

## NATURAL ATTENUATION OF PAH UNDER PINE

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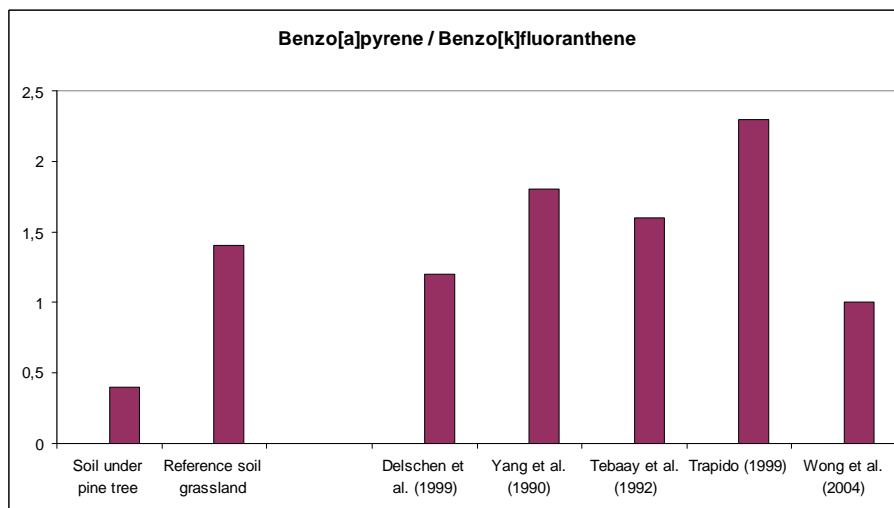
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Polycyclic aromatic hydrocarbons (PAH) pose a serious threat to human health due to their carcinogenic and mutagenic properties. A reduction in their emissions and dispersal is mandatory and regulating bodies work on the implementation of such reduction strategies. The ubiquitous nature of PAH due to their preferred origin from multiple combustion processes and their long-range transportation as trans-boundary pollutants complicates the enforcement of PAH-reduction regulations.

It is well established, that vegetation serves as a natural filter for airborne pollutants (Simonich and Hites, 1994) removing a considerable part of PAH from the atmospheric loading by adsorption onto plant surfaces and incorporation into biomass. Litterfall will consecutively transfer the accumulated PAHs from living needle or leaf to soil, where the compounds may be stabilized or degraded by micro- and macroorganisms. We investigated the fate of PAH captured by pine needles via comparison of soils under pine trees with adjacent grassland soils. The working hypothesis was that soils under pine trees will accumulate much higher PAH loadings given the much larger surface area and filter capacity of pine trees compared to grasses (Simonich and Hites, 1994). Four locations reflecting diverse PAH emission scenarios were analysed, whereby at each location three samples were taken under the canopy of a pine tree and three reference samples were collected from adjacent grassland outside the canopy area at a distance of at least 8 m from the stem.

The 5-ring PAHs are considered the environmentally most dangerous compounds and the toxicity of other PAHs is often normalized to the most toxic compound benzo[a]pyrene. When comparing reference soil PAH patterns with those under the pine tree, it was observed that the total concentration of all quantified PAHs in the humus layer under pine (0-3 cm) was on average two to three times higher than in grassland topsoil (0-10 cm). However, the concentration of PAHs in the mineral soil horizon (3-10) under pine was only half of that in reference soil for two of the locations and comparable PAH loadings were observed in the other two. This indicates a very effective and fast PAH degradation in soils under pine trees. Moreover, the distribution pattern of the most environmentally problematic PAH, the 5-ring membered benzopyrenes and benzofluoranthenes changed notably between soils under pine

and reference soil. The ratio of benzo[a] pyrene vs. benzo[k]fluoranthene is reported to vary between values of 1.0 and 2.3 (see figure) in topsoils according to literature data. The reference soils studied comply with such values but the soils under pine were strongly depleted in benzo[a]pyrene. This decline in the most toxic PAH can not be attributed to photolytic processes known to affect PAH patterns (Wang et al., 2005) or water solubility and bioavailability as this would be identical for pine and reference soil. The different pH values of grassland soils commonly is higher than under pines and a range of pH-values between 7.0 to 7.8 has been determined to optimally promote microbial PAH degradation (Wilson and Jones, 1993). We could not observe a systematic relation between soil pH-values and the preferred benzo[a]pyrene degradation. It is rather suggested that the strong lignolytic activity of fungi proliferating in pine soil and humus layer degrades PAH by broad oxidative enzymatic attack (Kästner et al., 2000). As these fungi are much less abundant in grassland soils, the preferential degradation of benzo[a]pyrene is hampered. Pine trees and forests will therefore contribute notably to natural attenuation of PAH in atmospherically highly polluted environments.



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