidades de Zn, Cd y de la mezcla de ambos, intentando simular un vertido residual. Se le aplicaron seis tratamientos distintos, de modo que si los metales fueron adsorbidos totalmente, cada uno de los suelos alcanzaron su contenido de Zn y 500 mg/kg de Cd, 100 y 1000 mg/kg de Zn, 50 mg/kg de Cd y 100 mg/kg de Zn y 500 mg/kg de Cd y 1000 mg/kg de Zn.

Todas las experiencias se realizaron triplicado, utilizando un control para cada suelo.

Para determinar la influencia de las propiedades del suelo en la adsorción de ambos metales y, en su caso, las interacciones entre ellos, se determinaron los contenidos asimilados y total en cada uno de los suelos y se analizaron las aguas de drenaje.

Los resultados obtienen ponen claramente de manifiesto la influencia de las propiedades de los suelos en la adsorción de ambos elementos, así como la mayor movilidad del Cd que del Zn. El suelo S3 con mayores contenidos en M.O. y acrica y menor capacidad de intercambio catiónico efectivo, es el que retiene mayor cantidad de Zn y Cd y el que posee menor contenido asimilado.

En todos los suelos se aprecian los efectos de la interacción entre ambos metales cuando se añaden conjuntamente. Cuando la dosis de Zn es no muy alta inhibe la adsorción de Cd, mientras que cantidades importantes de Zn reforzar la adsorción de Cd y viceversa.

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Palaabra clave: suelos, adsorción, Zn, Cd
Mots clés : sols, adsorption, Zn, Cd

Key words: soils, sorption, Zn, Cd

Mechanisms of Nickel Sorption on Illite: A Molecular Approach
Mécanismes d’adsorption du nickel sur l’illite: approche moléculaire

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Retention of heavy metal ions on soil mineral surfaces is a crucial process for maintaining environmental quality since sorption reactions at solid-water interfaces decrease the solute mobility and often control the fate, bioavailability, and transport of trace metal ions such as Zn, Cd, Ni, and Cu in aquatic and soil environments. Correctly determining the sorption mechanisms of metals on clay surfaces such as illite is therefore of great importance for understanding the fate of such pollutants in contaminated soils and sediments, and will facilitate successful environmental remediation procedures.

Nickel sorption on illite clays can take place at different sorption sites: edge sites, planar sites, interlayer sites, and wedge zone sites. To characterize the mechanisms of different Ni sorption processes on illite, Ni sorption was studied as a function of pH, reaction time, type of illite (K treated and K untreated), and ionic strength. Extended EPR field structure adsorption spectroscopy (EXAFS) was used as a tool to study Ni sorption mechanisms on a molecular level. Our results show that sorption at interlayer sites does not play a significant role in the overall sorption process, and that reaction time has a strong effect on the observed Ni sorption behavior. At pH values above 6.2 the formation of a multinuclear Ni-Al hydrate phase takes place. In this paper, macroscopic and spectroscopic EXAFS data on Ni sorption studies on illite are presented. The Ni sorption behavior as a function of experimental conditions will be described, and the operative sorption mechanisms will be discussed.

Key words: illite, nickel, sorption mechanisms, EXAFS

Mots clés : illite, nickel, mécanisme d’adsorption, EXAFS

The effect of application of different chromium rates to soils on radish yield and chromium uptake
Effet de divers apports de chrome dans les sols sur le rendement du radis et l’absorption du chrome

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The aim of this work was to evaluate the effect of four rates of Chromium (Cr) (0, 10, 50, and 100 mg·kg⁻¹) in two oxidation states, Cr(III) and Cr(VI), on radish (Raphanus sativus) dry matter (DM) yield, and uptake of Cr. A pot experiment was carried out in a greenhouse with soil samples from Ap horizons of a Ferric Luvisol (LxS) and a Stagnic Luvisol (LxV) which differ mainly in free iron oxides (FeO) 24000 and 4000 mg·kg⁻¹, respectively and clay mineralogy. Besides, LV soil contains more oxides. The sample soils were first incubated with Cr and then radish seeds were sown and harvested 25 days later. During the experiment the pots were maintained at 60% of field moisture capacity. Shoots and roots were separated and weighed. The plant material was digested in a microwave and Cr was determined using an ICP. In soil LV DM yield showed greater values for both oxidation states than LxS soil, except when 100 mg·kg⁻¹ of Cr(VI) was applied. The DM yield response to the application of Cr(III) and Cr(VI) of shoots and roots in soil LxS was described by linear equations, with negative slopes (p<0.05) for LV soil the DM yield responses were different concerning shoots and roots and Cr oxidation states. The increase of Cr concentration in the plant in both soils does not always correspond to an yield decrease. With few exceptions (especially in the case of the LxV) Cr(VI) the uptake of Cr by the shoots was higher than in roots. The contents and uptake for both oxidation states of Cr were always higher in LV soil than in LxS. This is due for the former soil to the presence of Mn oxides (which induced Cr(III) oxidation), stresses and low values of iron oxides. These soil characteristics decrease Cr(VI) adsorption increasing its availability. Unlike in LxS soil iron oxides and kaolinites acted as a sink for Cr(VI), whereas Cr(III) forms were not adsorbed by soil components. The significant uptake response (p<0.05), of the Cr by the plant to the application of Cr different rates and oxidation forms for soil LxS was described by straight lines, whilst for soil LV the response was exponential although it is not significant (p<0.05)

Keywords: Chromium, hexavalent and trivalent forms, dry matter yield, contents, uptake, radish. Mots clés : chrome, formes hexavalente et trivalente, production de matière séche, teneurs, prérétion, radis.

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