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Soils of Urban, Industrial, Traffic, Mining and Military Areas

SUITMA 7

Toruń, 16-20 September 2013

Abstracts

Soils of Urban, Industrial, Traffic, Mining and Military Areas

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Toruń, 16-20 September 2013

Abstracts

Edited by:

Przemysław Charzyński
Maciej Markiewicz
Piotr Hulisz
Marcin Świtoniak
Łukasz Mendyk

Polish Society of Soil Science 2013

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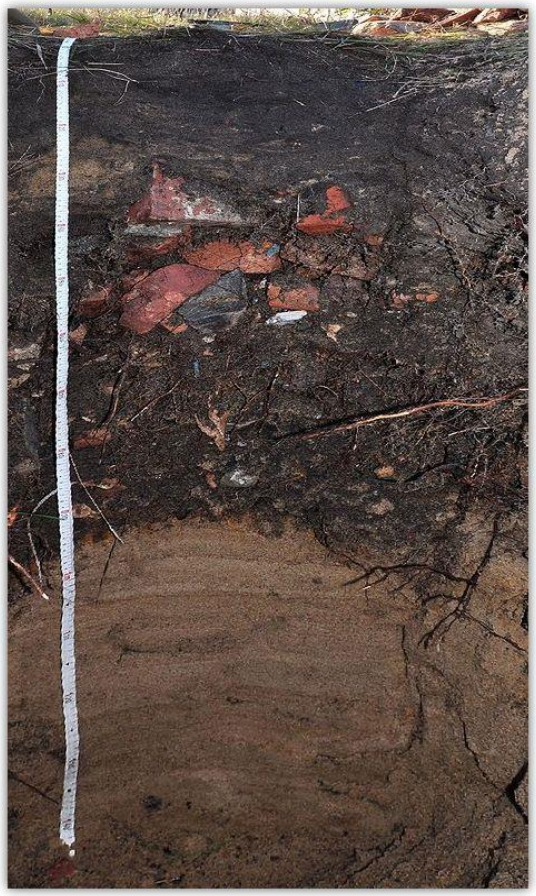

ECOSYSTEM SERVICES PROVIDED BY SUITMAS

Jean Louis Morel[a], Klaus Lorenz[b], Claire Chenu[c]

[a]*Laboratoire Sols et Environnement; University of Lorraine, INRA; Nancy, France*
[b]*Global Soil Forum, Institute for Advanced Sustainability Studies, Potsdam, Germany*
[c]*UMR Bioemco (Biogéochimie et Ecologie des Miliieux Continentaux, AgroParisTech Grignon, France*
e-mail: Jean-Louis.Morel@univ-lorraine.fr, Klaus.Lorenz@iass-potsdam.de,
Claire.Chenu@grignon.inra.fr

The urban ecosystem and its ecosystem services (ESs) are managed for the wellbeing of urban dwellers. Thus, sustainable urban development depends on ESs aside economic, cultural and political dimensions. Soils play a central role in the urban ecosystem as they fulfill various functions and provide several ESs. In urban areas, they are usually built to perform specific functions and provide specific ESs, e.g., (i) supporting buildings, roads and infrastructure; (ii) waste adsorption; (iii) supporting biomass production for green infrastructure and urban agriculture; (iv) filter, buffer and transformation of contaminants; (v) regulating air and water quality; (vi) supporting nutrient cycling.

In urban areas, some soils may be strongly modified by human activities, which changes their composition and functions, and, therefore, their ability to provide ESs. Urban soils and, more generally, SUITMAs (soils in urban, industrial, traffic, mining and military areas) may fulfill individually a smaller number of ESs, smaller than those of natural soils outside of urban areas. Secondary and incidental ESs, if not disservices, may also be performed by SUITMAs.

In this paper, we attempt to rank SUITMAs, according to the ESs they provide. Focus is made on the nature of services, their importance and the number of services provided by each soil type. Work is also assigned to assess the extent to which urban soils can be deliberately altered to enhance ESs.

After the tentative classification of soils, two examples will be given, i) sealed soil deemed to complete only few functions and provide specific services, and ii) soils of green-roofs designed to provide a wide range of ESs, including particularly the control of the quality of air and water, the temperature control, and the moderation of biodiversity loss.

In conclusion, focus is to turn the attention towards the recognition of SUITMAs and their management as basis for the sustainable development of the urban ecosystem.

CLASSIFICATION OF TECHNOSOLS AND RELATED SOILS IN WRB: FROM 2006 TO 2014

Peter Schad

Bodenkunde, Technological University of Munich, Germany
e-mail: schad@wzw.tum.de

Keywords: WRB, Technosol, Technic qualifier, soil formation, artefacts

The 2nd edition (2006) of the international soil classification system World Reference Base for Soil Resources (WRB) introduced the new Reference Soil Group (RSG) of Technosols. The definition is based on the presence of artefacts or technic hard rock (two diagnostic materials newly introduced and defined in WRB) or on the presence of an artificial geomembrane (which is already a common word and did not require a specific definition in WRB). A Technosol is present as long as weathering or decomposition of these materials is not yet advanced. The presence of a more or less continuous technic hard rock (defined as consolidated material resulting from an industrial process) at shallow depth leads to a Technosol with the Ekranic qualifier and the presence of an artificial geomembrane to a Technosol with the Linic qualifier. Artefacts are related with 3 qualifiers: Urbic (rubble and refuse of human settlements), Spolic (industrial waste), and Garbic (organic waste). The broadest discussion was on the artefacts: definition (made, modified or excavated by humans), required amount (≥20% by volume) and the allowed degree of weathering/decomposition. For most other RSGs, the Technic qualifier (≥10% artefacts by volume) was introduced. It has to be noticed that degraded technic hard rock and geomembranes also fulfil the definition of artefacts. Natural material, transported by humans, is not included in Technosols. For these materials, the Transportic qualifier is provided.

Several suggestions for revision have been made. There is a bunch of proposals for new qualifiers, some for Technosols only, some also for other RSGs. And how much soil formation is allowed in a Technosol? For example, if weathering of artefacts leads to the in-situ formation of a cambic horizon (but the soil still having enough artefacts for a Technosol), should the soil then be classified as Technic Cambisol or as Cambic Technosol? Decisions have to be made by the end of this year in order to allow the publication of the 3rd edition of WRB in 2014 at the World Soil Congress in Korea.

ECO-ENVIRONMENTAL IMPACTS OF URBAN SOIL SEALING AND COMPACTION — A REVIEW

Gan-Lin Zhang, Jin-Ling Yang

State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science, Chinese Academy of Sciences
email: glzhang@issas.ac.cn

Keywords: soil sealing, soil compaction, ecological impacts, environmental impacts, runoff, urban flooding, heat island

With global economic development, urbanization rate has increased rapidly especially in developing countries. Up to 2012, there were already more than 50% of Chinese population lived in cities while it was only 10.6% in 1949. Developed nations like in Europe, are also experiencing constant land-take from open (vegetated) surfaces. Decrease of vegetated soil surfaces is concerning all land use types both in China and Europe but the conversion rate of built-up areas is the highest from croplands.

Whilst highlighting the loss of soil through sealing, it should be noted that much land close to that which is sealed is also lost through compaction. Below sealed and compacted soils the physical soil properties are markedly different from under arable conditions, with higher bulk densities under sealed and compacted soils, with associated lowering of infiltration rates where compaction occurs, additionally many soils in non-rural environments will have a high proportion of large fragments (bricks and other building materials) in the upper layers. Apart from the direct impacts on the soils there are also numerous ecological impacts of soil sealing and compaction. These included urban flooding, a decline in soil water quality through contamination with runoff water from urban environments, poor plant growth, a heat island effect, limited gas exchange at the soil surface and lower microbial biomass and enzyme activities. The loss of soil water storage and the rapid runoff in urban drainage systems has resulted in a marked increase in the frequency and extent of urban flooding, with inundations occurring more widely and in areas not previously subject to flooding. The heat island effect is also becoming a major consequence of the increase in soil sealing with temperatures in large urban areas being higher, particularly because of the higher temperatures associated with pavements and buildings. A study in Suzhou, China, a city which has grown rapidly in the last decade, shows a marked increase in average temperatures because of this heat-island effect. The changes in soil and related environmental conditions with the increase of urbanisation and soil sealing occur rapidly and maybe irreversible.

Competition for land and intensification of soil use threaten soil resources and optimisation of land resource allocation usually do not account for sustainability. Future planning of urban development must recognise these impacts and seek to mitigate them. Urban soil studies face the challenge to provide a sound basis for quantitative modeling of impacts of urban soil sealing and compaction.

1. Classification of SUITMAs

ORAL PRESENTATIONS

VISUALISATION OF SUBSOIL USING GIS: CASE STUDY IN SURFERS PARADISE OF AUSTRALIA

Haider Al-Ani[a], Leila Islami-Andargoli[b], Erwin Oha, Gary Chai[c]

[a] *School of Engineering, Griffith University, Australia*
[b] *School of Environment, Griffith University, Australia*
[c] *Centre of Infrastructure and Engineering Management, Griffith University, Australia*
e-mail: h.al-ani@griffith.edu.au

Keywords: GIS, IDW, peat, SPT-N, zonation map

The subsoil conditions of Surfers Paradise in Southeast Queensland of Australia have been examined in terms of soil stiffness by using geographic information system (GIS). Peat is a highly organic and compressible soil. Surfers Paradise (as a study area) has problematic peat layer which has different thickness at different locations between R.L. -10 to -19.6 m below the ground surface. Buildings in Surfers Paradise are using piled foundations to avoid the high compressibility and low shear strength peat layer. Spatial Analyst extension in the GIS ArcMap10 has been utilised to develop zonation maps for different depths in the study area. Depth classification scheme has been created to easily deal with each depth layer. Each depth has been interpolated as a surface to create Standard Penetration Test SPT-N value GIS-based zonation maps for each depth. Inverse Distance weighing (IDW) method in Spatial Analyst extension has been used to interpolate SPT-N values for each depth and up to R.L. -40 m. SPT-N value parameters N60 and (N1)60 have been calculated for each depth class and for each soil type in the study area. Based on the depth classification scheme developed in this study, interpolated surfaces have been performed for all the depth categories within the study area. As shown in the result, one suitable GIS interpolation method for the study area is spatial analyst interpolation IDW method.

HETEROGENEITY OF URBAN SOILS – FACT OR MYTH?

Andrzej Greinert

University of Zielona Góra
Faculty of Civil and Environmetal Engineering
Department of Land Protection and Reclamation
15 Prof. Z. Szafrana St.; 65-516 Zielona Góra, Poland
e-mail: A.Greinert@iis.uz.zgora.pl

Keywords: urban soils, Technosols, urban planning

Despite the 30 years of work on the problem of urban soils, it is still a small degree of their recognition. There is the divergence about the need to extend the work on urban soils. It results from a variety of thoughts on the real meaning of soils diversity for the urban areas functionality. It also reflects a significant difference in the perception of environmental elements by representatives of the natural sciences and engineering. In the natural science, differentiation of soil properties is considered important for the complex chain of biological and biochemical relationships. In this light, the study of soils in urban areas require treat them as very different. The urban planning is reflected a different approach to urban soil cover. It is treated as a layer of 0-20 cm constructed for the development of green areas or blurred properties through the process of wide interpolation. The result is a statement about the uniformity of soil properties within the urban areas of similar functionality. This is a convenient approach, and for the architecture and building seems to be rational.

The research was carried out in the town and administrative commune of Zielona Góra – a medium-size town located in the western part of Poland (51°56'07"N, 15°30'13"E). In the paper are described results from 105 soil profiles at the depth of 150 cm (samples from each of the morphological layers and horizons) and 32 collective surface samples (an area of approximately 20 m^2 each, samples from humus horizons). In total, 562 samples were tested. Soils were classified according to the classification of the WRB (IUSS 2007) and PSSS (2011). The morphological characteristics and properties of the soils were analysed according to standard procedures described in the Guidelines for Soil Description (FAO 2006).

It has been found variations in the characteristics: stones content 0-38%, gravel content 0-91%, parts under 0.02 mm 0-55%, parts under 0.002 mm 0-18%, TOC 0-60%, pH-H_2O 4.1-9.2, pH-$CaCl_2$ 3.5-8.3, EC 0-2.5 mS·cm^{-1}, HA 0-18 cmol·kg^{-1}, TEB 0-25 cmol·kg^{-1}, CEC >1-40 cmol·kg^{-1}, BS 0-99%, K_t 0.07-2.4%, Ca_t 0.1-24.4%, Fe_t 0.1-1.3%, Cd 0.1-2.9 mg·kg^{-1}, Cu 2.6-475 mg·kg^{-1}, Co up to 14.3 mg·kg^{-1}, Ni 1-55 mg·kg^{-1}, Pb up to 2400 mg·kg^{-1}, a Zn 5.4-510 mg·kg^{-1}. Another very important aspect of the discussion is the spatial distribution of urban soils – it has been shown the location of a number of extremely different properties within a distance of several-dozen meters.

Considering the plants growing in urban areas, maintain the biological balance, soil and ground water protection, conservation of living organisms and sustainable land management, a purely technical approach to urban soils (disparaging their diversity) is not acceptable. It does not give information about the actual state of soil and its consequences, but also eliminates the uncertainty with respect to the effects of anthropogenic transformation of urban areas. The soils within the urban areas are characterized by high heterogeneity, with a very complex spatial distribution. Significant environmental risk factor is also the presence of the so-called 'hot spots' – locations of distinctly different properties in compare with soils of the close surroundings.

EARLY PEDOGENESIS OF A TECHNOSOL DEVELOPING ON IRON INDUSTRY DEPOSITS

Hermine Huot[a,b,c,d], Marie-Odile Simonnot[c,d], Françoise Watteau[a,b], Philippe Marion[e,f], Jacques Yvon[e,f], Pierre Faure[g,h], Philippe De Donato[e,f], Patrick Charbonnier[i], Jean-Louis Morel[a,b]

[a]*Université de Lorraine, Laboratoire Sols et Environnement, UMR 1120, Vandoeuvre-lès-Nancy, F-54518, France*
[b]*INRA, Laboratoire Sols et Environnement, UMR 1120, Vandoeuvre-lès-Nancy, F-54518, France*
[c]*Université de Lorraine, Laboratoire Réactions et Génie des Procédés, UMR 7274, Nancy, F-54001, France*
[d]*CNRS, Laboratoire Réactions et Génie des Procédés, UMR 7274, Nancy, F-54001, France*
[e]*Université de Lorraine, GéoRessources, UMR 7359, Vandoeuvre-lès-Nancy, F-54518, France*
[f]*CNRS, GéoRessources, UMR 7359, Vandoeuvre-lès-Nancy, F- 54518, France*
[g]*Université de Lorraine, Laboratoire Interdisciplinaire des Environnements Continentaux, Vandoeuvre-lès-Nancy, France*
[h]*CNRS, Laboratoire Interdisciplinaire des Environnements Continentaux, UMR 7360, Vandoeuvre-lès-Nancy, France*
[i]*ArcelorMittal Real Estate France, F-57700 Hayange, France*
e-mail: hermine.soro@univ-lorraine.fr

Keywords: Technosol, iron industry settling pond, pedogenesis, rhizosphere

As a result of increasing soil anthropisation, large surface areas covered by anthropogenic materials are submitted to environmental factors (*e.g.* climate, organisms). Pedogenesis of the developing Technosols is often characterized by an intense and rapid weathering. However, the nature, localization, and extent of the pedogenetic processes occurring in Technosols are still little known.

To assess the soil formation on purely anthropogenic parental materials, a former settling pond of iron industry sludge colonized by vegetation since *ca.* 50 years was chosen. The soil is composed of contrasted layers, and an organic layer has developed at the surface. Composition, mineral and organic components and structure of the soil were studied as tracers of the material origin and indicators of early pedogenetic processes. Also, historical records regarding the industrial operations were analyzed. Twelve layers were sampled in the first two meters of the profile. Mineralogy was determined with XRD, IR, Mössbauer spectroscopy, SEM and TEM-EDS. Spectroscopic and molecular analyses were carried out on solvent extractable organic matter. Thin sections were prepared for some layers.

Results showed a stratification of the soil profile resulting from successive sludge supplies. Composition, mineralogy, and structure of the layers of the Technosol were derived from the industrial raw materials and processes. Elemental composition reflected the enrichment in volatile elements, and organic analyses the dumping of oil and combustion by-products. Part of the mineral phases was inherited from raw materials, and others resulted from the industrial processes (e.g. high temperature phases). Pedogenetic processes were obvious with the development of an organo-mineral horizon. In the deeper layers, analysis of microstructure and mineralogy revealed physical (cracks, solute movements) and chemical processes (dissolution, precipitation). These phenomena occurred primarily in cracks and at the interfaces between two layers. Also, roots, which have colonized the whole profile, and developed preferentially in these areas, have induced changes in their rhizosphere (modification of porosity and metal extractability). In conclusion, the Technosol results from successive steps of pedogenesis, driven firstly by drying-wetting cycles and changes of physico-chemical conditions induced by the climatic factor, and finally by biological processes in relation with root development.

MODELLING PEDOGENESIS IN THE ANTHROPOCENE

Sophie Leguedois, G. Sere, J. Cortet, S. Ouvrard, J. L. Morel, F. Watteau, C. Schwartz

UMR LSE Universite de Lorraine/Inra
e-mail: sophie.leguedois@univ-lorraine.fr

Keywords: quantitative models, soil evolution, soil functioning, resilience, soil-plant interactions, decade time scale

The objective of this communication is to propose a framework to model pedogenesis in the context of the Anthropocene, i.e. the present geological epoch, during which humanity has become the main impact on the environment. This modelling framework addresses output variables, time scales, spatial representation, model structure, and control variables. It was built upon the reviews of the concepts behind pedogenesis modelling as well as of 15 existing quantitative models. Our reviews highlight that, in an Anthropocene era, pedogenesis modelling is expected: (i) to have outputs that integrate technic materials as well ecosystem functions and services; (ii) to simulate vegetation growth and its feedbacks on soil; (iii) to link evolution at the decade scale, relevant for sustainability, and cyclic short-term changes representing soil functioning; (iv) to reproduce resilience thresholds as a mean to relate the two above-mentioned time scales; (v) to be based on an energetic global common metric to quantify concomitantly the numerous factors and perturbations influencing soil. From this, we propose a general conceptual model of soil evolution. The review of the existing soil-plant models shows that some of their features could be used to model soil evolution in the Anthropocene but several developments are also needed: (i) integration of the characteristics of technic materials, (ii) a global energy-based metric, (iii) the modelling of interactive biology and structure-related processes, (iv) the representation of soil heterogeneity. We suggest acquiring data series reliable for model development with constructed Technosols as experimental models.

CLASSIFICATION OF URBAN SOILS INTO THE WRB SYSTEM IN THE CENTRE OF DEBRECEN (HUNGARY)

Gábor Sándor, György Szabó

University of Debrecen, Department of Landscape Protection and Environmental Geography, Hungary
e-mail: sandorgabor87@gmail.com

In our study we examined urban soils in the centre of Debrecen. Debrecen is situated on the border of the Hajdúság and the Nyírség. According to WRB there are Chernozems and Phaeozems soils in the first mesoregion, and Arenosols in the second. The road network has radial structure in the city centre and roads are wider outward. There are mainly housing blocks with 2-4 floors and closed frontage buildings fronting to the street.

The aims are the following: explore and analyze the characteristics of urban soils in Debrecen, separate the layers to natural and anthropogenic groups, examine the vertical distribution of trace elements and classify the examined soil profile with the WRB system.

67 samples were taken from 11 soil profiles. During the laboratory works we determined the artefact content, the grain composition, the $CaCO_3$ content, organic matter content and trace elements content of samples. Reference groups were classified by the help of the WRB 2006 handbook.

The average artefact content of the upper 100 cm layer never reached the 20%, the maximum value was just 15%. There is artificial hard formation in the 95% of the surface cover in the case of 70% of the examined soil profiles, so they could be classed in the Technosol reference group, on the basis of the 3. point of the Technosol reference group criterion. The Ecranic and Calcaric are the most frequently used prefix and suffix qualifiers.

Samples can be classified mainly in the group of moderately calciferous (2-10%) grounds. The pH values of the samples are between 7.9 and 8.9, most of them are slightly alkaline, the others are alkaline. Our soils primarily dispose of low organic matter content (1-2%).

According to our results soils in the examined area are under strong anthropogenic effect what is proved by the artefact content, the cover and the disturbed structure of soil profiles. The alkaline soil is due to anthropogenic effects if calcium content is growing by the building waste and the higher lime content results in alkaline soil.

Acknowledgments
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SELECTED PROBLEMS WITH THE CLASSIFICATION OF TECHNOGENIC SOILS DEVELOPED FROM SULPHIDE-BEARING MINE WASTES

Łukasz Uzarowicz[a], Stefan Skiba[b], Zbigniew Zagórski[a]

[a]*Warsaw University of Life Sciences SGGW, Faculty of Agriculture and Biology, Warsaw, Poland*
[b]*Jagiellonian University, Institute of Geography and Spatial Management, Krakow, Poland*
e-mail: lukasz_uzarowicz@sggw.pl

Keywords: Technosols, mine wastes, iron sulphides, soil classification

Soil profiles developed from sulphide-bearing mine wastes located in selected abandoned industrial sites in Poland were investigated using standard pedological field and laboratory methods. The objective of the study was to highlight certain problems with the classification of these technogenic soils. All of the soils studied were classified as diverse variants of Spolic Technosols (WRB) and as Typic Udorthents (U.S. Soil Taxonomy). Technogenic soil layers (specified in soil descriptions as C horizons), with acid reaction and yellowish colours (hue of 2.5Y and chroma of 6 or more), have the features of thionic horizon (pH less than 4.0, thickness of more than 15 cm, presence of jarosite) in most of the soil profiles. Although one of the diagnostic criteria of thionic horizon is the occurrence of sulphates, the description of the horizon in WRB does not mention the possibility of the presence of weathered sulphide minerals. Such feature was documented in the soils studied. The authors suggest that the diagnostic criteria of thionic horizon in WRB should be supplemented with a remark that macroscopically and microscopically recognizable sulphide minerals, or sulphides recognized using any field test, may occur in thionic horizons. Such remark could also be added to the definition of sulfuric horizon in the U.S. Soil Taxonomy. Moreover, it seems justified to add a remark saying that thionic horizon may occur not only in soils developed on coastal sulphidic materials, but also in other sulphide-bearing soils, including technogenic soils developed on mine spoils containing sulphides. A similar remark could be added to the definition of sulfuric horizon in the Soil Taxonomy. The approval of the above mentioned remarks would also require supplementing the definitions of sulphidic (WRB) and sulfidic (Soil Taxonomy) materials, regarding parent technogenic materials (e.g. mine spoils, sludges) containing sulphides as sulphidic (sulfidic) material. Such materials are currently defined as waterlogged deposits containing sulphides, most commonly occurring in coastal regions. It is also suggested to add (1) the 'Thionic' suffix qualifier to the key to the Technosols within the WRB classification and (2) adjective 'Sulfic' to the set of Udorthents Great Group qualifiers, which would allow the formation of Sulfic Udorthents taxon. It would allow for a better determination of soil properties, and a more precise indication of such properties in names of soils.

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1. Classification of SUITMAs

POSTER PRESENTATIONS

THE EFFECT SALT ADDED AS NaCl, Na_2SO_4, AND KCl ON CO_2 EVOLUTION IN SOME GEFARA SOILS OF LIBYA

Fathi Elyaagubi

AIN ZARA, Tripoli, Libya
e-mail: fathi_khalifa@yahoo.com

Keywords: soil salinity, Gefara Plain, NaCl, Na_2SO_4 and KCl, CO_2 evolution

The high water requirements for the populations and agriculture are depleting the groundwater aquifer, resulting in intrusion of seawater in the first few kilometres along the Gefara coast. Due to increasing salinity in the groundwater used for irrigation, the soils of the Gefara Plain are becoming increasingly saline. The objective of this study is to investigate the effects of salinity on CO_2 evoluion rates in the Gefara Plain soil. This study investigated the sensitivity of these soils to increased salinity using rates of CO_2 evolution as an integrating measure of soil function. Soil was collected from four sites located in the Gefara Plain, Almaya, Janzur, Gargaresh and Tajura. Soil EC values were more increased with increasing salinity levels when added as NaCl than when added as Na_2SO_4 or KCl in Tajura, Gargresh, Almaya and Janzur respectively. We examined which type of salts (NaCl, Na_2SO_4 and KCl) at concentrations of 10 and 50 mM had the greatest negative influence on rates of CO_2 evolution. It was found the rate of CO_2 evolution was more inhibited by NaCl than by Na_2SO_4 or KCl in all four sites.

GARDEN SOILS IN URBAN AREA OF TORUŃ (POLAND)

Patrycja Hudańska, Przemysław Charzyński, Renata Bednarek

Department of Soil Science and Landscape Management, Faculty of Earth Sciences, Nicolaus Copernicus University, Lwowska 1 Str., 87-100 Toruń, Poland
e-mail: pecha@umk.pl

Keywords: urban soils, Hortisols, garden soils, SUITMAs, classification of urban soils

In the area of Toruń exists soils whose morphology, physical and chemical properties have changed through anthropogenic activity. It can be found also natural soils which underwent only slight transformations. Allotment garden soils occupy in Toruń about 373 ha (3.3% of total town area) in 27 allotment gardens and compose a significant greenery base of the town. The aim of this study was to characterize the physical and chemical properties of soils of selected allotment gardens in Toruń and evaluate if they meet the classification criteria for hortisols according to Systematic of Polish Soils (2011) and WRB (2006/2007). Three profiles was located in the flood plain of the Vistula river, originally covered with alluvial soils in allotment gardens founded about 30 years ago. The other two profiles was located on the 4th terrace, originally covered by Brunic Arenosols in old botanical garden of NCU. Standard methods of analysis was used to determine texture, pH, content of organic carbon total nitrogen, citric acid soluble phosphorus and carbonates. Some of the gardens are located on the outskirts of the city, other ones in the vicinity of industrial areas or traffic routes, therefore also analysis of heavy metals (Pb, Zn, Cu, Cd) content was performed. The heavy metal concentration does not exceed the Polish standards in any profile.

According to the Systematic of Polish Soils all profiles are classified as *gleby urbiziemne próchniczne* (urbic humus soils). According to the WRB two of the studied soils can be classified as Terric Phaeozem, one as Terric Fluvisol, one as Terric Umbrisol, while the fourth profile with horizon containing 80% of artefacts becomes a Urbic Technosol.

This study showed that none of the humus horizon do not meet the criteria for *hortic* horizon, due to too low phosphorus content (highest amount was 92 $mg \cdot kg^{-1}$). Therefore none of the tested garden soils is Hortic Anthrosol. This allows to conclude, that the agronomic treatments to improve the soil quality in investigated allotment gardens was insufficient and lasted not long enough. 30 years was not enough to develope appropriate *hortic* horizon.

A COASTAL ZONE SOIL SURVEY FOR THE URBAN EASTERN SEABOARD OF THE UNITED STATES

Maxine Levine, Maggie Payne, Jim Turenne, Debbie Surabian

United States Department of Agriculture
Natural Resources Conservation Service
e-mail: maxine.levin@wdc.usda.gov, debbie.surabian@ct.usda.gov

Keywords: subaqueous soils, SAS

With over fifty percent of the United States' population living in coastal communities and as the Nation's population continues to grow, it is imperative that we understand, manage, and protect our coasts. Since 1996, USDA Natural Resources Conservation Service soil scientists have been actively involved with the mapping, classification, and interpretation of subaqueous soils along the United States Atlantic coast from Florida to Maine. Thirty seven new soil map units were established to map subaqueous soils, dunes, marshes, and beaches along the coastal zone. Some of these soils have properties and pedogenesis dominated by profound human influences such as dredging or construction, while other soils are dominated by natural influence like sea-level rise and super storms. Applications such as expansion of shellfish aquaculture practices, eelgrass and coastal restoration efforts, dredging for island creation and navigational channels, mooring field construction, trafficability of military vehicles, and increased pressure from development in coastal areas has created a need for more detailed soil maps of these highly valuable areas at the land and water interface.

CHEMICAL AND PHYSICAL PROPERTIES OF NECROSOLS ON THE AREA OF ABANDONED CEMETERIES IN NORTHERN POLAND

Leszek Majgier[a], Oimahmad Rahmonov[a], Renata Bednarek[b]

[a]*University of Silesia, Faculty of Earth Science, Department of Physical Geography, Poland*
[b]*Nicolaus Copernicus University, Faculty of Earth Science, Department of Soil Science and Landscape Management, Poland*
e-mail: leszekmajgier@o2.pl

Keywords: Necrosols, abandoned cemeteries, northern Poland

The aim of this study was to determine physical and chemical properties of soils within cemetery areas. Sixteen soil profiles were investigated on the area of eight cemeteries and they were compared with four references profiles outside of the cemeteries.
Study was conducted on abandoned evangelical cemeteries in Great Mazurian Lakes District (northern Poland). Cemeteries are differentiated in term of ages, sizes and location in various type of landscape. After World War II they had been abandoned and nowadays do not functioning as cemeteries.

Standard methods of analysis used to determine organic carbon (OC), total nitrogen (N_t), total phosphorus (P_t), calcium carbonate ($CaCO_3$), reaction (pH), exchangeable cations, total composition of elements (Ca, Na, K, Mg, Al, Fe, Zn, Cd, Pb).

Within cemeteries distinguished Necrosols of burial and non-disturbed cemeteries soils. They are differ with morphological and physico-chemical properties. Morphological variability was evident only in the surface horizons of non-disturbed cemeteries soils, in the case of burial Necrosols concerned the all of solum. Soils located within the cemetery, irrespective of the transformation and disturbance horizons should be included to Necrosols (burial) and non-disturbed cemeteries soils. Although not-disturbed cemeteries soils are not mechanically transformed but remain continuously under the influence of burial grounds. Their chemical properties are similar to burial Necrosols.

PEDOGENESIS EVOLUTION OF DIFFERENT MINING TECHNOSOLS: TOWARDS A BETTER UNDERSTANDING

Grégoire Pascaud, Marilyne Soubrand, Marion Rabiet, Emmanuel Joussein

Université de Limoges, FST, GRESE Groupement de Recherche Eau Sol Environnement, EA 4330, 123 avenue Albert Thomas, 87060 Limoges, France
e-mail: gregoire.pascaud@etu.unilim.fr

Keywords: mining technosols, pedogenetic processes, evolution, environmental impact

Technosols include soils subject to strong anthropogenic pressure and particularly to soil influenced by human-made materials. In this context, abandoned mine sites can contain a large amount of transformed waste materials often enriched with metals and metalloids. When wastes are contaminated by heavy metals, the natural evolution of soils (pedogenesis) may induces the change in contaminants behaviour in term of stability of bearing phases, modification of pH oxydo-reduction conditions, change in permeability, or influence of vegetation cover. Thus the fate of these elements in the soil can induce major environmental problems (contamination of biospehere and water resource). This will contribute to a limited potential use of these soils which represent yet a large area around the world. The aims of this study are to understand the functioning and the pedogenic processes of mining Technosols in the way to improve their properties and to reduce their environmental impact. Then, it is necessary to identify and quantify these processes at different time scales and in different physical chemical contexts.

To do this, 6 different mining soil profiles were collected corresponding respectively to W, Pb-Ag, Sn and Au exploitations. Several pedological parameters were determined like CEC, pH, Corg, granulometry and chemical composition. The nature and the stability of the solid phases are determined by mineralogical analyses (XRD, SEM-EDS, Reitveld) and chemical extractions (e.g. selective and BCR).

The sampling allows to observe natural mining Technosol evolution from 120 to 35 years old. Some of these soils show various andic properties evidenced by selective extractions and governed by the presence of organo-metallic complex (no allophane). Moreover, the results give evidences that differences of geochemical behavior of heavy metals are effective. This fact can be explained by the mineralogy variability and by the difference of the physical chemical properties of waste. The formation and the evolution of technosols are largely affected by the presence of hightly reactive materials. The relation between the soil evolution and the mineralogy will be discussed in relation to the general pedogenic characteristics of these mining soils.

URBAN SOIL CLASSIFICATION SHOULD SELECT THE DIAGNOSTIC CHARACTERISTICS RELATED LAND RECLAMATION EVALUATION

Fengrong Zhang and Xiangbin Kong

College of Resources and Environmental Sciences, China Agricultural University
Yuanmingyuanxilu No.2, Beijing, China 100193
e-mail: frzhang@cau.edu.cn

Keywords: urban soil classification, refuse types, land reclamation, classification criteria

Urban soils are mainly formed by various kinds of refuses that produced by urban activities. Those refuses are not only coming from resident daily life; but also from construction activities. It is said that there are seven million tons refuses produced and 33 hectares farmland occupied by urban refuses one year in Beijing, that means there are 33 hectares urban soil formed a year in Beijing. Facing the status of land resources deficiency, refuse site reclamation is important work for replenishing land requirements in Beijing. According to the refuse composition, some refuse sites may be suitable to use as farmland to grow crops after reclamation; some of them may be better as wood land or lawn after reclamation; some of them may be only suitable to be constructing land. Soil classification must take the suitability of refuse site reclamation as one of principles of classification criteria selection. Those properties related to reclamation suitability evaluation should be selected diagnostic characteristic of classification. Urban refuse sorting already made general classification based on refuse composition and its origin; urban soil classification should take refuse sorting types as reference. We suggested that urban soil should divide as construction refuse soils and resident refuse soils in the first category. Construction refuse soils are formed by construction refuses that are made of various kinds of construction material fragments, such as bricks, concrete, rebar, and wood as well the earth materials. Resident refuse soils are formed by daily life refuses that are made of various kinds of garbage, such as kitchen garbage. In the second category, the diagnostic characteristics of classification should be the physical and chemical properties of refuses. For example, resident refuses could be classified as decomposable material and un-decomposable material. If we classify urban soil according to the application purpose, the urban soil classification could be used by other people not only by soil scientists themselves; otherwise, urban soil classification could be died, even if we make a “comprehensive classification”.

EFFECTS OF DIFFERENT ORGANIC MATERIALS ON SOIL CARBON ACCUMULATION

Qiang Zhang

Institute of Agricultural Environment and Resources, Shanxi Academy of Agriculture Sciences (SAAS), No.17, Beiyuan Street, Taiyuan, China
e-mail: sxsnkytfs@163.com

Keywords: biochar, organic materials, soil carbon accumulation, reclaimed carbon

In the experimental base in reclaimed area of coal mine subsidence in Wuyang, Shanxi, we studied the effects of different organic materials applied carbon-equivalently on soil carbon accumulation , and investigated soil carbon flux using LI-8100.The results showed that the application of different organic materials changed the accumulation of organic carbon in reclaimed soil significantly. Among all kinds of materials used, biochar showed significantly better effect than other materials. Organic materials increased the organic carbon content in surface soil by 6623 kgC/ha/y in the biochar treatment, 4729 kgC/ha/y in the compost treatment, 5343 kgC/ha/y in the biogas residue treatment, 5462 kgC/ha/y in the cattle manure treatment, -977 kgC/ha/y in the straw treatment and -224 kgC/ha/y in control. Different fertilizing measures made different influence on soil carbon flux, which led to difference in soil carbon emission.The results also showed that soil carbon accumulation in treatments of biochar, compost, biogas residue and cattle manure was 2.3, 1.77, 1.64 and 1.64 times that of control, respectively. Therefore, application of biochar, compost, biogas residue and -cattle manure increased soil carbon accumulation in reclaimed coal mine area, and biochar was the most efficient.

