THE BACKGROUND CONTENTS OF HYDROCARBONS IN TAIGA SOILS

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Introduction

The global ecological problems related to the transboundary transfer of pollutants and the regional and local sources of environmental contamination presently require new approaches to the assessment of the specific ecological situations developed in natural biogeocenoses. Natural environments are overloaded with hydrocarbons (HCs). At present, there is no nonwaste production at any oil field.

Large oil fields are being intensively developed in the Komi Republic. The increase in production of raw HCs significantly complicates the ecological situation in this region (the far-northern and northern taiga). Anthropogenically degraded soils are widely spread in the production areas of oil fields, at the sites of prospective and geophysical boring, and along the oil pipelines and transportation lines. They are developed because of mechanical disturbances of the soil cover, oil well accidents, pipeline damage and corrosion, breaches of pits with oil sludge and drill cutting waste, contamination with waste water, and emissions of toxic compounds. The contamination of soils with oil is a specific type of contamination, which results in profound changes in all the main parameters of soils: the morphological, chemical, physical, and biological properties. The reasons for this phenomenon are related to the complex composition of oil and its pulse input into soils, high mobility, capacity to circulate among different ecosystem components, and persistence.

Results

The accumulation and distribution of HCs in the soil cover depend on several factors: the particle-size composition of the parent rocks, the relief of the area, and the type of pedogenesis. The analysis of the entire data set showed that the distribution of HCs in the soils has a positive asymmetry. Positive asymmetry usually indicates that most variations in the weight portion of the HCs correspond to values lower than the arithmetic mean. It was found that the background variation ranges of the HCs in the organic horizons are similar for the loamy bog-podzolic, podzolic, and gley-podzolic soils at a significance level of 0.5. This is related to the similarity of parent rocks, particle-size composition of the soils on the mantle loams, and the common features governing the HC migration in the landscape. An analogous distribution of HCs in the litters was noted for the soils developed on old alluvial and glaciofluvial sandy deposits and poorly drained watershed ridges and glaciofluvial terraces covered by sandy deposits, but the absolute content of HCs in these soils (podzols and bog-podzolic humus-illuvial and iron-illuvial ones) is lower than that in the soils developed on loamy soil-forming rocks. The mountainous soils are characterized by negative asymmetry values (A from –0.75 to –0.29) and an insignificant accumulation of HCs.

The determined contents of HCs in the soils under study allowed revealing their accumulation in the organic (litter) horizons. These horizons serve as a geochemical barrier for the migration of HCs within the profile. The differentiation of the HCs among the genetic horizons is more pronounced in the soils developed on loams (gley-podzolic soils) and less

pronounced in the soils on sandy parent rocks (humus-illuvial podzols). The profile accumulation of the HCs in the podzols is significantly lower than in the gley-podzolic soils. The comparison of the downward migration of the HCs in the humus-illuvial podzols and the gley-podzolic soil shows that they are more uniformly distributed along the profile and are leached from the podzolic horizon of the podzols, while an accumulation of HCs in the A0 and A2B horizons and a decrease of their content in the A2, B, and BC horizons occurs in the loamy gley-podzolic soils.

The background concentrations of the HCs vary among the soils in the different landscape elements. The bog-podzolic soils are characterized by an increased content of HCs. These soils occupy accumulative and eluvial-accumulative landscapes, where the natural accumulation of HCs during pedo genesis occurs under conditions of periodic anaerobiosis and slow decomposition of plant residues. The accumulation of HCs in bog-podzolic soils can also be related to the active lateral inflow from the surrounding landscapes. In the organic horizons of bog-podzolic soils developed on mantle loams, the content of HCs varies in the range from 26 ± 4 to 32 ± 6 mg/kg.

In the litters of the podzols developed on the different-aged terraces of rivers with old-alluvial mainly fine quartz sands, the average content of HCs is 12.7 ± 2 mg/kg; in humus-illuvial bog-podzolic soils on poorly drained plain watershed ridges and glaciofluvial terraces covered by sandy deposits, the content varies in the range from 13 ± 3 to 22 ± 4 mg/kg. It should be noted that an increase in the HC accumulation was found in the bog-podzolic sols of the mountain landscapes compared to the soddy mountain-meadow and mountain-tundra soils.

Conclusions

The landscape-geochemical assessment of the background content of hydrocarbons in the organic (litter) horizons of the northern soils in the promising regions of oil development and production of the Komi Republic was performed. The differentiation of the HCs among the genetic horizons is most pronounced in the soils developed on loams and less pronounced in the soils on sands. A database on the contents of HCs in the soils of the far-northern and northern taiga was created using GIS technologies. The results of the studies are used in the engineering-ecological investigations and the ecological expertise of projects for the development and maintenance of drilling units during hydrocarbon production.

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