

## JSS Subject Area 'Soils' (Editor-in-Chief: Zhihong Xu)

### Section 5: Soil and landscape ecology

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DOI: <http://dx.doi.org/10.1065/jss2007.03.215>

#### Responsible for:

- Soil molecular ecology
- Soil microbiology
- Soil mineralogy

#### Areas of interest:

- Soil microbial diversity
- Soil biological processes
- Soil molecular approaches
- Biogeochemical cycles of nutrients and pollutants
- Soil chemistry and mineralogy



#### Challenges: Molecular Microbial Ecology and Molecular Soil Science

I have a multidisciplinary research background in soil science with interests in soil molecular microbial ecology and soil chemistry. I was a professor of soil chemistry for ten years and am now a professor of soil ecology. These disciplines merge well at a molecular level and most soil processes are combined chemical and microbiological processes. My experiences appeal to the needs of multidisciplinary and interdisciplinary collaborations.

Many new concepts of soil science are emerging in line with the development of molecular biotechnology and molecular scale analytical techniques (e.g., synchrotron-based spectroscopy). For example, we proposed a concept of soil macromolecular chemistry in the 18<sup>th</sup> WCSS. Clay minerals, clay oxides, humic substances, proteins (enzymes) and DNA can be regarded as soil inorganic and organic macromolecules. Their composition, structure, characteristics and reactions in soil are the main research topics, and the interaction mechanisms among these macromolecules are the core of the soil macromolecular chemistry. The emphasis of current soil microbial ecology has shifted from conventional culture to molecular microbial ecology based on modern molecular biotechnology. Molecular ecology has entered the stage of genomics or even post-genomics, i.e., proteomics. Thus, understanding the interaction mechanisms among soil macromolecules at a molecular level is essential for the research of molecular microbial ecology.

The papers published in JSS about soil and sediment microbial ecology are very limited, with most papers focusing on the microbial degradation of pollutants and the microbial community changes under polluted environments by using approaches of community level physiological profiling (Biolog) (Dobler et al. 2001, Palmroth et al. 2006), fluorescent in situ hybridization (Lachmund et al. 2003), phospho-

lipid fatty acids (Hund-Rinke et al. 2004), and 16S rDNA-based fingerprints (Jontofsohn et al. 2002). The central challenge in soil microbial ecology is the relations between their genetic diversity and community structure and between community structure and function. A better understanding of the relations between microbial diversity and soil functions requires not only the use of more accurate assays for taxonomically and functionally characterizing DNA and RNA extracted from soil, but also high-resolution techniques with which to detect inactive and active microbial cells in the soil matrix (Nannipieri et al. 2003). The development of some new molecular approaches, such as stable isotope probing and metagenomics, sheds light on the sound understanding of microbial community structure and their ecological functions at a molecular level.

#### References

- Dobler R, Burri P, Gruiz K, Brandl H, Bachofen R (2001): Variability in microbial populations in soil highly polluted with heavy metals on the basis of substrate utilization pattern analysis. *J Soils Sediments* 1 (3) 151–158
- Hund-Rinke K, Simon M, Lukow T (2004): Effects of tetracycline on the soil microflora: function, diversity, resistance. *J Soils Sediments* 4 (1) 11–16
- Jontofsohn M, Pfister G, Severin G, Schramm KW, Hartmann A, Schloter M (2002): Bacterial Community Structure in Lake Sediments of Microcosms Contaminated with Nonylphenol. *J Soils Sediments* 2 (4) 211–215
- Lachmund C, Köcher B, Manz W, Heininger P (2003): Chemical and microbiological in situ characterization of benthic communities in sediments with different contamination levels. *J Soils Sediments* 3 (3) 188–196
- Nannipieri P, Ascher J, Ceccherini MT, Landi L, Pietramellara G, Renella G (2003): Microbial diversity and soil functions. *European Journal of Soil Science* 54 (4) 655–670
- Palmroth M, Koskinen P, Pichtel J, Vaajasaari K, Joutti A, Tuhkanen T, Puhakka J (2006): Field-scale assessment of phytotreatment of soil contaminated with weathered hydrocarbons and heavy metals. *J Soils Sediments* 6 (3) 128–136

#### Submitted to JSS

<http://www.scientificjournals.com/sj/all/DetailESS/artikelID/9287>

#### Multivariate Geostatistical Analysis of Heavy Metals in Topsoil from Beijing, China

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Regional soil environmental quality is a hotspot and difficulty in the environmental sciences for the spatial variability of pollutants and the relationship between them. Knowledge of a pollutant concentration is thus of great interest when location of measurement is known and accounted for in the data analyses. Beijing, the capital of China, is undergoing rapid development of economy during the past three decades and some environmental problems also emerged gradually. Beijing might be encountered the same problems with the developed countries. The soil environmental quality of heavy metals remains unknown in Beijing. The main objectives were to conduct multivariate statistical analyses, including geostatistical analysis assisted with GIS tools, with soil heavy metal concentrations to identify the spatial variability and main sources of heavy metals. These results would contribute to the establishment of the soil quality baseline and the management of regional environment.

The heavy metal concentrations in the topsoil of Beijing are mostly comparable with the background values, especially for As, Cr and Ni. In the city center of Beijing, Cu, Pb and Zn had high concentration distribution. The spatial features of As, Cr and Ni are mainly controlled by pedogenic factors, while Cd, Cu, Pb and Zn are controlled by anthropogenic and parent factors. Traffic and smelting contribute greatly to the increase of Pb, Zn and Cu in the soil, especially in the center of the city. Landfill may have also affected the soil quality around it.

Multivariate statistical analyses (principal component analyses) and geostatistics assisted with the GIS tools were useful in the description of spatial distribution pattern of soil heavy metals and the assessment of regional soil quality.