2. SUITMAs as a resource of goods

ORAL PRESENTATIONS

GARDEN SOIL: EVOLUTION ALONG A GRADIENT OF URBANIZATION IN THREE CITIES

Sophie Joimel, Jérôme Cortet, Benjamin Magnus, Noëlie Maurel, Nathalie Machon, Jean-Noël Consales, Christophe Schwartz

Université de Lorraine-INRA, France
e-mail: *christophe.schwartz@univ-lorraine.fr*

Keywords: urban agriculture, soil survey, fertility, contamination

Gardening is a very common practice in many industrialized and developing countries. In France, gardens cover more than one million hectares, and many of them are situated inside anthropic areas (peri-urban, urban and/or industrial). However, the functioning and the ability of garden soils to provide support of vegetation and biodiversity are underrated. These functions are essential to provide ecosystem services such as biomass production with food value or carbon storage. Recently, these soils have been previously considered to be subjected to seven influential factors: urbanisation (e.g. urban, rural, peri-urban), age and sex of the gardener, gardening practices, socio-professional category of the gardener, the types and relative shares of productions, climate and age of the garden (Chenot et al., 2010, SOJA-program, ADEME). Among these criteria, two factors are independent of the garden: climate and urbanisation. This last criterion is particularly important because gardens are located in anthropic environments, at the interface between agricultural, industrial and urban surfaces (El Hamiani et al., 2010). The aim of the study is to determine the ability of allotment sites to provide edible biomass in an urban environment depending on the influences of gardening practices or urbanisation degree. Allotments sites are selected in three French cities, situated in contrasted climatic areas (Continental, Oceanic and Mediterranean): Nancy, Nantes and Marseille. These sites were sorted according to the type of land use: residential, industrial and mixed. For each of these degrees of urbanisation, and for each city, at least 10 soil samples were collected. In total, soils from 100 separate gardens have been sampled. Fertility is estimated through physico-chemical and biological characteristics of the contrasted garden soils. Soil analysis takes into account two types of characteristics: agronomics parameters like nutrient contents (e.g. C, N, P) inform on the fertility of soil and trace elements concentration (e.g. Pb, Cu, Cd) advise the degree of anthropisation. Correlations between characteristics of garden soils and their position along a gradient of urbanisation are investigated with statistical analysis. The authors thank the French National Research Agency (Villes et Bâtiments Durables) for the financial support for the JASSUR program, ANR-12-VBDU-0011-01) and local partners from Nancy, Nantes and Marseille.

THE URBAN LAND GRAB - CHALLENGES TO SOIL MANAGEMENT

Klaus Lorenz

Institute for Advanced Sustainability Studies Potsdam e.V., Germany
e-mail: klaus.lorenz@iass-potsdam.de

Keywords: urban planning, sustainable soil use, soil management, urban soil functions

The recognition of soils and their functions by the public and, in particular, the planning community is generally poor. However, conversion of soils to urban uses is occurring at an unprecedented rate due to an increasing share of the population living in urban areas and changing lifestyles. Urban planners, developers and planning agencies allocate urban lands to varying uses but land use decisions are generally not based on soil information as urban growth is managed predominantly for economic development. However, urban areas must also deal with challenges such as demographic change, urban densification, climate change and infrastructure provision. Thus, managing urban sustainability has to include ecological aside economic, cultural, and political dimensions. Urban development needs to be managed to minimize negative impacts and maximize environmental quality. Policy decisions towards maximizing short-term economic benefits must be balanced by decisions towards sustainable use and management of urban soils as urban land use has long-term consequences. The recognition of soils by the planning community can particularly be improved by highlighting the value of urban soil functions for the well-being of urban dwellers. This approach was recommended at the dialogue session 'Urbanization: Challenges to Soil Management' during the first Global Soil Week 2012 in Berlin, Germany. Further suggestions how to raise the awareness about urban soils and how to deal with challenges regarding their management will be presented.

PHOSPHORUS IN TECHNOGENIC SUBSTRATES - CONTENTS AND DIFFUSION

Thomas Nehls, Sarah Rokia, Lydia Paetsch, Tobias Diekmann, Christophe Schwartz, Gerd Wessolek

Technische Universität Berlin, Germany
e-mail: thomas.nehls@tu-berlin.de

Keywords: phosphorus, technogenic substrates

Modern agriculture depends on mineral P fertilization. These origin from geogenic Rock phosphates as participants of Suitma 6 will remember. Although approximations of peak P differ by about 200 years, the problem of depleting P resources forces us to develop new P recycling strategies. Besides chemical, metallurgical and biotechnological methods the employment of technogenic substrates and Phyto-P-Mining in urban areas (gardening, ornamental reasons, urban framing) seems promising in terms of P recycling and the closure of local-nutrient and good cycling.

The goal of the Berlin-Nancy collaboration is to assess the potential of technogenic substrates for the P supply of plants. In this study, we studied the technogenic materials compost, green wastes, paper mill sludge, charcoal, street sweeping waste, rubble, bricks and concrete. We investigated their physical (pF-WC, Ksat etc.) and chemical properties (P adsorption isotherm) and integrated both in a numerical diffusion study simulating a resin experiment.

The P content varies from 0.7 to 21 $g \cdot kg^{-1}$ for bricks and compost, the available P (Olsen) varies from 0.026 to 1 $g \cdot kg^{-1}$ for bricks and green wastes. Compared to former farmland (Fox and Kamprath, 1970) the technogenic substrates show 10 to 100 times higher P diffusion rates at pF 1.3 to 1.8. Thereby, green wastes show the highest and bricks the lowest rates.

Based on that study constructed soils can be designed with optimized physical and chemical behaviour as well as optimized water management.

References

Fox, R.L. and Kamprath, E.J. (1970): Phosphate Sorption Isotherms for Evaluating the Phosphate Requirements of Soils. Soil Science of America Journal, 34(6): 902-907.

DISTURBANCE OF SOILS FOR FOOD PRODUCTION BY URBAN EXPANSION – A PIGGERY CASE-STUDY, SYDNEY, AUSTRALIA

Robert A. Patterson

University of New England, Armidale, Australia
e-mail: lanfaxlabs@bigpond.com.au

Keywords: urban soils, food production, piggery, wastewater

This study examines a peri-urban piggery operation and the potential loss of agricultural use of valuable soil resources due to urbanization. Do agricultural enterprises simply relocate to more distant areas, ignoring the permanent loss of soils for agriculture? Or, does the future use of valuable agricultural land be integrated to complement urban living, providing community markets and low transportation costs?

Sydney's surrounding Cumberland Plain covers 275 000 ha, home to a projected 2.2 million people by 2019. Since European settlement in 1788, this region provided an increasing but now diminishing source of food, fibre, water and shelter to an expanding urban population. Current expansion into the South-West Growth Centre (SWGC) will further disturb 17 000 ha of small agricultural and horticultural holdings to make way for 70 000 homes and associated urban infrastructure. While significant legislation protects threatened ecological communities, paltry protection is afforded soils that support viable and vibrant agricultural enterprises and their communities.

A small, long-established piggery in the SWGC produces pork and bacon products as well as genetically bio-secure pigs for human medical research. While the soils are mainly duplex, sodic and moderately fertile, on-site effluent disposal from the piggery has proven to be sustainable. Recent government resumption of the effluent irrigation area for a rail corridor placed the piggery in an untenable position. However, current piggery operations will continue, in the short term, after huge investment in effluent treatment and high energy costs.

The ultimate consequence of urban expansion into such unconstrained greenfield areas will result in closure of this piggery and nearby agricultural enterprises. In the long term, agricultural activity will be squeezed out by urban development, or its profitability will be eroded by urban rates. This paper demonstrates how, with some minor planning adjustments, the piggery operation could survive.

SOIL FUNCTION ASSESSMENT FOR THE HETEROGENEOUS SOIL LANDSCAPES OF THE CITY HAMM/WESTPHALIA (GERMANY)

Anette Rother, Gerald Krüger, Susanne Hell, Lutz Makowsky

University of Applied Sciences Osnabrueck, Germany
e-mail: l.makowsky@hs-osnabrueck.de

Keywords: soil function assessment, city of Hamm/Westphalia, spatial planning, soil protection

In spatial planning SUITMAs play an essential role in German cities. Reduction of land consumption and effects of climate change are relevant soil related issues. Thus, mapping and assessment of soil functions is financially promoted by the urbanized federal state of Northrhine-Westphalia. Consequently, the city of Hamm participated in this programme. The city area is characterized by an extremely heterogeneous soil landscape. The parent material originates from sandy to clayey glacial sediments in the north, organic and fine textured floodplains in the center and silty aeolic loess in the south. For an area of 136 km^2 the natural soil function (basis for life and habitat, buffer in water cycle), the function as an archive for cultural/natural history and natural soil fertility function (crop yield) were considered. The assessment is based on digital soil maps in the scale of 1:50 000 covering the whole investigated area and partially 1:5 000. In the latter scale digital evaluation maps for agricultural and forest soils were available, too. On-site soil mapping was done to validate the digital soil data at representative sites. Five assessment value levels were distinguished ranging from very low relevance for soil protection to very high. The principles of maximum value and priority settings were combined in the summarizing assessment. It turned out that one third of the area (49 km^2) is of high to very high relevance for soil protection. The main reasons are the naturally fertile aeolic loess deposits with an high value for crop yield (Luvisols). In second place, the natural soil functions represented by groundwater influenced and/or organic soils (Gleysols, Histosols) are relevant. Finally, unique and only locally distributed soils like Plaggic Anthrosols and carbonaceous wetland soils (Calcic Gleysols) have to be mentioned. Medium to low values were calculated for two third of the investigated area (86 km^2). Typical soil types are Cambisols and Stagnosols. The main guideline to protect soil functions in spatial planning should target at minimizing the loss of soil value. The soil function map is a tool for the authorities to set-up compensation measures for the impact on soils, e.g. construction of residential, industrial or commercial sites. Nevertheless, about 18 km^2 of soils in the city of Hamm should be under total protection because they carry a very high and non-reparable value.

CONSEQUENCES OF RECENT SOIL PROTECTION APPROACHES IN CITIES OF CENTRAL EUROPE

Grzegorz Siebielec, Artur Łopatka, Magdalena Łysiak, Anna Żurek, Tomasz Stuczyński, Jaroslava Sobocka, Sigbert Huber, Petra Bluemlein, Isabel Wieshofer, Marco Parolin, Josef Kozak, Borut Vrscaj

Institute of Soil Science and Plant Cultivation-State Research Institute, Puławy, Poland
e-mail: *gs@iung.pulawy.pl*

Keywords: soil, sealing, urbanization, land use, participatory impact assessment

Various methods were utilized for assessment of soil consumption patterns and trends in cities of Central Europe within Urban Soil Management Strategy (URBAN-SMS) project. The detailed goals of the work presented here were:

- to conduct an ex-post analysis of land use change, responding to different soil protection regulations in several Central Europe cities
- to gather opinions of stakeholders on key sustainability issues in cities of Central Europe and potential impacts of soil protection scenarios in a semi-quantitative form.

The framework of the analysis of loss of high quality soils in test areas involved development of land use change maps based on consistent satellite image data, analysis of land use change trends within 15 years period and subsequent assessment of on what soils the urbanization took place. The analysis was performed for Bratislava, Prague, Vienna, Stuttgart, Milan, Salzburg and Wroclaw.

Expansion of artificial surfaces in the test areas took place mostly on arable lands. High quality soils were efficiently protected in Bratislava which, at least partly, might be the effect of the fee payment system. The most valuable soils were preferentially taken for urbanization in Vienna, Wroclaw, Prague and Salzburg while in Stuttgart and Milan their consumption was proportional to their share in total area. Soil management systems in these cities did not efficiently protect the best soils until 2006. Interestingly, there is no strong conflict between soil protection goals and demand for land related to economic development of cities. The pool of available low and medium quality soils is much greater than the land demand for urbanization.

The participatory impact assessment involved series of meetings with stakeholders and collecting their opinions in a semi-quantitative form. It revealed that in all the cities continuation of current soil protection regulations would lead to loss of all environmental soil functions. Economic functions were set as key issues for city development which makes awareness of soil role even more important. According to stakeholders – strengthening of soil protection (medium protection scenario) would not limit the economic development (land availability for new industrial and transport constructions).

NEW HYDROMETALLURGICAL PROCESS FOR SOIL REMEDIATION AND NICKEL RECOVERY FROM HYPERACCUMULATING PLANTS

X. Zhang, V. Houzelot, R. Barbaroux, E. Plasari, G. Mercier, J.F. Blais, A. Bani, G. Echevarria, J.L. Morel, M.O. Simonnot

Université de Lorraine CNRS, France
e-mail: marie-odile.simonnot@univ-lorraine.fr

Keywords: phytomining, nickel, hyperaccumulating plants, hydrometallurgy

Phytomining can be defined as the harvesting of hyperaccumulating plants followed by the recovery of metals from the biomass. This concept, born in the 90s, became a real market opportunity when metal prices sharply rose in 2007. In some areas of the world, soils developed on serpentine rocks exhibit a high concentration in nickel. However, this natural resource is too dispersed to be recovered by conventional extraction processes. Some hyperaccumulating plants, e.g. Alyssum murale naturally grow on such soils and accumulate high quantities of nickel, up to 3%. Research on agronomical options compatible with ultramafic areas has shown that it was possible to obtain more than 100 kg Ni ha^{-1} (Bani et al., 2009). In the future we expect to get up to 400 kg Ni ha^{-1}.

Two methods based on hydrometallurgy have been developed at the bench scale to obtain valuable nickel products. The first method consisted in producing nickel from the acid leachate of the dry biomass. Nickel was extracted by solvent extraction, re-extracted by an acid and recovered by electroplating (Barbaroux et al. 2011). This process was not economically feasible mainly because of the cost of the solvent.

The second one, presented here, consisted in producing a double salt of nickel of high purity from the plant ashes. Acid leaching was followed by neutralization and evaporation step to produce a purified solution enriched in Ni. The cold crystallization at 2°C of this solution by adding ammonium sulphate enabled us to obtain a Ni ammonium disulphate salt, $(NH_4)_2Ni(SO_4)_2{\cdot}6H_2O$, potentially valuable for industry (Barbaroux et al. 2012). We are currently working on the optimization and upscaling of this process up to the pilot scale. The final objective is a transfer to industry.

References

Bani A. et al. Northeastern Naturalist, 16 (2009) 385.
Barbaroux R., Mercier G., Blais J.F., Morel J.L., Simonnot M.O., Separation and Purification Technology, 83 (2011) 57-65.
Barbaroux R., Plasari E., Mercier G., Simonnot M.O., Morel J.L., Blais J.F. Science of the Total Environment, 423 (2012) 111-119.

2. SUITMAs as a resource of goods

POSTER PRESENTATIONS

ANALYSIS OF EUROPEAN REGULATORY GUIDANCE VALUES FOR THE SOIL CONTAMINATION AND THEIR APPLICATION TO URBAN SOILS FROM MINING TOWNS

J.M. Penas Castejon, B. Soro Mateo, S.M. Álvarez Carreno

Universidad Politécnica de Cartagena, Spain
e-mail: jose.castejon@upct.es

Keywords: Urban soils contamination, regulatory guidance values, law

The urban soils degradation by exposure to heavy metals that come from mining and industrial areas, as consequence of wind and water erosion processes, is a common problem in the European countries located in the Mediterranean basin. Due to high concentration of heavy and transition metals that are contained in these soils, it can be classified according to European and nationals legislations no only as soil but also as mining waste or even as a mining resource. The aim of this work is on the one hand examining the regulatory guidance values being used in European countries legislation to regulate the most important surface soil pollutants and on the other the possible applicability of these regulatory guidance values to urban soils from mining towns. Element regulatory values were identified by internet search pages of European countries official web pages. In this work we use, as study case, the soil heavy metals concentration obtained in samples that were taken in urban soil from mine towns located in the municipalities of Cartagena and La Union. The results obtained from the analysis of pollutants on the basis of the laws analyzed and the regulatory guidance values given in them that these urban soils can be classified as mining waste strictly. This should be taken into account by authorities in the development of management plans for these soils.

THE DIVERSITY OF URBAN SOILS IN THE WEST–TRANSDANUBIAN REGION

Adrienn Horváth, Péter Szűcs, András Bidló

University of West Hungary, Department of Soil Site Survey
e-mail:hadri@emk.nyme.hu

Keywords: west-transdanubian region, anthropogenic effects, land use types, suburban areas, physical and chemical characteristics, GIS methods

Our aim is to identify the main feedback effects between the town and its environment. In the course of our investigation we have analysed the physical and chemical parameters of soils from various sampling sites in three Transdanubian cities - Szombathely, Sopron and Székesfehérvár.

We collected 672 samples on 336 points from 0 to 10 and from 10 to 20 cm depth in a standard network and also at industrial territories. The results of the field and laboratory investigations have been represented in a GIS system. In the laboratory the chemical analyses of the soil samples have been focused on the following properties and components: acidity (pH H_2O, pH KCl), calcium-carbonate content, hydrolytic and exchange acidity, particle size distribution, humus content, total nitrogen content, ammonium-lactat-acetous acid (AL) solvent potassium and phosphorus content, KCl solvent magnesium and calcium content, the strength of ethylene-diamin-tetra-acetous (EDTA) or diethylene-triamin-penta-acetous (DTPA) measurements of manganese, copper, zinc and iron element.

Using the data we observed the relationship between these elements in both layers. The acidity and calcic soils are determined fundamentally by the parent material, but in the downtown the acidity of soils were alkaline (by the greatest number of point). The cause of this is the calcareous deposited debris. In most cases there was a high value of organic substance in the downtown area, partly due to frequent grass fertilisation and soil spreading. The particle size distribution of soils showed various appearances, but there was not possible to discover the tendencies. In the three cities the highest iron and manganese contents of the soils were found in the forest areas. Downtown sites can be characterized as having high levels of zinc.

In this year we will start to analyse the heavy metal content and chemical compositions of the collected soil samples with infrared spectrometry to get a whole picture about the industrial and the anthropogenic effects. Our examinations can give a useful basis for the future urban soil development and for the traceability of transformation, for correction of the urban soils and for their protection.

PHOSPHORUS FLOW MODEL IN URBAN AREAS OF SEOUL, ULSAN AND JECHEON

Mina Lee, Hyuck-Soo Kim, Kye-Hoon Kim

The University of Seoul, Korea
e-mail: johnkim@uos.ac.kr

Keywords: phosphorus flow model, urban area, Seoul, Ulsan, Jecheon

Phosphorus (P) is an essential nutrient for all living organisms. Human beings absorb P by food ingestion. Large amounts of P are required for food production to meet the food demands of the ever increasing world population. P is mostly obtained from mined rock phosphate. However, existing rock phosphate reserves could be exhausted in the next 50-100 years. Most P is consumed as food in urban area since more than half of the world's population live in urban area these days. Thus, a model for identifying P flow in urban area is needed to trace the major P reservoir in urban area so that we can prepare for the P recovery in the event of P depletion.

In this study, a P flow model was suggested based on traditional material flow analysis and was applied to three cities, Seoul, Ulsan and Jecheon which were selected based on population, size, population density and type of the city. Seoul is a megalopolis with over 10 000 000 people, whereas Ulsan is an industrial city with 1 000 000 people. Jecheon is a garden city with 130 000 people. In applying traditional material flow analysis to anthropogenic P cycle, use (agriculture, animal husbandry, food consumption) and waste management components were included and excavation and fabrication & manufacturing components were excluded in this study since this study dealt with P flow in urban areas only. The quantities of P were calculated by the amount of used or consumed materials such as fertilizer, food and feed multiplied by their P contents.

The results showed that the total P input into Seoul was 10 772 tons. Most of P brought to Seoul was as food, accounting for 99.4%. Total P waste from Seoul was 4 930 tons. The amount of P input to Ulsan was 2 588 tons. Sixty-seven percent of P input to Ulsan was as food. The waste of P from Ulsan was 816 tons. The total P input into Jecheon was 822 tons. Among P input to Jecheon, the animal feed accounted for the largest rate (56%). Approximately 29 tons of P from Jecheon was waste. Lost and waste P from the urban areas can be new reservoirs for the future, which indicate that use of these P can be the solution in preparing for the depletion of P in the future.

INTEGRATE SOIL HEALTH MANAGEMENT INTO URBAN AND MINE RECLAMATION CONSERVATION SYSTEMS-AN OVERVIEW OF SYSTEMS IN THE EASTERN US

Maxine J. Levin[a], David Kingsbury[b]

[a]USDA NRCS, Beltsville MD1, USDA
[b]NRCS, Morgantown, WV2
e-mail: maxine.levin@wdc.usda.gov

Keywords: soil diversity in urban areas (properties, soil types, mapping), urban agriculture

Main problem

World population is estimated to be at 9.1 billion by 2050. To sustain this level of growth, food production will need to rise by 70 percent. In agricultural areas, between 1982-2007, 14 million acres of prime farmland in the U.S. was lost to development of suburban, urban, mining and transportation uses. From 1995 and 2005 the U.S. increased fertilizer imports by 48 percent for anhydrous ammonia, 93 percent for urea (solid), and 349 percent of other nitrogen fertilizers to compensate and maintain production in viable agricultural areas. Our capacity to produce food and fiber through chemical and technological solutions will not keep up with the overall loss of farmland to competing sources. At the same time, the nation is facing expanding and conflicting environmental, land use, and food production priorities. Within the region of the eastern seaboard to the Cumberland Plateau and Pennsylvania coalmines and Marsalis shale gas drilling competing interests are limiting the viability of these areas to provide sustainable food and fiber locally. Societal support for expanded regulation appears to be waning. Growing interest in sustainability by the consumer will continue to push stakeholder groups to adopt and implement sustainability goals and actions if not regulatory constraints. By integrating soil health management system planning and implementation into the United States Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS) conservation program and service delivery in urban and mine reclamation areas presents a unique opportunity to increase acreage of land devoted to the production of food and fiber in sustainable way. It also affords the agency and opportunity to increase employee, customer and stakeholder awareness and understanding of healthy soil ecosystems and biology, and healthy soil's role in natural protection and agricultural production.

Methods and results

The USDA NRCS is working to increase the number of producers operating with Soil Health Systems (at the NRCS criteria level). With a focus on implementing soil health systems through existing programs and services initially in agricultural areas, the agency hoped to expand to other areas eventually. In the NE part of the US, this focus shifts to alternative cropping systems, as well as conversion and repurposing of urban based land or mined reclamation areas immediately and is being fueled by the cost effective solution of soil health management systems. Using a point system, higher ranking producers who choose to implement entire soil health systems are encouraged to participate in national cost share programs. By jump starting a Soil Health Program through policy implementation, benefits multiply. The Soil Health Management System is advertised and advocated within the Field Office Technical Guide and a soil health assessment module has been developed for use with the Mobile Planner. Though these are primarily in agricultural areas the same principles could apply to forest restoration in mining reclamation or the actual appropriation of mined land to return to some sort of agricultural production. Examples of these systems are being tested to improve watershed viability and water quality.

Conclusions

The Soil Health Management Initiative gives NRCS the chance to treat the systemic cause of resource degradation on the vast majority of America's cropland, cost-effectively, while increasing productivity of our nation's working lands, even those which are severely degraded from other uses. NRCS can help America's farmers and ranchers save energy, address climate change, and help meet the needs of the world's growing population. By supporting the re-focusing to provide customer conservation technical assistance related to soil health on all lands, the nation will mitigate potential NRCS criteria development opposition from stakeholder groups and realize continental-scale resource improvements as producers adopt systems.

EXPLORING THE RELATIONSHIP BETWEEN NEW URBAN SOILS AND SOIL SEALING AS AN INDICATOR OF SUSTAINABLE TOURISM PLANNING

M.P. Jiménez Medina, J.M. Penas Castejon, A. Artal Tur, M. Jesús Penalver

Universidad Politécnica de Cartagena, Spain
jose.castejon@upct.es

Keywords: soil sealing, new urban soil, tourism developement, second home

A malpractice concerning planning, in combination with a model of unsustainable tourism development and disrespectful to the environment, has triggered severe ?sometimes irreversible- environmental impacts on the natural and sociocultural environment. Among the impacts mentioned above, it is worth noting those derived from changes in traditional land uses to uses related to urban sprawl, process which in turn leads to a great extent and effect of importance as is the soil sealing. The purpose of this paper is to analyze the new urban land vested in these developments in relation to the total soil sealing, and if the ratio between soil sealing and urban soil is optimal for these new floors meet ecological and social functions for which they are created. The framework chosen as a case study is the geographical area of Los Alcazares, located in the Spanish Mediterranean coast, since it is a paradigm of urban sprawl processes that have taken place in the countries of the Mediterranean basin. As a result, the study aims to demonstrate the process of land use change on the surface that integrates the town of Los Alcazares in the period 2002-2011, along which the land use has changed from a strong agricultural use to urban use linked to tourism mainly focused on second homes. To achieve this goal digital orthophotos, belonging to the Spanish National Air Orthophotography Programme (PNOA) corresponding to flights taken in 2002 and 2011, have been used. Initial digitization of land use for each of the years indicated and subsequent, followed by the application of a spatial analysis model ?implemented in a Geographic Information System- consisting of the intersection of the coverage of information derived from digitization, results in obtaining coverage spatial information that will allow the development of the conclusions drawn from this study.

BRICKS CONTRIBUTION TO URBAN SOIL PROPERTIES

Thomas Nehls, Sarah Rokia, Beate Mekiffer, Christophe Schwartz, Gerd Wessolek

Technische Universität Berlin, Germany
e-mail: thomas.nehls@tu-berlin.de

Keywords: urban soils, artefacts, brick, technogenic substrate

Bricks can be considered as anthropogenic markers since they are regularly found in urban soils worldwide. They are among the most resistent residues of building materials, therefore are called technogenic substrates. They have been dumped to urban soils since more than 4000 years and can be dated back to their burning using thermoluminescence. In Berlin, bricks have been piled up to more than 37 rubble mountains in the city after WW II. The devils mountain, the most prominent of them is higher than 60 m. However, bricks are known not to be isolated in the soil but to fulfill soil functions due to their porosity. Therefore, they are nice research objects for soil scientists. The purpose of this study is to investigate abundance and functions of bricks in urban soils, focusing on plant nutrition and contamination aspects. Three different Berlin urban soils have been studied for their brick contents in the coarse and fine earth fractions by endless hand sorting. Light and scanning electron microscopy was then employed to investigate the bricks for proofs of plant roots. Third, CEC, pH, EC, Corg, nutrient storage (XRF) and availability (2:1 extract, ion chromatography, AAS) of bricks and fine earth fractions of the corresponding soil horizons have been investigated. The fine earth fractions of the investigated soils contain 3 to 5% of bricks, while the coarse fractions contain up to 50%. We found roots entering brick pores or at least attached to brick surfaces. Therefore, plants can use the water and nutrients stored in bricks. The CEC of bricks is grain size dependent and reaches a maximum of 6 $cmol_c \cdot kg^{-1}$ for particles smaller than 0.063 mm. This dependency is not explained by a low pore connectivity. Rather, it is the result of the restricted diffusion into the brick pore system due to the short shaking time in the CEC analysis protocol. From the nutrient storage and availabilities we conclude that bricks can better supply plants with K, Mg, Ca and S than the bulk soil at the investigated sandy site. However, in general, the nutrient availability from bricks is rather low compared to agricultural soils, except for Ca and S. Because of the water and nutrient storage, low contamination status and the possible rooting of bricks, they can be used for amelioration of poor sandy soils and for soil construction.

DIFFUSION OF PHOSPHORUS FROM TECHNOGENIC MATERIALS TO PLANT ROOTS

Lydia Paetsch[a], Thomas Nehls[a], Sarah Rokia[b,c],
Tobias Diekmann[a], Laure Vidal-Beaudet[c], Olivier Damas[d], Geoffroy Séré[b],
Christophe Schwartz[b], Gerd Wessolek[a]

[a]*Technische Universität Berlin, Germany*
[b]*Université de Lorraine-INRA, France*
[c]*AgroCampusOuest, Centre d'Angers, France*
[d]*Plante et Cité, France*
e-mail: christophe.schwartz@univ-lorraine.fr

Keywords: soil construction, Technosol, agronomy, fertility, phosphorus, availability, plants, modeling

Modern intensive agriculture aiming to feed the rising world population depends on mineral P fertilizers. These origin from geogenic rock phosphates. Although approximations of peak P differ by about 200 years, the problem of depleting P resources forces the development of P-recycling strategies such as chemical, metallurgical and biotechnological extraction methods. Besides that, Phyto-P-Mining - the use of plants to extract P from wastes and by-products - was discussed recently. Technogenic materials and mixtures of them in constructed Technosols can be used for plant cultivation in urban areas (e.g. gardening, ornamental, urban farming). This is promising in terms of P recycling and the closure of local-nutrient and good cyclings. The goal of our collaboration is to assess the potential of technogenic materials for the P supply of plants. In this study, we investigated the pure technogenic materials compost, green wastes, paper mill sludge, charcoal, street sweeping waste, rubble, bricks and concrete for their P diffusion from solids to solution to plant roots. Therefore, we studied their physical (e.g. pF-WC, Ksat) and chemical properties (P adsorption isotherms) and integrated both in a diffusion simulation (HYDRUS 1D) of a resin experiment. The water retention functions of the technogenic materials vary widely from sand-like to clay-like behaviour. They were well described by the models of Kosugi and van Genuchten. The P adsorption isotherms could be well described by Freundlich's model. The isotherm parameters indicate the highest retardation for bricks and the highest desorption for compost and green wastes. The effective diffusion rates were derived from 100d simulations. Thereby, green wastes show the highest and bricks the lowest rates for comparably wet soil conditions (pF=1.3). At such conditions, the technogenic substrates show up to 100 times higher P diffusion rates compared to former farmland (Fox and Kamprath, 1970). Diffusion rates decrease fastly with increasing suction. Based on that study constructed soils can be designed with optimized physical and chemical behaviour as well as optimized water management.

References

Fox, R.L. and Kamprath, E.J. (1970): Phosphate Sorption Isotherms for Evaluating the Phosphate Requirements of Soils. Soil Science of America Journal, 34(6): 902-907.

TECHNOGENIC SUBSTRATES FOR CONSTRUCTED SOILS

Eleonora Flores Ramírez[a,b], Peter Dominik, Martin Kaupenjohann[b]

[a]*Instituto de Geología, UNAM, Mexico*
[b]*TU Berlin Department of Soils Science, Germany*
e-mail: eleonorluwz@mailbox.tu-berlin.de

Key words: technogenic materials, sealed surface, water holding capaciy

The challenge in urban areas to counteract the high number of sealed areas is a growing concern. Greening of the urban areas is an important point when referring to human well being inside the cities. The artificial constitution of a soil cover (Technosol) can avoid collateral damages of soil translocation from a natural source, and can be purpose-designed to perform specific soil functions.

This project is developing an artificial soil for covering a sealed surface of concrete, to sustain vegetation for an urban green area with the specific requirements to support the growth of garden trees. A 1.20 m deep soil profile is planned. The substrate is based on Fe (hydr)oxide coated sand mixed with a technogenic porous material (TPM) to enhance the effective field capacity. Lava powder shall be added as a source of nutrients, and the top layer will be enriched with compost. Due to the sealing at the bottom, the main concern is to ensure a high conductivity to enable drainage and avoid anaerobic conditions in the profile during wet periods while having a high effective field capacity to support plant growth during dry periods.

The suitability of six TPM -such as porlite, bims and expanded clay were tested. Two volume percentages (12 and 25%) of the materials were mixed with sand and the soil water characteristic curve with and without compost was measured at reasonable proctor densities. To find an optimal coating process for the sand with Fe(hydr)oxides we quantified the mechanical and kolloidal stability of the coating as well as its phosphate adsorption capacity. The long term stability of the whole mixture will be tested in column experiments.

The preliminary results lead us to conclude that it is possible to reach a suitable mixture of artificial soil, which has both high effective field capacity and at the same time ensures sufficient drainage in wet periods.

CONSTRUCTED SOIL FOR GREENING SEALED URBAN SURFACES

Eleonora Flores Ramírez, Peter Dominik, Maritn Kaupenjohann

TU Berlin, Germany
e-mail: eleonorluwz@mailbox.tu-berlin.de

Keywords: technogenic materials, sealed surfaces

Soils for parks or gardens in urban areas can be established over new surfaces that lack a previous soil cover. The artificial constitution of this soil cover can avoid collateral damages of soil translocation from a natural source.

The aim of this project is to develop an artificial soil over a sealed surface of concrete in Hamburg to sustain vegetation for an urban green area, containing community orchard patches. Due to the sealing at the bottom, the main concern is to ensure a high conductivity to enable drainage and avoid anaerobic conditions in the profile during wet season while having a high effective field capacity to support plant growth during dry seasons.

A profile is planned based on Fe (hydr)oxide coated sand, to absorb P as a nutrient, mixed with different porous materials (technogenics) to enhance the effective field capacity, such as porlite and expanded clay; lava powder as fertilizer, and a top layer enriched with compost. All of them in different arrangements and proportions that are being tested.

The soil water characteristic curve of different ratios of sand and characterized porous materials was measured. For coating with Fe(hydr)oxides we test the use of different byproducts of industries, water works and mining and quantify the stability of the coating as well as its phosphate adsorption capacity. Possible mixtures of materials and coatings, which will support all needs of plants are calculated. Some of them have pF values enough to keep plants. Besides, we count with the coating process and its resistance to mechanical detachment data.

The preliminary results lead us to conclude that is possible to reach a useful mixture of artificial soil, and the coating sand process is economic in time and resources.

EVALUATING PHYSICAL STABILITY OF MODEL SOILS IN RELATION TO THE INITIAL DEVELOPMENT OF CLUSTER ROOTS OF *LUPINUS ALBUS*

Juan Carlos Ramírez[a], Fernando Borie[a], Mirén Alberdi[a], Jörg Bachmann[b]

[a]*Universidad de La Frontera. Departamento de Ciencias Químicas y Recursos Naturales. Temuco, Chile*
[b]*Leibniz Universität Hannover, Institut für Bodenkunde. Hannover, Deutschland*
e-mail: jramirez@ufro.cl

Keywords: soil degradation, erosion, root system, rainfall simulator

Soil degradation is a major environmental issue of natural and urban areas. In Chile, soil degradation affects about 60% of the territory. Causes for this are diverse, like deforestation, quarry extraction or increasing urbanization. Soil conservation can be improved by maintaining forest patches or establishing native or introduced species. In the case of urban and surrounding areas in Chile, the environmental benefit of green areas is just a recent topic of scientific concern, especially the relation between plant growth and soil physical properties. This research shows results of a project evaluating the contribution of cluster roots to soil physical stability. Cluster roots can significantly improve soil aggregation, nevertheless, this effect has not yet been cuantified. Three soils representing urban areas of southern Chile were evaluated: (A) silt-loam, (B) sandy-clay, (C) sand (bulk density: 0.66, 1.27, 0.86 $g \cdot cm^{-3}$, respectively). They were air-dried and sieved (diameter: <2 mm). Seedlings of Lupinus albus were established in individual pots (volume: 0.8 L; 20 pots per soil). Pots were maintained in greenhouse during 4 months. Then, the aerial section of plants were removed and the root-soil system stability was evaluated by a rainfall simulator. Previously, soil moisture and bulk density were determined. As control, pots with no plants establishment were also tested. All pots were submitted to a rainfall equivalent to 400 mm, similar to that expected in the test area (Temuco, Chile) during winter. Pots were then air-dried and weighed for determination of stable material (weight-based calculations). It was observed that bulk density increased slightly in all cases after 4 months (up to 0.2 $g \cdot cm^{3}$), which is explained by the re-arrangement of particles due to irrigation and gravity. The stable material reached for (A) 43.2%, (B) 47.2% and (C) 26.8%. Control pots showed significantly lower values of stability (t-test; p: 0.05), with an average of (A) 11.9%, (B) 1.3% and (C) 7.4%. It is concluded that the development of the root system of L. albus can increase significantly the physical stability of soil to rainfall, depending on the soil type. In this line, finer textures showed better stability, probably due to the relatively higher amount of colloids than sandy soil. Future research will focus on evaluating the combined effect of different physical properties (e.g. texture and bulk density), as also the comparison of cluster and normal roots.

