Trace metals in phosphate fertilizers : Cadmium behavior in Lebanese soils

Valérie El Kazzi, Bruno Lartiges, Antoine El Samrani, Ahmad Kobeissi, Veronique Kazpard, Laurence Denaix

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RST PAU 2014

27-31 octobre 2014

24e Réunion des Sciences de la Terre

Palais Beaumont

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Abstracts

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Des géologues au service de la société

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Abstracts

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Géosciences

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dépasser les frontières

[1]*ANDRA, Chatenay Malabry*
[2]*Linköping University, Suède*
[3]*EDF R&D, Chatou*

While chlorine is worldwide used as a pillar of the chemical chemistry for more than 100 years to produce a huge variety of compounds, the biogeochemistry of that element remains puzzling and its ecological role still poorly understood. Chlorine is very soluble at a global scale with chloride (Cl-), the dominating form. Because of its high solubility, chlorine was usually perceived as a good conservative tracer in hydrological studies and by analogy as little reactive in biosphere. However, it is now admitted that chlorine participates in fact in a complex biogeochemical cycle, which involve a non-conservative behavior, notably because of natural processes of organic matter (SOM) chlorination (Öberg, 1998) mainly occurring in surface soils and mediated by microbial activities on a large extent (Bastviken et al., 2007). Our recent studies have strengthened the view that an organic cycle for chlorine should now be recognized, in addition to its inorganic cycle. Major results showed that :

- organochlorine (Clorg) formation occurs in all type of soils and ecosystems (culture, pasture, forest), leading to an average fraction of the total Cl pool in soil of about 80 % (Redon et al., 2012),
- chlorination in more organic soils over time leads to a larger Clorg pool and in turn to a possible high internal supply of inorganic chlorine (Clin) upon dechlorination. (Gustavsson et al., 2012),
- average Cl residence time in forest soils calculated for Clin and Clorg together was 5-fold higher that the residence time estimated for Clin alone (Redon et al., 2011),
- locally, Cl amount taken up by vegetation is much larger than atmospheric deposits, the Cl in excess being recycled mainly by throughfall (Thiry, 2010),
- Cl root uptake and transformation rates in soils are essential to calibrate dynamic compartment models since those processes control the persistence of chlorine in the whole system but data are still deficient for different land uses (Van den Hoof & Thiry, 2012).

8.3.11 (p) Interaction sols-vegetations dans la region d'Annaba (N.E. Algérie) : étude chimique comparative

Ahmed Arafa[1], Menana Daif[1]

[1]*Laboratoire de Géodynamique et ressources naturelles, Université de Annaba, Algérie*

Dans la région Nord Ouest de Annaba, l'essentiel des sols et de la végétation se répartissent de la manière suivante :

- Sur les hauteurs de plus de 600 mètres et surtout vers les sommets humides du massif cristallin de l'Edough, poussent sur un sol brun du chêne-liège (Quercus suber) exploité pour le liège ; du Chêne Zeen (Quercus mirbeckii), du pin maritime et de rares châtaigniers.
- Sur les calcarénites quaternaires se développe un sol brun à ocre. Les arbres y sont rares. C'est un maquis à bruyère arborescente, ciste, lentisque, myrte, arbousier, daphné, smilax, chêne kermès, calycotome épineux (guendoul), palmier nain (doum), et diss.
- Au fond des vallées, avec un engorgement quasi permanent, on trouve de rares sols grisâtres hydromorphes où poussent des joncs, carex, typha... On trouve également quelques arbrisseaux de tamaris dans le lit des petits oueds côtiers, tout près du rivage..
- Sur les versants à forte pente, le sol ne peut se développer car régulièrement réduit par transport gravitaire, on trouve de minces pellicules de sols d'érosion peu évolués. Quand la pente n'est pas trop forte, il se développe des sols rougeâtres peu profonds, sur roches cristallines, où domine une végétation acidophile : fougères, genêts, ajoncs, bruyères.

L'étude comparée des éléments majeurs et de cinq éléments traces montre qu'il y a une interaction entre la végétation et le sol. De plus une nette corrélation existe entre la nature de la roche mère (marneuse, gneissique, granitique..) et le type de pédogenèse. La composition minéralogique intervient sur les caractères de la fraction minérale du sol ; de même que la structure et la dureté conditionnent largement la vitesse de la dégradation.

8.3.12 (p) Trace metals in phosphate fertilizers : Cadmium behavior in Lebanese soils

Valérie El Kazzi[1,2,3], Bruno Lartiges[2], Antoine El Samrani[3], Ahmad Kobeissi[3], Veronique Kazpard[3], Laurence Denaix[4]

[1]*Lebanese Agriculture Research Institute, Fanar, Liban*
[2]*GET, Toulouse*
[3]*Plateforme de Recherche et d'Analyses en Sciences de l'Environnement, Ecole Doctorale des Sciences et Technologies, Faculté des Sciences, Université Libanaise, Hadath, Liban*
[4]*INRA, Bordeaux*

Phosphate fertilizers are extensively used to increase crop production but are major sources of metal contamination in soils. These metals can be harmful to environment and human due to their persistent in soil and potential to enter human food chain. Phosphorus can be found in the market as simple, triple, super phosphate, mono and di-ammonium phosphate (SSP, TSP, MAP, DAP...). A survey of phosphate fertilizers was undertaken to quantify trace metals input via fertilizers to Lebanese soils. A total of 50 chemical phosphate fertilizers were collected from Lebanese market. Crystallography, mineral phases and chemical structure investigations were determined respectively by X-ray diffraction and Fourier Transform infrared spectroscopy. In parallel, elemental compositions were analyzed by using X-ray fluorescence spectroscopy and atomic absorption spectroscopy. A Principal Component Analysis (PCA) of the different parameters was performed to provide hints as to which phosphate fertilizer possesses the greatest potential to contaminate the soil with trace metals. The average metal levels in the fertilizers were respectively 3 ; 14 ; 496 and 67 (mg/kg) for Cd, Pb, Zn, and Cu. Fifty percent of the samples had the trace metals concentrations below 2 ; 12 ; 153 and 24 (mg/kg) for Cd, Pb, Zn, and Cu respectively. Cadmium and sulfate were abundant in superphosphate, Zinc and Copper in NPK fertilizers and Lead was abundant in potassium phosphate. These elements were also found in urea-phosphate samples but with less concentration comparing to the other. All the trace metals were positively correlated with the phosphate concentrations whereas Cadmium and Calcium were also correlated to the sulfate phase. The input of trace metals to the soil were beyond the limit set by European countries. A template of soil columns contaminated with cadmium coming from phosphate fertilizer showed a significant transfer of this metal to lettuce leaves. Moreover, cadmium diffused throughout the first 10cm of the soil columns but without showing a significant difference in behavior between compacted and non-compacted soils.

8.3.13 (p) Phyotomanagement of an old bauxite mine (Serra da Brígida, Minas Gerais, Brazil) : evaluation of metal transfert in plant

Maurílio Figueiredoa[1], Arnaud Gauthier[2], Alessandra Kozovits[3], Mariangela Garcia Praça Leite[1], Michel Dubois[1]

[1]*Department of Geology, Federal University of Ouro Preto, Ouro Preto, Brésil*
[2]*LGCgE, Lille*