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Great Norilsk Expedition – Overview

- **Great Norilsk Expedition:** comprised of 30 leading scientists from 14 research institutes of the Siberian branch of the Russian Academy of Sciences with a support of Norilsk Nickel
- **Expedition scope:** a 6-weeks-long field trip to the Taymyr Peninsula to conduct a comprehensive study of the ecosystems and environment of the Arctic
- **Research scope:** surface water, bottom sediments, soil and vegetation, perennially frozen soils (permafrost), biological and zoological diversity
- **Expedition targets:**
 - Development of viable, sustainable solutions to address local environmental issues and area remediation following the recent fuel spill in Norilsk
 - Development of recommendations on minimization of environmental impact of operations in the Arctics
- **Methodology and key deliverables:**
 - Collection of soil, plant, and sediment samples around Norilsk and water samples from Taymyr rivers and Pyasino Lake for further analysis
 - Examination of the Norilskaya-Pyasino water system
 - Examination of the area impacted by the fuel spill and its vicinity, assessment of the current status of permafrost areas
 - Preparation of expert opinions and reports based on analytical studies, development of recommendations
- **Timeline:**
 - Fieldwork and samples' collection (completed): July 27 – September 2, 2020
 - Laboratory research: completion by the end of October 2020
 - Results and final report: December 2020



Great Norilsk Expedition – Selected Facts



30 scientists

split in 5 teams focusing on terrestrial ecosystems, hydrobiology, biodiversity, bottom sediments, and permafrost soils



over 1,000 km

have been covered by expedition from the Bezymanny Stream to the Kara Sea



6 rivers

inspected (including the Pyasina, Daldykan, Barn, Tareya, Dudypa, and Boganida), 2 lakes (Melkoe and Pyasino) and the coastline of the Kara Sea