SOIL CONSTRUCTION WITH TECHNOGENIC MATERIALS TO RECYCLE PHOSPHORUS FOR PLANT GROWTH IN CITIES

Sarah Rokia[a,b], Laure Vidal-Beaudet[b], Geoffroy Séré[a], Thomas Nehls[c], Gerd Wessolek[c], Olivier Damas[d], Christophe Schwartz[a]

[a]*Université de Lorraine-INRA, France*
[b]*AgroCampusOuest, Centre d'Angers, France*
[c]*Technische Universität Berlin, Germany*
[d]*Plante et Cit, France*
e-mail: christophe.schwartz@univ-lorraine.fr

Keywords: soil construction, pedological engineering, Technosol, wastes, by-products, agronomy, plants

After more than half a century of high application of phosphorus fertilizers in agriculture, the P resource is progressively depleting. The risk of lower yields due to P deficiency exists. Therefore, alternatives to the use of rock phosphates have to be proposed to sustainably fertilise soils. Urban wastes and industrial by-products might present high potential to be recycled as P fertilisers. Mainly organic materials have already been studied regarding their fertilizing potential. However, pedological engineering proposed recently to mix technogenic materials in order to create fertile substrates. Soil construction is then a potential way to recycle P. In addition to organic materials, mineral wastes will be necessary to obtain fertile organo-mineral constructed Technosols. This approach including a wider range of wastes has poorly been described. The present study proposes a methodology to select appropriate pure technogenic materials and to optimise mixtures for plant growth in cities. Across all the indicators of fertility, we will focus on P phytoavailability. This has been measured by complementary chemical (P_{total}/P_{Olsen}), physico-chemical (anion exchange membrane) and biological (plant test) approaches. Ten technogenic materials were selected for their abundance in urban soils and their fertility potential: sewage sludge, sewage sludge-green waste compost, green wastes, street sweeping wastes, paper mill sludge, bricks, concrete, rubble, track ballast and loess from a deep horizon of agricultural soil. Total P concentrations in pure materials ranged from 0.17 (loess) to 104 (sewage sludge) $g \cdot kg^{-1}$ dry matter (DM) as POlsen ranged from 0.017 (loess) to 4.9 (sewage sludge) $g \cdot kg^{-1}$ DM. As a comparison, P total concentration in natural soils is ranging from 0.1 to 3 $g \cdot kg^{-1}$ DM. Contrasted mixtures of organic and mineral technogenic materials were characterised and the P status was compared to those of the constitutive pure materials. For example, the mixture of (80% in volume) bricks with low P fertility (P_{total}/P_{Olsen} 0.7/0.03) and (20% in volume) compost with high P fertility (21.0/0.96) resulted in an optimised P fertility (3.4/0.10). Out of more than 100 mixtures studied, we will present the top 10 for P fertility based on phytoavailability and plant demand. The perspective of the work will be to develop a decision support system to optimise soil construction with technogenic materials selected for a local P recycling in urban environments.

3. DEGRADATION of SUITMAs and HUMAN HEALTH

ORAL PRESENTATIONS

GEOCHEMICAL PROPERTIES AND CONTAMINATION POTENTIAL OF SOILS ASSOCIATED WITH GENOCIDE MASS GRAVES IN RWANDA

Solomon Amuno

Geoforensic Environmental Services, Toronto, Canada
e-mail: solomon.amuno@gmail.com

Keywords: necrosols, Rwanda, trace metals, mass graves, contamination

The purpose of this paper is to present findings regarding the geochemical properties and contamination potential of soils associated with two post-conflict mass graves in Rwanda, namely the Gisozi Memorial sites and Murambi memorial site. Geochemical assessment of the first site indicated that onsite mean concentration for twelve selected trace elements (As, Ba, Cr, Cs, Ga, Ni, Rb, Sc, Th, V, Y, and Zr) were generally higher than their offsite background values. The soils also showed higher contamination ratio for four trace elements (As, Cr, Ni, and Sc) relative to Clarke values (world averages for soils). The soils exhibited significant enrichment with two priority pollutant metals (As and Cr) in comparison with world averages for agricultural soils. Quantitative assessment of the potential ecological risks status (RI) of the soils indicated that the soils from the first site were only contaminated to a low degree. For the latter site, average enrichment factor (EF) values for both onsite and offsite areas were generally within the class of natural background. From the resulting pollution index values it was determined that the soils from the second site were similarly contaminated to a low degree. The findings of this investigation preliminarily suggest that the selected post-conflict mass graves have not caused significant pollution, with reference to surface soils of the selected sites and surrounding areas. The findings also showed that trace element contents of the soils are within safety threshold, except for a few locations that showed slight elevated concentrations. This research is the first empirical work that examined the geochemical properties of mass grave soils in Rwanda and Africa at large.

URBAN SOILS OF MINING TOWNS: MECHANISMS OF CONTAMINATION AND ENVIRONMENTAL RISKS ASSOCIATED FOR THE CITIZENS

J.M. Pejas Castejon, G. García Fernandez

Universidad Politécnica de Cartagena, Spain
e-mail: *jose.castejon@upct.es*

Keywords: mining towns, heavy metals, environmental risk, urban soils, sequential extraction

Soils and mining wastes from the Mediterranean mining area placed in the Sierra Minera of Cartagena La Union are highly enriched in heavy metals such as lead and zinc, but also other metals such as cadmium and arsenic. Wind erosion processes in this area is considered extremely high and hazards associated to this eroded sediments seems to be high because the huge amount of metals present in this wastes. Around this areas are placed a several mining towns provided with gardens and kindergarten playgrounds areas where urban soils are presents. Urban soils of these gardened spaces receive sediments eroded by wind and water erosion from the surrounding mining areas, giving rise to contamination thereof. This research has been focused on the assessment of the real environmental and health hazards of cadmium and arsenic in relation to geochemistry and metal mobility in surface urban soils from five mining towns in SE Spain, under semiarid weather conditions. A total of 49 samples were taken according with the main groups of urban soils. In order to assess the reactivity of the species or binding forms of heavy metals in urban soils samples, extraction procedures have been applied both as single leaching steps and combined in sequential extraction scheme with a representative sample size. Mineral composition of urban soil was identified using powder X-ray diffraction analysis and scanning electron microscope with energy-dispersive system. The achieved results show that cadmium is not only mainly associated to primary sulfides but also to secondary sulfides and exchangeable fraction while arsenic is associated mainly to oxides and hydroxides. Total concentration of arsenic in analyzed samples was between 50 and 160 $mg \cdot kg^{-1}$ and for cadmium between 11 and 21 $mg \cdot kg^{-1}$. Regarding with these results, it must be taking into account on the one hand that concentrations of arsenic greater than 0.39 $mg \cdot kg^{-1}$ may cause carcinogenic effects in humans, and concentrations above 22 $mg \cdot kg^{-1}$ may result in adverse noncarcinogenic effects. On the other, cadmium is considered carcinogenic above 10 $mg \cdot kg^{-1}$. In this study all analyzed samples exceeded the reference values and as consequence restoration measures must be taken by authorities in order to prevent effects of toxic metals on human health.

SEASONAL SPECIFIC PHYSICAL PROPERTIES AND HYDROPHOBICITY DYNAMICS OF ORGANIC MATTER IN THE SEDIMENT OF A RAINWATER INFILTRATION BASIN

Anais Coulon, Laure Vidal-Beaudet, Patrice Cannavo

Agrocampus Ouest - Centre d'Angers, UR EPHOR, France
e-mail: laure.beaudet@agrocampus-ouest.fr

Keywords: hydrophobicity, sediment, infiltration basin, organic matter

In order to collect excessive run-off water, infiltration basins have been built in urban areas and alongside road axes. These basins collect high volumes of water after rainstorms but can remain dry for several weeks between two rainfalls. In the basins, sediments accumulate at the soil surface and their physical properties are directly linked to the specific nature of organic matter.

We studied the sediment organic matter of the Cheviré basin (West of France) at two humidity states: a high water content in May 2009 (water potential of -10 kPa) and a low water content in July 2010 (water potential of -1600 kPa). Between these two dates, only one centimeter of sediment was deposited. For the two water contents, we measured water retention capacity, structural stability and saturated hydraulic conductivity in the sediment. Water repellency of the sediment organic matter was measured in July 2010. It will be assessed again between March and June 2013 in laboratory studies to determine sediment hydrophobicity dynamics as related to rewetting duration.

Total organic carbon contents (TOC) of the sediment were between 60.1 and 130.9 $g \cdot kg^{-1}$ and represented 71% of the organic matter (OM) with an OM/TOC ratio of 1.4. This ratio value was specific to this particular sediment organic matter, which had a double origin: natural and anthropic. Sediment water retention was linked with organic matter content and water content at the time of sampling. The wet sediment presented higher water retention (0.1 cm3 of water per cm^3 of soil) and increased microporosity compared to the dry sediment. Rainfalls induced aggregate alterations and the wet sediment had a very low aggregation rate compared to the dry sediment which had very stable aggregates (MWD>2 mm). Saturated hydraulic conductivity was 10 times higher in the wet sediment than in the dry sediment: $7.15 \cdot 10^{-6}$ and $0.76 \cdot 10^{-6}$ $m \cdot s^{-1}$, respectively. These observations are in contradiction with the high MWD measured in the dry sediment. Wettability measurements showed the high hydrophobicity of the dry sediment with apparent contact angles higher than 90° for the crushed and sieved sediment and with values between 113 and 127° for the sediment aggregates. New wettability measurements will be performed in spring 2013 at different water repellency levels, and relations will be established between sediment hydrophobicity, aggregation level and hydrodynamic properties.

The organic matter of urban basins undergoes high variations in water content which modify the organisation and properties of the sediment over the seasons and induce basin clogging processes. Modelling the hydrodynamic functioning of the Cheviré infiltration basin needs a better knowledge of the hysteresis induced by sediment hydrophobicity. Determining the kinetics of sediment hydrophobicity recovery is essential for producing accurate models.

APPLICATION OF SOIL POLLUTION INDEX (SPI), PLANT POLLUTION INDEX (PPI) AND CONTAMINATION-POLLUTION INDEX (CPI) FOR BIOGEOCHEMICAL ASSESSMENT OF THE CITY POLKOWICE (POLAND)

J. Diatta, W. Grzebisz, A. Swędrzyński, M. Biber, R. Łukowiak, A. Andrzejewska, K. Przekop

Poznan University of Life Science, Department of Agricultural Chemistry and Environmental Biogeochemistry, ul. Wojska Polskiego 71F, 60-625, Poznan (Poland)
e-mail: Jeandiatta63@yahoo.com

Keywords: pollution indices SPI, PPI, CPI, heavy metals, bioindicator, *Taraxacum officinale*

Aim, materials and methods

The biogeochemical investigations carried out in the city Polkowice (51°50' N 16°05' E, Poland) dealt with the use of a bioindicator, dandelion (*Taraxacum officinale*), for evaluating the degree of contamination/pollution with Pb, Cd, Cu and Zn. In total 104 soils and 104 plants samples were collected 2009 from 6 streets, namely: Wojska Polskiego, Dąbrowskiego, Kominka, 3-go Maja, Głogowska and Kolejowa (total length 10.75 km).

Soluble metals in soils (aqua regia) and plant samples were determined by AAS method. Soil and plant pollution indices (SPI and PPI, respectively) were calculated according to Sanka et al., (1995), whereas Contamination-Pollution Index (CPI) as reported by Lăcătuşu (1998).

Results

The content of analysed metals exceeded the threshold values in soils, particularly for copper (Cu). This metal exerted the greatest impact on the magnitude of soil pollution indices (SPI). The highest SPI values occurred within the Dąbrowski street (140.9) and Glogowska street (120). The levels of Pb, Cd, Cu and Zn in the dandelion tissues have been also exceeded. This concerns mainly cadmium and to a lesser extent copper, lead and zinc. The highest plant pollution indices (PPI) were noted at the Dąbrowski (114.70) and Glogowska (90.78) streets, i.e., the same as in the case of SPI values.

Conclusions

Data of soil and plant analyses have shown, that the main generator of heavy metals along the main roads in Polkowice are car transportation and mining activity, mainly copper ores extraction. This was confirmed by heavy metals content, which exhibited a significant share related to transportation in the contamination of soils and dandelion.

References

Sanka M. Et al. (1995): Sources of soil and plant contamination in an urban environment and possible assessment methods. Intern. J. Environ. Anal. Chem. 59: 327-343.

Lăcătuşu R. (1998): Appraising levels of soil contamination and pollution with heavy metals. European Soil Bureau, Research Report No. 4, Romania: 397-404.

MODELING WATER FLOW AND NITRATE DYNAMIC ON FUTURE GOLF COURSE UNDER TURFGRASS

Vilim Filipović, Gabrijel Ondrašek, Radka Kodešová

Faculty of Agriculture, University of Zagreb, Croatia and Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, Czech Republic
e-mail: vfilipovic@agr.hr

Keywords: golf turf, water flow, nitrate, modeling, HYDRUS

Urban environment is expanding fast in recent years, and also the area of artificially created urban soils which are developed intentionally (parks, golf courses, green houses) for different land use or unintentionally by development or industry (construction, mining, traffic). The number of golf courses is also rapidly expanding due to its high demand. The golf courses are mostly constructed from artificially developed layers which are placed on natural soil. The reason for that is construction of highly permeable layers which can conduct large amount of irrigation water quickly and also construction of subsurface drainage system. Golf turf is one of the most intensively managed urban landscapes regarding fertilization and irrigation practices.

Large amount of nitrogen fertilizer are applied which can then pollute surface and groundwater. Numerical experiment was conducted in order to explain water flow and nitrate behavior in artificial layers and possibility of nitrate leaching into deeper natural soil layers and consequently groundwater. Experimental data form future golf course in Istria for natural soil was used and the artificial layers were constructed according to USGA recommendations. Simulations of water flow and nitrate transport were conducted with HYDRUS 1D/2D program for period of one year. UREA was used as source of nitrogen fertilizer for three scenarios i) 50 $kg \cdot ha^{-1}$ ii) 75 $kg \cdot ha^{-1}$ and iii) 100 $kg \cdot ha^{-1}$. Results of two-dimensional simulations with tile drainage indicate that good permeable layer and drainage system set according to USGA standards can lead to protection of natural soils and prevent nitrate to percolate into the soil even at the high rate of fertilizer application. In addition experiment without drainage was conducted (HYDRUS 1D) in which a large amount of nitrate concentration reached bottom of the soil profile which can then be leached into groundwater. Because subsurface drainage is installed mostly only on golf greens and not on the entire golf course area, fertilization practices needs to be applied only on that part of landscape which is not always the case and also tile drainage outflows needs to be treated before reaching surface and ground waters.

URBAN SOIL MAPPING: 2- PREDICTING URBAN SOILS QUALITY BY THE LAND USE HISTORY (NE PARIS, FRANCE)

Catherine Franck-Néel, Aurore Fauchas, Camille Diome, Wolfgang Borst, Branchu Philippe

CETE de Lyon, Dpt. Laboratoire de Clermont-Ferrand, France - Groupe Risques Environnement Infrastructures
e-mail: catherine.neel@developpement-durable.gouv.fr

Keywords: urban soil, land use history, PAH, metal

Main problem

In cities, semi-natural areas (parks, playgrounds, gardens...) become scarce. Though, they are important component of urban ecosystems that require protection for their beneficial functions. In such areas, the man is regarded as the main pedological factor. It can thus be assumed that the analysis of the history of land use allows the prediction of the degree of human impact (or anthropization). The present study tries to assess this assumption in the site of the plateau de Belleville-Montreuil (North-East of the city of Paris). The final goal is to see whether an accurate mapping of the land use history can allow a predictive mapping of the urban soil quality at the plot scale.

Methods

The historical analysis has been performed from the Napoleonic era to the present day. Plots of similar history were mapped at scale of the city districts. These maps were then confronted with point data obtained at the field scale with at least three soil cores by studied plot. The field survey consisted of recording the main soil characteristics (horizon, color ...) and of sampling undisturbed soil cores with a hand auger. In situ chemical diagnosis of each soil core was conducted evey 5 cm using a portative X-ray spectrofluorimeter. Further analysis of the main chemical properties (pH, major, trace elements, PAHs...) and of grainsize and coarse fraction were performed on composite soil samples in the laboratory.

Results and conclusions

In 1800, the study site was nearly entirely (90%) covered by farmland (arbori- and horti-culture). Today (2005), extent of residential and industrial areas leaves only 3% of the surface to farmland, gardens and urban parks. Despite the huge variation of the plots size since the Napoleonic period, it has been possible to identify seven districts of homogeneous and contrasted land history. Due to lack of time, only three of the seven zones were investigated in the field. All studied zones are characterized by absence of land use modifications since the thirties. A huge variability of horizonation occured between soil cores of the same plot. Still, the human impact appears by similar features. The contents in PAHs, Cu, Zn, Pb et Hg as well as analyses of grain size and coarse fraction appear to be the most indicative parameters of the degree of the soil anthropization. However, these preliminary conclusions would deserve verifications on a larger number of plots.

URBAN SOILS QUALITY AND HEALTH RISKS - STUDY OF TRACE METALS ANOMALIES IN AN URBAN GARDEN IN NANTES

Liliane Jean-Soro, Cécile Le Guern, Béatrice Béchet, Thierry Lebeau,
Marie-France Ringeard

Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux (IFSTTAR), Centre de Nantes, France
e-mail: liliane.jean-soro@ifsttar.fr

Keywords: soil, garden, urban, trace elements, anomaly, cartography, arsenic, lead

Urban gardens are expanding worldwide, especially in industrialized countries. This practice tends sometimes to put the gardens in the center of the food strategies of some urban households. However, the garden location and soil quality, which have not been taken into account beforehand, can induce health risks.

For many years, the city of Nantes supports the neighbourhood gardening. Attentive to the potential health risks associated with this practice, for instance the consumption of vegetables grown on contaminated soil, the parks and gardens and environment department has launched a program to check the soil quality of its 24 gardens towards pollutants. The Eglantiers garden (2 ha) located north of Nantes, has been studied in 2011.

The spatial distribution (horizontal and vertical) of As, Cu, Pb, and Zn, in the 95 plots of the garden, was determined, completed by a survey of the cultivation practices and a historical analysis of the site. The studied elements were quantified using a portable X-ray fluorescence spectrometer. To assess the transfer of Pb in vegetables, its accumulation in vegetable samples was measured by atomic absorption after digestion with aqua regia.

Trace elements contents were mapped using four anomaly levels (from no anomaly to very high anomaly). The corresponding levels are mainly based on the results of the ASPITET program (Baize, 2004) showing the trace element contents of French soils. Significant As and Pb anomalies were observed in several plots. Thus, the Regional Health Agency helped choosing levels to select the plots where gardening must be restricted. The garden was separated in two parts. In the western part, plots with high As and/or Pb levels were shown to be no longer cultivable. For some vegetables (e.g. carrot), a close positive relation between soil and vegetable levels was observed for Pb.

Increasing amounts of trace elements with depth led to conclude to the natural origin of these anomalies.

This study provides new data and decision support tools for gardening soil management. X-ray fluorescence spectrometry allowed in-situ and fast semi-quantitative investigation, saving time and cost laboratory analysis. The parks and gardens and environment department used these results to manage the soil plots of the Eglantiers garden.

DEVELOPMENT OF ECO-FRIENDLY REMEDIATION TECHNOLOGIES FOR ANIMAL CARCASS BURIAL SITES DUE TO FOOT-AND-MOUTH DISEASE

Kye-Hoon Kim, Junghwan Yoon

The University of Seoul, Korea
e-mail: *johnkim@uos.ac.kr*

Keywords: animal carcass burial, foot and mouth disease, remediation technology

The outbreak of foot and mouth disease (FMD) in Korea from Oct. 2010 to April 2011 resulted in burial of some 3.5 million livestock in 4799 burial sites, which made most of Koreans worry about soil and groundwater contamination. The Korean government ordered a research project to identify soil and groundwater contamination and to develop eco-friendly remediation technology for contaminated animal burial sites. This study was carried out to identify potential soil and groundwater contamination around animal burial site and to develop eco-friendly remediation technologies for contaminated soil and groundwater using black carbon (BC), microorganism, and woody plants.

An animal burial site located at a rural area was selected for monitoring soil and groundwater contamination. Soil and groundwater samples from the burial site were collected twice a month and were analyzed for pH, electrical conductivity (EC), NH_4-N, Cl^-, total organic carbon (TOC), total phosphorus (T-P), and antibiotics. Black carbon produced from rice husk, wood waste from roadside trees, and natural vegetation around the animal burial sites were used for adsorption experiment for N, P, and antibiotics. Microorganisms obtained from the soil around the animal burial sites were identified and were tested for total carbon decomposition capacity. Two tree species, poplar and willow were selected and were tested N and P removal efficiency using liquefied fertilizer from swine manure. Lettuce was planted in pots with BC and antibiotics treated soils to find out effect of BC on reducing transfer of antibiotics from soil to plant.

Groundwater from the monitoring well which is about 5 m from the boundary of animal burial site showed high EC, NH_4-N, TOC, and Cl^-. Black carbon significantly reduced N, P, and antibiotics concentration by adsorption. Microorganisms reduced total carbon concentration in soils from animal burial site. Poplar and willow trees removed N and P efficiently showing potential to apply tree species for removing N and P in the soils contaminated with leachate from the sites. Black carbon reduced transfer of sulfamethazine from soil to lettuce for 64%.

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FATE OF TRACE ELEMENTS IN CONTAMINATED LANDSCAPES: A COMPARISON OF SOILS AND SEDIMENTS AROUND A FORMER ZINC SMELTER

Amandine Liénard, Gilles Colinet

University of Liege (Belgium) - Gembloux Agro-Bio Tech - "Soil – Water" Systems Unit
e-mail: Amandine.Lienard@ulg.ac.be

Keywords: soil, river sediments, trace element, fractionation

The Meuse valley from Namur to Liege (Belgium) has hosted an important industrial activity during the last two centuries. In Sclaigneaux, the chimney of a zinc smelter spread around a lot of metallic dust in the atmosphere until 1971. Nowadays around old factory, a metalliferous site has been classified as a natural reserve. However, contamination has not been restricted to the protected area and evidences of soil contaminations by Zn, Pb and Cd have been measured on a distance of 3 km in a previous study. Fields and pastures are numerous in that area and the fate of contaminants in the soil-plant-water systems is a crucial question. Migrations of trace elements (TE) can mainly occur by surface run-off and erosion under particulate form or by leaching as soluble ions or complexes. This study aims at assessing whether the location of contaminants under aerobic (soils) or water-saturated (sediment) conditions should influence the mobility of TE.

The sampling strategy was developed according to soil type, land use and distance to the source of the river or to former chimney. A spatially comprehensive survey of soil surface had already been made in a first study and kriged maps were produced for contaminants contents. Eighteen sediments were then taken along the river active stream in order to compare the geographical extent of contaminants in soils and in sediments. In eight locations, soil was sampled at various depths till max 1.2 m. Pseudo-total contents in TE and available contents in trace and major elements, pH and TOC were measured. Then, in a second stage, four pairs were selected for deeper insight on their TE status. A modified Tessier fractionation scheme was applied for TE and Al, Fe and Mn.

The presentation will focus on these various angles taken in the comparison of contaminations in soils and sediments. Besides classical statistical analysis, (i) correlations between parameters of soil and sediments, (ii) ANOVA and (iii) PCA were performed. Results confirm the importance of the distance to the source of contaminants as the main factor for both situations. Different spatial signatures suggest that the fate of TE deposited in the valley bottom might have been different than for neighbour soils. Chemical fractionations show significant differences of solubility between Zn (higher residual fraction), Pb (affinity with organic matter) and Cd (importance of adsorbed fraction), as well as in some occasions differences between soils and sediments.

MAGNETIC PROPERTIES OF SOILS INFLUENCED BY URBAN AND INDUSTRIAL DUST DEPOSITION

Tadeusz Magiera, Marzena Rachwał, Adam Łukasik

Institute of Environmental Engineering, Polish Academy of Sciences, Poland
e-mail: tmagiera@ipis.zabrze.pl

Keywords: magnetic susceptibility, heavy metals, technogenic magnetic particles, soil pollution, dust deposition

Magnetic properties of soils reflect different soil mineralogy, especially forms and concentration of iron minerals. The origin of iron minerals in soil is both natural (geogenic, pedogenic, biogenic) or anthropogenic. Soils on urban and industrial areas have been influenced by long-term dust deposition containing strongly magnetic (ferro- or ferrimagnetic) technogenic magnetic particles (TMP), produced during wide variety of technological processes (metallurgy, fossil fuel combustion, cement, ceramic and coke industry) in high temperatures. The easiest to measure magnetic parameter, directly related to concentration of magnetic minerals in soil is magnetic susceptibility (κ). The susceptibility is a parameter very sensitive for detection of ferrimagnetic minerals even in trace amount. For example, some 0.01% of magnetite in typical soil mineral population contributes some 85% to the total magnetic susceptibility. The presented data are results of 15 years study on magnetic properties of topsoil cores (30 cm long) collected in urban parks and municipal forests of Upper Silesian Industrial Region (USIR) and forests surrounding this area. In most anthropogenically influenced soil profiles the maximum κ values were detected at the uppermost 10 cm layer, which represents usually Of and Oh subhorizons. In the same horizons of forest soils the highest concentration of potentially toxic trace elements (mostly heavy metals as Pb, Zn, Cd, Cu) was usually detected. The TMP are known as carriers of trace elements adsorbed on a large surface of technogenic iron oxides. The study revealed that in every case when the κ value is over 100 $\times 10^{-5}$ SI magnetic units the concentration at least one of heavy metal exceeds the national threshold value. In many studied areas correlations between κ values and heavy metal contents in the organic soil horizons were considerably high ($r > 0.7$). In such areas κ value is a good parameter to estimate the thickness of contaminated layer and assess a spatial range of polluted area. The lower correlation observed in some urban and industrial areas are result of strong influence of natural geological background (magnetic or geochemical anomaly), strong physical degradation of uppermost horizon, presence of artificial materials in soil as well as specific pollution sources e.g. actual or historical areas of Zn and Pb ore exploitation and processing concentrated in eastern part of USIR.

URBAN GARDEN SOILS AND THE PROSPECTS FOR LAY PUBLIC INVOLVEMENT IN SOIL HEAVY METAL EXPOSURE MITIGATION

Salvatore Engel-Di Mauro

SUNY New Paltz, USA
e-mail: engeldis@newpaltz.edu

Keywords: heavy metals, contamination, urban gardens, participatory field analysis

Many cities face heavy metal (HM) and other contamination problems that may stymie urban farming by exposing people to greater risk. To address this, a pilot study is being carried out in urban gardens in three cities in New York State (USA) to assess the feasibility of non-experts using basic field techniques to identify soil HM crop contamination potential. In this manner, HM exposure could be mitigated through the active involvement of better informed gardeners. Field analyses for bulk density, colour, pH, texture, and carbonate content serve as proxies for variables known to be associated with HM movement and bioavailability. Urban gardeners conduct the field tests following training through workshops. The workshops' objective is to inform about soil HM contamination processes and have gardeners conduct the soil descriptions. Soil samples are analysed at the Cornell University lab for HM content and other variables affecting HM-mobility in soils (pH, clay and organic matter content). HM content in crop samples, taken from crops grown within 10 cm of the soil samples, is used to establish a relative uptake index to verify the extent of HM mobility into crops. Results from the tests done by urban gardeners', university students', and professional lab analysts are to be compared through multiple statistical analyses. For interval/ratio data, ANOVA for multiple means and Pearson?s r will be used. Spearman correlations for ordinal data will be used for field-analysis based proxy indicators, namely texture, colour, and carbonate content. The project?s outcome will be deemed successful if a significant correlation is found between field and lab analyses. As the project is in progress, the actual results cannot be divulged until the conference presentation. If the study is successful, further funding will be sought to conduct a survey in the US Northeast with the aim of developing an urban soil-screening protocol that sufficiently reduces requirements of resources and scientific background so as to reach the widest possible applicability. However, further elaborations of the protocol will be accompanied with more sophisticated lab analyses, using fractionation methods and testing for such variables as iron oxy-hydroxide and carbonate content, organic matter fractions (e.g., humin, fulvic/humic acids), and clay mineralogy.

HEAVY METAL DISTRIBUTION AND CHEMICAL SPECIATION IN SURFACE SOILS AROUND MINING AREAS OF MONGOLIA

Bolormaa Oyuntsetseg, Watanabe Makiko, Dorj Daichaa, Yondonjamts Jajinjav, Erdenetuya Ochir

National University of Mongolia
e-mail: bolormuis@yahoo.com

Keywords: soil, mining area, sequential extraction, soil properties, heavy metal

The mining industry is now being considered as a main source of the economy in Mongolia. Evaluation of heavy metal pollution on the mining operations has been one of the major concerns for governments, local communities and researchers. The purpose of this work is to study the heavy metal distribution and chemical speciation in soils around mining industry controlled by government and illegal small-scale mining areas of Mongolia. The Erdenet copper and molybdenum mining industry is located in the northern part of the country, and lies in a valley between the Selenge and Orkhon rivers about 400 km northwest of Ulaanbaatar, the capital city of Mongolia. Other two study areas, where small-scaled gold mining is operated, locate in the Bornuur sum, Tov aimag, at the distance about 120 km from Ulaanbaatar, and in the Zaamar sum Western Tov aimag. The surface soil samples were taken from each other mining areas and examined for extractability and mobility of heavy metals (Pb, Zn and Cd) and major elements (Mn, Fe, Al, Ca and P), and their relationship by using sequential extractions. Each of the chemical fractions was operationally defined as: (a) exchangeable; (b) bound to carbonates or specifically adsorbed; (c) bound to Fe-Mn oxides; (d) bound to organic matter and sulphides; (e) residual. Soil properties such as total carbon (TC) and nitrogen (TN) content, pH, and electrical conductivity (EC) were also performed. The chemical properties of soils and correlation analysis between elements were determined for all studied soil samples. The toxicity and the mobility of heavy metals in soils depend not only on the total concentration, but also on their specific chemical form, their binding state, the metal properties, environmental factors and soil properties. All information collected allowed the understanding of the small-scale mining effect on soil degradation, thus contributing to the qualitative prediction of pollution evolution on the basis of metal mobility.

ASSESSMENT OF TRACE METAL AND PAH CONCENTRATIONS IN SOILS FROM PERI-INDUSTRIAL REGIONS: LESSONS FROM A SURVEY IN THE WALLOON REGION (BELGIUM)

Benoît Pereira, Hugues Titeux, Julie Leclercq, Philippe Sonnet

Université Catholique de Louvain, Earth and Life Institute - Environmental sciences (ELIE), Belgium
e-mail: benoit.pereira@uclouvain.be

Keywords: trace metal elements, PAH, peri-industrial areas, urban baseline concentrations

Soils from peri-industrial areas are usually disturbed by urbanization, mixed with technogenic material and affected by smoke and dust fallout. A precise knowledge of the local baseline content of pollutants in soil is needed by the government agencies in order to implement the environmental protection policies. However, in peri-industrial areas, pollutant concentrations often exhibit a high spatial variability which requires an appropriate investigation methodology. Here, we outline the key results obtained from a survey on baseline soil concentrations of trace metal elements (TME) and polycyclic aromatic hydrocarbons (PAH) in peri-industrial soils from the Walloon region (Belgium).

For the survey, 8 areas were selected in order to represent the range of current and historical industrial activities of the region. These include chemical plant, steelmaking blast furnace, collieries, coal agglomeration and coke production plants and nonferrous metals smelting plants (Pb, Zn). The sampling points (70 to 200 in each area) were spatially distributed and were representative of the various land uses that occur in peri-industrial area: vegetable gardens, urban parks, farmland and forest. At each sampling point, we collected a sample of the topsoil and, when possible, a sample from a deeper horizon (between 60 cm and 1m depth). Concentrations were measured for 5 major elements, 14 TME and 16 PAH (EPA).

This sampling and analyzing scheme made it possible to distinguish the effects of the four main factors that affected the concentrations of TME and PAH in the topsoil: (1) the pedogeological soil type (2) the predominant industrial activities responsible for the atmospheric fallout of pollutants (3) the amount and the nature of the technogenic materials and (4) the type of land use. In the peri-industrial areas of Wallonia, we found that the presence of As, Co, Cr, Ni, Be, Ni and Mo was predominantly linked with the pedogeological soil type and was not related to atmospheric fallout of pollutants. Two different kinds of industrial activities were shown to have a clear footprint in terms of TME and PAH contents in topsoil: the non-ferrous metallurgy smelting plants were associated with high values in Cd, Pb and Zn, and the steel and coal industrial activities were associated with high PAH values and moderately high Zn values. The presence of technogenic material resulted in elevated Ba, Cu, Hg, Ni, Pb and PAH values.

SPATIAL HETEROGENEITY EFFECTS ON Zn/Cd REMOVAL EFFICIENCY BY THE HYPERACCUMULATOR *SEDUM ALFREDII* GROWN ON CONTAMINATED SOIL

Lu Tang[a], Yetao Tang[a,b], Xiaowen Zeng[c], Shizhong Wang[a,b], Rongliang Qiu[a,b]

[a]*School of Environmental Science and Engineering, Sun Yat-Sen University, Guangzhou 510275, P.R. China*
[b]*Guangdong Provincial Key Lab of Environmental Pollution Control and Remediation Technology, Sun Yat-Sen University, Guangzhou 510275, P.R. China*
[c]*School of Public Health, Sun Yat-Sen University, Guangzhou 510008, P.R. China*
e-mail: eestyt@mail.sysu.edu.cn, esqrl@mail.sysu.edu.cn

Keywords: spatial heterogeneity, zinc, cadmium, hyperaccumulator, phytoextraction efficiency, *Sedum alfredii*

Zn and Cd are often heterogeneously distributed in soils. We examined the effects of spatial heterogeneity on Zn/Cd removal efficiency by the Zn/Cd hyperaccumulator *Sedum alfredii* grown on an agricultural soil contaminated with mine waste. Field-collected contaminated and control soils were arranged in pots either homogeneously or heterogeneously in "half" or "quarter" patterns. Young shoots of *S. alfredii* were grown on these substrates in a greenhouse. The efficiency of Zn and Cd removal from soil by *S. alfredii* was highest in the "quarter" pattern heterogeneous treatment, in which the percentages of total soil Zn and Cd extracted were 8.02 and 7.27, respectively. For the homogeneous contaminated soil, the corresponding percentages for Zn and Cd extraction were 3.90 and 1.15, respectively. The amounts of Zn and Cd accumulated in *S. alfredii* shoots were significantly greater in the "quarter" pattern heterogeneous treatment than in the "half" pattern treatment. The efficiency of Zn/Cd removal by *S. alfredii* grown on contaminated soil was affected by the scale of Zn/Cd spatial heterogeneity in the substrate. These results may have important implications for the efficiency of phytoremediation by hyperaccumulators in the field.

THE COMPARISON OF SOIL LOAD BY POPS IN TWO MAJOR COAL MINING AREAS OF THE CZECH REPUBLIC

Radim Vacha, Jarmila Cechmankova, Jan Skala, Viera Horvathova, Jiri Hladik

Research Institute for Soil and Water Conservation, Praha, Czechia
e-mail: vacha.radim@vumop.cz

Keywords: coal mining, soil contamination, persistent organic pollutants

The Czech Republic belongs to the countries with long-term industrial history. It is known that industrial development loads the environment by persistent organic pollutants and especially by polycyclic aromatic hydrocarbons since 19th century. The imission out-puts reached maximum in 70th years. Two coal mining areas exist in the Czech Republic. The soil is one of the important parts of environment and soil load of pollutants reflects long-term load by dry and wet depositions. This work compares the load of both regions by three types of persistent organic pollutants: polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and DDTs (DDT, DDE and DDD). Although PCBs and DDTs are not used any more in Europe, the load of soil by both groups of pollutants is increased still.

Methods

The amount of 179 soil samples in North Bohemian region and 106 soil samples in North Moravian region were collected and analyzed. The contents of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and DDTs in soil samples were evaluated and compared with emission sources in both areas.

Results and conclusions

The data of soil load by observed POPs groups in two environmentally affected areas indicate generally higher load of North Moravian Region in comparison with North Bohemian Region. This result is supported by the comparison of soil load by polycyclic aromatic hydrocarbons especially. The load relate with high concentration of metallurgy in the region and with high population living in urban area in Ostrava district. The load of soil by PAHs has surface character and exceeding of proposed preventive limit value (based on PAHs background values in the soil) was detected on most observed localities. Markedly increased soil load was monitored in the case of PCBs also in North Moravian Region where the effect of increased urban environment plays important role. While soil load by DDTs is comparable in both regions (with some qualitative differences) the load of agricultural soils by MAHs is markedly higher in North Bohemian Region in district Most especially.

HEAVY METAL RETENTION OF DIFFERENT ROADSIDE HARD SHOULDER CONSTRUCTIONS

Moritz Werkenthin, Bjoern Kluge, Gerd Wessolek

Department of Ecology, Soil Conservation Group, Berlin Institute of Technology, Germany
e-mail: moritz.werkenthin@tu-berlin.de

Keywords: heavy metal, road runoff, roadside soil, seepage water

The accumulation and retention of heavy metals in roadside soils has been studied for at least over forty years, but it is still subject of major interest. The continuously increasing road traffic induces high heavy metal loadings in runoff and seepage water. Elevated concentrations of heavy metals are a potential environmental risk. Especially in the long term development there is an increasing problem of soil contamination and groundwater pollution. A significant rate of road runoff infiltrates into the hard and soft shoulder. They are usually built during road construction and located directly along the road edge. According to valid german law, newly constructed hard shoulders have to provide a specific bearing capacity to enable trafficability in emergency cases. Therefore the applicable materials consist of defined gravel-soil mixtures, which can fulfill this requirement.

