FULL TITLE OF THE PROJECT AND ITS ACRONYM

PERMAFROST IN THE USA BASIN: DISTRIBUTION, CHARACTERIZATION, DYNAMICS AND EFFECTS ON INFRASTRUCTURE (PERUSA)

BRIEF PREHISTORY OF PROJECT

Research conducted in the Usa basin under the EC-funded TUNDRA project (described in this brochure) revealed an urgent need to explicitly include the permafrost component. Permafrost which was highly dynamic in the region of interest had to be taken into account in hydrological modeling, studying treeline dynamics and other TUNDRA tasks. Therefore, PERUSA project had been developed.

PROJECT LOGO

DATES OF IMPLEMENTATION OF PROJECT

1997-2000

FUNDING ORGANIZATION

INTAS foundation (under the grant INTAS Open 97-10984)

Photo: G.Mazhitova

PROJECT CO-ORDINATOR

Dr. Peter Kuhry (Arctic Centre, University of Lapland, Finland)

RESPONSIBLE SCIENTISTS

Prof. Dr. L. Hacquebord, Dr. Naum Oberman, Dr. Galina Mazhitova, Dr. Vladimir Romanovsky

GOAL AND TASKS

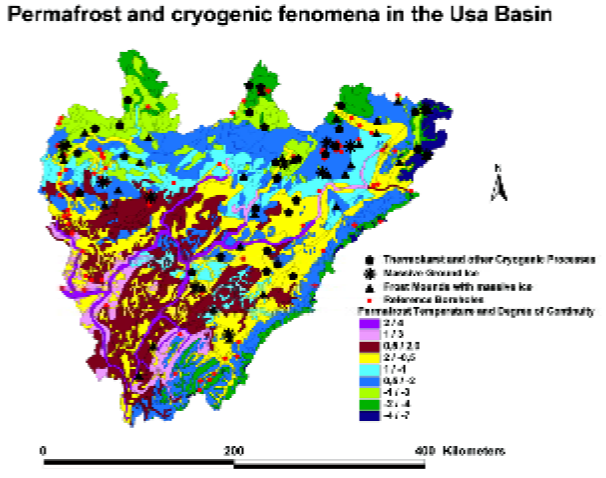
The primary objectives were to map permafrost conditions (implement in a GIS), to investigate the sensitivity of permafrost to climate change, to assess the present relationship between the distribution of permafrost terrains and urban/industrial infrastructure using a GIS, and to evaluate where future permafrost collapse due to anticipated global warming might affect the infrastructure.

PARTICIPATING ORGANISATIONS

University of Groningen (the Netherlands)
"PolarUralGeology" Stock Company, Vorkuta (Russia)
Institute of Biology, Komi Science Centre UrD RAS (Russia)
University of Alaska, Fairbanks (USA)

MAIN SCIENTIFIC RESULTS

The GIS "Permafrost in the Usa Basin" shows that about 75% of its area is occupied by permafrost terrain with various degrees of discontinuity. Of the total area of terrain with permafrost, about 75% corresponds to the zones of isolated, sporadic and discontinuous permafrost. The temperatures of permafrost in these zones are in the order of 0 to -2°C. Therefore, most of the Usa basin (nearly 60%) is underlain by "warm"



and “more discontinuous” permafrost. These zones of isolated, sporadic and discontinuous permafrost were defined under the project as “high risk” area because they are sensitive to even moderate increases of temperature under expected future global warming.

The sensitivity of permafrost to climatic warming in the order of 3°C was examined over yearly, decadal and century timescales. Even under moderate conditions of global warning, most of the permafrost terrains in the “high risk” area of the Usa Basin are likely to start to thaw within a decade or century, but talik depth will only increase gradually due to energy consumption related to phase transitions of water. Future permafrost conditions (over a period of 85 years) were derived from a transient, one-dimensional (depth) permafrost model.

Long-term monitoring data shows how different sites have responded to recent warming, in terms of active layer/seasonal freezing depths, permafrost temperatures and talik formation. Generally permafrost has warmed, but at different degrees. Opposite trends were observed in drained thermokarst lakes due to changed surface conditions.

Between 37 and 74% of the different types of urban/industrial infrastructure in the Usa Basin are located in the “high risk” area. In most landforms, permafrost will start to thaw and ground to subside within the 21st century. The response will be differential depending on permafrost terrain, with even some transient permafrost aggradation and frost heave in drained thermokarst depressions. At places, the lateral erosion of thermokarst lakes also poses serious economic and environmental risks (e.g. pipelines failures).

The Pechora region at large (which includes the Usa Basin) is experiencing a sharp increase in oil/gas activities (exploration and exploitation) due to higher fossil fuel prices on the international markets. The different patterns of permafrost response to global warming represent a significant challenge to permafrost engineers in the 21st century. Recommendations of the project participants were to continue with existing long-term permafrost monitoring near the town of Vorkuta and to expand the monitoring in the tundra North of Usinsk and around the town of Naryan-Mar (Pechora Delta). In addition, sound investments in good materials and construction techniques are necessary to cope with the differential response of permafrost terrain to anticipated global warming, which will create entirely new conditions that those experienced in the recent past.

MAIN PRODUCTS

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