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Effect of petroleum products on the decomposition of soil organic matter as assessed by ^{13}C natural abundance

Wioleta Stelmach (1), Paweł Szarlip (1), Andrzej Trembaczowski (2), and Andrzej Bieganowski (1)

(1) Institute of Agrophysics, Polish Academy of Science, Doświadczalna 4, 20-290 Lublin, Poland (w.stelmach@ipan.lublin.pl), (2) Mass Spectrometry Laboratory, Institute of Physics, Maria Curie-Skłodowska University, Pl. M. Curie-Skłodowska 1, 20-031 Lublin, Poland

Petroleum products are common contaminants in soils due to human activities. They are toxic for microorganisms and threat their functions, including decomposition of soil organic matter (SOM). The direct estimation of altered SOM decomposition – based on the CO_2 emission – is impossible after oil contamination, because oil decomposition also contributes to the CO_2 release. We used the natural differences in the isotopic signature ($\delta^{13}C$) of SOM and of oil products to partition the total CO_2 for both sources and to analyze the suppression of SOM decomposition. The dynamics of ^{13}C fractionation during the mineralization of gasoline and diesel was measured during 42 days. The ^{13}C fractionation varied between -8.8‰ and +3.6‰ within the first 10 days, and stabilized thereafter at about -5.3‰ for gasoline and +3.2‰ for diesel. These ^{13}C fractionations and $\delta^{13}C$ values of CO_2 emitted from the soil were used for correct partitioning of the total CO_2. Contamination with gasoline reduced the CO_2 efflux from SOM decomposition by a factor of 25 (from 151 to 6 mg C-CO_2 kg^{-1} soil during 42 days). The negative effect of diesel was much lower: the CO_2 efflux from SOM was decreased by less than a factor of 2. The strong effect of gasoline versus diesel reflects the lower absorption of gasoline to mineral particles and the development of a thin film on water surfaces, leading to toxicity for microorganisms. We conclude that the small differences of ^{13}C of SOM and of organic pollutants can be used to partition CO_2 fluxes and analyze pollutant effects on SOM decomposition.