To determine and compare the concentration of Pb, Cd, Zn, Cu, Ni, Cr in the road runoff and seepage water of different hard shoulder substrates, we installed 6 lysimeters along the edge of the german highway A115. Three lysimeters were filled with different materials wich are commonly used for road construction in Germany and compacted afterwards. Surface runoff is sampled, as is seepage water in two depths in the three lysimeters. Furthermore three lysimeters where installed and filled with plain gravel, to observe the distribution, quantity and quality of road runoff. Additionally soil column experiments were carried out with the same construction material.

First analytical results of the road runoff show concentrations of up to 12.9 $\mu g \cdot dm^{-3}$ Pb, 0.1 $\mu g \cdot dm^{-3}$ Cd, 19.8 $\mu g \cdot dm^{-3}$ Cu, 3.9 $\mu g \cdot dm^{-3}$ Cr, and 49.6 $\mu g \cdot dm^{-3}$ Zn. They are in the same order of magnitude as literature values. Both, the measured seepage water concentrations from field and column experiments of Pb, Cd, Zn, Cu, Ni, Cr do not yet exceed the trigger values of the German Federal Soil Protection and Contamination Ordinance (BBodSchV). No significant differences in heavy metal concentrations of the three artificial hard shoulder lysimeters were determined so far.

MODELING MOISTURE AND SOLUBLE SALT TRANSPORT IN EXPERIMENTAL PLOTS OF RECONSTRUCTION STRATIFIED SOIL WITH COAL COMBUSTION RESIDUES

Chen Xiaoyang, Yan Jiaping, Chen Lei, Wang Xi, Wang Changlei, Yu Jiahe

School of Earth and Environment, Anhui University of Science and Technology, China
e-mail: chenxy@aust.edu.cn

Keywords: moisture transport, soluble salt, stratified soil, fly ash, compensation factor

Purpose

The arable area of many plains rigorously decreased due to coal mining in China, and the soil reclaim works had to be carried out for controlling arable area lossing filled with coal combustion residues (i.e. fly ash, FA). FA with the special physicochemical characteristics is low bulk density, extensive specific surface area, strong water retention capacity, and so on. So how to model water transport of the reconstructed stratified soils well? And the possibilities of salt contaminants moving to groundwater or confining crop root activities need confirm.

Materials and methods

Different field plots were constructed as 100x100x200 cm^3, control plots (undisturbed), topsoil 25 cm and 45 cm experimental plots filled with FA . -150 cm groundwater table was controlled and the winter wheat was planted in all plots. Tensiometers were inserted into depth -20, -40, and -60 cm for monitoring soil water potential respectively, and probes were settled simultaneously for extracting the solution to determine soluble salt concentration.

The water retention curve (WRC) and saturated hydraulic conductivity (Ks) were measured in the laboratory, while the unsaturated hydraulic conductivity function was estimated from WRC and Ks.

Results and discussion

Water content of FA in experimental plots are close to saturation in wheat growing period under the given groundwater level (-150 cm), less impact from weather conditions. A limited additional thickness does not improve topsoil water content. Modeling directly water transport by Richardsâ™ equation with root water uptake is obvious defect, namely calculated values is significantly lower than measured ones. So compensation factor are added to the water movement model. SO_4^{2-}, Mg^{2+}, and Ca^{2+} content are higher of reconstruction soil profile in experimental plots, and $CO_3^{2-}$and HCO_3^- content lower than that of control plots.

Conclusions

High water content in FA layers is invalid to covering soil and inversely stress wheat root activities. Total soluble salt content in reconstruction soil profiles is averagely 3.821 $g \cdot kg^{-1}$ in harvest stage, and the correlation coefficient between total soluble salt of topsoil and wheat grain yield is 0.9908, as remarkably related ($p<0.01$). The salt content of FA can affect on the wheat yield in reconstruction soil, and the reason is because low its content cannot obtain optimum absorption state of nutrition salt.

3. DEGRADATION of SUITMAs and HUMAN HEALTH

POSTER PRESENTATIONS

SULPHATE RELEASE FROM CONSTRUCTION AND DEMOLITION MATERIAL IN URBAN SOILS

Stefan Abel, Thomas Nehls, Gerd Wessolek

Technische Universität Berlin, Germany
e-mail: stefan.abel@tu-berlin.de

Keywords: sulphate release, calcium sulphate, construction and demolition material, technogenic soil substrates

In Berlin and many other cities soils are heavily influenced by anthropogenic activities and deposited substrates. A widespread technical substrate in technosols is construction and demolition material from residential and industrial buildings. Existing rubble landfills without sealing facilities pose threats to ground water quality.

In the central city of Berlin rising sulphate concentrations of groundwaters (up to 1200 $mg \cdot dm^{-3}$) are measured since more than two decades. Previous studies point out that the high sulphate concentrations are mainly attributed to World War II rubble. The major part of debris was deposited in form of landfills and contains approximately 0.3 wt% gypsum.

The scope of our research is to determine mechanisms of sulphate release from debris material, interactions between sulphate release, soil hydraulic properties and potential sinks of sulphur. To estimate equilibrium concentration of sulphate release of various debris components batch and column experiments are conducted. To analyse the impacts of soil hydraulic properties on sulphate leaching we carry out soil column experiments with defined boundary conditions and different water flow velocities. Simultaneously we monitor sulphate concentration of soil leachate in a 1.8 m^2 lysimeter.

First results of the batch experiments show that gypsum from broken stucco is the main source of sulphate in the observed technosols. Other components as mortar and slag show a quite low sulphate release. Similar results are found within the column experiments. For brigs medium and strongly time dependent sulphate release is determined. Concentrations up to 1200 $\mu g \cdot dm^{-3}$ are measured in the soil leachate from the lysimeter.

We conclude that the sulphate release differs among the various components. In further column experiments we will focus our studies on the adsorption and retardation of sulphate in the soil.

PROPERTIES OF THE ORGANIC MATTER OF FLUVISOLS OF THE LOWER VISTULA FLOODPLAIN

Magdalena Banach-Szott, Krystyna Kondratowicz-Maciejewska, Mirosław Kobierski

University of Technology and Life Sciences, Bydgoszcz, Poland
e-mail: magdybe@poczta.fm

Keywords: Fluvisols, humic acids, HPLC, HPSEC

The research covered the Lover Vistula floodplain (Poland), undergoing intensive flooding processes. Fluvial sediments deposited during the annual flood events determine the properties of Fluvisols with agricultural activity, connected with cereals growing and cattle grazing in pasture land. The aim of the paper was to provide characteristics of organic matter in the surface horizons of the soils located at a different distance from the Vistula riverbed, namely 50, 200, 600 and 900 m. The following were assayed in the soil samples: the basic physicochemical properties of soils, content of carbon of humic acids (C_{HAs}), of fulvic acids (C_{FAs}) and humins (C_{HUMIN}) as well as dissolved organic carbon (DOC). There was performed a chromatographic separation of humic acids (HAs) into fractions: high- (S1) and low-molecular (S2) as well as hydrophilic (HIL) and hydrophobic (HOB) fractions. The results demonstrated that the land use method affected the soil properties. Higher values of basic soil properties and a higher share of fractions DOC, C_{HAs} and C_{FAs} were reported for the soil sampled from the pasture land, as compared with the arable soils. The share of the HIL and HOB fractions in HAs depended on the soil sampling site since the greater the distance from the riverbed, the greater the share of the hydrophilic fraction. The humic acids of the soils sampled 600 and 900 m away showed a greater share of fraction S1, as compared with the HAs of the soils 50 and 200 m away from the Vistula riverbed. Besides, in the HAs of the humus horizon of the pasture land there were identified higher values of the S1/S2 ratio, as compared with the HAs of the plough horizon of the arable fields. A varied range of flood events affected the properties of both organic matter and humic acids of the soils. The organic matter of the soils away from the Vistula riverbed (600 and 900 m) demonstrated a higher share of fractions DOC, C_{HAs}, C_{FAs}, as compared with the soil sampled 50 and 200m way from the river. The humic acids of the soils most distant from the riverbed showed a higher molecular weight and a higher level of aromaticity, as compared with the HAs of the soils 50 and 200 m away. The relationships point to the range of flood events determining the properties of organic matter in Fluvisols of the Vistula floodplain.

USE OF PORTABLE X-RAY FLUORESCENCE FOR HEAVY METAL QUANTIFICATION IN URBAN SOILS

Philippe Branchu, Liliane Jean-Soro, Catherine Franck-Néel

Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux (IFSTTAR), Centre de Nantes, France
e-mail: liliane.jean-soro@ifsttar.fr

Keywords: Urban soil, heavy metal, quantification, portable X-Ray fluorescence

Main problem

In urban soils, heavy metal concentrations are controlled by a great variety of factors: natural background, historical land use and land use practices (excavated material/backfill, potentially polluting activities), vicinity of contaminant sources (road infrastructure, waste incinerator). Due to this variety, a huge range of metal contents occurs (from µg up to several g/kg) with important spatial variability thus requiring a large number of chemical analysis with a sufficient spatial distribution. To this purpose, high-yield field methods such as LIBS (Laser Induced Breakdown Spectroscopy) or XRF (X-ray fluorescence) present advantage of being rapid, cheap and non-destructive. However, these analytical tools are sensitive to matrix variations (water content, texture). Therefore, data are often used as qualitative or semi-quantitative values.
The main objective of this study is to illustrate, through laboratory and field investigations, the quantification capacity of a field-portable XRF (PXRF) spectrometer, the Niton XL3T GOLDD.

Methods

Intrinsic performances were tested by certified reference materials (CRM) and materials from proficiency testing programs (PTP). XRF sensitivity tests were performed for: (i) analytical conditions (eg. measure durations), (ii) matrix effect, (iii) texture and aggregation effect and (iv) water content. PXRF analysis of urban soils from Parisian Basin and Armorican Massif were compared to data acquired with normalized methods (acid digestion with aqua regia and analysis with ICP-OES or G/F-AAS).

Results and conclusions

Measures on PTP and CRM realized in optimal conditions (dried and sieved samples) show strong correlation (r^2>0.8) between PXRF and conventional analysis for Pb, Zb, Cu, As, Ni, Fe, Ca and K and weak correlation for Cr (r^2=0.5). Sensitivity tests show that water content influence XRF measures more than the soils texture. Data obtained with PXRF on urban soils in degraded conditions (wet samples, 4 mm sieved) show a strong correlation with normalized approach for Pb, Zn, Cu and Ca (linear regression with r^2>0.8).
Even if XRF measures are sensitive to sample preparation, a quantitative approach of urban soil characterization was possible using a correction factor based on cross-analysis with normalised methods. This cost effective approach thus allows to optimise urban soil investigations.

HEAVY METALS CONTENT IN ANTHROPOGENIC SEDIMENTS FROM SZCZECIN OLD TOWN AREA

Justyna Chudecka[a], Joanna Podlasińska[b]

[a]*Department of Reclamation and Chemistry of Environment*
[b] *Department of Environmental Management and Protection, Faculty of Environmental Management and Agriculture, West Pomeranian University of Technology Szczecin, Słowackiego 17 Str., 71-434 Szczecin, Poland*
e-mail: Joanna.Podlasinska@zut.edu.pl

Keywords: urban soils and grounds, anthropogenic sediments, mechanical pollutants, heavy metals

The main aim of this study was to characterize the anthropogenic sediments lingering in the oldest area of the Szczecin city. In particular the total content of Zn, Cu, Pb, Ni, Cr and Cd, as well as the morphology, particle size and basic chemical properties.
Material for analysis was taken from a drilling made in the center of the old town, on the lawn of the White Eagle Square. Old Town is the oldest settlement area in Szczecin, dated to the second half of the eighth century. After giving the city rights to Szczecin in 1243 year, the area has been surrounded by defensive walls. Those walls haven't been enlarged, despite the growing number of people, up to the year 1873, when the city walls have been demolished. This area underwent the strong anthropogenic pressure for over a thousand years. Drilling was carried out by the entire thickness of the anthropogenic deposits up to the depth of the natural material.

Collected material was analyzed according to the methods commonly used in soil science. It was found that the layer of anthropogenic sediments of the Old City of Szczecin reached thickness of about 4 m, and its' materials are enriched in organic matter, including decay. These deposits contain a huge amount of impurities, in which dominating fraction are the waste from construction debris. They are formed in a typically rubble layer of ten feet thickness within the anthropogenic layer. Rubble waste enriched the anthropogenic soil in calcium carbonate, and alkalized it, even to the level pH_{KCl} = 8.7. Rubble addition caused a substantial increase in the content of lead and zinc in the sediments, distinct increase – of copper and in a small degree of cadmium. The influence of rubble addition to increasing of nickel and chromium content in sediments was not confirmed. The maximum content of Zn, Cu, Pb and Cd, recorded in a typically rubble layer, were as follows: 685, 146, 716, and 1.7 $mg \cdot kg^{-1}$. These amounts exceeded acceptable levels defined by Polish law, especially seven times for the lead, twice times for zinc and one and a half times for copper.

SALINITY AND TOTAL CONTENT OF CO, MN, FE IN MECHANICALLY POLLUTED SEDIMENTS OF PEAT-BOG

Justyna Chudecka[a], Joanna Podlasińska[b]

[a]*Department of Reclamation and Chemistry of Environment,*
[b]*Department of Environmental Management and Protection, Faculty of Environmental Management and Agriculture, West Pomeranian University of Technology Szczecin, Słowackiego 17 Str., 71-434 Szczecin, Poland*
e-mail: Joanna.Podlasinska@zut.edu.pl

Keywords: mechanical pollutants of soils, sediments, heavy metals, suburban areas

The aim of this work is the assessment of influence of mechanical pollution on salinity and total content of cobalt, manganese and iron in peat-bog sediments from the urban area of Szczecin city (Duńska Street).

The soils and grounds of old cities and suburban areas were subjected to long-lasting and strong human pressure and this is why they often contain so-called "longstanding, barred loads". These old contaminations are a constant threat to groundwater quality and danger of accumulation of toxic substances in living organisms. The area along Duńska Street in Szczecin was until recently cultivated fields and waste lands within Warszewskie Hills, where between end-moraine plateaus, peat-bogs were formed. Some of them, especially the very deep, were used by German settlers and Polish inhabitants as local landfills of household wastes. In one of such peat-bogs authors made in 2007 bore-hole to the depth of 11.5 m below ground level, drilling the whole thickness of anthropogenic sediments (mechanically polluted) until the ceiling of natural material (clay). From separated layers of bore-hole were collected 13 samples.

Within the anthropogenic skeleton, authors analyzed kinds of mechanical pollutants and character of dominant impurities. In samples without skeleton, the following properties were analyzed: losses on ignition, pH in 1M KCl, electric conductivity (EC), total content of cobalt, manganese and iron. The texture was analyzed for samples containing up to 10% organic matter. The correlation coefficients of Pearson's (r) were calculated using Excel Program.

Examined soil material taken from bog-peat contained in average 35% of skeleton (maximum - up to 65%). The top two meters thick layer of deluvial sediments were characterized by distinctly lower quantity of anthropogenic skeleton in relation to lower sediments layer lying down at 2.0-10.8 m below ground layer. This layer characterizes in average seven times higher EC values than the top (0-2.0 m) one, it is also less contaminated by anthropogenic skeleton layer. The important statistical dependence between cobalt and manganese (r=0.65) and iron (r=0.77) content was stated. Statistically important correlation (r=0.80) was also stated for organic matter and manganese content.

HYDRODYNAMIC PROPERTIES AND PORAL SPACE ORGANISATION EVOLUTION OF INFILTRATION BASIN SEDIMENT

Anais Coulon, Laure Vidal-Beaudet, Patrice Cannavo

Agrocampus Ouest - Centre d'Angers, UR EPHOR, France
e-mail: patrice.cannavo@agrocampus-ouest.fr

Keywords: Hydrodynamic properties, pore space organisation, sediment, infiltration basin

Infiltration basins that collect rainwater runoff make it possible to decrease their flow and/or volume while allowing for groundwater recharge. However, infiltration basin capacity is progressively limited by the settling of suspended matter to the bottom of the basin. This leads to progressive clogging of the basin. During the clogging process, the sediment layer, whose thickness increases with time, is submitted to physical and chemical changes that lead to changes in the hydrodynamic properties of the basin. The objective of our work was to study the physical process of sediment clogging at the millimetre scale to better understand the global hydrodynamic functioning of the Cheviré infiltration basin (Nantes, France).

The experiment was conducted in laboratory, on soil columns (10 cm in dia). The columns were filled in with 20-cm thick sandy soil made of original soil from the basin, above which sediment progressively settles. Basin ageing was accelerated in order to simulate 36 months of functioning within 9 weeks in the laboratory. To do this, water supply was based on the rainfall regime of the Nantes city area (mean annual rainfall of 820 mm). Before each water supply, dry sediment quantities from the Cheviré basin were applied onto the surface of the columns. These quantities were based on the mean concentration of suspended matter in water runoff in the basin (ie 400 mg L^{-1}). Two times a day and 5 days a week, the soil columns were water-supplied for 4hrs with a flow of 20 mL min^{-1}. Sediment layer thickness, matric potential at 2, 10 and 18 cm from the soil base, saturated hydraulic conductivity, and the water volume collected at the base of the columns were continually measured. A rest time of 8 hrs between rainfalls was respected. The following parameters were studied after 6, 12, 24 and 36 months of basin functioning (2 replicates): poral space analysis by image analysis, and total organic carbon content (TOC). Microbial processes were supposed negligible, following Coulon et al. (2012) who measured extremely low organic matter mineralisation and microbial biomass.

Our results show that sediment accumulation represented 1 $cm \cdot yr^{-1}$, as observed in the basin, without solid particle migration into the sand. From 6 months of ageing, a water layer became visible above the sediment layer; it reached 16 cm height after 36 months, whereas the sediment layer was 3 cm thick. Over the 36 months of the experiment, saturated hydraulic conductivity was divided by 4, decreasing from $28 \cdot 10^{-6}$ to $7 \cdot 10^{-6}$ $m \cdot s^{-1}$. This suggested a modification in sediment organisation along with time. Image analysis confirmed this hypothesis. Along with time, void spaces in the sediment decreased. During the first 24 months, the number of small-size sediment particles was high. However, after 36 months, this number decreased strongly to the benefit of large-size sediment particles. This analysis shows that over time, sediments tended to clog up and build up big solid masses. This contributed to decreasing intrinsic sediment porosity, and thereby its infiltration capacity, leading to clogging. These results went along with measurements performed at the meter scale in the Cheviré basin (Coulon et al. 2012) and made it possible to improve the understanding of the infiltration basin clogging process.

FORMS AND MOBILITY OF HEAVY METALS IN SOILS OF PARK AREAS FROM THE CITY OF BYDGOSZCZ

Halina Dąbkowska-Naskręt

University of Technology and Agriculture, Bydgoszcz, Poland
e-mail: dabkowska@utp.edu.pl

Keywords: heavy metals, mobility, park soils

Increasing human activity affects urban ecosystem, including soils. The objectives of the study were: (1) to examine contents of lead, cadmium, copper, zinc and manganese in soils of city parks and green areas from Bydgoszcz agglomeration, (2) estimate their forms and mobility, (3) characterize distribution within soil profile, (4) estimate their origin - anthropogenic or natural. Three green areas from the older part of the city were selected for the study. Multistep sequential extraction was conducted for the separation of seven metal fractions. Chemical parameters such as total metal contents, soil pH, organic carbon, and texture were determined. Statistical analysis was used for the interpretation of the data. It is concluded that a significant degree of metal pollution occurs in soils, particulary for zinc and lead. These metals exist mainly in relatively mobile forms i.e. as exchangeable cations and associated with soil organic matter. The distribution within soil depth varied due to the elution process and variation of mixed soil material and additives.

ACCUMULATION AND DESTRUCTION OF POLYCHLORINATED BIPHENYLS BY *MEDICAGO SATIVA* AND *AGROSTIS TENUS* IN SERPUKHOV CITY SOILS

Dmitry Demin, Danila Aladin, Ivan Tatarkin, Sergey Sevostyanov, Nadezhda Deeva, Aleftina Ilyina

Institute of Basic Biological Problems RAS, Russian Federation
e-mail: aladin-danila@rambler.ru

Keywords: dioxins, polychlorinated biphenyls, congeners, biodegradation, phytoremediation, sanitation

Problem of pollution Serpukhov city soils by polychlorinated biphenyls (PCB) is relevant for several decades. Due to the high stability of these compounds in the environment self-purification processes if soils are extremely slow. Within the city, there are some areas, the degree of pollution which lately has not decreased, but increased. Due to the broad pollution of the city, which housed the production of toxicant, a combustion method of urban soils seems too costly and requires the development of biotechnological methods to reduce pollutant concentrations in urban soils. The experiment was carried out with two plants: alfalfa (Medicago sativa) and bentgrass (Agrostis tenus). Larger PCB doses in the soil leads to inhibition of plants at different stages of their vegetation. The level of inhibition depends on the plant species. Thus, noted inhibition of alfalfa in the early stages of plant development. Subsequently, observed adaptation to high doses of PCBs in soil for this species. For bentgrass was revealed inverse relationship. Initially, the presence of organochlorine compounds in the soil stimulates plant growth. After a certain period of time takes place the oppression of the species and its lag in development compared to the control. Our data showed that the accumulation of PCBs by roots of these plant species is several times higher than the accumulation by green mass. Has been argued that because of the low solubility and high sorption capacities of hydrophobic organic compounds are not able to translocate from the root system in ground part, and vice versa. In our experiment, the air transport of PCBs has been excluded. We can therefore conclude that the translocation of PCBs from the roots to the shoots is still going, but the extent of this process are small. At approximately same mass of plants absorption of PCBs different. Thus the roots of alfalfa accumulate PCBs in 2 times more than the bentgrass, and for aboveground mass accumulation in alfalfa up to 1.7 times. Notes changes of congener compound in soil samples after the growth of plants. In PCB compound observed increase content of light fractions from 51.6% at baseline to 59% of the soil and 60.6% after the alfalfa and bentgrass, respectively. That is, the molecules of PCB dehalogenation takes place, which is a positive result, because most low-chlorinated congeners are available for microbial degradation.

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SPATIAL DISTRIBUTION AND SIMULATED INTAKE OF PB AND NI IN SANDBOXES OF THE CITY POZNAN (POLAND)

J. Diatta, W. Grzebisz, K. Przygocka-Cyna, D. Swędrzyńska, A. Andrzejewska, M. Formanek

Poznań University of Life Sciences, Department of Agricultural Chemistry and Environment, Poland
e-mail: Jeandiatta63@yahoo.com

Aim, Materials and Methods

The purpose of the study was to evaluated the levels of lead (Pb) and nickel (Ni) in sandboxes (SB) of the city Poznan and to assess their potential intake by children. Sand samples were gathered from sandboxes within Poznan agglomeration which was divided into five zones: Zone 1: 20; Zone 2: 30; Zone 3: 18; Zone 4: 29; Zone 5. In total 110 sandboxes have been investigated. Sand samples were subjected to the following analyses: pH - H_2O, electrical conductivity (EC). Moreover, for all samples the total content of Pb, Ni and the physiologically available fractions (Physiologically Based Extraction Test - PBET test) were determined. Furthermore, the potential intake of PbPI and NiPI by children frequenting these places have been evaluated.

Results

The amounts of Total Pb and Ni varied from 8.97 to 11.09 and 1.62 to 2.83 mg kg^{-1}, irrespective of the investigated zones. In the case of the PBET concentrations, i.e., physiologically available, the following ranges have been observed: Pb: 2.26-3.71 and Ni: 0.27-0.71 mg kg^{-1}. The calculated potential intake (PI) of Pb and Ni from the respective zones dealt with children < 6 years and 15 kg body weight. The lowest PI value amounted to 0.0301, whereas the highest reached 0.0494 µg kg^{-1} body day^{-1}. Nickel levels fluctuated within the ranges 0.0055 and 0.0096 µg kg^{-1} body day^{-1}.

Conclusions

These reported data show a zone-dependent distribution of Pb and Ni. Risk assessment models indicated that potential metal intakes can be predicted by the knowledge of the level of physiologically bioavailable metal fractions (PBET test).

References

Ruby M.V., Schoof R., Brattin W., Goldade M., Post G., Hanois M., Mosby D.E., Casteel S.W., Berti W., Carpenter M., Edwards D., Cragin D., Chappell W. (1999). Advances in evaluation the oral bioavailability of inorganics in soil for use in human health risk assessment. Environ. Sci. Technol. 33, 3697.

Biesiada M. (ed.). (2006). Heath risk evaluation of inhabitants of Wiślinki as related to the impact of the phosphate-gypsum slag heap. Inst. Med. Pr. i Zdrow. Środow., Sosnowiec, 72 p. (in Polish).

MOBILITY OF CU AND CO IN METALLIFEROUS ECOSYSTEMS: RESULTS OF A LYSIMETER STUDY IN LUBUMBASHI (RDC)

Kaya Muyumba Donato[a,b], Lienard Amandine[a], Pourret Olivier[c], Mahy Gregory[a], Ngongo Luhembwe Michel[b], Colinet Gilles[a]

[a] *University of Liege, Gembloux Agro – Bio Tech,*
[b] *University of Lubumbashi, Faculté d'agronomie, RDCongo*
[c] *Institut LaSalle, Beauvais, France*
e-mail: Gilles.Colinet@ulg.ac.be

Keywords: Copper, Cobalt, ecosystems, mobility, lysimeter

Numerous soils in Katanga have been contaminated by Cu-ore extracting and treatment activities. In order to further develop phytostabilization, as well as conservation of biodiversity, research are conducted in natural ecosystems of the copper hills to evaluate mobility of Cu and Co in soil-plant systems.

This paper presents the results of a lysimeter experiment in which a forest soil has been artificially spiked with rock fragments from outcrops of Fungurume hills. The Cu an Co content of percolating water has been analysed at repeated intervals and the impact of rock on soil properties was evaluated at the end of the experimentation.

Five rocks were sampled in one copper hill. These rocks outcrop at the upper part of the hill and are mixed to surface soil horizon along the slope through colluvial processes. Cu and Co contents of these rocks range between 470 (Siliceous Rock) and 140,000 ppm (Shale) and between 450 (dolostone) and 5,300 ppm (Shale). Rock fragments were mixed with two horizons (Hemiorganic A, 2,7% of Total Organic Carbon, and mineral B, 0.3% of TOC) of an acid (pH_{water}<4,5) acrisol under forest. Mixture was installed in 1L-lysimeters and left in Lubumbashi outdoor conditions during the rain season. Percolating water has been collected at six periods and the content in Cu and Co has been analyzed. At the end of the experiment, the soil from the lysimeters was removed for analysis of pH, TOC, available nutrient and trace elements, $CaCl_2$-extractable Cu and Co.

Results show strong differences of Cu and Co release in the percolating solutions according to the nature of rock. Unsurprisingly, the quantities released were correlated to the quantities originally present in the unweathered rocks. At The concentrations of the percolating solutions are variable between periods but no constant trend could be found.

Differences were also found between horizon A et B which indicate that the physico-chemical properties of the soil do influence the reaction with the rock, among the differences between both horizons are mainly the organic content, the cationic exchange capacity and the nutrient content which were higher in the A horizon, and the pH which was more acid compared to B horizon. Differences in biological activities should therefore occur.

Significant correlations were found between chemically –extractable Cu and Co and concentrations of the soil percolates. The $CaCl_2$ extractable Cu an Co can therefore be used as proxies of risks of soil solution in the assessment of vertical migrations.

ASSESSEMENT OF BOTTOM SEDIMENTS FROM AREA IN EASTERN SLOVAKIA BY MEANS OF THERMAL AND SPECTRAL ANALYZES

Lenka Findoráková, Oľga Šestinová, Jozef Hančulák

Slovak Academy of Sciences, Institute of Geotechnics, Department of Environment and Hygiene in Mining, Watsonova 45, 043 53 Košice, Slovak Republic
e-mail: findorakova@saske.sk

Keywords: bottom sediment, particle size, trace and semi-metals, thermal analysis (TG/DTG, DTA), X-ray Fluorescence Spectrometry (XRF)

Purpose

There is growing interest in the characterization of the physico-chemical properties of the bottom sediments from the Water reservoir the Ružín No.1, which is located in Eastern Slovakia, because of their removal and finding ways how to use them. The aim was to describe the physico-chemical properties of bottom sediments collected in years 2010-2011 and compare the obtained results. Attention was also paid to study the mineralogical composition and thermal properties of sediments in fractions 100, 63, 40 and under 40 µm. The concentrations of metals (Cu, Zn, Cr, Cd, As, Pb, Hg) in individual sediment fractions were investigated due to understanding of sediment contamination and potential toxicity.

Materials and methods

Sediments were collected from a monitoring station on the Water reservoir the Ružín No.1 concretely on the river Hornád during two years (2010-2011). The mineralogical composition of the individual fractions was investigated through X-ray powder diffraction (XRPD) integrated with differential (DTA) and thermogravimetric analysis (DTG). The infrared spectroscopy (IR) was also done to diagnostic their mineralogy. The concentrations of metals were analyzed using XRF, F-AAS and RF-AAS methods.

Results and discussion

It was found that the highest concentration of trace metals was occurred in the fraction < 40 µm. The results of X-ray powder diffractometry (XRPD) showed that the study sediments contain the reflection of quartz, kaolinite, aragonite, montmorillonite and aluminum oxide at the beginning of their thermal decomposition. The main reflection was found quartz (SiO_2) in both samples. The reflection of quartz a bit decreased after thermal decomposition of samples, which was confirmed by XRPD. The thermal analysis results showed that thermal decomposition of sediment in individual fractions is multistep process and the samples in fraction > 40 µm has the highest thermal stability.

Conclusions

The results from combination of thermal (TG/DTG, DTA) and spectral (XRPD, XRF, IR) techniques were used to characterization of the contaminated sediments. The obtained results might be useful in the planning of further sediment utilization.

GREEN MANURE PLANTS FOR POLLUTED SOIL RE-FUNCTIONALIZATION IN THE CASE OF URBAN BROWNFIELDS OR KITCHEN GARDENS CONTAMINATED BY METALS AND METALLOIDS

Yann Foucault, Thibaut Leveque, Tiantian Xiong, Eva Schreck, Annabelle Austruy, Muhammad Shahid, Camille Dumat

STCM, France
e-mail: yann_foucault@hotmail.fr

Keywords: green manure plants, metal(loid)s, polluted soils, soil respiration, ecotoxicity, bioaccessibility, phytoremediation and bioavailability

Rehabilitation of urban brownfields is nowadays a major issue for sustainable development of towns in the world. Among the techniques used to clean up sites contaminated with persistent metal(loid)s, phytoremediation is based on the natural abilities of certain plant species to extract or stabilize these elements. Usually used in agriculture or by gardeners, green manures plants improve the bio-physic-chemical properties of soils thanks to a highly developed root system and exudates roduction. The scientific questions investigated here were: green manure crops are they adaptable to different polluted soil conditions? Are green manures effective for refunctionalization of contaminated soils? To our knowledge, for the first time, green manures plants were tested on various polluted soils, with measures before and after treatment of both metal(loid)s transfers, ecotoxicity, soil respiration and human bioaccessibility. Borage (Borago officinalis), white mustard (*Sinapis alba L.*) and phacelia (*Phacelia stala*) were cultivated 10 weeks in various exposure conditions: different concentrations of metal(loid)s (up to 825 mg· kg^{-1} Pb and presence of Sb, Cd, Cu and Zn) and various soils (contrasted organic matter and $CaCO_3$ contents, pH and texture). Results firstly showed that unlike to phacelia, borage and mustard are able to efficiently grow on various polluted soils and modify soil characteristics, metal(loid)s behaviour and impact. Actually, borage and mustard increase soil respiration; decrease metal(loid)s ecotoxicity, quantities of bioaccessible lead and total metal(loid)s quantities in polluted soils respectively by phytostabilization and phytoextraction mechanisms. The plant efficiency to improve soil quality depends on soil characteristics, in relation to metal(loid)s compartmentalization and speciation. Results are thus encouraging for an original use of these two green manure plants to improve soil quality and reduce environmental and sanitary risks in the case of polluted soils in urban areas.

QUANTIFYING IMPACTS OF HISTORICAL SMELTING INDUSTRY ON SOILS: CONTRIBUTION OF THE PB ISOTOPES

Catherine Franck-Néel, Jakub Kierczak, Anna Potys, Anna Pietranik, Rafał Tyszka

CETE de Lyon, Département Laboratoire de Clermont-Ferrand, France
Groupe Risques Environnement Infrastructures
e-mail: catherine.neel@developpement-durable.gouv.fr

Keywords: historical industry, slag, lead

Main problem
Assessment of the heavy metals contamination induced by the smelting industry is of major concern especially when it comes to convert the former industrial site into a public area. However, it remains difficult to predict the natural evolution of the slags in soils over a long term. Therefore analysis of historical industrial sites seems to be of the particular interest. In the area of the Rudawy Janowickie Mountains (south-western Poland), historical Cu-slags were deposited from the 14th to the 16th century and are now forming unconfined heaps covered by a forest that is opened to the public. During the post-industrial period, slag particles were naturally transported by streams and distributed in the surroundings (Kierczak and Pietrani 2011). The study show how classical pedological and chemical analyses take benefit of measurements of the Pb isotopes for quantifying the human impact.

Methods
Four soil profiles were analyzed, each derived from a different underlying material. Profile 1 was set in the area where slags were not present and was developed on granite (background level). Profile 2 is also developed on granite, but set in the area where slags could have been spread. Profiles 3 and 4 were derived on a substrate consisting of a mixture of river sediments and slags and a slag heap, respectively.

Results and conclusions
The contamination in profiles 3 and 4 is evident as slag fragments occur within both profiles whereas profile 2 does not contain slag fragments, but shows Pb concentrations and 206Pb/207Pb ratios in horizons O and B similar to those in profile 3. The classical geochemical approach can only evidence enrichment in heavy metals of the topsoil. Comparatively, the 206Pb/207Pb isotope ratio (Kierczak et al, 2013) indicates that the slag-derived Pb was up to 60% in soils developed on the slag heaps (profile 3 and 4) and up to 40% in soils located a few meters from the slag heaps (profile 2). However, these results based on chemical composition
of horizons could be calculated only after a complete characterization of the slag particles present as a coarse fraction within the soils (mineralogy, leaching experiment).

References
Kierczak J & Pieranik A (2011) Mineralogy and composition of historical Cu slags from the Rudawy Janowickie Mountains. The Can. Min. vol 49 (5), 1029-1044
Kierczak et al (2013) Environmental impact of the historical Cu smelting in the Rudawy Janowickie 2 Mountains. J. of Geoch. Expl. vol 124, 183-194.

SOIL POLLUTION BY ATMOSPHERIC FINE PARTICLES ENRICHES WITH METAL(LOID)S: BIODISPONIBILITY AND (ECO)TOXICITY

Sylvaine Goix, Tiantian Xiong, Yann Foucault, Thibaut Leveque, Camille Dumat

ENSAT-Ecolab
e-mail: yann_foucault@hotmail.fr

Keywords: ultrafine particles, human health, ecotoxicity, bioaccessibility

Ultrafine particles enriched with metals and metalloids (PM) are emitted into the environment by various human activities (recycling plants, agriculture, mining/smelting ...) and can impact soil quality (Leveque et al., 2013; Foucault et al. 2013; Schreck et al., 2013). Studies of environmental and health impacts should be conducted throughout the life cycle of PM within the European REACH regulation. Our scientific project aims to study for metals and metalloids present in the PM, transfer to terrestrial ecosystems, ecotoxicity, bioaccessibility and toxicity (cellular and chemical tests). First test the toxicity and human bioavailability of different process PM (complex particles sampled in industrial sites) or model compounds (PbO, CdO, CuO): particles and polluted soils are studied. Size effects, the nature of the metal and mixing effects will be investigated. Acellular dithiothreitol chemical test (DTT) to measure the oxydative potential and bioaccessibility (Barge protocol) will be used. In collaboration with the LMRCX, cellular tests like cytotoxicity and inflammatory response in lung epithelial cells (WST) and protein oxidative damage will be then performed. Finally, ecotoxicity of PM will be measured by additional tests on terrestrial and aquatic organisms: Microtox test (bacterial), germination test, earthworms, etc.

Results indicate a strong influence of metal type, interaction with soil components (Schreck et al., 2011), speciation and particle size on inorganic pollutants transfer to terrestrial ecosystem (Schreck et al. 2012), (eco)toxicity (Uzu et al., 2011; Shahid et al., 2011) and bioavailability (Goix et al., 2012). Further, a global analysis of all the parameters can permit to propose a classification for these PM in relation with potential of transfer and (eco)toxicity. Moreover, as a perspective, the use of isotopic tool in the case of lead and cadmium for the various compartments (according to bioaccessibility, bioavailability?) could permit to highlight the mechanisms involved.

