Geophysical Research Abstracts
Vol. 20, EGU2018-1371-1, 2018
EGU General Assembly 2018

Lipid biomarkers and relationships with soil water repellency and other soil characteristics in Technosols from the region of Maritsa-Iztok coal mine in Bulgaria

Irena Atanassova (1), Milena Harizanova (1), Martin Banov (1), and Stefan Doerr (2)

(1) Nikola Poushkarov Institute of Soil Science, Agrotechnologies and Plant Protection, Sofia, Bulgaria (i.d.atanassova@abv.bg), (2) College of Science, Department of Geography, Swansea University, Swansea, United Kingdom

Technogenic soils from mine areas are heterogeneous materials that often exhibit small-scale spatial variability of water repellency, suggested to arise from the presence of irregularly distributed lignitic particles in overburden clay strata used for reclamation. However, water repellency is also a feature of undisturbed soils under various types of permanent vegetation. To elucidate its causes, we examined lipid extracts of non-vegetated and pine-afforested spoils from the area of Maritsa-East lignite coal basin in Bulgaria. The Technosols at both sites were characterized by strong to extreme water repellency and extreme acidity (pH 3-4), with finer texture at the pine-vegetated site. The GC chromatogram of the total lipid extracts indicate that the most abundant signature lipid compounds are diterpenoid coal biomarkers such as phyllocladane and kaurene, and steroids, fatty acids and fatty alcohols (> C22). The higher concentrations of the long chain, fatty acids, fatty alcohols, steroidal compounds and diterpenoids in the more water repellent samples are speculated as the reason for the severe and extreme water repellency observed. The concentration of long chain (> C22) homologous fatty acids, alcohols and C29 alkane were significantly correlated with water repellency as determined by water drop penetration time (WDPT) tests. Some contaminant compounds were present in high abundance, e.g. 4,4'-diacetyldiphenylmethane, which is a product of the photocatalytic oxidation of coal and polycyclic aromatic hydrocarbon (6H-Dibenzo[b,d]pyran and chromane) derivatives. The presence of other diterpenoids such as dehydroabietane in the non-vegetated technogenic soils indicate the conifer vegetation origin of the coal-forming mires of Maritsa-Iztok coal basin, while pimaric and myristic acids in the pine vegetated soils confirm the conifer vegetation dominance in the formation of soil organic matter (SOM). This is also confirmed by detection of hydroxy-benzoic and isovanillic acids in the non-vegetated site, indicating that conifers are the predominant coal progenitors in the peat bog of Maritsa-Iztok coal. Sesquiterpenoids in the soils were represented by α-cedrene at both sites. The abundance of steroids such as cholesterol and androstane derivatives indicates a source component from fauna, as these lands are used for occasional grazing. Principle Component Analysis (PCA) and cluster analysis (CA) were carried out, in order to study the simultaneous interaction of soil characteristics and properties with the lipid fraction dominated by fatty acids and fatty alcohols. The PCA was based on thirteen factors: WDPT, sand, silt and clay contents, hygroscopic moisture, cation exchange capacity (CEC), organic carbon (total organic carbon TOC, humic organic carbon, HOC and fulvic organic carbon, FOC), total nitrogen (N), mineral nitrogen (MN), electrical conductivity (EC) and lipids (fatty acids and fatty alcohols) composition. Four principle components were identified with eigenvalue > 1, accounting for 91 % of the total variability. There was a significant positive correlation between WDPT and TOC, HOC, FOC, MN and lipids and a negative correlation with the % of hygroscopic moisture. The results obtained indicate that TOC and the lipid fraction were the causes of soil water repellency in the studied technogenic soils.