THE INFLUENCE OF GAS PIPELINE ON FUNCTIONING OF FROZEN PEATLAND ECOSYSTEMS (north of West Siberia, Russia)

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Researching area

The length of the gas pipeline network in Russia is about 170,000 km. More than 10% of them are on the permafrost territories. Most of the gas pipeline in the Russian North is laid underground way with serious mechanical disturbances of the landscapes. In many cases, the "hot" gas with a temperature above 0 is transported throughout the year. Active development of the West Siberia North began over 40 years ago and now we can see large difference landscapes along the gas pipeline from the natural undisturbed landscapes. In this paper we examine the effect of construction and operation of "warm" gas pipelines in frozen peatland ecosystems (North of West Siberia , Russia).

RESULT OF GAS PIPELINE WORK:



Redistribution of precipitation (snow banks)

Intensification of flooding and thermokarst



Рис. 1. Карта современных трансформаций коренной растительности на территории Тазовского полуострова (по данным спутника NOAA, 1988 и 2001 г. съемки), М 1 :1 000 000 *I* – участки без изменения РП; 2 – участки нарушений РП до 1988 г.; 3 – участки нарушения РП в период с 1988 по 2001 г.; 4 – территории основных нефтегазоконденсатных месторождений (в границах ГВК и ВНК); 5 – магистральные газопроводы; 6 – границы участка сосредоточения промышленных объектов Ямбургского НГКМ; 7 – границы участка дегальных исследований Уренгойского НГКМ; 8 – границы территории Надымского заказника The research area is located in Northwest Siberia, within the forest-tundra and within the zone of discontinuous permafrost. This is hummocky tundra with frozen peatlands which have a complex of vegetation with a dwarf-shrub community on the hummocks and a lichen community in the inter-hummock areas. Permafrost occurs below 60 cm.

The main types of impacts on ecosystems as a result of gas pipeline construction were: mechanical disturbance of soil and vegetation cover, flooding and drainage. Later added warm effects as a result of the warm gas transportation and redistribution of precipitation.

Researching area

A typical method to build a gas pipeline is put it on the soil surface or in a trench depth of 1.5-2 meters.

The pipe (1) is covered with sandy mound (2) up to 1.5 meters.

The temperature of the transported gas ranges from +5 to +40 °C. Thus in permafrost zone for decades around the clock working a HUGE HEATER!!

Typical frozen peatland

Thawed peatland near the gas pipeline

BIG «HEATING» EXPERIMENT

In 1974 gas pipeline Nadym - Punga was stacked on the surface of peat bogs and covered mound height of about 1 meter. After reconstruction in 2004 pipe was buried at a depth of 1.5 m, and the top was covered sandy mound 1 m.

During 2011-2014 were carried out monitoring the active layer depth, soil temperature, CO2 efflux and concentrations CO2 in soil profile on 2 lines (••) across the pipeline and on undisturbed sites of frozen peatland. Soil properties were studied on 4 sites (

scheme of measurement points

RESULTS, DISCUSSION

Average annual temperatures of soils close pipeline are **2-3 times higher** the average temperatures of the undisturbed soils. Summer temperatures of soils on pipeline sites **are higher by 5-10°C**. Soils close pipeline are unfrozen **for 2-3 months longer**.

The average annual temperature of soils, (2012-2013)

The average daily temperature and moisture (% vol) of soils, (august 2014)

Permafrost table under the gas pipeline dropped from **0.5 to 6 meters** during the first 2 years of pipeline operation! The depth of thawing increase was found at a distance about 100 meters on each side from the pipeline.

In dry conditions, CO2 efflux close pipeline increase **by 3-5 times** (100 – 500 mgCO₂m⁻²h⁻¹ resp.). In wet conditions was an increase in CH4 efflux by **3-10 times** (5 – 50 mgCO₂m⁻²h⁻¹ resp.). The CO2 concentration in the soil profile close the pipe increased **2-10 times** (up to 3%)

Laboratory experiments have shown that there is a significant change in the biological activity of the soil around the pipeline: increased microbial biomass, reducing its activity, increased pH and content of labile organic matter (*WEOC*, *WEON*).

CONCLUSIONS

Construction and exploitation the pipelines with warm gas in Permafrost zone give a significant warming effect.

The main result is permafrost degradation and changing drainage regime. There is an active trees expansion along the pipeline to the north. Around the pipeline increases the biomass of plants.

Emission of greenhouse gases (CH4 and CO2) close pipeline increases several times. Accelerating the transformation of soil organic matter, change their properties and biological activity. The width of the pipeline influence up to 100 meters on each side.

So - hundreds km2 cryogenic landscapes along the gas pipeline system on Russian North are in the impact zone.

The impact of the pipeline with a warm gas can be regarded as a model of warm effects on the ecosystem of the North in the study of the climate change effects.