SOIL INVESTIGATION FOR THE REFORESTATION OF AN ABANDONED MILITARY AREA

Adrienn Horváth, András Bidló

University of West Hungary, Department of Soil Site Survey, Sopron, Hungary
e-mail: hadri@emk.nyme.hu

Keywords: Leptosol, reforestation, abandoned military area

In the course of our investigation we have analysed a polluted military area with a special soil type, intended for reforestation in the West-Transdanubian region, Hungary. The Hungarian special trait of this gritty clayey leptosol formed on alluvial deposit is that under the thin-skinned and acidic tilth lays a hard-faced gravel layer with iron compounds was formed, as a result of river drifts. This layer hinders the thickening of the tilth and it also impairs the water management and the air circulation of the soil. The study area of 65 hectare was used as a military shooting-range, therefore the surface and the subsurface is affected by heavy pollution, especially as the recultivation of the area has not been commenced yet. Altogether 50 samples from 12 soil profiles have been collected which proved to be substantial for the proper characterisation of the territory. After a ground reconnaissance we have been focused on the following properties and components in the laboratory: skeletal percent, acidity (pH-H_2O, pH-KCl), calcium-carbonate content, hydrolytic and exchange acidity, particle size distribution and humus content. The pH-values (ranging between 5.0 and 6.0) revealed that the samples belonged to the slightly acidic or acidic category. The pH-KCl values followed the values of the watery pH, the values of the hydrolytic and exchange acidity were in the medium range. Significant acidification of the soil was not observed despite the load of the surface, thus the area is ready for a reforestation. The physical assortment of the samples belongs to the sandy clay or clay category that depends on the high skeletal percent, because it reduces the water holding capacity of the soil. Although the upper layers contained 1.02-3.02% humus, the territory can be characterized with medium humus content. Further research is required for a firm conclusion, but basing on the present results it can be suggested that the iron compounds present in some of the soil layers can make these layers hard-faced thus preventing water transport into the soil and the transport of contaminants from the surface into the lower layers. As the rate of acidification is low, Scots pine is a suitable species for the reforestation of these large areas. This species can also bear the unfavourable and altering water management of the soil and it is not susceptible to surface contaminations.

SPATIAL VARIABILITY OF SOIL SALINITY IN THE INDUSTRIAL AREA OF INOWROCŁAW, POLAND

Piotr Hulisz, Łukasz Mendyk

Department of Soil Science and Landscape Management, Nicolaus Copernicus University
e-mail: hulisz@umk.pl

Keywords: salt-affected soils, soda industry, soil degradation, soil salinity mapping

The development of the soda industry in Inowrocław (north-central Poland) is associated with the occurrence of the salt rock deposits. The soda plant was built south of the city centre in 1881 (Mątwy quarter). In the past, the activity of this factory had significant influence on the transformations of the local environment. The long-term storage of strongly saline, semi-fluid waste products in the waste ponds (135 ha), situated directly on permeable grounds without proper sealing of the bottom, caused strong groundwater and soil contamination. The research was carried out in 1996 and 2007 in the salt meadow (3.25 ha) adjacent to the waste ponds. The material collected from topsoils (0-25 cm, 50 samples) was analysed. The maps of soil salinity (EC_e, Cl^-) were plotted using kriging method (Surfer 8 and ArcGIS sofware). Despite the fact that the waste ponds are currently not used due to technological process modernization the soil salinity still remained relatively constant. There were also no significant spatial changes in electrical conductivity and chloride content during the study period. Two likely reasons for this situation include a huge amount of accumulated wastes and environmentally adverse location of the soda plant in the Noteć River valley. However, considering the location of waste ponds near the salt dome, intensively exploited in the past, a simultaneous effect of the natural salinity source cannot be excluded either.

EFFECT OF BIOCHAR AMENDMENT ON THE CHEMISTRY OF METAL CONTAMINATED SOIL NEARBY MINING SITE AND PLANT (*LACTUCA SATIVA* L.) RESPONSE

Kim Hyuck-Soo, Kim Kwon-Rae, Kim Ho-Jin, Lee Ho-Chul, Yang Jae E., Ok Yong-Sik, Kim Kye-Hoon

University of Seoul, Korea
e-mail: mint1125@uos.ac.kr

Keywords: rice hull-derived biochar, heavy metal, arsenic, immobilization, lettuce

Many remediation options have been applied to the heavy metal contaminated agricultural soils nearby abandoned mining sites mainly due to hazard effects of heavy metals to human through agricultural crop dietary. Hence, the current study was carried to examine the heavy metal immobilizing effect of biochar produced from rice hull and subsequent heavy metal uptake by lettuce.

For this, incubation and pot study were conducted using the metal contaminated soils obtained from upland nearby an abandoned mining site. The total concentrations (aqua regia digested) of Cd, Pb, Cu, Zn, and As in the initial soil were 5, 2781, 133, 689, and 528 $mg \cdot kg^{-1}$ respectively, which exceeded the guideline values in Soil Conservation Act, Korea. The introduced biochar was produced from rice hull (Rice hull Charcoal®, Daewon GSI, Korea), whose pH was 10.22. The biochar was incorporated to 1 kg each soil at 0, 0.5, 1, 2, 5, 10% (w/w) with triplicates for each treatment level. After that, soil pH and phytoavailable metal concentrations (1 M NH_4NO_3 extracted) were determined 0, 15, 30, 60 days after treatment. In the meanwhile, lettuces were cultivated in the soils incorporated with biochar at the same level with the incubation study and then soil pH, phytoavailable metal concentrations in soils, and metal contents in lettuces were determined after harvesting lettuces.

Biochar application declined the phytoavailable Cd, Pb, Cu, and Zn with observing the maximum decline in the soil received biochar at 10% in which the phytoavailable Cd, Pb, Cu, and Zn were 29, 274, 12, and 526 times lower than those of the control soil (no biochar treatment). The immobilization of heavy metals was related with the elevated soil pH following biochar incorporation ($p<0.0001$). The soil pH increased from 6.24 in control to 7.70 in biochar treated soil at 10%. In contrast to phytoavailable Cd, Pb, Cu, and Zn, phytoavailable As was not detected in all soils except the one with 10% biochar treatment. As a result of decline in phytoavailable heavy metals, metal uptake by lettuce was reduced showing positive relationship between phytoavailable metals in soil and metal contents in lettuce. Interestingly, dry weight of lettuce was declined as the biochar application rate increased despite decline in phytoavailable metal. This was related with the adsorption of inorganic N to biochar resulting in deficiency of N to lettuces.

SPATIAL VARIABILITY OF TOTAL FORMS OF COOPER AND ZINC IN SOILS OF THE FOREST PARK OF CULTURE AND LEISURE IN BYDGOSZCZ, NORTHWEST POLAND SUBJECTED TO THE CITY TRAFFIC

Hanna Jaworska, Jacek Długosz

Department of Soil Science and Soil Protection, University of Technology and Life Sciences, 6 Bernardyńska St., 85-029 Bydgoszcz, Poland
e-mail: hjawor@utp.edu.pl

Key words: spatial variability, geostatistics, cooper, zinc, city traffic

City traffic is one of the main reasons of contamination of the environment with heavy metals. They result from combustion of fuels, from abrasion of car tires and brakes, etc. Therefore the occurrence of heavy metals in the soil surface is considered a good indicator of the effects of car transportation on the condition of adjacent soils. Contaminants generated by cars are more dangerous than industrial ones because they are distributed very closely to the ground at higher concentrations and very close to the sites of human dwelling. The aim of the study was to evaluate the influence of the communications route on the spatial variability of total forms of cooper and zinc in soils of Forest Park of Culture and Leisure in Bydgoszcz. Soil samples were collected along the communication route, 25 meters away from road, every 100 m, from 0-20 and 20-40 cm depth. The following analysis were done: particle size (laser diffraction methods) pH (potencjometrically) and organic carbon content (by dichromate oxidation). The total content of Cu and Zn in soils was determined with the ASA method after mineralization in the mixture of HF and $HClO_4$ acids. To estimate the spatial variability of Cu and Zn in surface horizon of the studied area, geostatistical methods were used. Empiric and the best fitted model variograms were drown as well as the sill, nugget, nugget effect and the range of the influence were calculated.

The grain-size distribution of the soils qualified them as light soils, which suggests that the soils have low buffer properties, and as such they are susceptible to pollution . The analysis of granulation of soil samples indicates that their granulation is corresponding to a granulometric group of loamy sand, sand and sandy loam. In surface horizons the content of C_{ORG} ranged from 3.5 $g \cdot kg^{-1}$ to 14.6 $g \cdot kg^{-1}$. The pH in 1M KCl ranged from 6.01 to 8.03. The total content of Cu was in range of 4.84 – 18.9 $mg \cdot kg^{-1}$ in surface samples and 3.61-18.7 $mg \cdot kg^{-1}$ in sub-surface samples. The total content of Zn in the investigated soils was in range of 51.5-18.1 $mg \cdot kg^{-1}$ in surface samples and 12.9-81.4 $mg \cdot kg^{-1}$ in sub-surface samples. Spatial variability of total Cu and Zn was described by a spheric model with the nugget effect. The nugget effect calculated for Cu and Zn fitted in the medium class of spatial variability (nugget effect between 25% and 75%). Spatial autocorrelation range calculated for both Cu and Zn was similar (154 m and 163 m, respectively).

SHORT TIME CLAY EVOLUTION IN VARIOUS MINING TECHNOSOLS

Emmanuel Joussein, Marilyne Soubrand, Grégoire Pascaud

Université de Limoges, FST, GRESE, France
e-mail: emmanuel.joussein@unilim.fr

Keywords: mining soils, clays, soil evolution

Comprehensions of soils developed from human-made substrates are of interest due to the increase of the anthropogenic activities (mining or industrial) around the world. A part of these activities are responsible of the increase of contaminants occurrence in the environment. One of the main concerns of mining activities is the production of a huge amount of contaminated wastes, which are usually stored in the vicinity of mines. Soils can develop rapidly on these wastes whatever the properties of the media in relation to the colonisation of vegetation. These soils on mining substrates are referenced as Technosols or mining Technosols. The aim of this study is to understand the pedogenesis of young mining Technosols toward clay minerals evolution.

To do this, various mine soil profiles were sampled and present different kinetic of soils evolution (from 35 to 120 years old). Samples were characterized in term of pedological properties, chemical and mineralogical (XRD, SEM and TEM) characterization. Clay and fine clay fraction were also extracted and quantify from each soil sample then X-rayed onto oriented slides (natural and glycolated). Each XRD pattern has been decomposed from peakod.

The waste materials are metals and metalloids-rich whatever the soil samples and present fine size fraction. Technosols are naturally developed on it for each time evolution and accompanied by native vegetation. Clay minerals from XRD investigations evidenced for example the formation of smectite in the upper horizons in a short time (35 years). Results has to be taken as an indication of a low degree of evolution of these young Technosols, as already shown in the case of young volcanic soils with andic properties. Discussion will be realised toward soil pedogenesis, mineralogical way and physical chemical properties.

INVESTIGATING THE EFFICACY OF ZEROVALENT IRON PARTICLES FOR SOIL AND GROUNDWATER REMEDIATION

T. Kabeche, L. Muhr, C. Chene, M.O. Simonnot

Université de Lorraine CNRS, France
e-mail: *marie-odile.simonnot@univ-lorraine.fr*

Keywords: zerovalent iron, soil depollution, chromium

Reactions involving iron play a major role in the environmental cycling of a wide range of important organic, inorganic and radioactive contaminants [1]. Zerovalent iron (ZVI) powder micro and nanoparticles have been proposed as cost-effective materials to remediate soils and groundwater contaminated by a wide range of pollutants by in-situ or ex-situ techniques [2, 3]. They can be applied to organic pollutants e.g. chlorinated volatile organic compounds and to reducible inorganic compounds e.g. hexavalent chromium. In situ chemical reduction is currently an emerging clean-up process, especially when applied to soils in the vadose zone. This contribution aims at providing a better understanding of the processes governing the efficacy of ZVI particles in soil decontamination.

Six different samples of commercial ZVI powders, manufactured with several methods, were characterised and compared. Particle size distributions and BET surface areas were measured. Particle morphology was observed by scanning and transmission electron microscopy (SEM and TEM) and surface composition was obtained by EDX and Mössbauer spectroscopy. Redox potential and pH of the powders in water were measured and zeta potential against pH as well. Isoelectric points were determined.

Results of particle's properties are different from one to another, most of them are micrometric, and their median size is between 2.19 µm and 284.7 µm. SEM and TEM images showed that all of them form aggregates, different morphologies of particles were observed in the same sample, spheres, plates, fibers and irregular forms.

The proportion of elemental iron in the particle composition is 79%-94%. The main iron phase observed is Fe, iron oxides crystalline phases were also observed for the smallest one. Iso-electric point is in the range of pH 5.2-9.9.

All these characteristics compared with the ability of the powders to reduce chromium in controlled conditions provide a helpful tool to select ZVI for soil decontamination.

[1] A.B. Cundy, L. Hopkinson R.L.D. Whitby. Sci. Total Environ. 2008, 400, 42.
[2] K. Darko-Kagya, A.P. Khodadoust, K.R. Reddy. J. Hazard. Mater. 2010, 182, 177.
[3] A. Ghauch, A. Tuqan, H.A. Assi. Environ. Poll. 2009, 157, 1626.

INFLUENCE OF ASPHALT PAVEMENT ON ELEMENTAL COMPOSITION AND PHYSICO-CHEMICAL PROPERTIES OF SUBGRADE SOILS

Kimihiro Kida, Masayuki Kawahigashi

Department of Geography, Tokyo Metropolitan University, Japan
e-mail: egonoki-eko@sound.ocn.ne.jp

Keywords: urbanization, urban soils, subbase, alkalinization, material cycling

Road area in Japan occupies about 7500 km^2 equivalent to approximately 2% of Japanese land area and now it is still enlarging. In particular road cover in Tokyo region is high reaching to 183 km^2 corresponding to approximately 8% of total land area of Tokyo. Road area also spontaneously expands in world cities due to urbanization and increase in population. Materials consisting of road construction probably influence soil beneath an asphalt pavement that is Ekranic Technosols (WRB). In this study, vertical distribution of major elements in the soil profiles in subgrades, crushed-stones in subbases and asphalt layers were determined depending on road constructed years to reveal material cycling in urban ecosystems. Soils in the subgrades, blacktop and crushed-stones in the asphalt pavement structure were collected from differently aged roads. Physico-chemical properties and elemental analysis by X-ray fluorescence analysis were determined for the solid samples. Crushed-stones consisting of asphalt layers and subbases were characterized as high pH and C/N values and high content of Ca and sulfate. Elemental composition and physico-chemical properties changed with depth in soils in subgrades, indicating that artificial coverage of pavements influence on soils in upper layers of subgrades. The property of deeper soils was similar to natural soils locating close to the road. Materials from old subbases showed different properties in pH and Ca contents of those from new subbases probably due to the lapse of time after the road construction. Principal component analysis using the chemical properties and the elemental composition separated samples into new subbases, old subbases, asphalt layers and soils in subgrades by two major components characterized by major metal constituents in soils and additives for asphalt pavements. Broader distributions of samples in a scatter diagram of principal component scores were observed for both soils in subgrades and old subbases, indicating that elements and constituents originated from artificial materials in asphalt pavements moved with downward water infiltration. Since a permeable asphalt layer and/or cracks on an asphalt pavement allow water to infiltrate into soils in subgrades, water can drive material cycling in a road system.

EVALUATION OF THE CONTENT OF ZINC, COPPER, LEAD AND MERCURY IN THE RHIZOSPHERE SOIL OF DANDELION (*TARAXACUM OFFICINALE*) AND THE NON-RHIZOSPHERE SOIL OF GRASSLANDS

Mirosław Kobierski

Department of Soil Science and Soil Protection, University of Technology and Life Sciences, Bydgoszcz, Poland
e-mail: kobierski@utp.edu.pl

Keywords: rhizosphere soil, trace elements, floodplain

The environmentally valuable floodplain areas within the Chełmno and Vistula Landscape Parks (Lover Vistula Valley) are annually flooded with flood waters. The research covered grasslands within the Fordon Valley and Grudziądz Basin mesoregions floodplains. The research involved the sampling of dandelion (*Taraxacum officinale Veb.*) used in the natural environment bio-monitoring due to its high capacity for phytoextraction. The dandelion roots and leaves as well as the rhizosphere and non-rhizosphere soil were sampled from six sampling points. In the soil samples the following were assayed: basic physicochemical properties and the total content of zinc, copper, lead and mercury as well as the bioavailable forms of Zn, Cu and Pb. Similarly the content of metals in dandelion roots and leaves was determined.

The total Zn content in the non-rhizosphere soil ranged from 94.3 to 164.4 $mg \cdot kg^{-1}$ and for Cu – from 20.1 to 29.4 $mg \cdot kg^{-1}$ and it was higher than in the rhizosphere soil. As for lead, similarly its higher total content was recorded in the non-rhizosphere soil than in the rhiosphere soil. The total Hg content in the rhizosphere soil was similar and lower, as compared with the content noted for the non-rhizosphere soil. In the rhizosphere soil, however, there was found a higher content of Zn and Cu extracted with the DTPA solution than in the non-rhizosphere soil, unlike the content of bioavailable lead forms. As for the total content of the metals in the rhizosphere soil, for dandelion there were calculated the values of the translocation factor (TF) and bioaccumulation factor (BAF). The highest TF values from 7.50 to 30.0 were reported for Hg, which shows that the metal was accumulated mostly in the leaves. The rhizosphere soil rich in organic matter and the clay fraction creates a natural filter of an excessive pollution with trace elements deposited together with sediments during floods. Under Regulation of Minister of the Environment, of September 9, 2002 (Dz. U. No 165, item 1359), the non-rhizosphere soil of four out of the six grasslands was polluted with zinc.

INFLUENCE OF CHEMICAL TREATMENT OF SNOW REMOVAL ON THE SEASONAL CHANGES OF SALINITY IN SOILS ALONG THE ŻWIRKI AND WIGURY STREET IN WARSAW

Wojciech Kwasowski, Monika Czyż

Warsaw University of Life Science, Poland
e-mail: *wojciech_kwasowski@sggw.pl*

Keywords: soil salinity, sodium chloride, lime tree

The studies were focused on estimating the influence of sodium chloride application in the chemical treatment of snow removal from road surfaces on the seasonal changes of soil salinity and ionic composition of soluble soils. The condition of *Tillia* sp. trees growing along the street was also analyzed.

The studies were conducted for a period of four years. Soil samples were collected to the depth of 120 cm of soil in three intervals: March, June and September. The following features were determined: pH, grain size composition, organic carbon content, content of soluble salts (Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl, SO_4^{2-}, HCO^{3-}), electrical conductivity of saturated soil extracts, capacity of the sorption complex and the contribution of exchangeable cations. Simultaneously, leaves of Tillia sp. trees growing along the street were collected by the end of August each year. The content of ash particles was analyzed in the plant material.

The analyses have shown a significant influence of chemical treatment of snow removal on soil properties. Seasonal changes in the content of soluble salts in the soils varying from 0.05% to 0.6% were observed during four years of the experiment. They referred to the accumulation of sodium (2.1 mg·100 g^{-1} – 151 mg·100 g^{-1}) and chlorine (3.2 mg·100 g^{-1} - 231 mg·100 g^{-1}). Seasonal variability was also observed in the value of electrical conductivity of the saturated soil extracts, which reached the highest values at 8 dS·m^{-1}. The studies indicated a high contribution of exchangeable sodium in the sorption complex of soils (ESP) reaching from 4 to 9% in the lower parts of the studied soil profiles.

The leaves of *Tillia* sp. trees growing in direct vicinity of the street showed strong symptoms of injury caused by sodium chloride in form of necrosis on leaf edges, browning, and in consequence - complete drying up and premature leaf loss. Leaves with intense symptoms of injury contain less calcium, more sodium and chlorine as well as a smaller ratio of bivalent to univalent cations in comparison to healthy leaves.

BIOFILTERS TO IMPROVE ROAD RUN-OFF QUALITY: INTERACTIONS BETWEEN WATER, SOIL AND THE BIOSPHERE

Marie-Charlotte Leroy[a], Florence Koltalo[b], Franck Le Derf[b], Stephane Marcotte[b], Marc Legras[c]

[a]*INFRA Services*
[b]*University of Rouen, COBRA*
[c]*Esitpa, AGRI\'TERR, BIOSOL*
e-mail: marie-charlotte.leroy@etu.univ-rouen.fr

Keywords: heavy metals, hydrocarbons, PAH, road run-off, swales, phytoremediation

Biofilters have been widely implemented in the past few years due to combined ecological and economic advantages, such as improved road run-off quality, impervious surface reduction and low cost. However, poor is known about the role of microorganisms and plants on pollutants remediation in such infiltration systems. Thereby, we studied during one year trace elements (TE), total hydrocarbons (HC) and polycyclic aromatic hydrocarbons (PAH) in water, soil and plant in two experimental road side biofilters, one covered with grass, the other one being planted. We also faced the challenge to build four representative large-scale outdoor mesocosms, spiked with Cd, Pb, Zn, phenanthrene, pyrene and benzo[a]pyrene, to better understand the biofilters functioning. Four plant species were tested for remediation in the mesocosm experiments: Juncus effusus, Iris pseudacorus, Phalaris arundinacea and grass (50% Lolium perenne and 50% Festuca L.). PAHs were extracted from soils by microwave assisted extractions and analyzed by gas chromatography while microwave-acid digestion was used to extract metals, which were then analysed by ICP. Total, fungal and bacterial biomasses were investigated using Q-PCR, 16S rDNA and 18S rDNA. Fluorescein diacetate (FDA) enzymatic activity allowed us to measure the total microbial activity.

The passage of runoff through the experimental swale showed a significant removal of organic and inorganic pollutants in water: from 27 to 79% for Cu, 21 to 37% for Pb, 27 to 62% for Zn, and 56 to 70% for total HC. Hg, As and Cd were under their detection limits. Phenanthrene and pyrene concentrations in the soils of mesocosms were divided by 100 in 6 months and by 5 to 10 for benzo[a]pyrene, depending on the plant species. The mesocosm experiments showed that Juncus effusus facilitated PAH degradation and that Phalaris arundinacea had the highest shoot concentration of TE. Both in the experimental swale and in the mesocosm, grass appeared to be the best filter for suspended solids (5 to 77% removal) because of its dense rhizosphere.

Swales design could be improved using a mix of plants composed of grass, *Juncus effusus* and *Phalaris arundinaceae* that respectively, trap suspended solids, facilitate PAH degradation and absorb TE. These results show that biofilters could be an alternative to hydrocarbon separators to treat road run-off.

OBSERVING THE TRANSFER OF POLLUTANTS IN URBAN SOILS AND SUBSOILS: CASE OF A FORMER LANDFILL

C. Le Guern, B. Bechet, Y. Lotram , P. Conil

BRGM, France
c.leguern@brgm.fr

Keywords: groundwater, urban, pollutants, transfer, Nantes, France

Observations of the transfer of pollutants in soils and groundwater in the immediate environment of a former landfill of the city of Nantes are carried out since 2009. This site is particularly interesting because it contains a mixture of pollutants linked to the presence of household and industrial wastes associated with rubble. In addition, it presents vertical and horizontal heterogeneities of both anthropic and natural origin. The site is indeed located in an urban zone in the alluvial valley of the Loire river next to basement rocks.

The methods of observation include the physico-chemical monitoring of groundwater, and investigations on soils and subsoils. A network of wells located on and around the landfill is equipped with pressuremeter and multi-parameter probes for level and non-conservative parameters monitoring. In addition, regular field campaigns allow water sampling for physico-chemical analyses of until more than 80 parameters. The investigations on solids include excavation of materials with a shovel, core sampling and upper soil collection with a hand-held helicoidal auger.

Groundwater conductivity (from 4000 in the landfill to 1700 $\mu S \cdot cm^{-1}$ close to the bank, 400 $\mu s \cdot cm^{-1}$ in the river) points out that the leachate plume reaches the Loire River. Trace element analyses stress high concentrations of heavy metals (As, Ni, Pb, Cr, Cu, Zn) in the waste (up to 800 $mg \cdot kg^{-1}$). Only As and Ni show high concentrations immediately downstream the landfill. Their concentrations are back to the background level in the wells near the Loire river. The concentrations of PAH are lower in the downstream groundwater (mean value 0.2 $\mu g \cdot L^{-1}$) than in the leachates (mean value 5.5 $\mu g \cdot L^{-1}$) and in the waste (up to 19 $mg \cdot kg^{-1}$). Most soluble PAH such as naphthalene, phenanthrene, fluorene, acenaphtene and 2-methylnaphtalene were measured in the groundwater immediately downstream the landfill with mean concentrations from 0.01 to 0.1 $\mu g \cdot dm^{-3}$.

These results highlight that natural attenuation processes contribute to protect the alluvial groundwater from heavy metals and partly from PAH contamination. The investigations on soils and subsoils indicate that these processes probably include i) cationic exchange onto smectites of green sandy clays underneath the landfill and ii) co-precipitation with ferrous oxides. Besides the scientific contributions, these observations also allowed making operational proposals to the local authorities.

CONTAMINATION OF GROUNDWATER BY LANDFILL LEACHATE - ATTEMPT TO MODEL THE POLLUTION PLUME IN HETEROGENEOUS LITHOLOGY

Y. Lotram, B. Bechet, L. Lassabatere, C. Le Guern, H. Andrieu

FSTTAR, BRGM, IRSTV
e-mail: beatrice.bechet@ifsttar.fr

Keywords: landfill, leachate, contamination, soil heterogeneity, impact on water quality, modeling

Urban soils have been often the place of waste storage or landfill in the past. The waste may have various origins: household, industrial, hospital... Old landfills were rarely equipped with a leachate collection system or an impermeable layer (clay or geomembranes) to prevent the spreading of contaminated leachate to aquifers. The environmental impact of the landfill is therefore characterized through the spatial and temporal extension of a contaminated leachate plume. The models are then interesting to describe and simulate the migration of pollutants but they must take into account the specificities of urban soils: soil sealing, water pumping, mixed pollution?

In the case of a former landfill of municipal waste in Nantes, a simulation of the spatial and temporal dynamics of the transfer of water and solutes was performed using VisualModflow 4.2 (coupling GUI Modflow-2000 (flow) and MT3DMS (transport)). A conceptual hydrogeological model was developed thanks to the existing data and investigations on soils (boreholes and trenches in and around the landfill). But, as the mesh modeling capabilities of the program proved inadequate to represent the complex and heterogeneous system, the initial conceptual model was reduced to a set of two layers of varying thickness, each with uniform and isotropic properties. Piezometric data, groundwater quality and pollutant concentrations in waste were used data for model calibration and/or validation. Hydrological data (rainfall, ETP) have been incorporated. Three types of boundary conditions have been used to describe the hydrogeology of the catchment areas. In addition, the estimation of the water recharge was carried out taking into account the land use and the level of sealing.

The results indicate that i) the piezometric fluctuations of the alluvial aquifer modeled correspond to the overall dynamics of the groundwater observed in the field, ii) the extension of the plume is also well described and iii) there is a strong relationship between soil and groundwater quality for the studied site. However, the limits of the code are also highlighted: inability to introduce geological heterogeneities such as paleochannels, to take into account the subsurface water pumpings...

Although the modeling tools used in this study showed limitations in the context of heterogeneous soils, a simplification of the system, based on sufficient field data, provided a satisfactory simulation of the contamination plume extension.

IMPACT OF ARTEFACTS ON TOPSOIL MAGNETIC SUSCEPTIBILITY ENHANCEMENT IN URBAN PARKS OF THE UPPER SILESIAN CONURBATION

Adam Łukasik, Marcin Szuszkiewicz, Małgorzata Wawer

Institute of Environmental Engineering Polish Academy of Sciences, Poland
e-mail: adamlukasik@ipis.zabrze.pl

Keywords: magnetic susceptibility, artefacts, soil cores, Transforming Topsoil Factor

Soils of urban parks feature transformation of horizon arrangement, structure, physical and chemical properties as a result of anthropopression. Industrial dusts of various origin (power plants, steelworks, coking plants, cement plants) and urban dusts, related to transport and domestic heating systems (low emission), contain ferromagnetics. Their deposition leads to magnetic susceptibility enhancement and accumulation of heavy metals in topsoils of urban parks. Besides urban-industrial immisions, artefacts play a significant role in topsoil pollution. Analysis of vertical distribution of volume magnetic susceptibility (κ) values, were conducted in 106 topsoil cores taken in areas of four urban parks of the Upper Silesian Conurbation. In order to examine relations between heavy metal concentrations and mass specific magnetic susceptibility (χ) value, 57 soil samples from A horizons have been taken for detailed analysis. Additionally, κ and χ values of artefacts, sampled from topsoil of urban parks, was measured. Results pointed out, that magnetic susceptibility enhancement in topsoil cores was significantly influenced by artefacts and mechanical transformations of soil horizons. In areas, where natural sequences of uppermost soil horizons were observed, vertical distribution of magnetic susceptibility exhibit one peak curve, that is characteristic to immission - derived technogenic magnetic particles (TMPs). Moreover, in such areas, relation between χ values and heavy metal concentrations present strong positive correlation. For mechanically transformed soils containing artefacts, multi peak curve of vertical distribution of magnetic susceptibility is characteristic. Magnetic susceptibility measurements of individual artefacts, display a wide range of χ and κ values. In order to assess the level of anthroporession on topsoil horizons we introduce Transforming Topsoil Factor (TTF) on the basis of soil core magnetic susceptibility measurements. Low TTF corresponds to high positive Pearson's correlation coefficients (r) between magnetic susceptibility and heavy metal contents in analyzed soil samples. TTF seems to be promising indicator to improve soil magnetic susceptibility screening in urban-industrial areas were topsoil transformations and presence of artefacts are common.

THE POLLUTION BY HEAVY METALS SOILS, INDICATOR AND CULTIVATED PLANTS IN ALLOTMENT GARDENS NEARBY EXPRESS ROAD IN GORZÓW WIELKOPOLSKI

Malinowski Ryszard[a], Meller Edward[a], Niedźwiecki Edward[a],
Sammel Adam[a], Malinowska Katarzyna[b], Lisowska Sylwia[a]

[a]*Department of Soil Science, The West Pomeranian University of Technology in Szczecin, Poland*
[b]*Department of Plant Physiology, The West Pomeranian University of Technology in Szczecin, Poland*
e-mail: Ryszard.Malinowski@zut.edu.pl

Keywords: urban soils, hortisols, heavy metals, vegetables

The stepping out in grounds of municipal agglomerations gardens are element of urban green and places of active the occupants' cities rest. Beside recreational functions was growed there vegetables and fruit.

Dusts and aerosols be emitted by industry and car transportation, they cause accumulation the heavy metals within urban and especially in hortisoil. Conducted investigations in grounds of allotment garden located nearby lively Kasprzak street in Gorzów Wielkopolski showed, that garden soils stepping out directly near road and distance 20, 50 and 100 m from road, content of Co, Cd, Ni, Cu, Pb, Zn, Mn and Fe was at a low, natural level. Only in case one investigative point, located in distance 100 m from road was elevated (I degree of contamination). Accumulation heavy metals was higher in vegetables (*Petroselinum crispum*, *Daucus carota* L., *Beta vulgaris* L.) and indicator plants (*Plantago maior*, *Taraxacum officinale*).

SOIL AND WATER MANAGEMENT UNDER URBAN AND PERI-URBAN AGRICULTURAL PRODUCTION IN AND AROUND THE CITY OF MAFIKENG IN THE NORTH WEST PROVINCE OF SOUTH AFRICA: IMPLICATIONS FOR PUBLIC HEALTH AND ENVIRONMENTAL QUALITY

Simeon A. Materechera

North West University (Mafikeng Campus), South Africa
e-mail: albert.materechera@nwu.ac.za

Keywords: urban environment, heavy metal contamination, soil quality, water management, food security

About 87% of the 120 households studied (May-August 2011) using a participatory approach within the urban and peri-urban areas of the city of Mafikeng engaged in crop production including arable crops (42%), fruits (86%), vegetables (97%), and flowers (89%). Due to the low and unreliable rainfall in the area 92% rely on irrigation. The plot sizes vary widely (mean 85, range 65-870 m^2). The seedbeds are prepared mostly by hand with hoes, spades and folks to a depth of 10-15 cm and the structure was mostly homogenised by repeated tillage. Eighty-one percent of the households planted on raised beds (5-10 cm) while 19% planted on the flat. The main irrigation practices include watering cans and buckets (88%), drip micro irrigation (27%), Sprinklers (42%) and furrow (38%).The major sources of irrigation water were municipal tap water (91%), underground/borehole (65%), sewage and domestic waste treated water (11%) and dam (24%). Fixed irrigation scheduling (usually mornings and evenings) was used by 88% the households with some using moisture meter (7%) and experience (35%). Signs of water logging were evident on most soils. Mulching was used by 76% of the households using mostly grass clippings from the lawns, plastic (7%), leaves (21%) and sand (3%). The majority of the households used organic fertilizer in forms of kraal manure (87%), compost (67%) and green manure (26%). Inorganic fertilizer was used by 54%) while a large proportion (97%) combined organic and inorganic fertilizer. Most of the household (86%) used chemical pesticides to control insects and pests mainly on vegetables and fruits. Crop rotation was used by very few of the households and weed control was mostly by hand or hoe (78%) and a minority (18%) applied organophosphate chemicals. Only 17% of the respondents applied lime to their soils. Soil salinity was cited as a problem in 64% of the plots.

Although the soil heavy metal content in the study areas are not so high, the continued use of animal manure, pesticides, fertilizer and sewage treated water for irrigation poses a potential threat of heavy metal accumulation in the soil and their subsequent uptake by crops and entrance into human food chain. Even if the municipality does not allow livestock production within 10 km radius of the city, both cattle and small stock (especially goats) were cited feeding within the city during the study thereby raising health and environmental risks associated with keeping livestock in cities. The current seedbed preparation methods contribute to soil erosion and dust particles into the air.

CARBON AND NITROGEN ACCUMULATION IN SOILS OF PRUSZKOW TOWN - THE PART OF THE WARSAW METROPOLITAN AREA

Lidia Oktaba, Kamil Paziewski, Wojciech Kwasowski, Marek Kondras

Department of Soil Environment Science, Section of Soil Science,
Warsaw University of Life Science (SGGW)
e-mail: lidia_oktaba@sggw.pl, wojciech_kwasowski@sggw.pl

Keywords: carbon, nitrogen, accumulation

Main problem

Soil chemical properties, especially carbon accumulation, depend on many factors. Land use is one of them. City environment has a specific conditions, caused by physical, mechanical or chemical human impacts. Urban soils are under disturbances leading to acidification or alkalization, salinity, heavy metals accumulation and other. Often, in big cities, we can observe carbon accumulation because of atmospheric deposition of soot and different compounds from incomplete combustion of fossil fuels and tires attrition.

The aim of the study was to evaluate the effect of land use on carbon and nitrogen accumulation and some chemical properties in soils from Pruszkow town.

Methods

The study was conducted in Pruszkow area, the - medium sized town located near capital of Poland. 20 cm surface soil layers (0-20cm) were collected using soil core sampler from 36 points, covering fields, fallows, lawns and allotment gardens. All samples were obtain by mixing over a dozen subsamples from each place. Finally 9 field's samples, 12 from lawns, 11 from allotment gardens and 4 from fallows were assessed. Lawns and allotment gardens can be treated as central zone, fields and fallows belong to periphery area.

Total organic carbon, total nitrogen and some chemical properties (CEC, pH) in ground air-dried soil samples were measured. C/N ratios were calculated.

Results and Conclusions

Different land use in Pruszków town influenced some soil chemical properties, especially carbon and nitrogen content. Statistical analysis showed significantly higher amount of organic carbon in lawns (mean 2.05% C in soil) and allotment gardens (2.17% in soil) than in fallows (1.04% in soil) and fields (1.28% in soil). Surface layer of soil from allotment gardens and lawns contained higher amount of nitrogen (mean content 0.11% and 0.08% in soil respectively), too. The C/N ratio was the highest in soils of lawns (mean value 26.2). It indicates low intensity of humus transformation and could be the result of anthropogenic deposition of pyrogenic carbon.

Soils in allotments have very special properties. Often they are created by their owners. The surface material is imported and the big amount of fertilizers (mineral and organic) are used.

