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Peat fires as source of polycyclic aromatic hydrocarbons in soils

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Polycyclic aromatic hydrocarbons (PAHs) arrive from pyrogenic sources including volcanism and the combustion of oil products and plant materials. The production of PAHs during the combustion of plant materials was considered in a number of publications, but their results were mainly obtained in laboratory experiments. Insufficient data are available on the hightemperature production of PAHs in environmental objects. For example, natural fires are frequently related to the PAH sources in landscapes, but very little factual data are available on this topic.
On Polistovskii reserve (Russia, Pskov region) the soil series were separated depending on the damage to the plants; these series included soils of plots subjected to fires of different intensities, as well as soils of the background plots.
The series of organic and organomineral soils significantly differed in their PAH distributions. In this series, the concentration of PAHs in the upper horizons of the peat soils little varied or slightly decreased, but their accumulation occurred at a depth of 5–10 or 10–20 cm in the soils after the fires. For example, in the series of high moor soils, the content of PAHs in the upper horizons remained almost constant; significant differences were observed in the subsurface horizons: from 2 ng/g in the background soil to 70 ng/g after the fire.
In the upper horizons of the oligotrophic peat soils under pine forests, the total PAH content also varied only slightly. At the same time, the content of PAHs in the soil series increased from 15 to 90 ng/g with the increasing pyrogenic damage to the plot.
No clear trends of the PAH accumulation were recorded in the organomineral soils. The content of PAHs in the soddy-podzolic soil subjected to fire slightly decreased (from 20 to 10 ng/g) compared to the less damaged soil.
In peat fires, the access of oxygen to the fire zone is lower than in forest fires. The oxygen deficit acts as a factor of the organic fragments recombination and PAH production; therefore, larger amounts of PAHs are formed in peat fires. In addition, the peat fires occur directly in the soil layer; therefore, larger amounts of the resulting polyarenes remain in the soils of the fire sites. PAHs also can be formed at the heating of organic matter on the areas adjacent to the fire sites.
After the combustion of peat in fires, phenanthrene, chrysene, benz[a]pyrene, and tetraphene accumulate in soils. This is mainly the group of 4-nuclear compounds with the participation of 3-nuclear phenanthrene and 5-nuclear benz[a]pyrene. The formation of high-molecular weight compounds like benz[a]pyrene and, in some places, benzo[ghi]perylene is possible during smoldering under a low oxygen supply.