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Behaviour of polycyclic aromatic hydrocarbons (PAH) in soils under freeze-thaw cycles

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The arctic region will be one of the most affected regions by climate change due to the predicted temperature rise. As a result of anthropogenic actions as mining, exploration and refining as well as atmospheric transport pollutions can be found in arctic soils. Therefore questions on the behaviour of organic contaminants in permafrost influenced soils are of high relevance.
First investigations showed that permafrost can act as a semi-permeable layer for PAH (Curtosi et al., 2007). Therefore it can be assumed that global warming could result in a mobilization of PAH in these permafrost influenced soils. On the other hand a low but detectable mineralization of organic hydrocarbons by microorganisms under repeated freeze-thaw cycles was analysed (Börresen et al. 2007, Eschenbach et al. 2000).
In this study the behaviour and distribution of PAH under freezing and periodically freezing and thawing were investigated in laboratory column experiments with spiked soil materials. Two soil materials which are typical for artic regions, a organic matter containing melt water sand and a well decomposed peat, were homogeneously spiked with a composite of a crude oil and the PAH anthracene and benzo(a)pyrene. After 14days preincubation time the soil material was filled in the laboratory columns (40cm high and 10 cm in diameter).
Based on studies by Chuvilin et al. (2001) the impact of freezing of the upper third of the column from the surface downwards was examined. The impact of freezing was tested in two different approaches the first one with a single freezing step and the second one with a fourfold repeated cycle of freezing and thawing which takes about 6 or 7 days each.
The experimental design and very first results will be shown and discussed. In some experiments with the peat a higher concentration of anthracene and benzo(a)pyrene could be detected below the freezing front in the unfrozen part of the column. Whereas the concentration of PAH had slightly decreased in the frozen part of the column. However these results were not statistically significant they could proof results from Chuvilin et al. (2001). Who found similar results in sandy and clayey material and presumed the expulsion of petroleum hydrocarbons. Barnes et al. (2004) specified that the exclusion of petroleum hydrocarbons due to freezing is caused by displacement from the pore spaces due to expansion of the ice and the forming of crystalline ice structure.
Further experimental approaches to investigate the effect of freezing and thawing of permafrost influenced soils on PAH migration will be discussed.

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