OCCURENCE OF TECHNOGENIC MAGNETIC PARTICLES, HEAVY METALS AND PAHS IN SOILS OF AREA INFLUENCED BY COKE AND METALLURGICAL INDUSTRY

Marzena Rachwał, Tadeusz Magiera, Małgorzata Wawer

Institute of Environmental Engineering, Polish Academy of Sciences, Zabrze, Poland
e-mail: marzenarachwal@ipis.zabrze.pl

Keywords: as technogenic magnetic particles, heavy metals, polycyclic aromatic hydrocarbons, magnetic susceptibility, soil contamination

Upper Silesia is an area where many different kind of industry are concentrated. Most of them are founded on high-temperature processes connected with fossil fuel combustion (e.g. power plants, metallurgical and steel works, coking plants, cement mills etc.) causing emission of harmful gases and dusts. Heavy metals, polycyclic aromatic hydrocarbons (PAHs) as well as technogenic magnetic particles (TMPs) are their constituents which harmfully influence on the environment. Occurrence of TMPs (ferro-, ferrimagnetics) in soils can be rapidly and easily detected by using magnetic susceptibility that is geophysical parameter measurable directly in the field or in laboratory. Presented research was carried out in the area influenced mainly by coke and metallurgical industry, in a lesser degree by power plant and transport.

The objective of this study was quality assessment of forest soils, which organic horizon is considered as the filter accumulating pollutants. Applying integrated magnetic, geochemical and mineralogical methods for qualitative and quantitative characterization of pollution accumulated in forest topsoil and their mutual correlations was also the aim of the study. Investigated forest soils were characterized by increased values of magnetic susceptibility which decrease with increasing distance from the emitters. Magnetic susceptibility of soils depends mainly on the distance from an emission source, the wind direction and emission rate. The higher level of soil contamination by TMPs, PAHs and heavy metals in close vicinity of coking plant and metallurgical work. Content of benzo(a)pyrene, which is highly carcinogenic, as well as a sum of PAHs exceeded threshold values in almost all samples. The content of heavy metals of technogenic origin (especially Zn, Pb and Cd) was very high and also exceeded the limits. Strong positive relationships between magnetic susceptibility and contents of PAHs and heavy metals testified technogenic origin of pollutants in investigated soils. Results of mineralogical analyses of soil samples after magnetic separation revealed a high heterogeneity of magnetic particles in respect of their morphology, grain size as well as mineral and chemical constitution. Magnetite, maghemite and hematite were the dominant magnetic minerals and they were accompanied by non-magnetic phases of clay minerals, feldspars, dolomite and quartz.

HEAVY METALS IN RHIZOSPHERE OF *KOELERIA GLAUCA* AND *CORYNEPHORUS CANESCENS* ON SANDY SOILS FROM AREAS POLLUTED BY ZN-PB MINING

Dorota Rożek, Jerzy Cabała, Oimahmad Rahmonov

Faculty of Earth Sciences, University of Silesia
e-mail: dorota.rozek87@gmail.com

Keywords: rhizosphere, metalliferous minerals, heavy metal pollution, Olkusz Zn-Pb mining area, *Koeleria glauca*, *Corynephorus canescens*

The research of rhizosphere of *Koeleria glauca* and *Corynephorus canescens* grasses had to determine the role of plant roots and symbiotic fungus in rhizoaccumulation of metalliferous submicroscopic mineral phases rich in heavy metals. It was investigated the soil and plants of spontaneous succession from the habitats with initial soils transformed by Zn-Pb ore mining and the later reclamation. Study area is localised in the SE part of Silesian-Kraków Upland (Olkusz region, Poland). It is under the strong influence of historical and contemporary Pb-Ag and Zn-Pb ore mining and processing. Research areas are situated in different distance of pollution sources (Zn-Pb processing plant, Zn smelter, flotation tailing wastes). The plant roots were investigated using the Scanning Electron Microscope (SEM, EDS) and soils using AAS and XRD methods. Collected data indicate that some pioneering psammophilic species develop in degraded contaminated (Zn, Cd, Pb, Tl, As) soils. The secondary metalliferous phases, in association with Zn, Pb sulphides, sulphates, Fe oxides, Zn carbonates et al. were identified in rhizosphere of *Koeleria glauca* and *Corynephorus canescens*. The presence of secondary, uncommon mineral phases prove the occurrence of metals in dissolved ionic forms during the plan wegetation. Their attendance were increasing the pool of bioavailable metals. That research carry weight with a recognition of factors influencing on a large transfer of heavy metals in the soil-root-plant system.

IN SITU AND LABORATORY CHARACTERIZATIONS OF GREEN ROOF ABILITIES TO STORE AND RELEASE METALS

Julie Schwager, Amandine Irles, Jérémy Thiriat, Rémy Claverie, Véronique Ruban, Jean-Louis Morel

CETE de l'Est, France
e-mail: julie.schwager@developpement-durable.gouv.fr

Keywords: green roof, water quality, metal balance

To reach the objectives of good chemical states for waters introduced in Europe by the Water Framework Directive, it is important to control pollutant fluxes. Urban runoff being recognized as one of the major sources of pollutants in surface water and rainwater harvesting spreading in the meanwhile, upstream stormwater management is necessary.

As green roofs are constituted by "soil" and plants, two materials used in water pollution control, this technique may be regarded as an efficient solution to obtain a good roof water quality. Nevertheless, green roof impacts on water quality have proven to be mixed. This can be explained by their current design, which does not aim to purify rainwater.

To be able to make suggestions for green roofs suitable for water treatment, it is important to better understand pollutant fluxes in their multi-layer structures. Therefore, one of the main goals of this thesis is to answer the following question: which layers store or release which metals?

This study is based on two complementary steps. The first one is the monitoring of eight green roofs built with different materials near Nancy (France) in 2010. In order to assess a global metals balance, materials constituting the structures have been analyzed at the beginning of the project and will be sampled at the end. In the meanwhile, the inputs (atmospheric depositions) and outputs (roof waters, plants) are collected for metal analysis. Along with this in situ study, experiments are led in laboratory to understand the phenomenon inducting pollutants release and storage (extractions, adsorption kinetics and isotherms).

Concerning their global impact on water quality, green roofs appear to alternate between pollutant sources and sinks according to the measuring unit choice. Indeed, metal concentrations are generally higher in green roof waters than in rainwater. However, this approach does not take into account the significant water retention capacity of green roofs. Consequently, metal amounts coming from the green roofs, expressed as monthly surface emissions, are often less important than the amounts brought by the atmosphere. Laboratory experiments have confirmed that metal release is not linked to a higher initial content but to the availability of the metals in the materials. As for the ability to retain Zn, the in situ observations are correlated with the results obtained in laboratory which allowed identifying the high adsorption capacities of one of the drainages.

GEOCHEMICAL BEHAVIOR AND FATE OF ARSENIC, ANTIMONY AND LEAD IN TECHNOSOLS DEVELOPED FROM OLD MINING SITE

Marilyne Soubrand, Emmanuel Joussein, Matthieu Stapor, Grégoire Pascaud, Salma Boussen

Université de Limoges GRESE, France
marilyne.soubrand@unilim.fr

Keywords: mining technosol, mobility, antimony, arsenic, lead

Anthropogenic activities such as mining activities are responsible of the increase in the environment of inorganic pollutants occurrence, i.e. metallic and metalloids elements. One of the main concerns of mining activities is the production of a huge amount of contaminated wastes, which are usually stored in the vicinity of mines. Waste materials contain pollutants in various amounts (depending of industrial process) and represent contamination hazards for groundwater and food chain especially through transfer to vegetation. The aims of this work are (i) to study the distribution, the mobility and the fate of metallic and metalloid elements (Pb, As et Sb) in 3 mining Technosols, and (ii) to investigate their potential mobility in vegetation.

The studied acidic soils are developed from mining waste and are Pb-, As- and Sb-rich (up to 1.4%, 0.1% and 95 $mg \cdot kg^{-1}$ respectively). The results show a weak depletion at the profile scale of As, Sb and Pb in the three studied profiles during the short pedogenesis rate (up to 100 years). The potential release of these elements has been confirmed by leaching tests (batch experiments): (i) the Pb is more release than As and Sb, and (ii) the solubility of As and Sb increases from parental materials to upper A horizons whereas Pb content slightly decreases. BCR extraction procedures highlighted different speciation of metalloids (As and Sb) and metallic (Pb) elements in the different solid phases (XRD investigations).

According to these results, the Pb mobilisable fraction (F1 + F2 + F3) is about 60 to 98% of the total Pb content whereas about 80% of As and Sb are located in the residual fraction (eg no mobile fraction). The mineralogical investigations give evidence that As and Sb are trapped to the residual fraction in the beudantite minerals. This fact induces non mobile characters of these two elements in soils during pedogenesis. In the parental material, Pb-bearing phases are galena, anglesite, scorodite, Pb-oxide. The presence of Pb-oxides only in the parental material horizons explain the high Pb solubility compare to others horizons.

This study highlights difference of As, Sb and Pb geochemical behavior in the mining Technosols. Sequential extractions and mineralogical study evidenced difference of Pb- and As/Sb-bearing phases. Thus, this leads to evidence a different mobility of these elements as shown by leaching tests.

STUDY OF METALS MOBILITY AND PHYTOTOXICITY IN BOTTOM SEDIMENTS INFLUENCED BY FORMER MINING ACTIVITIES IN THE AREA OF EASTER SLOVAKIA

Oľga Šestinová, Lenka Findoráková, Jozef Hančuľák

Slovak Academy of Sciences, Institute of Geotechnics, Department of Environment and Hygiene in Mining, Watsonova 45, 043 53 Košice, Slovak Republic
e-mail: sestinova@saske.sk

Keywords: sequential extraction, bottom sediment, trace and semi-metals, mobility, phytotoxicity tests, *Sinapis alba*, environmental toxicity

Purpose

The trace metals mobility and environmental ecotoxicity in the bottom sediments is strongly dependent upon specific physical and chemical forms of metals. Sequential extraction methods used for this purpose are inevitably operationally defined. The aim of this study was to determine mobility of metals in contaminated sediments in the area of water reservoir Ružín No.I that is situated on the Hornád and Hnilec River (Slovakia). Moreover, the study was aimed at assessing of the potential phytotoxic effect on biota using Phytotoxkit tests.

Material and methods

The mobility and solid-state distribution of Cu, Zn, Ni, Pb, Cr, Cd, As, Sb and Hg ions in the impoundment materials have been investigated using a five-step sequential extraction procedure. Evaluation of sediments phytotoxicity was based on germination of the seeds and the decrease of root growth of the plant *Sinapis alba.* The relationship of biological assays with physicochemical data is needed for interpretation and characterization of contaminated sites.

Results and discussion

Extraction process evaluates the strength of bond of metal forms for different soil phases as are water-soluble, ion-exchanged, reducible, oxidizable and finally to resistant residue. The results of the sequential extraction pointed out the low ratio of metals in the water-soluble fraction in the both samples. The high bioavailability of metals was determined in copper, zinc, lead and cadmium. Nickel, arsenic, antimony and chromium are only extracted in the rest and have low bioavailability. The mercury was extracted in the oxidizable organic and sulphide phase. In the majority of tested *Sinapis alba* seeds the potential phytotoxic effect of metals was not observed.

Conclusions

Environmental toxicity is the major problem of an industrially loaded region, where the water reservoir of the Ružín No.I is situated. The results of plant *Sinapis alba* test pointed out to low phytotoxicity effect of contaminated sediments, which may be caused by plant mechanisms such as adaptation to stress factors. When the more experiments on contaminated sediments will be done then the mechanism of phytotoxic effect of the plant will better understand.

ONSITE WASTEWATER DISPOSAL IN SANDY SOILS: FIELD RESEARCH AND APPROACHES

Gurpal S. Toor

University of Florida, USA
e-mail: gstoor@ufl.edu

Keywords: soil, wastewater, nutrients, trace organics

A variety of contaminants - inorganic and organic are present in human-dominated systems because of the human use (and sometimes abuse) and disposal in our two precious natural resources, land and water. Anthropogenic activities have contributed a wide variety of contaminant to the terrestrial environment. Situations where the contaminants can be more concentrated include soils in urban environments close to contaminant sources and soils that receive biosolids and wastewater. This presentation will discuss dynamics of domestic wastewater-borne nutrients and trace organics in the soil vadose zone and groundwater.

SUCCESSFUL DECONTAMINATION OF A SEWAGE FARM

Steffen Trinks, Michael Facklam, Olaf Zeuschner, Gerd Wessolek

Technische Universität Berlin, Department Soil Conservation, Germany
e-mail: steffen.trinks@tu-berlin.de

Keywords:

Over a period of more than 100 years, the wastewater treatment in Berlin was realised by sewage farms. In the 1970s and 80s this treatment technique was replaced by sewage plants. It quickly became clear that the former sewage farms where highly loaded by organic and anorganic pollutants, as well as with nutrients. These areas where a significant environmental hazard and the recultivation and reuse was problematic.

In the north of Berlin a project startet in 1997, to immobilise the strong heavy metal contamination and to improve site conditions by the application and incorporation of calcareous loam. Over a period of several years a mass of 600 Tsd. t has been applied on an area of 100 ha.

In 2011 we took samples of a contaminated and decontaminated location and analysed the chemical and physical soil properties. The study results show a clear improvement of the soil and site condition. The environmental hazards have been reduced significantly and the habitat conditions for vegetation has improved.

We want to discuss the existing potential for the use and development of these areas and whether the cleaning method can also be applied on other regions.

WHO WILL NEED BACKGROUND CONCENTRATIONS OF POLLUTANTS IN URBAN AND INDUSTRIAL SOILS? A SURVEY OF THE INTENTIONS OF REGULATORS IN SEVEN EUROPEAN REGIONS

Aubry Vandeuren, Benoît Pereira, Philippe Sonnet

UCL-ELIe, Belgium
e-mail: aubry.vandeuren@uclouvain.be

Keywords: background concentrations, soil protection policies, backfill soil

Background concentrations of pollutants in soil can play different roles in soil protection policies. They can be used for instance to detect a local pollution or to calculate the cleaning targets if a site has to be remediate.

However, soils from urban and industrial areas generally present high concentration of pollutants, since they usually are disturbed by urbanization, mixed with technogenic material and affected by smoke and dust fallout. In these zones, background concentrations can be very high and fluctuating across short distances. It is therefore difficult to calculate them precisely, and use them properly for the roles they must fulfill. Dealing with this notion in soil protection policy can therefore be complicated.

We present seven western European approaches for the consideration of background concentrations in soil protection policies: Flanders, Wallonia, Grand Duchy of Luxembourg, Germany, France, England and the Netherlands. The definition of the concept of background concentrations of pollutants in soils, the way to calculate them and their roles are presented between these different systems that have various pedogeological and industrial contexts. The advantages and disadvantages of these systems are presented and discussed especially with regards to soils from urban and industrial areas.

It appears from this survey that neighboring states use background concentrations to diverse goals. Background concentrations are used to calculate cleaning targets in the case of soil remediation (France, Flanders, Wallonia and Grand Duchy of Luxembourg) and to detect local pollution (England, Grand-Duchy of Luxembourg and Wallonia). In the Netherlands and Germany, background concentrations are used for other purposes regarding soil protection (reuse of soil, spreading of sludge from wastewater treatment plants, etc).

EFFECT OF SIDEROPHORE DESFERRIOXAMINE B AND ORGANIC ACIDS ON FE RELEASE AND Pb^{2+} ADSORPTION/DESORPTION FROM HEMATITE

Yingli Wang[a], Shizhong Wang[a,b] , Xiaowen Zeng[c], Yetao Tang[a,b], Rongliang Qiu[a,b]

[a]*School of Environmental Science and Engineering, Sun Yat-Sen University, Guangzhou 510275, P.R. China*
[b]*Guangdong Provincial Key Lab of Environmental Pollution Control and Remediation Technology, Sun Yat-Sen University, Guangzhou 510275, P.R. China*
[c]*School of Public Health, Sun Yat-Sen University, Guangzhou 510008, P.R. China*
E-mail: wshizh2@mail.sysu.edu.cn; esqrl@mail.sysu.edu.cn

Keywords: siderophore, low molecular weight organic acid, hematite, synergistic effects

Siderophore has been proved capable in binding metal ions for promoting metal dissolution. However, it has less ability to dissolve common iron-bearing minerals in soil. In this research, we studied the effect of siderophore desferrioxamine B (DFOB) coupled with organic acids on Fe release from hematite, a common mineral in soil. Further investigation was also carried out for examining Pb^{2+} adsorption/desorption by hematite under the same condition. Results showed that the interaction between oxalate (pH 3, 5.5, 9)/citrate (pH 5.5) and DFOB had significant synergistic effects on dissolving hematite (Fe release). The adsorption of organic matters, complexation structures and stability of the complexation were the three factors dominating the ligand-promoted dissolution of minerals. The adsorption of Pb^{2+} on hematite decreased by 16%, 35.4% and 33% and the desorption of Pb^{2+} increased by 10.5%, 32.5% and 22.3%, respectively, in DFOB treatment and the treatments of DFOB coupled with oxalate/citrate at pH 5.5, which also indicated a positive Pb^{2+} release into the ambient environment. These results might have practical significance in phytoextraction of heavy metal contaminated soils by both increasing free ferric for plant growth promotion and providing more bioavailable heavy metals for plant uptaking.

HUMAN HEALTH RISK DUE TO INGESTION OF VEGETABLES CULTIVATED ON POLLUTED SOILS AND/OR EXPOSED TO ATMOSPHERE FALLOUTS OF FINE PARTICLES ENRICHED WITH METAL(LOID)S

Tiantian Xiong, Annabelle Austruy, Yann Foucault, Thibaut Leveque, V. Dappe, Sophie Sobanska, Camille Dumat

ENSAT-Ecolab, France
e-mail: yann_foucault@hotmail.fr

Keywords: (ultra)fine particles, risks assessment, gardens, ecotoxicity, bioavailability

Over the last decades, there has been a growing concern about atmosphere fallouts of fine particles enriched by metal(loid)s on soils and vegetables. The contamination of vegetables by metal(loid)s can further induce human exposure to the pollutants due to ingestion. In such cases, phytotoxicity and the risk for human and animal health regarding the ingestion of polluted plants should be considered. Several controlled, field experiments and model development are performed in order to measure, predict and reduce the sanitary risk induced by consumption of vegetables polluted by atmosphere fallouts of PM in the context of urban area near industries or motorways. Highlight the mechanisms involved for foliar and root uptakes, for various vegetables (lettuces, cabbage,radishes'), inorganic pollutants (Pb, Cd, As and Cu), exposure conditions (foliar only, root only or foliar + root) is aimed. Kinetic, speciation, ecotoxicity and bioaccessibility of metals after human ingestion are considered.

In addition to the root transfer, a strong foliar uptake of various metals was observed. Experiments and modelling showed that additive ecotoxicity can exist between the two ways of exposure. Microscopic observations show a strong interaction between pollutants and leave surfaces. In addition to lead, other metal(loid)s as Cu, Cd can be largely uptaken by salade and cabbage leaves exposed to particle deposits representative of high atmospheric pollution context. Localisation of metals in leaves by scanning electron microscopy coupled with energy dispersive x-ray (SEM-EDX) microanalysis shows that stomata openings are particularly enriched with metals, suggesting a preferential way of uptake. Metal(loid)s bioaccessibility depends of exposure way, metal and plant nature, maximum variation of a factor 3 was observed. Populations living in industrial or urban megalopolis zones exposed to high atmospheric quantities of PM enriches with metal(loid)s can therefore incur sanitary risks by consuming polluted vegetables. Actually, even after washing, a strong contamination of the vegetable leaves is observed; highly influenced by the plant morphology and physiology (cuticular waxes, stomata numbers) and metal(loid) species. Our results carry therefore important highlights to improve environmental and sanitary risk assessment in various contexts like polluted urban area (megacities in China), farms and kitchen gardens near industries.

IMPLEMENTATION OF ENVIRONMENTAL POLICIES LEADING TO A DECREASE IN HEAVY METAL CONCENTRATIONS IN SEWAGE SLUDGE: A NATIONAL SURVEY IN CHINA

Jun Yang, Tong-Bin Chen

Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences
e-mail: yangj@igsnrr.ac.cn

Keywords: sewage sludge, heavy metals, temporal variation, national survey, environmental policies

It is essential to know the heavy metal concentrations in sewage sludge to determine appropriate disposal methods. We conducted a national survey of heavy metal concentrations of sewage sludge from 107 sewage treatment plants located in 48 cities, covering 32 of the 34 provinces in China in 2006. The temporal trends in heavy metal concentrations in sewage sludge were identified by comparing the results with the surveys conducted in 1994-2001. The average values of As, Cd, Cr, Cu, Hg, Ni, Pb and Zn in the sewage sludge in this study were 20.2, 1.97, 93.1, 219, 2.13, 48.7, 72.3 and 1058 mg kg^{-1}, respectively. Increasingly stringent wastewater discharge regulations in China have led to decreases in the average concentrations of Cd, Cr, Hg, Ni, Pb and Zn of 32.3%, 49.7%, 54.9%, 25.0%, 37.2%, 44.8% and 27.0%, respectively, between 1994-2001 and this study. The proportion of sewage sludge samples that exceeded the heavy metals limits in Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant in China (GB 18918-2002) for Cd, Cr, Cu, Ni and Zn were 6.5%, 3.7%, 6.5%, 6.5% and 11.2%, respectively. Eighty five of the 107 municipal sludge samples analyzed would be considered suitable for land application.

4. SUITMAs and CLIMATE CHANGE

ORAL PRESENTATIONS

FUNCTIONING OF SOIL CONSTRUCTIONS EFFECTED BY METHANE IN HIGH CONCENTRATION

I. Lebed-Sharlevich, N. Mozharova, S. Kulachkova, O. Lisovitskaya

Lomonosov Moscow State University, Soil Science Faculty
e-mail: nvm47@list.ru, jana-13@mail.ru,

Keywords: greenhouse gases, soil construcntions, gas generating grounds

Grounds containing waste from illegal dumps which are a source of methane and carbon dioxide are often used for car parks, services and shopping centers building near highways in suburbs of megalopolises. Generation of these gases may cause a fire and explosion risk for constructed objects. Maximum CH_4 concentration (2-2.5% vol., emission level 900 $mg \cdot m^{-2}h^{-1}$) was detected in these grounds near Moscow ring road. Atmosphere CH_4 level twice exceeded Russian standards. The actual task is the development of actions preventing CH_4 and CO_2 accumulation in grounds and their emission to the atmosphere, e.g. the creation of special soil constructions utilizing methane biologically by means of methanotrophs bacterial community.

The experiment simulated consumption of CH_4 in 2.5% vol. in organic-mineral constructions proceeded since June 2011 to March 2012 under natural climatic conditions of Moscow. We made three constructions differed by CH_4 utilized substrates: humic horizon of Albeluvisol, organic-mineral mixtures with compost and peat. Substrates were placed in columns of 0.15x0.15x0.35 m equipped with leakless pipes for gas injection and sampling. Methane was injected twice a week. Gas samples were analyzed at chromatograph. CH_4 and CO_2 emission was determined by chamber method, CH_4 bacterial oxidation (MBO) - by kinetic method.

The experiment showed high rates of CH_4 consumption with some seasonal features. In summer maximum methane consumption rate (MCR) reached 45-4, 29-3 and 24-3 $g \cdot m^{-3}d^{-1}$ in topsoil, compost and peat construction, respectively. There was a clear correlation with MBO ($ng\ g^{-1}h^{-1}$) increased in row: peat (12.6-3.0), compost (17.1-5.0), topsoil (67.5-3.5) construction. CH_4 emission was slightly observed. In winter MCR reduced approximately in 2 times due to methanotrophic community inhibition by low temperatures. The average CH_4 emission to the atmosphere was significant - 9.5-3.7 $mg\ m^{-2}h^{-1}$.

There are two periods of CO_2 generation in the constructions: intensive production (with maximum in compost construction) in summer related to high microbial activity and CH_4 oxidation, and minimum formation in winter.

Thus, topsoil construction with developed and sustainable microbial community is better CH_4 utilizer in comparison with other constructions. Compost and peat construction use will be possible after finding measures for CO_2 reduction. Application of soil constructions requires additional solutions for effective methane utilization in winter.

THE SURFACE STORE OF PAVED URBAN SOILS (EKRANIC TECHNOSOLS) AND ITS IMPACT ON THE URBAN CLIMATE

Thomas Nehls, Fabian Kraus, Markus Menzel, Andre Peters, Gerd Wessolek

Technische Universität Berlin, Germany
email: thomas.nehls@tu-berlin.de

Keywords:

The surface storage (initial loss) plays an important role for the rain water partitioning on paved surfaces, which make usually 2/3 of the urban area. This is especially true for small rain events, which account for the greatest part of total annual rainfall in most cities of the temperate climate zone.

Usually the surface store is regarded as a fixed value, dependent on surface relief and porous material characteristics. Contrary to that assumption, we assume that the effective storage for water depends also on rainfall and evaporation demand, and thus is variable.

In this study the surface store and its filling dynamics is studied for three typical paving materials (dense, DP, porous PP and highly infiltrative IP) in dependence on rain intensity.

The surface relief store was measured directly by a terrestrial laser scanner. The pore system store was investigated in the lab. In a sealed Plexiglas box the pavers have been irrigated with different intensities ranging from 0.016 to 0.1 $mm \cdot min^{-1}$. These rainfall intensities have been identified as the 25% to 88% quantiles of the precipitation distribution in Berlin, Germany for 1961 to 1990.

Three different surface stores have been found and defined as follows: Storage until initial run-off, at maximum filling and after further drainage for steady state run-off. The latter depends on the micro relief of the surface and the porosity of the paving materials and varies from 0.2 to 3 mm for DP, PP and IP in the investigated range of rainfall intensities. For porous pavers, the surface store strongly depends on rainfall intensity.

In a simulation we assessed the efficiency of these surface stores for evaporation and thus cooling of paved surfaces. We can show that the prediction of evaporative cooling and realistic run-off rates needs a simulation with a much higher temporal resolution than it is usual today.

HOW CONSIDERING URBAN SOIL CAN IMPROVE REGIONAL SOIL ORGANIC CARBON ASSESSMENT AND MAPPING

V.I. Vasenev[a], J.J. Stoorvogel[b], I.I. Vasenev[c], R. Valentini[a]

[a]*Laboratory of Agroecological Monitoring, Ecosystem Prediction and Projecting, Russian State Agricultural University, 127550, Timiryazevskaya, 49, Moscow, Russia*
[b]*Wageningen University, Land Dynamics Group, P.O. Box 47, 6700 AA Wageningen, Netherlands*
[c]*Russian State Agricultural University, 127550, Timiryazevskaya, 49, Moscow, Russian Federation*
e-mail: vasenev@timacad.ru, vasenyov@mail.ru, jetse.stoorvogel@wur.nl, slava.vasenev@wur.nl

Keywords: soil organic carbon, digital soil mapping, urbanization, Moscow region

Soils provide the largest carbon stock in terrestrial ecosystems. Considerable impact of land- use change on soil organic carbon (SOC) stocks is well accepted, although urbanization effect on SOC is often ignored. Urban environment provides a number of specific features and processes: soil sealing, soil pollution, functional zoning, removing and adding of soil masses through greenery and engineering work. This makes a considerable impact on spatial distribution of urban carbon stocks in comparison with non-urban areas. Besides a few studies report on significantly higher SOC contents in urban soils, than in natural and agricultural ones. It's necessary to understand how including urban soils into can affect the results of regional carbon stocks' mapping and assessment.

Moscow region provides and interesting case study for the research because of high urbanization level and variety of climatic and soil conditions. Maps of SOC were developed basing on digital soil mapping (DSM) approach. To analyze the role of urban areas in regional carbon mapping two alternative types of general linear statistical models (GLM) were developed. The first "traditional" model included most widely-used soil forming factors, whereas urban specifics were ignored. The second "urban-specific" model in addition to traditional factors also considered age and size of the settlement, functional zones, percentage of sealed soils and cut-off profiles. Two models were calibrated basing on the results, obtained by stratified random soil sampling (n=242) within field campaign in Moscow region in 2010-2011. Secondary data was derived from available open sources. The accuracy of the developed maps were evaluated by validation with the independent dataset (n=50).

Comparison of the traditional and urban-specific maps revealed higher average carbon stocks estimated by traditional approach - 1916 Tg and 36.7 Gg/km^2 in comparison to 1657 Tg and 32.9 Gg/km^2 for total and specific stocks correspondingly. Although the spatial variability reported was much higher for the urban-specific maps the range and coefficient of variances was 50-70% larger than for traditional maps. Validation results proved higher accuracy of the urban-specific maps: R^2=0.32 in comparison to 0.02 for traditional one. Thus it can be concluded that despite of relatively small total carbon stocks in the settlements, urban soils make a considerable impact on the spatial variability of carbon stocks and should be considered The use of Rhizotests was very relevant to the study of microbial communities in the rhizosphere. Molecular screening and meta-analyzes of microbial genomics have highlighted differences in the bacterial communities studied in relation to different culture conditions by plant species, physico-chemical parameters of soil and soil contamination levels that induced taxonomic changes.

4. SUITMAs & CLIMATE CHANGE

POSTER PRESENTATIONS

CARBON STORAGE IN THE URBAN SOILS OF SOPRON TOWN

András Bidló, Adrienn Horváth

University of West Hungary, Department of Soil Site Survey, Sopron, Hungary
e-mail:abidlo@emk.nyme.hu

Keywords: carbon storage, soil, Sopron, Hungary

The soil carbon stock has a very significant role in the global carbon cycle. In many ecosystems the carbon content of soils is higher, than what is stored in plants and this is typical for urban soils too. In order to investigate the carbon content of the soils we have collected samples from the upper layer of sampling sites in Sopron city. Sopron can be characterised with a variety of geological conditions. The city has 61 000 inhabitants and it is located in the northwestern part of Hungary at the western border of the country. The major part of the city is in the Sopron-basin (calcareous alluvial), another part is located in the Sopron Mountains (consisting of polymetamorphic mica-schist and gneiss rock) and the rest of its territory is covered by neogene deposits. There are significant differences in the land use, as besides the old downtown there are also younger suburbs and suburban forests, vineyards, pastures, gardens and agricultural areas. Samples were collected from soil spots from 0-10 and 10-20 cms depth as well as from soil profiles, where samples were taken from each of the profile layers.

First we selected the appropriate method for the measurement of the soil carbon content, as there are several possible methods for this. Carbon content cannot be determined in calcareous soils using the C/N/S apparatus, thus we used wet-burning methods with potassium-permanganate.

The highest average carbon content has been determined in the upper layer (0-10 cm depth) in the samples of forest lands (4.6% C) and traffic zones (4.0% C). Lower values have been measured in the soils of garden areas (2.7% C) and industrial zones (3.2% C). In 10-20 cms depth the highest carbon contents could be determined at the banks of creeks and lakes (3.2% C) as well as in the soils of public parks (3.0% C). The lowest values in this layer have been measured in garden areas (1.9% C) and industrial zones (2.2% C). Differences between carbon results can be explained by the effects of the vegetation and land use. Land use is also significantly determined by ecological conditions.

GENERATION, CONSUMPTION AND EMISSION OF GREENHOUSE GASES BY URBAN SOILS OF RECLAIMED FILTRATION FIELDS

Svetlana A. Kulachkova, Nadezhda V. Mozharova

Lomonosov Moscow State University, Russia
e-mail: kulachkova_sa@inbox.ru, nvm47@list.ru

Keywords: methane, carbon dioxide, emission of GHG, urban soils

Recently reserve territories such as not operated filtration fields for sewage can be used for the urban residential construction. Their danger is sludge organic matter decomposition with CH_4 and CO_2 accumulation in soils and emission to the atmosphere. Quality of sludge removal during reclamation influence on greenhouse gases emission from created urban soils. The aim of research was to evaluate CH_4 and CO_2 formation, consumption and emission in the newly and 10 years created after reclamation soils (Moscow region).

Before reclamation technogenic surface formations (TSF) were the pasty mold-peat mass with high organic carbon, CH_4 and CO_2 content. After stop the fields use CH_4 and CO_2 emission exceeded 0.6 and 800 $mg \cdot m^{-2} \cdot h^{-1}$, respectively, their atmosphere content exceeded background by the order.

During reclamation the ground with sewage silt fragments (GS), Gleyic Technosol (GT), Urbic Technosol (Arenic, Transportic) (UT(AT)) and sandy Urbic Technosol (Humic, Transportic) (UT(HT)) consistently formed. At the final stage in the greening of built area Urbic Folic Technosols (UFT) are formed. Among these TSF reductive conditions change to oxidative, organic sludge is replaced to sand material in UT(AT) with organic substrates in UT(HT), covered with fertile peat-compost layer in UFT. In summer CH_4 generation decreases by 10 times from GS and peat-compost horizons of new UFT to UT(HT), UT(AT) and UFT. Bacterial CH_4 oxidation also decreases in the same row after reducing it content from 1100-2600 to 3-4 ppm. There is not enough of oxidation capacity in GS and GT, where high CH_4 emission is observed; in other TSF it is absent. CO_2 formation and emission for an exception of UT(HT) decreases in this row of TSF. As a result of reclamation atmosphere CH_4 content decreased from 60 to 2-4 ppm, CO_2 - from 0.20 to 0.13-0.18, in 10 years - to 0.08%. The low CO_2 decrease in initial period after reclamation is caused by its emission from organic matter decomposition in UT(HT). In contrast to the summer at the cold season CH_4 content in 7-27% of TSF grow by 1-3 order, emission increase its concentration in atmosphere up to 7-16 ppm. CO_2 concentrations in TSF are also increase. These facts indicate the fragmentary remains of sewage silt at a depth.

Thus, the urban soils of reclaimed filtration fields don't emit CH_4 in summer; while in the cold period the risk of atmosphere pollution exist. The risk of atmosphere pollution by CO_2 exist all year (≥50%), over time it decreases.

THE DETERMINATION OF GREENHOUSES GASES EMISSION FROM SOIL IN REPRESENTATIVE LANDSCAPES OF MOSCOW CITY

Maria Vizirskaya, Ilya Mazirov, Anna Epikhina, Viycheslav Vasenev, Ivan Vasenev, Riccardo Valentini

Russian Timiryazev State Agrarian University, Laboratory of Agroecological Monitoring, Ecosystem Modeling and Prediction
e-mail: mvizir@gmail.com

Keywords: soil respiration, monitoring, root and microbial respiration, urban area

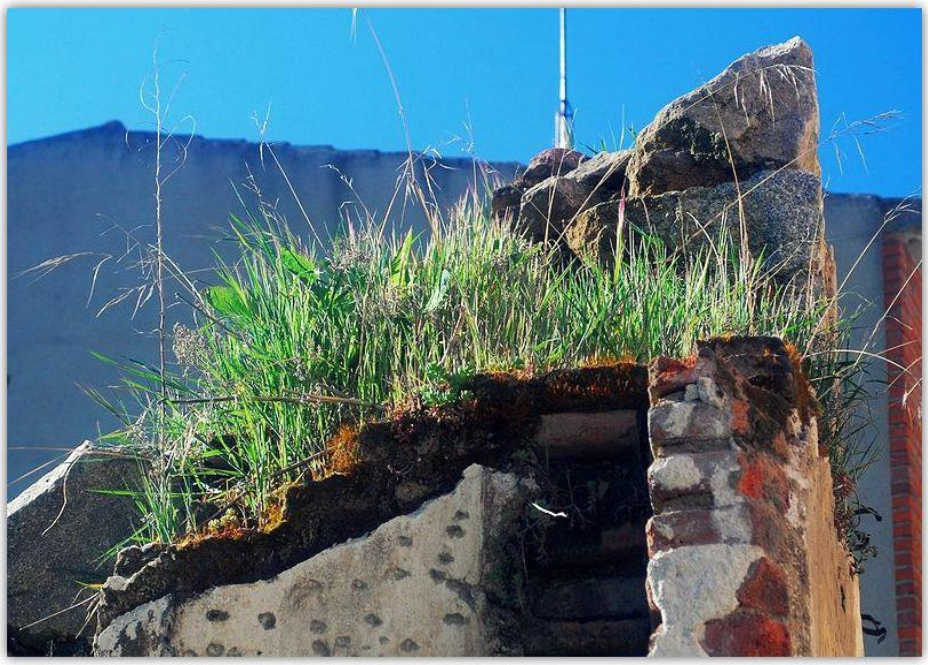
The modern Global climate change problems are closely connected to greenhouses gases (GHG) balance in dominated landscapes. This problem is especially actual in case of sharply man-changed urban landscapes. Up to now not so many studies have deal with urbanization effect (functional zoning, land-use type, soil contamination etc.) on soils GHG emission variability at the local and regional scale, although the global scale land-use change and human impacts are reported to be the main factors behind soil CO_2 emission. Moscow megalopolis is one of the biggest city not only for European territory of Russia but for Europe too.

