

# Soil composition matters – Minerals and charcoal control bacterial response to plant litter and to the pollutant phenanthrene

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Soil bacteria are known to be involved in many essential environmental processes such as nutrient cycling, plant growth promotion, and biodegradation of organic pollutants. However, the complex soil structure formed by heterogeneous compounds and their interactions hinders a mechanistic understanding of these processes. Here we used artificial soils under laboratory conditions to reduce the soil complexity. A microbial inoculant obtained from a natural soil and sterile manure were added to four different soil compositions varying in type of clay minerals and presence of charcoal or ferrihydrite, respectively. After more than two years of incubation, phenanthrene (2 mg/g) used as model compound for polycyclic aromatic hydrocarbons was spiked to artificial soils with or without added plant litter (1 wt%) in order to study bacterial responses as a function of the soil composition. After 21 days of incubation, total community DNA was extracted and bacterial structure and abundance was assessed by 16S rRNA amplicon-based techniques (DGGE, pyrosequencing, quantitative PCR).

The type of clay mineral present (illite, montmorillonite) was found to be the main driver of bacterial communities in

the long term while ferrihydrite and charcoal selected for specific bacterial classes. By DGGE, several populations were shown to be enhanced or decreased in abundance in response to the phenanthrene spike. In all artificial soils, *Actinobacteria* were revealed as dominant responders to phenanthrene. Soils containing illite showed stronger changes in the bacterial community than soils containing montmorillonite and soil composition-dependent responses to phenanthrene were identified by pyrosequencing at the genus level. Interestingly, the addition of plant litter, which was assumed to foster horizontal gene transfer and adaptation to the pollutant, affected bacterial communities but decreased their response to phenanthrene. Soils containing both phenanthrene and litter spike exhibited the highest 16S rRNA gene copy numbers indicating a synergistic effect. The decrease in phenanthrene concentrations in the treatments with and without litter suggested in both cases a biodegradation of the pollutant.

In conclusion, the present study proposes the long-term driving role of the soil composition (minerals, charcoal) on the establishment and functionality of bacterial communities.