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Effect of biochar or activated carbon amendment on the volatilisation and biodegradation of organic soil pollutants

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Biochar or activated carbon added to contaminated soil may temporarily reduce the volatilisation of organic pollutants by enhanced sorption. The long-term effect of sorbent amendments on the fate of volatile petroleum hydrocarbon mixtures (VPHs) will depend on the responses of the soil bacterial community members, especially those which may utilize VPHs as carbon substrates. We investigated the volatilisation and biodegradation of VPHs emanating from NAPL sources and migrating through one meter long columns containing unsaturated sandy soil with and without 2% biochar or activated carbon amendment. After 420 days, VPH volatilisation from AC amended soil was less than 10 percent of the cumulative VPH volatilisation flux from unamended soil. The cumulative CO_2 volatilisation flux increased more slowly in AC amended soil, but was comparable to the untreated soil after 420 days. This indicated that the pollution attenuation over a 1 meter distance was improved by the AC amendment. Biochar was a weaker VPH sorbent than AC and had a lesser effect on the cumulative VPH and CO_2 fluxes. We also investgated the predominant bacterial community responses in sandy soil to biochar and/or VPH addition with a factorially designed batch study, and by analyzing preserved soil samples. Biochar addition alone had only weak effects on soil bacterial communities, while VPH addition was a strong community structure shaping factor. The bacterial community effects of biochar-enhanced VPH sorption were moderated by the limited biomass carrying capacity of the sandy soil investigated which contained only low amounts of inorganic nitrogen. Several Pseudomonas spp., including Pseudomonas putida strains, became dominant in VPH polluted soil with and without biochar. The ability of these versatile VPH degraders to effectively regulate their metabolic pathways according to substrate availabilities may additionally have moderated bacterial community structure responses to the presence of biochar in VPH polluted soil.