Our study has been done in two representative urban landscape types typical for Moscow: urban forest (widespread in the North of Moscow) and green lawns with different functional zoning (11 sites in total). Forest sites are represented by 5 sampling plots located in mesorelief position (small hill summit and two slopes). Green lawns vary in the functional use (residential, recreational and industrial) and level of human impact (normal and high).

In each plot soil respiration was measured in-situ using Li-6400-XT system. We separate autotrophic (root-derived) and heterotrophic (microbial-derived) soil respiration in the field using micro (1 mm) and macro (1 cm) pore meshes. The measurements have been done weekly since June till October 2012 in 3 replicas per each plot. Additionally we analyze CH_4 emission using the method exposition chamber measurements.

The conducted research have shown high temporal and spatial variability of CO_2 and CH_4 fluxes due to functional zoning, slope, vegetation type, land-use practice, soil microclimate characteristics. The highest CO_2 emission is typical for green lawns where the CO_2 fluxes reached 3.3 μmol CO_2 $m^{-2}s^{-1}$, which is 2.5-3 times more than the one of the urban forest. Comparative analysis of the roots and microorganisms contribution in total soil respiration showed the domination of microbial respiration which is 79.1% and 72.0% for forest and green lawns sites respectively. The significant increase in CO_2 emissions is accompanied by essential rise in root derived respiration: in 1.35 times compared to urban forest ecosystems. Another important feature of green lawn sites is CH_4 sink domination. The soil of the forest ecosystems is almost in a state of CH_4 equilibrium.

5. BIODIVERSITY in SUITMAs



ORAL PRESENTATIONS

BIOINDICATION IN URBAN SOILS OF SWITZERLAND

Joël Amossé[a, b], Claire LeBayon[a], Edward A. D. Mitchell[b], Bertrand Fournier[a], Jean-Michel Gobat[b]

[a]*University of Neuchâtel, Laboratory Soil and Vegetation, Neuchâtel, Switzerland*
[b]*University of Neuchâtel, Laboratory of Soil Biology, Neuchâtel, Switzerland*
e-mail: joel.amosse@unine.ch

Keywords: urban ecosystem, disturbance, soil fauna, ecosystem services

The assessment of soil quality (or health) is defined as its ability to deliver ecosystem services in a sustainable way. Such assessment is however not straightforward, especially for urban soils that differ from natural and agricultural soils in their structure and their degree of anthropogenic perturbations. In this context, soil organisms may be used as bioindicators of soil quality and sustainability as they represent an integrative component of ecosystem functioning. However, this potential has not been explored much in urban settings.

Soil invertebrates are key actors of soil processes at different spatial and temporal scales and provide essential ecosystem services. They contribute significantly to organic matter decomposition, nutrient cycling, and soil structuring processes. In urban soils, one of the major constraints is compaction due to trampling. This affects the soil structure, water infiltration and air circulation and limits living conditions for plants (i.e. root penetration) and for soil organisms (i.e. habitat reduction).

The aim of our research project (Bioindication in Urban Soil - BUS) is to assess the potential of different soil fauna taxa (e.g. earthworms, enchytraeids, nematodes and ciliates) as bioindicators of soil disturbance. We first investigated urban and alluvial soils (considered as a near-natural reference) for their typology and history in terms of soil use and disturbance. The structure and functioning of soil communities (here earthworms and enchytraeids) were then studied in relation to soil physicochemical variables.

Our first results show that changes in earthworm community tend to be more influenced by physical than chemical soil variables in urban soils. Earthworm community was most strongly correlated to soil depth and soil bulk density. By contrast, enchytraeid community was correlated to the carbonate content.

EARLY COLONISATION OF A CONSTRUCTED TECHNOSOL BY SOIL ORGANISMS AFTER INDUSTRIAL SITE RECLAMATION

Jérôme Cortet[a,b], Thierry Béguiristain[c], Anne-Marie Charissou[d], Elodie-Denise Chenot[a], Sylvain Corbel[e], Daniel Cluzeau[f], Farhan Hafeez[g], Mickael Hedde[e], Corinne Leyval[c], Fabrice Martin-Laurent[g], Jean-François Masfaraud[h], Johanne Nahmani[h], Denis Piron[f], Christophe Schwartz[a], Geoffroy Séré[a], Cécile Villenave[i,j], Françoise Watteau[a]

[a]*Laboratoire Sols et Environnement, UMR 1120 Université de Lorraine/INRA, Vandoeuvre-les-Nancy, France*

[b]*Laboratoire de Zoogéographie,Université Paul Valery/CEFE UMR 5175, Montpellier cedex 5*

[c]*Laboratoire Interdisciplinaire des Environnements Continentaux, UMR 7360 Université de Lorraine - CNRS, Faculté des Sciences , BP239 54506 Vandoeuvre-les-Nancy Cedex*

[d]*EUROFINS IPL EST, Rue Lucien Cuenot, site Saint Jacques II, BP 51005, 54521 Maxéville, France*

[e]*INRA-PESSAC, Bâtiment 6, RD 10 78026 Versailles Cedex*

[f]*Université de Rennes I, UMR 6553 CNRS EcoBio, Station Biologique, 35380 Paimpont, France*

[g]*UMR 1347 Agroécologie, INRA/Agrosup/Université de Bourgogne, DIJON Cedex, France*

[h]*Laboratoire Interdisciplinaire des Environnements Continentaux UMR 7360 Université de Lorraine - CNRS, Campus Bridoux, Metz, France*

[i]*UMR ECO&SOLS 210, IRD, SupAgro, Montpellier cedex 1*

[j]*ELISOL environnement, Montpellier cedex 1*

e-mail: jerome.cortet@univ-montp3.fr

Keywords: soil biota, Technosols, biodiversity, soil functioning

Technosols (USS Working Group WRB 2006) are soils, whose properties and pedogenesis are dominated by artificial or transported materials. In the case of industrial brownfield management, constructed Technosols can be used intentionally to reclaim ecosystem. These Technosols are made of anthropogenic materials that are legally considered as wastes or by-products.

Sponsored by the French National Soil Programme GESSOL, and within the GISFI (Groupement d'Intérêt Scientifique sur les Friches Industrielles, www.gisfi.fr), a consortium of soil biologists has been constituted to study a model constructed Technosol ecosystem at the field scale on a derelict brownfield in the Lorraine Region (France). The studied Technosol, implemented in 2007, is made of a layer of green-waste compost at the surface, a layer of a mixture of treated industrial soil and paper-mill sludge, and a bottom layer of pure paper-mill sludge. The pedogenesis of this Technosol has been studied for several years demonstrating its capacity to perform basic soil functions (Séré, Schwartz *et al.* 2008). The working group comprised soil ecologist specialists of various biota (bacteria and mycorhiza, nematodes, microarthropods, macroarthropods and earthworms), agronomists, and soil bio-physicians. Sampling has occurred each year at spring time since 2008.

The main question of the project focuses on the capacity of the Technosols to fulfill essential functions of a natural soil, particularly vegetation development, which means restoration of physical and chemical fertility. Our hypothesis is that soil organisms, by their diversity and functional complementarities, are essential actors in the system for the main physical (aggregation, bioturbation) and chemical (carbon and nitrogen cycles) processes. In this context, our objective is to assess the colonisation dynamic of the Technosol by soil biota and their impact on several soil functions.

The results obtained within the 4 first years (2008 to 2011) of the project indicate that the initial system is typical of pioneer ecosystems, with the presence of bacterivorous nematodes and the absence of macrofauna. Initial Collembola communities are mainly influenced by the initial materials (origins of the composts) and the borders of the field, showing a centripetal colonisation during the first 2 years. However, an increase of species richness, particularly concerning nematodes, is

observed between 2008 and 2009. Furthermore, in 2011, an explosion of earthworm densities is observed, showing a fast colonisation of soil engineers. Finally this soil biota development can be strongly linked with the evolution of the soil structure and leads to a biomass production similar to a “natural” pasture, which conducts to the occurrence of a brumifer horizon.

ACTIVITY AND EVOLUTION OF RHIZOSPHERIC MICROORGANISMS UNDER GREEN MANURES CROPS INFLUENCED BY DIFFERENT SOIL PROPERTIES AND PTE CONTAMINATIONS

Yann Foucault, Stéphane Compant, Birgit Mitter, Thibaut Leveque, Angela Sessitsch, Camille Dumat

STCM, France
e-mail: *yann_foucault@hotmail.fr*

Keywords: Rhizotest, MTE-contaminated soils, green manures, microbial communities, root exudates, DNA extraction, T-RFLP, cloning

Rehabilitation of brownfields contaminated with MTE in urban areas is an important issue. Among the techniques for remediation of sites, phytoremediation uses the capabilities of some plants to extract (phytoextraction) or stabilize (phytostabilisation) these elements. Commonly used in agriculture or gardeners, these green manures improve soil quality. It has been demonstrated that phytoremediation is related to microbial activity at the roots interface and inside plants. The objective of the proposed work was therefore to study the activity of these microorganisms under green manure crops in relation to soil restoration and to determine the concentrations at which the effects occur, changes in terms of bacterial population and sub-populations and taxonomic changes.

The biotest Rhizotest allowed to grow two plants green manures, white mustard (*Sinapis alba*) and borage (*Borago officinalis*) in different exposure conditions: different concentrations of metal(loid)s (up to 825 mg kg^{-1} Pb and presence of Sb, Cd, Cu and Zn) and soil types (pH, texture, contrasted $CaCO_3$ and OM contents). Then, the soil DNA was extracted, amplified by PCR, and bacterial communities were determined by T-RFLP. The cloning of DNA was used to estimate more precisely the taxonomic changes.

The use of Rhizotests was very relevant to the study of microbial communities in the rhizosphere. Molecular screening and meta-analyzes of microbial genomics have highlighted differences in the bacterial communities studied in relation to different culture conditions by plant species, physico-chemical parameters of soil and soil contamination levels that induced taxonomic changes.

STRUCTURE AND ABUNDANCE OF MICROBIAL COMMUNITIES IN TECHNOSOLS CONSTRUCTED FOR THE RESTORATION OF AN INDUSTRIAL WASTELAND

Farhan Hafeez[a,b], Fabrice Martin-Laurent[a], Jérémie Béguet[a], David Bru[a], Jérôme Cortet[c], Christophe Schwartz[d], Jean-Louis Morel[d] and Laurent Philippot[a]

[a]*INRA, UMR 1347 Agroécologie, 17 rue Sully BP 86510, 21065 Dijon Cedex, France*
[b]*Department of Environmental Sciences, COMSATS Institute of Information Technology, Pakistan*
[c]*Laboratoire de Zoogéographie,Université Paul Valery/CEFE UMR 5175, Route de Mende, 34199, Montpellier cedex 5, France*
[d]*Nancy-Université, Laboratoire Sols et Environnement, UMR INRA/INPL 1120, BP 172, F-54505 Vandœuvre-lès-Nancy Cedex, France*
e-mail: drfarhan@ciit.net.pk

Key words: Technosols, industrial wastelands, soil ecosystems services, N cycling, microbial communities

Technosols, recently classified by the IUSS (IUSS Working Group WRB, 2006), consist of the materials technogenic in origin. Construction of Technosols through the assemblage of treated soil, recycled waste materials and industrial by-products is an innovative technology for the restoration of industrial wastelands and waste recycling. Although this technology is in expansion, knowledge about the microbial communities in Technosols is limited, despite their central role in ecosystem functioning. This study was carried out on a 1 ha experimental site built in 2007 on industrial wasteland in Homécourt, France (Groupement d'Intérêt Scientifique sur les Friches Industrielles, GISFI, www.gisfi.fr). Two Technosols (T1 and T2), using green waste compost, mixture of paper by-products and treated industrial soil, and pure paper by-products, were constructed for the restoration of an industrial wasteland. In this work, we characterized the structure and abundance of total bacterial community, abundance of crenarchaeal community and abundance of the functional guilds involved in N cycling, in both types of Technosols. The structure of the microbial community was analyzed by Automated Ribosomal Intergenic Spacer Analysis fingerprinting. Real time PCR was used to quantify the abundance of the different microbial guilds. Results demonstrated that the abundance of the total bacterial community and of the N cycling communities in Technosols were similar to 'natural soils' and were not significantly different between the two Technosols. It was observed that the differences in the genetic structure of the microbial community were greater between plots than between the two types of Technosols that may be attributed to the heterogeneous nature of the constructed Technosols. However, real time PCR quantification of the abundance of ammonia oxidizers, nitrate-reducing and denitrifying microbial communities involved in nitrogen cycling revealed that in contrast to most of the natural soils, bacteria and not crenarchaea were the dominant ammonia-oxidizers in the constructed Technosols. The spatial variability of the microbial community structure was high and decreased with time, suggesting an early pedogenesis of the Technosols leading to the homogenization of the microbial habitat. The study highlights the potential of constructed Technosols to perform important soil ecosystem functions and degraded land reclamation.

References

IUSS Working Group WRB (2006). World reference base for soil resources 2006.

IN SITU MONITORING OF THE EFFECT OF BIOLOGICAL ACTIVITY ON THE PEDOGENESIS OF A TECHNOSOL

Nouhou Salifou Jangorzo, Françoise Watteau, Dorian Hajos, Christophe Schwartz

Université de Lorraine-INRA, France
e-mail: christophe.schwartz@univ-lorraine.fr

Keywords: Technosol, pedogenesis, aggregation, fauna, plants, quantification, modeling

Pedogenesis is the set of steps, which lead to the formation and evolution of soils under pedogenetic factors and processes (e.g. aggregation, weathering, transfer). They may be described quantitatively for a modeling end. For this purpose, constructed Technosols are candidates to be studied, because their initial composition is well described. Furthermore, among pedogenetic factors, living organisms are known to play a major role in soil formation. The most challenging objective of our work is then to monitor in situ the effect of biological agents on soil evolution. However, soil pedogenesis is known to be dynamic, therefore visualizing in situ plant roots or soil fauna in contact with soil, will help understand better how pedogenesis occurs realistically. The aim of this work is to study in situ, visually and quantitatively, the evolution of a constructed Technosol pedogenesis using an innovative dispositive of observation on cosmes. The Technosol is constructed in three horizons, from bottom to top we have: gravels, treated industrial soil and paper mill sludge (2/3, 1/3 masse ratio) and green waste compost. The soil is put into a cosme equipped with image acquisition devices. Factors are organized into two modalities each repeated three times. “Plant” where five seeds of white lupin are sown in each cosme. “Plant and Fauna” where six epigeic adult earthworms and five seeds of white lupin are inoculated, and a “control”. A moisture of 60/80% field capacity is maintained in all modalities. Results show that roots grow at 10 $mm \cdot day^{-1}$ speed during the first three weeks. Roots increase porosity and aggregation with time. Earthworms explore the soil randomly by creating and filling burrows. At a second time, they create their burrows preferentially along plant roots. Roots and earthworms contribute to the rapid increase of porosity (9.81 times control at 268 days) and aggregation (10.15 times control at 268 days) during time, in the early stages of pedogenesis. In situ and non-destructive observation of soil profiles is therefore an innovative way of monitoring and quantifying the impact of pedogenetic factors on the evolution of Technosols.

POSSIBLE EFFECTS OF GLOBAL WARMING FOR FUNGAL COMMUNITIES OF URBAN SOILS

Marfenina O. E., Danilogorskaja A. A., Ivanova A. E.

Soil Science Faculty, Moscow State University, Moscow, Russia
e-mail: marfenina@mail.ru

Keywords: soil fungi, urban soils, global warming

Warming of the climate may inevitably greatly affect the structure and functioning of soil communities. Fungi are one of the most important groups of soil organisms. We have studied the reaction of the soil mycobiota to conditions simulating some scenarios of climate warming. In laboratory experiment with zonal (Umbric Albeluvisoil) and urban soils (Urbic Technosol, Moscow) studies were made of the structural and functional diversity of fungi at different soil temperatures (10, 20, 30°C) in the course of succession for 1 month. Functional diversity was determined by ECOLOG, the species diversity of cultivated microfungi was assessed by the isolation on the Capek medium. In field experiments with shelters studies were made on the changes of cellulolytic fungal assemblages in soils. The investigations were held with cellulose baits. Radial growth rate and sporulation of pothentially pathogenic fungus *Aspegillus sydowii* were measured on the solid Czapek medium at a temperature of 5-42°C and water activity of 0.99-0.80 aw. High temperature (30°C) had a negative effect on the microfungal assemblages in zonal soil, which manifested itself in a weak expression of successional stages, reduction of species and functional diversity of fungi. By contrast, for the fungal assemblages of Urbic Technosol at soil temperature (30°C) the changes of species and functional diversity have not been identified. In experiments with shelters it was shown that even short-term (monthly) changes in the course of daily temperatures can increase the diversity of cellulolytic fungi and the intensity of the colonization of cellulose. In urban soils, under shelters it was revealed that the frequency of thermotolerant species of *Aspergillus* (*A. fumigatus*, *A. ochraceus*, etc.), known to be potentially pathogenic for human, increased. In long-term field studies growth of abundance of these fungi in urban soils was noted in the hottest summers. On the example of species *A. sydowii* comparison of the properties of environmental and clinical isolates was made. Clinical strains of *A. sydowii* can easily survive in soils. It has been demonstrated that the optimal temperature for the growth of clinical isolates is higher than that for environmental ones. Climate warming may affect the species, functional diversity and the growth of a number of environmental and trophic groups of soil fungi, including those hazardous to humans.

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MEANING OF SOIL CHARACTERISTICS FOR INNER URBAN CONSERVATION AREAS – THE EXAMPLE OF THE KARLSRUHE OLD AIRPORT

Norra S., Wilhelms A., Schmid E., Wirsing T, Waldenmeyer G., Kull M.

Karlsruhe institute of Technology, Germany
e-mail: stefan.norra@kit.edu

Keywords: airport, conservation area, military use, soil properties

The Karlsruhe Old Airport is located on a sand dune formed in the late Pleistocene. The area has been used for military and urban purposes since 1820. First it was a drill ground, later an anchorage ground for zeppelins and in 1925 the first runway was established. After WWII, the airport was used by the US troops till 2003. Back in the ownership of the City of Karlsruhe the former airport was allocated as FFH conservation area to protect the unique biodiversity of extended mat grass carpets, sand grasslands and nutrient-poor swards. Management measures such as grazing by donkeys, mowing or cutting of invasive black cherries are unavoidable to protect the succession level of the occurring vegetation. Although the flora and fauna has been comprehensively identified, no information was available on soil characteristics. Thus, the management measures were undertaken without any knowledge on the soil status. Especially such intensively used areas like a former airport are known for soil pollution or addition of construction materials changing the status of nutrient supply and pH causing succession of plant communities.

In 2012 we started to investigate the soils of the Karlsruhe Old Airport. We documented soil properties such as texture, nutrient supply and pH at several locations and linked their variations to the respective vegetation cover and the management measures. Grazing by donkeys e.g. led to neutral pH values instead of slight acid conditions. More and above that construction rubble caused higher pH values, electrical conductivities and carbonate concentrations. Thus, we concluded that soil management operations are needed to improve the conservation area status and to control unrequested developments of the plant cover.

5. BIODIVERSITY in SUITMAs

POSTER PRESENTATIONS

SOIL FORMING PROCESSES ON COAL DUMPS AND ORE TAILINGS IN SOUTHERN SIBERIA

P.S. Bragina, M.I. Gerasimova

Lomonosov Moscow State University, Russia
e-mail: Polina.bragina.moscow@gmail.com

Keywords: coal dumps, tailings, elementary soil-forming processes, point-scale assessment

In accordance with the concepts of the monograph "Elementary soil-forming processes: Approach to conceptual analysis, characteristics, systematic", 1992, Moscow, the initial pedogenesis was studied on stony loamy wastes of coal mining and sandy silty iron-ore tailings; each type of technogenic substrates occurred in two zones: forest-steppe and mountain taiga. In soils on both substrates, six groups of processes were identified (at macro- and meso- levels), namely: metamorphism of mineral and organic matter; re-arrangement of the solid phase; migration of substances; gleying; inflow and loss of matter from the surface. The processes were analyzed using morphological, mesomorphological and chemical data, the latter including pH, TDS, carbon content.

The set of processes is unique at each of four objects, and depended more on the substrate fabric and composition than on the zonality. Thus, development of pedogenic structure was more advanced in stratified tailings than in coal wastes, because small sand particles are easily captured by the roots. Migration of carbonates was recorded only in coal-mining dumps because of admixture of limestone fragments.

The zonal imprint is revealed in the intensity of some processes. Rates of humification, salinization and gypsum formation are higher in forest-steppe, while biogenic structuring, inflow of organic matter and its transformation are quicker in taiga zone. Moreover, the processes are also associated with soil age. For example, the organic matter metamorphism predominated in old soils on both substrates, whereas in the youngest soils, more active were processes of solid-phase re-arrangement and migrations.

Using point-scale assessment of processes intensity we qualified processes as common to all study sites, and specific, which occur in some sites. The former are more active in silty tailings, because of smaller size of mineral particles, specific are processes of ferrugination and coagulation structuring there. On coal dumps, the unique processes are mineral matter metamorphism, because the overburden rocks have not undergone substantial transformation during the technological procedures, and are unstable on the earth surface. Spontaneous combustion induces additional processes on coal dumps, namely, salinization and rocks sintering.

IMPROVEMENT OF URBAN FILLING SOIL WITH COMPOST TO ESTABLISH A BIODIVERSE HERBACEOUS VEGETATION

F. Bretzel, B. Pezzarossa, M. Scatena, R. Pini, F. Vannucchi

CNR ISE Pisa, Italy
e-mail: francesca.bretzel@ise.cnr.it

Keywords: organic matter, subsoil, C_{org}, herbaceous plants, functional traits

Derelict urban soils are not suitable to grow ornamental traditional vegetation, but they can be for biodiversity and nature conservation. The low quality of those soils do not enable a uniform covering and development of species and plant sizes, necessary to satisfy esthetical requests. Aim of our work was to evaluate the contribution of compost in improving the quality of soil in terms of organic matter and structure, the plant community diversity and its self-sustainability in the cultivation.

The experimental study started in 2010 and was carried out in eight, 2 m^2 beds, filled with urban subsoil and sown with a mix of 29 autochthonous herbaceous species growing in spontaneous associations in the nearby countryside. In four boxes we added compost coming from selected municipal organic waste in the first 15-20 cm of soil, while the other four boxes were not treated. Then we sowed the seed mixture on a thin layer (about 2-4 cm) of commercial seeding substrate. The filling soil was poor in N_{tot} (0.2 $g \cdot kg^{-1}$) and C_{org} (4,3 g·kg-1) and had alkaline pH (8.3), this very low nutrient content can affect negatively the growth of plants: the addition of compost could improve the content of N_{tot} and C_{org} and decrease the value of pH. Half of the vegetation was mowed in July half in October each year. We analyzed the soil properties and measured the number of individuals, height and biomass of the plants. We attributed the ecological strategy to the species (*sensu* Grime) in accordance to their behavior to the presence of compost and to the time of mowing.

Two years after the treatment in the C boxes N_{tot} was 1.04 $g \cdot kg^{-1}$, C_{org} was 15.5 $g \cdot kg^{-1}$ and the bulk density of the 0-10 cm layer was 1.27; in the NC boxes N_{tot} was 0.55 $g \cdot kg^{-1}$, C_{org} was 10.1 $g \cdot kg^{-1}$, the bulk density of the 0-10 cm layer, was 1.32. The composition of the vegetation after two years was of 11 species, some functional groups (*therofite* i.e. annuals) completely disappeared. Some ruderal species were more productive in terms of dry weight in presence of compost, (e.g. *Centaurea nigrescens* L.), while some stress-tolerators were more affected by the time of mowing in terms of number of individuals (e.g. *Dianthus carthusianorum* L.).

The adding of compost in subsoil improved the content of C and N. The presence of compost can also affect the composition of the herbaceous vegetation in terms of productivity (DW) and number of individuals and so influence the biodiversity.

THE IMPACT OF SOIL SEALING ON THE MICROBIAL BIOMASS CONTENT AND ACTIVITY

Anna Piotrowska-Długosz[a], Przemysław Charzyński[b]

[a]*Department of Soil Science and Soil Protection, Division of Biochemistry, Faculty of Agriculture and Biotechnology, University of Technology and Life Sciences, 6 Bernardyńska St., 85-029 Bydgoszcz, Poland*
[b]*Department of Soil Science and Landscape Management, Faculty of Earth Sciences, Nicolaus Copernicus University Toruń, 187 Lwowska St., 87-100 Toruń, Poland*
e-mail: ap03@wp.pl, pecha@umk.pl

Keywords: Ekranic Technosols, enzyme activities, soil microbial biomass, soil respiration

Soil sealing is an increasing problem in all urban areas. Covering soils with impenetrable materials, e.g. asphalt, concrete, paving slabs, etc. has a significant impact on the functioning of the soil. The sealing of soils prevents the exchange of gases, water and nutrients between the soil and the atmosphere, thus resulting in a negative effect on their physicochemical properties. This, in turn, negatively influences microbial and enzymatic activity, since soil microorganisms are the main source of enzymes in soils.

The aim of the work was to evaluate the soil microbial properties of Ekranic Technosols and neighboring, reference soils that were not sealed. In general, 43 soils from different parts of the city of Toruń (NW Poland) were sampled. The studied soils were divided into 3 groups: (1) soils sealed with concrete paving slabs, which allow water and air to partially pass through (group A), (2) soils sealed with impenetrable surfaces, such as asphalt and concrete (group B) and (3) non-sealed soils that are situated in adjacent areas (group C). Soil samples were assayed in relation to (1) the activities of soil enzymes (β-glucosidase - GLU, cellulase - CEL and catalase - CAT), (2) the content and the activity of the soil microbial biomass, assayed as the microbial biomass C content - MBC, soil dehydrogenase activity -DH, fluorescein sodium salt hydrolysis -FDAH and soil respiration - RESP. In addition, some physicochemical properties of the soils were studied as a background.

Soil sealing significantly decreased the soil microbial properties (Tukey's test; $p<0.05$). For all of properties studied, with the exception of CEL activity, significantly higher values were noted in the reference soil samples as compared to the sealed soils. The data for MBC, FDAH, GLU and DH were higher in soils sealed with concrete paving slabs (A) as compared to soils sealed with asphalt and concrete (B), and the difference was in the range of 17-23%. Soil CEL activity ranged from 4.6-4.8 mg glucose$\cdot kg^{-1}\cdot h^{-1}$ in the reference soils (C) and the soils sealed with concrete paving slabs (A), while in the soils sealed with asphalt and concrete (B), the activity amounted to 3.6 mg glucose$\cdot kg^{-1}\cdot h^{-1}$. A higher RESP was noted in the soils covered with asphalt and concrete (B) than in the soils under concrete paving slabs (A). The CAT activity was similar (mean value amounted for 4.65 mg $H_2O_2\cdot kg^{-1}\cdot min^{-1}$) in both groups of sealed sites and it was about 24% lower than in the reference soils.

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AN EVALUATION OF THE CONTENT AND ACTIVITY OF THE MICROBIAL BIOMASS IN SEDIMENTS OF THE VISTULA RIVER, NORTHWEST POLAND

Anna Piotrowska-Długosz[a], Mirosław Kobierski[b], Jacek Długosz[b]

[a]*Department of Soil Science and Soil Protection, Division of Biochemistry, Faculty of Agriculture and Biotechnology, University of Technology and Life Sciences, 6 Bernardyńska St., 85-029 Bydgoszcz, Poland*
[b]*Department of Soil Science and Soil Protection, Faculty of Agriculture and Biotechnology, University of Technology and Life Sciences, 6 Bernardyńska St., 85-029 Bydgoszcz, Poland*
e-mail: ap03@wp.pl, kobierski@utp.edu.pl, jacked@utp.edu.pl

Keywords: bottom sediments, enzyme activities, soil microbial biomass, soil respiration

The depositional areas of slow-moving sections of rivers can accumulate sediments over time. They are responsible for transporting a significant proportion of many nutrients and contaminants. They also mediate their uptake, storage, release and transfer between environmental compartments. Monitoring sediment quality is important not only for aquatic ecosystems, but also for adjacent areas, especially those used as arable fields or pastures that are recurrently flooded by the river.

The study was conducted on the sediments of the right-bank of the Vistula River in the area of the Fordon Valley and Grudziądz Basin, located in the Cuiavia-Pomerania Province, northwest Poland. The area, which is legally protected and naturally precious (landscape park), is, however, threatened with contamination of heavy metals and others toxic substances that are emitted by two big cities Toruń and Bydgoszcz. In order to evaluate the content and activity of the microbial biomass, 20 sediment samples were collected from the river bed of the right-bank of the Vistula (10 samples in the Fordon Valley and 10 in the Grudziądz Basin). The sediments were assayed for the activities of β-glucosidase (GLU), catalase (CAT), dehydrogenase (DH) and fluorescein sodium salt hydrolysis (FDAH), the content of microbial biomass C (MBC) and soil respiration (RESP). In addition, some physicochemical properties of the soils were studied as a background. Classical statistics was used to study the central tendencies and the variability of the samples. Additionally, simple linear regression was calculated among all of the studied properties. The studied sediments varied widely in C_{ORG} and N_{TOT} content, which ranged from 5.7 to 37.2 $g \cdot kg^{-1}$ and from 0.48 to 3.93 $g \cdot kg^{-1}$, respectively. The sediments were neutral (pH_{KCl} from 6.8 to 7.4) and EC was ranged 0.78 – 5.69 $mS \cdot cm^{-1}$. The following enzyme activities were determined: CAT from 5.5 to 32.6 mg $H_2O_2 \cdot kg^{-1} \cdot min^{-1}$, DH from 51 to 2979 mg $TPF \cdot kg^{-1} \cdot h^{-1}$, GLU from 0.20 to 1.46 mM $pNP \cdot kg^{-1} \cdot h^{-1}$ and FDAH from 25.8 to 331.7 mg of $F \cdot kg^{-1} \cdot h^{-1}$. The activity of CAT and GLU was higher in sediments taken from Grudziądz Basin, while the activity of DH and FDAH was higher in sediments collected in the Fordon Valley. The mean value of MBC content was similar in sediments taken from both places (264 $mg \cdot kg^{-1}$) with CV higher in Grudziądz Basin (87%) than in the Fordon Valley (41.3%). Among the enzymes studied the highest variability was noted for DH activity (CV = 89 and 118%).

STUDIES ON THE EFFECTS OF SEALING OF URBAN SOILS (EKRANIC TECHNOSOLS) IN TORUŃ AREA (POLAND) ON BACTERIAL AND FUNGAL NUMBERS AND ON THE OCCURRENCE OF SOME PHYSIOLOGICAL GROUPS OF BACTERIA

Henryk Różycki[a], Przemysław Charzyński[b]

[a] *Department of Microbiology, Faculty of Biology and Environmental Protection, Nicolaus Copernicus University, ul. Lwowska 1, 87-100 Toruń, Poland*
[b] *Department of Soil Science and Landscape Management, Faculty of Earth Sciences, Nicolaus Copernicus University, ul. Lwowska 1, 87-100 Toruń, Poland*
e-mail: henroz@umk.pl

Keywords: sealed soils, Ekranic Technosols, SUITMAs, number of bacteria, number of fungi, plate count, abundance of selected physiological groups of bacteria

Sealing of soils presents a problem dealing with all urban areas in Poland and in the world, as well as with the transportation tracks in rural areas. Edaphic and ecological effects of such a human action are still very poorly known. In particular, there almost nothing is known about microbiological activity of the Ekranic Technosols, as compared with the adjacent but uncovered soils. Therefore this study has been undertaken.

There were selected 16 study sites in Toruń, Poland. In all study sites 2 or 3 soil profiles were made. It was reference, unsealed soil and 1 or 2 Ekranic Technosols, if two different soil covers was used in direct neighborhood (e.g. asphalt and concrete slabs or cobblestone). In Ekranic Technosols soil samples were taken from uppermost horizon, which survived sealing process, usually B horizon, in few cases A. From reference soils samples were taken from the same depth. Estimation of the number of bacteria and number of fungi were carried out using Koch's Plate dilution method and the soil extract agar medium with antifungal antibiotic (nystatin) – for bacteria (Lochhead, 1958), and Martin's (1950) rose bengal agar medium with streptomycin – for fungi. Abundance of the selected physiological groups of bacteria [a) acidifying the medium with glucose, b) reducing nitrate to nitrite, c) ammonifiers] was estimated by the most probable number method (MPN), using the media and procedures recommended by Allen (1951).

Considering a part of the soil profiles studied, general bacterial numbers ranged from $3.4 \cdot 10^4$ to $4.2 \cdot 10^6$ colony forming units (cfu)$\cdot g^{-1}$ dry soil, and fungal numbers – from $1 \cdot 10^3$ to $2.5 \cdot 10^5$ cfu$\cdot g^{-1}$ dry soil, respectively. MPN values for selected physiological groups ranged from $4.4 \cdot 10^1$ to $1.3 \cdot 10^6$ cfu$\cdot g^{-1}$ dry soil, diminishing in the following order: acidifying the medium with glucose > reducing nitrate to nitrite > ammonifiers. In many cases microbial numbers and MPN values in sealed soils were lower than those in the adjacent control soils, sometimes significantly ($p \leq 0.05$). However it cannot be stated definitely, that microbial activity of any sealed soil is always lower than in case of the appropriate control.

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EFFECTS OF ROAD CONSTRUCTION ON THE OLIGOTROPHIC HILL MARSH HABITAT OF SCARLET PYGMY DRAGONFLY, NANNOPHYA PYGMAEA RAMBUR

Mie Takeda

Aichi Institute of Technology, Japan
e-mail: *mtakeda@aitech.ac.jp*

Keywords: biodiversity, human activity, regional ecosystem

Oligotrophic hill marsh areas, are scattered throughout the hilly coastal area of Ise Bay in central Japan. The Kaisho forest in the southern part of the Aichi Prefecture (southeast of Seto) was chosen as a potential site for the Aichi World Fair in 2005.
In addition to the construction of the Seto World Fair site next to the Kaisho forest, a road was constructed next to the oligotrophic wetland ecosystem, known as the dragonfly wetland. The road construction used highly alkaline soil-solidifying material.
Sand and gravel beds from the Tertiary period, which have granite as the parent materials, are distributed throughout the hilly part of this area. Spring water with weak to strong acidity flows to the surface, and the characteristic plants that grow in the area, such as *Drosera tokaiensis* and *Eriocaulon nudicuspe*, are endangered.

The so-called dragonfly wetland is inhabited by *N. pygmaea* Rambur and low-growing wetland plants, which are adapted to acidic conditions. However, Canadian goldenrod is invading the areas along the road, and it is considered that road construction is affecting the ecosystem.

This study aimed to determine the effects of the highly alkaline embankments produced during road construction on the water quality, soil chemistry and *N. pygmaea* Rambur dragonflies. Therefore, the water temperature, pH and *N. pygmaea* Rambur counts were determined. Water temperature and pH were measured between December 2009 and June 2012.

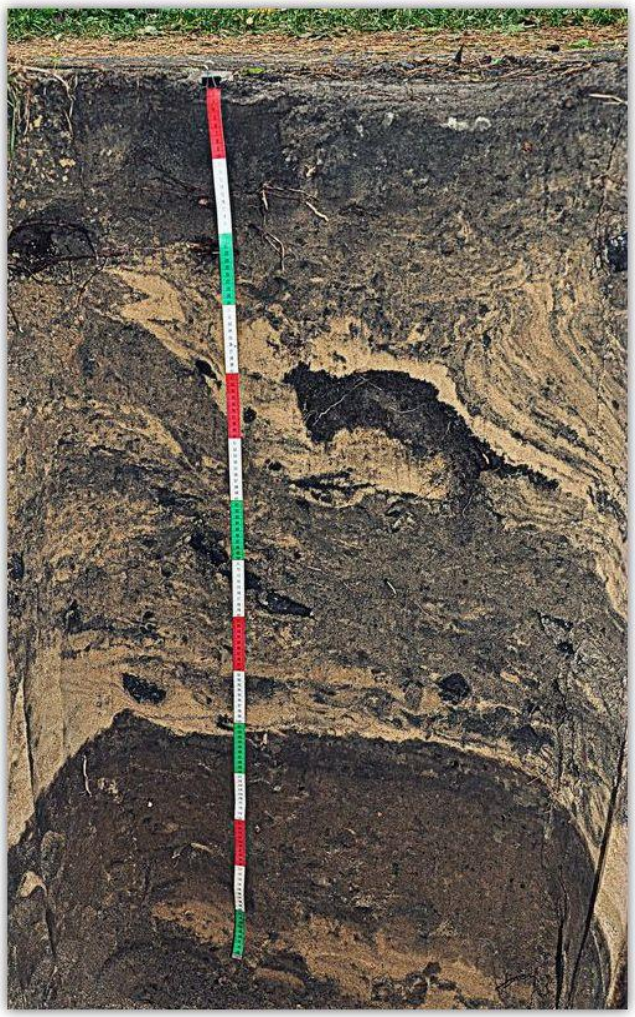
In the wetland areas, the surface water in the waterways tapers off during winter when precipitation is low. The mean pH of the spring water was the lowest at 6.3, whereas the pH of wastewater from the drain pipes underneath the road and the wastewater puddles was 7.6 and 8.1, respectively, in August.

In summer, the pH levels tended to increase in all areas affected by the effluent from the drain pipes. However, the pH of the soils inhabited by *N. pygmaea* Rambur larvae was 4.5 or 4.7, and alkalinisation did not occur.

The *N. pygmaea* Rambur count was 110 in June 2010, 124 in June 2011 and 75 in June 2012.

The *N. pygmaea* Rambur count has increased compared with that 6 years ago; therefore, the effects of road construction are not evident at present. However, *N. pygmaea* Rambur utilises the low-growing plants which live in acidic soils. There is a need for construction methods that prevent the drying and alkalisation of soil as well as for management methods to maintain small amounts of surface water.

6. SUITMAs and CULTURE



ORAL PRESENTATIONS

EFFECTS OF CONSTRUCTIONS ON SOIL AND RELATED REGULATIONS IN TURKEY

Havva Kaptan

Ministry of Forestry and Water Affairs, General Directorate of Forestry, Turkey
e-mail: havvakaptan@yahoo.com

Keywords: soil, soil properties, soil management, excavation, constructions, regulations

Soil is a mixture of sand, silts, clay, water, and air. Topsoil is the upper layer of soil, typically the top 5-10 cm, which contains the highest concentration of organic matter, nutrients and vegetation with root systems. Soil is one of the most important essential elements of nature that has many vital functions which are social, economic, cultural and environmental importance. During construction projects, road works, installation of utility cables and similar operations, volumes of soil are excavated or stripped from the surface. Sometimes this excavated soil is reused as filling material on the excavation site. In most cases, however, the excavated soil will be carried off for reuse on other locations. Salvaging, storing and using topsoil are important for rehabilitation. Retain site topsoil for rehabilitation, preserve topsoil quality during moving and storage are the main objective in situ and ex situ soil management. Prevention of waste, reuse and recycling of waste are the main objective in waste management. However, waste that cannot be recycled is usually burnt or landfilled. Soil is at risk from a number of threats driven by a range of man-made, natural pressures, land use change, land management practices including constructions, urbanisations, housing and infrastructure. Soil and protective vegetation cover can be destroyed and balance becomes delicate for long periods of time. Human activities have changed the properties and quality of soils. These are some of the main threats to soil quality and quantity: (i) conversion of soil physical, chemical, biological properties, (ii) excavation, digging, stripping, environmental damage and interactions, (iii) top soil (vegetative), subsoil removal, change of soil characteristics, (iv) top soil (vegetative), subsoil disposal, losses, reuse, deposition of native or excavated soil, (v) soil placement, stockpiling, compaction, (vi) soil aftercare and remediation, (vii) soil-plant-water interactions, (viii) accumulation of water in the excavation. Ministry of Environment and Urbanisation and Municipalities are responsible for waste management in Turkey. In this regard, related regulations are issued by Ministry of Environment and Urbanisation such as; (i) regulation on solid waste control, (ii) regulation on excavation, construction, ruin waste control, (iii) regulation on obtaining and working out material similar sand and gravel, (iv) regulation on soil remediation lands destroyed by mining activities.

HISTORY OF SOIL ENGINEERING AT A PUBLIC PARK IN STUTTGART, GERMANY

Andreas Lehmann, Karl Stahr

Institute of Soil Science and Land Evaluation, University of Hohenheim, Germany
e-mail: as@uni-hohenheim.de

Key words: soil functions, urbanisation, history, archaeology, museum, melioration, Stuttgart 21

Main problem

Valuable information about soil and land-use management practices could be conserved in urban. Construction activities at the public park "Mittlerer Schlossgarten" in Stuttgart, Germany, for an underground railway station (project "Stuttgart 21") made it necessary to excavate monoliths of historically highly important soils to conserve both historical and ecological information.

However, no measures for archaeological work before and during the construction work for the project called "Stuttgart 21" was planned by the public administration. Also, the ecological functionality of the concerned soils were not respected in the planning process. As these soils where recognised by previous pedological work for the soil map of Stuttgart (Holland 1995), an effort was made to recover soil monoliths from the park area. This study became interesting because of large public attention for the construction activities as well as the co-operation with the constructor "Deutsche Bahn AG" became favourable.

Material and Methods

Soil monoliths were excavated at the construction site for soil analysis and the preparation of soil exponates, which will be shared with the "Stadtmuseum Stuttgart". The soils were described at three locations with the site and soil samples taken to 1.2 m depth. The chemical, physical analysis, including ^{14}C-measurements and archival research are currently will be finished in July 2013.

Results and Conclusions

A uniform layer overlying fluvial sediments with a thickness of about 0.5 m was found in the soils of the park "Mittlerer Schlossgarten" covering an area of about 1 hectare. This layer consisted of clayey soil from local origin which was presumably sieved to achieve a favourable soil quality. Also, about 1 o/oo of ceramic artefacts were observed in this clayey layer. During the pedological work a portrait bust was recovered at a depth of 1.2 m. Manufacturing of the bust was dated back to the 16th century. These findings combined with historical information are helpful to compare changes in the valuation and consideration of soil quality in urban areas in different periods of time. Specifically, the historic efforts to improve soil quality in the public park "Mittlerer Schlossgarten" tremendously exceeds current soil and land-use management practices to improve park soil quality in Middle Europe.

Literature

Holland, Karin (1995): Die Boeden Stuttgarts. Schriftenreihe Amt für Umweltschutz Landeshauptstadt Stuttgart (1995/3), 240 p.

SOIL SCIENTISTS IN THE WORLD OF FORENSICS

Maxine Levin, Debbie Surabian

USDA NRCS
e-mail: Maxine.levin@wdc.usda.gov, debbie.surabian@ct.usda.gov

Keywords: soil forensics, disturbed soils, bone decomposition

USDA Natural Resources Conservation Service soil scientists have recently become an important part of the Henry C. Lee Institute of Forensic Science. The Henry C. Lee Institute of Forensic Science places the State of Connecticut as a world leader in the arena of public safety and forensic science. The Institute's goal is to make the criminal justice system more effective through training, research, consulting and education. At the Forensic Anthropology and Human Remains Workshop, soil scientists have educated police detectives, civilians with working cadaver dogs (also known as HRD or Human Recovery Dog), and forensic scientists to understand how soils can be used in locating and examining clandestine graves.

Soils are the physical context within which forensic evidence is found, therefore, it is important that forensic specialists and police detectives understand some of the potential implications of different physical and chemical soil properties. Soil properties such as the depth of soil, rock fragment content, soil reaction (pH [acidity or alkalinity]), soil temperature, soil texture, and soil moisture play a significant role in bone decomposition and in locating a clandestine grave. Each of these soil properties, along with the identification of a natural versus disturbed soil, can be determined by a skilled soil scientist.

Soil scientists also have the ability to read the landscape and describe and compare soil details enabling them to recognize natural versus disturbed soils and the extent of disturbance in soils, skills not everyone has. Over the years, demand for this type of work has grown and soil scientists are finding themselves working closely with archaeologists in identifying unmarked or mismarked graves and locating the boundary of a grave shaft.

6. SUITMAs and culture

POSTER PRESENTATIONS

PROPERTIES OF SOILS OF GERMAN NAZI CONCETRATION CAMP STUTTHOF

Renata Bednarek, Maciej Markiewicz, Przemysław Charzyński, Magdalena Majorek

Department of Soil Science and Landscape Management,
Nicolaus Copernicus University, Toruń, Poland
e-mail: mawicz@umk.pl

Keywords: Necrosols, Nazi Concentration Camp, cultural layer, archaeology, phosphorus

The aim of this study was to determine the soil properties in the area of the former German Nazi Concentration Camp Stutthof (nowadays northern Poland) for possible reconstruction of the functional differentiation of individual parts of the camp. The soil samples were collected from the boreholes carried out at intervals of 10-30 m. The obtain results of phosphorus content in connection with other properties of soils (OC content, Nt, pH) led to the appointment of additional indicators of the past human activity.

Phosphorus content in soils is often used by archaeologists to study of ancient human activity. The maximum content of total phosphorus in soils of Nazi Concentration Camp Stutthoff were more than fourteen times higher than the approved geochemical background (50 to 150 $mg \cdot kg^{-1}$). It can be stated, that the most likely north of the crematorium and gas chamber the ashes of the murdered prisoners were scattered - maximum phosphorus content of 2099 $mg \cdot kg^{-1}$ was registered in this area. Zones of the highest intensity of extermination practices were the Old Camp II, where the maximum amount of phosphorus as high as 2099 $mg \cdot kg^{-1}$ (to a depth of 20 cm) and 1981 $mg \cdot kg^{-1}$ (at a depth of more than 20 cm) and cremation pyre, where the maximum concentration of the researched element was 10 times higher than accepted for phosphorus geochemical background. Probably cremation pyre had a diameter greater than about 10 meters memorial obelisk now commemorating this place. Investigated soils can be considered as a specific type of Necrosols.

SOIL INVESTIGATIONS AT THE HISTORICAL MAIN SQUARE OF SOPRON

András Bidló, Bernadett Bolodár-Varga, Adrienn Horváth

University of West Hungary, Department of Soil Site Survey
e-mail: abidlo@emk.nyme.hu

Keywords: historical soil, anthrosols

The area of the city has been inhabited since the prehistoric age. The city was named Scarbantia by the Romans, after 1277 when it became a free royal city the name was changed to Suprun. In the time of the occupation of the Turkish, the city became the centre of the unoccupied territories. In 1676 a conflagration destroyed a large part of Sopron and in World War II the city survived many air raids. In December 2009 renovations began at the historical square of the city, which had been preceded by a fundamental archaeological excavation. This gave us the chance to collect several samples from this site and to research the soil. The layers of the soil were deposited on a road built during the Roman age, therefore the layers were easily separable. We collected our samples from a well-layered sidewall, where we separated 8 soil layers. We measured the most important chemical and physical parameters of the samples in our laboratory. All of the samples were slightly alkaline or alkaline (pH: 8.0-9.0), the highest values were measured in “the red-burned-layers”. The red-burned-layer is the remains of a wooden rampart that was built on the old Roman city wall, which was completely burnt down. The highest skeletal percent (14-46%) showed connection with the highest lime content (25-45% $CaCO_3$), but we found very high values in all layers. The samples belonged to the sandy, sandy loam or loam category by the physical assortment. The humus content was favourable (1.34-4.31%) except for the uppermost and the two red burned layers. Low nitrogen contents (0.01-0.13 N%) were determined. In all samples we detected very high AL-soluble potassium and phosphorus values (136 mg $K_2O \cdot 100g^{-1}$ of soil and 215 mg $P_2O_5 \cdot 100 \cdot g^{-1}$ of soil), the potassium content in the “the red-burned-layers” was exceptionally high. The EDTA/DTPA soluble nutrient contents were generally not high, except the EDTA/ DTPA soluble iron, manganese and copper content in the layer under “the red-burned-layers” (43 $mg \cdot kg^{-1}$ Fe, 30 $mg \cdot kg^{-1}$ Mn, 13 $mg \cdot kg^{-1}$ Cu). The acidity, the lime content and the favourable humus content are in accordance with the typical values of our previous results on these urban areas. Basing on the high humus content in the lower layers we have concluded that also significant organic material deposited in each of the layers. Anthropogenic effects are obvious not only in the present city construction but also in the change of the composition of the soils in the city centre.

PROMOTING KNOWLEDGE OF ALLOTMENT SOILS TO INCREASE CITIZEN AWARENESS OF FOOD SECURITY AND ENVIRONMENT

Francesca Bretzel, Enzo Sparvoli, Manuele Scatena, Pini Roberto

Institute of Ecosystem Studies - CNR, Pisa, Italy
e-mail: roberto.pini@ise.cnr.it

Keywords: urban soil, allotments, gardening skills

The cultivation of allotments is increasing in European urban areas. Gardening can provide healthy food for self consumption, stimulate healthy activity, promote relaxation and positive social interactions. Recently some studies raised the worry for contamination of such food, from the exposition to urban pollutants. The aim of our study was to correlate the soil characteristics of urban allotments with the management skills of the gardeners. We analysed the soils of two areas of the town of Pisa: one already used for allotments and the other intended for the same purpose by the local authorities. At the same time we interviewed the gardeners to gather personal information, and to investigate the reasons of cultivation, what was cultivated and how, level of gardening skills. The results of the soil analysis showed that the two soils were similar, because of their common alluvial origin, and had low organic carbon content. Heavy metal contents were below the levels allowed by the Italian law, and their non mobile fraction was low, even though Zn showed high concentration in some cultivated allotments. On the side of the "human factor" we achieved an identikit of the allotment gardeners: they were generally retired men, with low education, that worked for some hours every day. They said to practice organic farming, but actually they were using pesticides and fertilizers. They tried to obtain compost from organic waste, often unsuccessfully. Combining data of soil analyses and interviews we concluded that: i) allotment soils did not present contamination from urban sources; ii) high concentrations of some heavy metals resulted from the excessive use of chemicals; iii) the soil organic matter content could be increased by means of quality compost produced by the gardeners, or even given by the municipality; iv) the recovery of soil fertility required a preventive training of gardeners, to avoid a careless use of chemicals; v) training should have been continuous and systematic, providing information about soil quality and organic farming. As a consequence, we organized training courses, where gardeners had the opportunity to compare their usual techniques with sustainable/organic techniques of cultivation and to employ local varieties of vegetables both to promote knowledge of the local heritage and to preserve horticultural biodiversity.

INVENTORY AND EVALUATION OF EXTENSIVE GREEN ROOFS SUBSTRATES PROPERTIES SOLD IN FRANCE

Olivier Damas, Jason Brunet, Jean-Charles Michel

Plante&Cité, France
e-mail: olivier.damas@plante-et-cite.fr

Keywords: green roof, substrate, growing media, inventory, physical properties, water

Substrates for thin layer green roofs are fundamental in growth and lasting quality of plants. Substrates must supply high technical performances: (i) water and minerals in extreme drought and management conditions, (ii) the minimum possible load to the building (low density and thickness).

Green roof design is not legally framed in France. Nevertheless, non-normative professional rules exists, mostly issued from the German and international reference FLL rules. So far, green roof substrates properties are not well known in France. No professional or technical survey exists.

The aims of this survey were to (i) obtain a global vision of the French extensive green roof substrates market in 2012, (ii) characterize the properties of these substrates, (iii) propose ways of thinking for prescriptions, substrate formulations and professional rules.

The survey was performed in 2012 thanks to a double call for census and substrate sample supply submitted to the French professionnal networks. The frame of the survey concerns substrates commercialized in France. They might be produced in France or in any other country.

Parameters analyzed are: particle size distribution, compaction, organic matter content, dry and maximum water retention bulk densities, maximum water retention, water retention curve, wettability, permeability, pH, cation exchange capacity (CEC), electrical conductivity, total nitrogen, C/N ratio, total available nutrients. Results were interpreted with a crossing approach between the French and German professional rules, and the current scientific references in agronomy.

Sixty five (65) different substrates were inventoried corresponding to thirty three (33) different companies. For substrates analysis, eleven (11) different substrates (i.e. 11 different companies) were supplied corresponding to one-third of the market.

This work provides the first commercial, technical and scientific report never directed on substrates for extensive roofs in France, maybe worldwide. It allows new technical and regulatory considerations for the benefit of professional practices. It highlights new tools and methods for prescription and updates of the current professional rules (for example including water retention curves and wettability parameters).

PLAGGIC ANTHROSOL - SOIL OF THE YEAR 2013 IN GERMANY

Luise Giani, Klaus Mueller, Monika Frielinghaus, Lutz Makowsky

University of Applied Sciences Osnabrueck, Germany
e-mail: l.makowsky@hs-osnabrueck.de

Keywords: Plaggic Anthrosol, soil awareness, soil functions

Since 2005 each year one type of soil is elected in Germany as Soil of the Year by a curatorship of the German Soil Science Society. The initiative targets at promoting public awareness for soils and their meaning and importance for society. The Plaggic Anthrosol has been granted the title Soil of the Year 2013.

The formation of Plaggic Anthrosols is closely connected with the Plaggen management which is assumed to have started nearly 1.000 years ago. The introduction of the Plaggen management was in line with the beginning of continuous rye cultivation, called eternal rye cultivation in Germany. It was an important agricultural improvement comparable with the introduction of mineral fertilizers.

The Plaggen management starts with cutting sods with special tools in common lands. Sods are composed of grass, herb or shrub material with its roots and soil components sticking to them. They were taken to the stables, enriched with dung, mostly composted afterwards and finally spread on the fields. In the course of periodic application of this organo-mineral manure a comparably high man-made soil fertility with humic horizons of more than 40 cm up to 150 cm were created. Raised structures with typical field slopes witness the impact on landscape formation. The common lands exhausted in humus and nutrients and became susceptible to erosion which locally formed shifting dunes.

The colour of the plaggic horizon originating from heathlands sods is grey and from meadows brown. As a matter of fact, the *plaggic* horizons often contain artifacts of charcoal, bricks or other remains of domestic use.

The main spatial distribution of grey Plaggic Anthrosols are the nutrient-poor Saalian glacial deposits of the Netherlands, Northwestern Germany and Denmark. In Germany the brown Plaggic Anthrosols occur predominantly in the regions of Osnabrück and the south-eastern Münsterland. Isolated occurrences are documented on the north-frisian islands.

Plaggic Anthrosols are important archives of landscape and cultural history because archaeological findings can be discovered within and below the *plaggic* horizon. Moreover, the humic plaggen horizons represent climatic relevance by functioning as a sink for carbon.

Because of their distribution close to settlements, many Plaggic Anthrosols are threatened by built-up areas. Tree nurseries are also a matter of concern, because the trees are excavated with the surrounding soil material.

HISTORICAL METALLURGIC ACTIVITIES AND THE POLLUTION OF SOIL ENVIRONMENT AT THE MARKET SQUARE IN CRACOW

Marta Wardas-Lasoń[a], Aldona Garbacz-Klempka[b], Stanisław Rzadkosz[b]

AGH University of Science and Technology, Poland
[a]Faculty of Geology, Geophysics and Environment Protection,
[b]Faculty of Foundry Engineering
e-mail: wardas.marta@gmail.com, mw@geol.agh.edu.pl

Keywords: artefacts, ecofacts, metallurgy, geochemistry, copper, lead

Archaeological surveys conducted at the Main Square since 2004 enabled performing various analyses of metal artefacts and soil samples, like those of heavy metal content (Cd, Cr, Ni, Cu, Pb, Zn, Mn and Fe), inorganic anions, pH, electrolytic conductivity and organic matter. The research aims at determining the degree and character of the influence of human metallurgic operations on the changes in physicochemical properties of the soil and ground in archaeological strata, especially within the production and utility levels. The origin of the environment pollution of Mediaeval Cracow lies with metallurgic and production activities. The fact is that a significant source of lead and copper existed here resulting from the operation of the Great Scales at the Market Square, so mainly two factors - the lie of the land and the impact of water presence and its usage in the town were considered, as they created favourable conditions for easy leaching and transportation of the pollutants. Special attention is paid to the presence and chemistry of micro-artefacts and ecofacts, the latter being depositions of organic or environmental remains. In the grain, chemical and phase content the markers were searched which would determine the way of heavy metals bonding and their susceptibility for migration. Using fluorescence and spectroscopy methods, chemical comparative analysis was conducted of the metal artefacts and soil samples with the aim of determining the mechanisms of pollution. The sediments thickness at places reaches 150 cm, they contain artefacts which make it possible to determine when the polluted layers of sediments formed. The quality of soils and grounds, and especially heavy metals concentration in separate layers including information about their formation time, offers the opportunity for recreating both the technology used in the old metallurgical processes and the stages of polluting of the town soils in the area of the Old Cracow. The geochemistry of the strata may yield lots of additional information about how people functioned and the role of objects in the given area. The purpose of geochemical studies was to determine the degree and character of the impact of human activities on the changes in physicochemical properties of the soil in the strata. The soil quality was treated as a representative indicator of historical anthropopression, useful for the determination of the origin and the degree of environmental transformation of our ancestors.

INDICATORS FOR THE OPTIMIZATION OF SOIL CONSTRUCTION PROCESSES FOR GREEN LANDSCAPING

Sarah Rokia[a,b], Geoffroy Séré[b], Maha Deeb[b], Patrice Canavo[a], Béatrice Béchet[c], Michel Legret[c], Pascale Chenon[d], Benoît Grandmougin[e], Sophie Guimont[f], Thomas Nehls[g], Olivier Damas[h], Christophe Schwartz[b], Laure Vidal-Beaudet[a]

[a]*AgroCampusOuest, Centre d'Angers, France*
[b]*Université de Lorraine-INRA*
[c]*IFFSTAR*
[d]*RITTMO*
[e]*Actéon*
[f]*Valterra*
[g]*Technische Universität Berlin, Germany*
[h]*Plante et Cité*
e-mail: christophe.schwartz@univ-lorraine.fr

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The population growth and the change of lifestyles lead to an expansion of the urban and sub-urban areas that goes along not only with a loss of soil surfaces but also with the implementation in the cities of green areas that require arable earth which is a non-renewable resource. The SITERRE program is financed by the French Environmental Agency (ADEME) and explores an alternative way by constructing fertile soils dedicated to landscaping with urban wastes and by products. The definition of both relevant indicators of the soil fertility and expected quality for constructed soils are then crucial information needed to be defined. An inventory of the main different land uses in green areas was realised by consulting several French urban landscape services, in order to define the two most representative ones as model land uses. They were described in terms of expected levels of soil functions (medium for plant growth, habitat for soil organisms, filter and exchange). Then, a bibliographic study was conducted to determine a limited set of indicators establishing the soil quality (physical and chemical fertility, potential health risk, load bearing capacity). Each indicator was ranked into four classes from 3 to 0: three for the optimal quality and 0 for the worst. Indicators were applied to describe the expected soil quality of the model land uses. Based on their representativeness in the urban area and their strong contrast, the land uses "park" and "street tree" were chosen as model land uses. Their ideal layouts (arrangement and depth of the soil horizons) were defined as well as their expected soil quality in the form of sets of classes for eighteen indicators. On the other hand ten urban by-products - five organics and five minerals - have been selected and characterized for their mechanical, physical, chemical and ecotoxicological properties. A large range of combinations of these materials (16 binary mixtures and 11 ternary mixtures) have been prepared at the lab and then characterized for their properties. A specific multi-criteria analysis was applied to select the combinations that were the most adapted to the model land uses. All the experimental data on the properties of all mixtures were analysed by the multi-criteria tool and gave as a result a ranking of the by-products combinations for each soil horizons. This work aims at providing an efficient decision support system for urban landscape managers.

SUITMA 7
List of participants

No.	Last name	First name	Institution	Country	e-mail
1	Abel	Stefan	Technische Universität Berlin	Germany	stefan.abel@tu-berlin.de
2	Aladin	Danila Yurievich	Institute of Basic Biological Problems RAS	Russia	aladin-danila@rambler.ru
3	Al-Ani	Heider	Griffith University, Labrador, Gold Coast	Australia	h.al-ani@griffith.edu.au
4	Amossé	Joël	University of Neuchâtel,	Switzerland	joel.amosse@unine.ch
5	Amuno	Solomon	Geoforensic Environmental Services, Toronto	Canada	aruomero.amuno@usj.edu.mo
6	Banach-Szott	Magdalena	University of Technology and Life Sciences, Bydgoszcz	Poland	magdybe@poczta.fm
7	Bechet	Beatrice	The French Institute of Science and Technology for Transport, Development and Networks	France	beatrice.bechet@ifsttar.fr
8	Bednarek	Renata	Nicolaus Copernicus University, Toruń	Poland	bednarek@umk.pl
9	Bidló	András	University of West Hungary, Department of Soil Site Survey	Hungary	abidlo@emk.nyme.hu
10	Bragina	Polina	Moscow State University, Faculty of Geography	Russia	Polina.bragina.moscow@gmail.com
11	Bretzel	Francesca	Italian National Research Council, Institute of Ecosystem Studies, Pisa	Italy	francesca.bretzel@ise.cnr.it
12	Burghardt	Wolfgang	University of Duisburg-Essen, Faculty of Biology	Germany	wolfgang.burghardt@uni-due.de
13	Cannavo	Patrice	Agrocampus Ouest	France	patrice.cannavo@agrocampus-ouest.fr
14	Castejon	José Matías	Technical University of Cartagena	Spain	Jose.castejon@upct.es
15	Colinet	Gilles	University of Liege, Gembloux Agro – Bio Tech	Belgium	Gilles.Colinet@ulg.ac.be
16	Cook	Mary Ellen	USDA/NRCS	USA	maryellen.cook@ny.usda.gov
17	Cortet	Jérôme	Université Paul Valery Montpellier3	France	jerome.cortet@univ-montp3.fr
18	Damas	Oliver	Plante&Cité	France	olivier.damas@plante-et-cite.fr
19	Dąbkowska-Naskręt	Halina	University of Technology and Life Sciences, Bydgoszcz, Poland	Poland	soil.dabkowska@interia.pl
20	Di Mauro	Salvatore Engel	Department of Geography, SUNY New Paltz	USA	engeldis@newpaltz.edu
21	Diatta	Jean Bernard	Poznań University of Life Sciences, Department of Agricultural Chemistry and Environmental Biogeochemistry	Poland	Jeandiatta63@yahoo.com
22	Długosz	Jacek	University of Technology and Life Sciences, Bydgoszcz	Poland	jacekd@utp.edu.pl
23	Elyaagubi	Fathi Khalifa	Alfrnage, Tripoli	Libya	Fathi_khalifa@yahoo.com
24	Ferdyn-Rachwał	Marzena	Institute of Environmental Engineering of the Polish Academy of Sciences	Poland	marzenarachwal@ipis.zabrze.pl
25	Filipović	Vilim	Faculty of Agriculture, University of Zagreb	Croatia	vfilipovic@agr.hr
26	Findoráková	Lenka	Slovak Academy of Sciences, Institute of Geotechnics	Slovakia	findorakova@saske.sk
27	Foucault	Yann	Société de Traitements Chimiques des Métaux	France	y.foucault@stc-metaux.com
28	Greinert	Andrzej	University of Zielona Góra,	Poland	A.Greinert@iis.uz.zgora.pl
29	Horváth	Adrienn	University of West Hungary, Department of Soil Site Survey	Hungary	hadri@emk.nyme.hu

No.	Last name	First name	Institution	Country	e-mail
30	Hudańska	Patrycja	Nicolaus Copernicus University, Toruń	Poland	
31	Hulisz	Piotr	Nicolaus Copernicus University, Toruń	Poland	hulisz@umk.pl
32	Huot	Hermine	Laboratoire Sols et Environnement	France	hermine.huot@univ-lorraine.fr
33	Jankowski	Michał	Nicolaus Copernicus University, Toruń	Poland	mijank@umk.pl
34	Jaworska	Hanna	University of Technology and Life Sciences, Bydgoszcz	Poland	hanna.jaworska@utp.edu.pl
35	Jean-Soro	Liliane	The French Institute of Science and Technology for Transport, Development and Networks, Nantes	France	liliane.jean-soro@ifsttar.fr
36	Joimel	Sophie	Université de Lorraine-INRA	France	sophie.joimel@univ-lorraine.fr
37	Joussein	Emmanuel	Université de Limoges GRESE,	France	emmanuel.joussein@unilim.fr
38	Kaptan	Havva	Ministry of Forestry and Water Affairs	Turkey	havvakaptan@yahoo.com
39	Kawahigashi	Masayuki	Tokyo Metropolitan University	Japan	kawahigashi-masayuki@tmu.ac.jp
40	Kida	Kimihiro	Department of Geography, Tokyo Metropolitan University	Japan	egonoki-eko@sound.ocn.ne.jp
41	Kobierski	Mirosław	University of Technology and Life Sciences, Bydgoszcz	Poland	kobierski@utp.edu.pl
42	Kwasowski	Wojciech Kwasowski	Warsaw University of Life Sciences	Poland	wojciech_kwasowski@sggw.pl
43	Kye-Hoon	Kye-Hoon Kim	The University of Seoul	Republic of Korea	johnkim@uos.ac.kr
44	Lakeev	Pavel S.	Timryazev Academy, Elektrostal	Russia	burn_vessor@mail.ru
45	Lasoń-Wardas	Marta	AGH University of Science and Technology	Poland	wardas.marta@gmail.com,
46	Lebed-Sharlevich	Iana Ivanovna	Lomonosov Moscow State University	Russia	jana-13@mail.ru
47	Lee	Mina	University of Seoul	Republic of Korea	
48	Legret	Michel	The French Institute of Science and Technology for Transport, Development and Networks	France	michel.legret@ifsttar.fr
49	Lehmann	Andreas	Institute of Soil Science and Land Evaluation, University of Hohenheim	Germany	as@uni-hohenheim.de
50	Leroy	Marie-Charlotte	INFRA Services	France	marie-charlotte.leroy@etu.univ-rouen.fr
51	Levin	Maxine	USDA Natural Resources Conservation Service	USA	maxine.levin@wdc.usda.gov
52	Liénard	Amandine	University of Liege	Belgium	Amandine.Lienard@ulg.ac.be
53	Lorenz	Klaus	Institute for Advanced Sustainability Studies Potsdam	Germany	klaus.lorenz@iass-potsdam.de
54	Magiera	Tadeusz	Institute of Environmental Engineering, Polish Academy of Sciences	Poland	tmagiera@ipis.zabrze.pl
55	Majgier	Leszek	University of Silesia, Faculty of Earth Science	Poland	leszekmajgier@o2.pl
56	Makowsky	Lutz	University of Applied Sciences Osnabrueck	Germany	l.makowsky@hs-osnabrueck.de
57	Malinowski	Ryszard	West Pomeranian University of Technology, Szczecin	Poland	Ryszard.Malinowski@zut.edu.pl
58	Manfredo	Rhonda	VisionOne	USA	rhonda@v-1.com
59	Marfenina	Olga Evgenievna	Moscow State University, Soil Science Faculty	Russia	marfenina@mail.ru
60	Markiewicz	Maciej	Nicolaus Copernicus University, Toruń	Poland	mawicz@umk.pl

No.	Last name	First name	Institution	Country	e-mail
61	Materechera	Simeon Albert	North West University (Mafikeng Campus)	South Africa	albert.materechera@nwu.ac.za
62	Mendyk	Łukasz	Nicolaus Copernicus University, Toruń	Poland	mendyk.geo@gmail.com
63	Morel	Jean Louis	University of Lorraine	France	Jean-Louis.Morel@univ-lorraine.fr
64	Mozharova	Nadezhda	Lomonosov Moscow State University	Russia	nvm47@list.ru
65	Neel	Catherine Franck	CETE de Lyon	France	catherine.neel@developpement-durable.gouv.fr
66	Norra	Stefan	Karlsruhe Institute of Technology	Germany	stefan.norra@kit.edu
67	Oyuntsetseg	Bolormaa	National University of Mongolia	Mongolia	bolormuis@yahoo.com
68	Pascaud	Grégoire	Université de Limoges GRESE	France	gregoire.pascaud@etu.unilim.fr
69	Patterson	Robert Alfred	Universtity of New England	Australia	lanfaxlabs@bigpond.com.au
70	Pereira	Benoit	Université Catholique de Louvain	Belgium	benoit.pereira@uclouvain.be
71	Pini	Roberto	National Research Council, Institute of Ecosystem Study, Pisa	Italy	roberto.pini@ise.cnr.it
72	Piotrowska-Długosz	Anna	University of Technology and Life Sciences, Bydgoszcz	Poland	ap03@wp.pl
73	Podlasińska	Joanna Krystyna	West Pomeranian University of Technology, Szczecin	Poland	Joanna.Podlasinska@zut.edu.pl
74	Qiu	Rongliang	School of Environmental Science and Engineering, Sun Yat-sen University	China	eesqrl@mail.sysu.edu.cn
75	Ramirez	Eleonora Flores	Technische Universität Berlin	Mexico	eleonorluwz@mailbox.tu-berlin.de
76	Ramirez	Juan Carlos Flores	Universidad de la Frontera	Chile	jramirez@ufro.cl
77	Rożek	Dorota	Faculty of Earth Sciences, University of Silesia	Poland	dorota.rozek87@gmail.com
78	Różycki	Henryk	Nicolaus Copernicus University, Toruń	Poland	henroz@umk.pl
79	Sándor	Gábor	Department of Landscape Protection and Environmental Geography, University of Debrecen	Hungary	sandorgabor87@gmail.com
80	Schad	Peter	Bodenkunde, Technological University of Munich	Germany	schad@wzw.tum.de
81	Schwartz	Christophe	Université de Lorraine-INRA	France	christophe.schwartz@univ-lorraine.fr
82	Sewerniak	Piotr	Nicolaus Copernicus University, Toruń	Poland	sewern@umk.pl
83	Siebielec	Grzegorz	IUNG-PIB	Poland	gs@iung.pulawy.pl
84	Szuszkiewicz	Marcin	Institute of Environmental Engineering, Polish Academy of Sciences	Poland	marcin.szuszkiewicz@ipis.zabrze.pl
85	Šestinová	Oľga	Slovak Academy of Sciences, Institute of Geotechnics, Košice	Slovakia	sestinova@saske.sk
86	Simonnot	Marie-Odile	LRGP - Université de Lorraine - CNRS	France	marie-odile.simonnot@univ-lorraine.fr
87	Sonnet	Philippe	Université Catholique de Louvain	Belgium	philippe.sonnet@uclouvain.be
88	Świtoniak	Marcin	Nicolaus Copernicus University, Toruń	Poland	swit@umk.pl
89	Takeda	Mie	Aichi Institute of Technology,	Japan	mtakeda@aitech.ac.jp
90	Tang	Yetao	School of Environmental Science and Engineering, Sun Yat-sen University	China	eestyt@mail.sysu.edu.cn

No.	Last name	First name	Institution	Country	e-mail
91	Toor	Gurpal	University of Florida	USA	gstoor@ufl.edu
92	Trinks	Steffen	TU Berlin FG Standortkunde und Bodenschutz	Germany	steffen.trinks@tu-berlin.de
93	Uzarowicz	Łukasz	Warsaw University of Life Sciences SGGW	Poland	lukasz_uzarowicz@sggw.pl
94	Vacha	Radim	Research Institute for Soil and Water Conservation	Czech Republik	vacha.radim@vumop.cz
95	Vandeuren	Aubry	Université Catholique de Louvain	Belgium	aubry.vandeuren@uclouvain.be
96	Vasenev	Viacheslav	Russian State Agricultural University	Russia	vasenyov@mail.ru
97	Vidal-Beaudet	Laure	AGROCAMPUS OUEST Angers	France	laure.beaudet@agrocampus-ouest.fr
98	Wang	Shizhong	School of Environmental Science and Engineering, Sun Yat-sen University	China	wshizh2@mail.sysu.edu.cn
99	Watanabe	Makiko	Tokyo Metropolitan University	Japan	m.wata@tmu.ac.jp
100	Watteau	Françoise	LSE-ENSAIA	France	francoise.watteau@univ-lorraine.fr
101	Werkentihn	Moritz	Technische Universität Berlin, FG Standortkunde & Bodenschutz	Germany	moritz.werkenthin@tu-berlin.de
102	Xiaoyang	Chen	Anhui University of Science and Technology	China	chenxy@aust.edu.cn
103	Yan	Jiaping	School of Earth and Environment, Anhui University of Science and Technology	China	jpyan@aust.edu.cn
104	Zeng	Xiaowen	School of Public Health, Sun Yat-sen University	China	zengxw123@163.com
105	Zhang	Quiang	Institute of Agricultural Environment and Resource, Shanxi Academy of Agriculture Sciences (SAAS)	China	sxsnkytfs@163.com
106	Zhang	Fengrong	China Agricultural University	China	frzhang@cau.edu.cn
107	Zhang	Gan-Lin	Institute of Soil Science, Chinese Academy of Sciences	China	glzhang@issas.ac.cn