30 preferred locations

for sampling examined



over 1,500 samples

totaling ca. 600 kg in weight collected

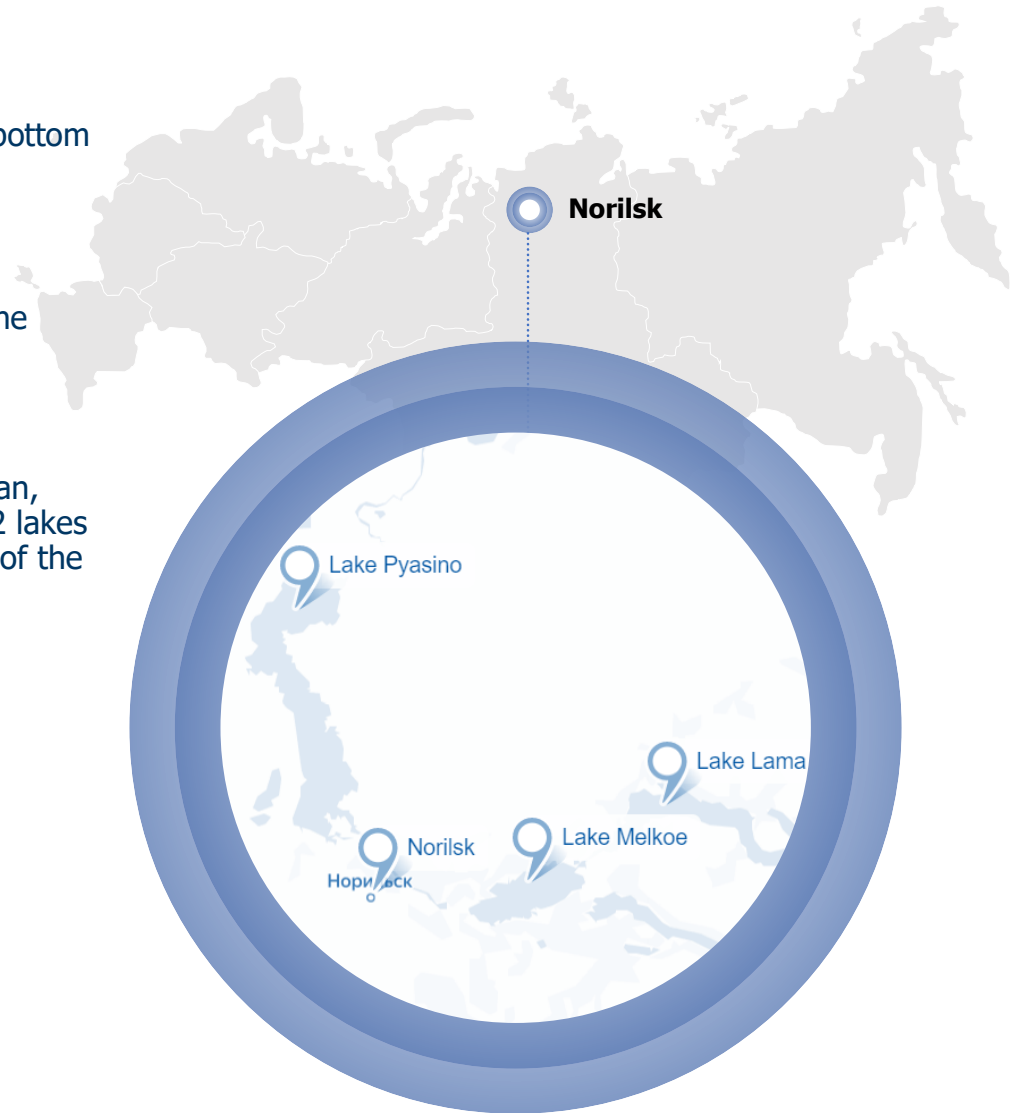


the samples from Pyasino Lake collected

at a 7-8m depths

measuring permafrost temperatures

at a 15m depth



Research Participants

Scientists from 14 leading research institutes of the Siberian Branch of the Russian Academy of Sciences (1):

- The Trofimuk Institute of Petroleum Geology and Geophysics (Novosibirsk)
- The Sobolev Institute of Geology and Mineralogy (Novosibirsk)
- Institute of Soil Science and Agrochemistry (Novosibirsk)
- Central Siberian Botanical Garden (Novosibirsk)
- Institute of Chemistry and Chemical Technology (Krasnoyarsk)
- Sukachev Institute of Forest (Krasnoyarsk)
- Biophysics Institute (Krasnoyarsk)
- Melnikov Permafrost Institute (Yakutsk)
- Institute of Oil and Gas Problems (Yakutsk)
- Research Institute of Agriculture and Ecology of the Arctic (Norilsk)
- Institute of Petroleum Chemistry (Tomsk)
- Institute for Water and Environmental Problems (Barnaul)
- Institute of Economics and Industrial Engineering (Novosibirsk)
- Institute of Computational Mathematics and Mathematical Geophysics (Novosibirsk)



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Source: Company data

Note: 1. Siberian Branch of the Russian Academy of Sciences established in 1957 is the largest regional branch of Russia's Academy of Sciences, comprised of 86 research centers and over 11 thousand scientists. About half of its scientists are based at the Novosibirsk Scientific Centre

Scientific Scope

Scientific research of the Great Norilsk Expedition is focused on the following subjects:



Surface water

Hydrobiological and hydrochemical studies (oil products)

Hydrochemical research (microelements, heavy metals)



Soil and vegetation

biological, basic and geochemical research



Bottom sediments

biological, basic and geochemical research



Perennally frozen soils (permafrost)

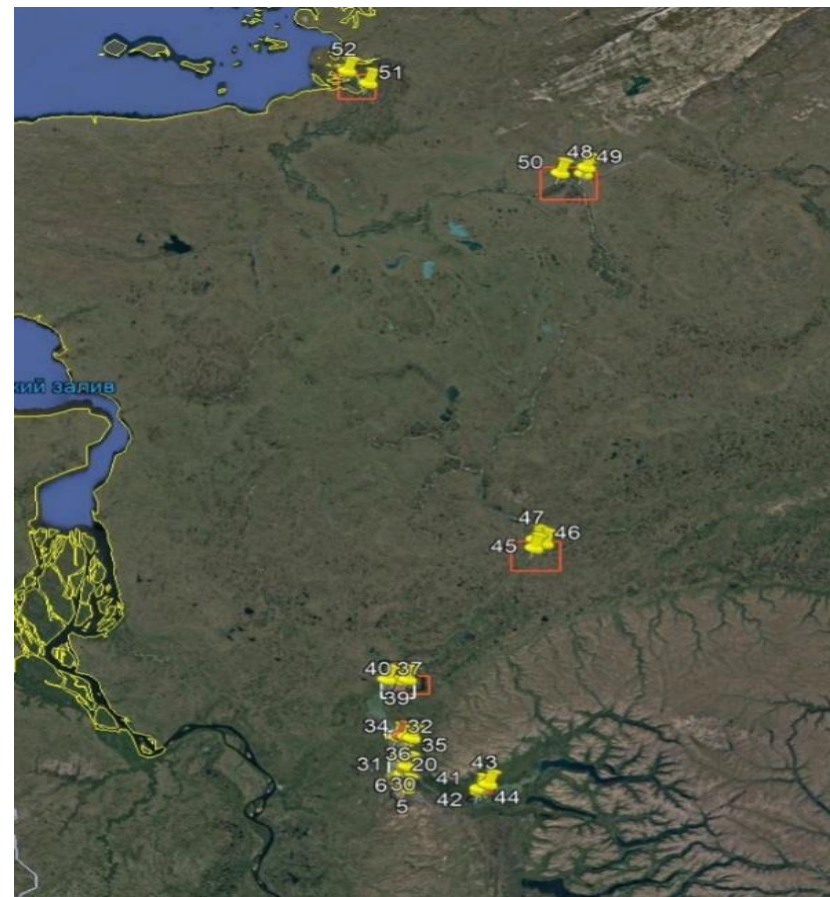
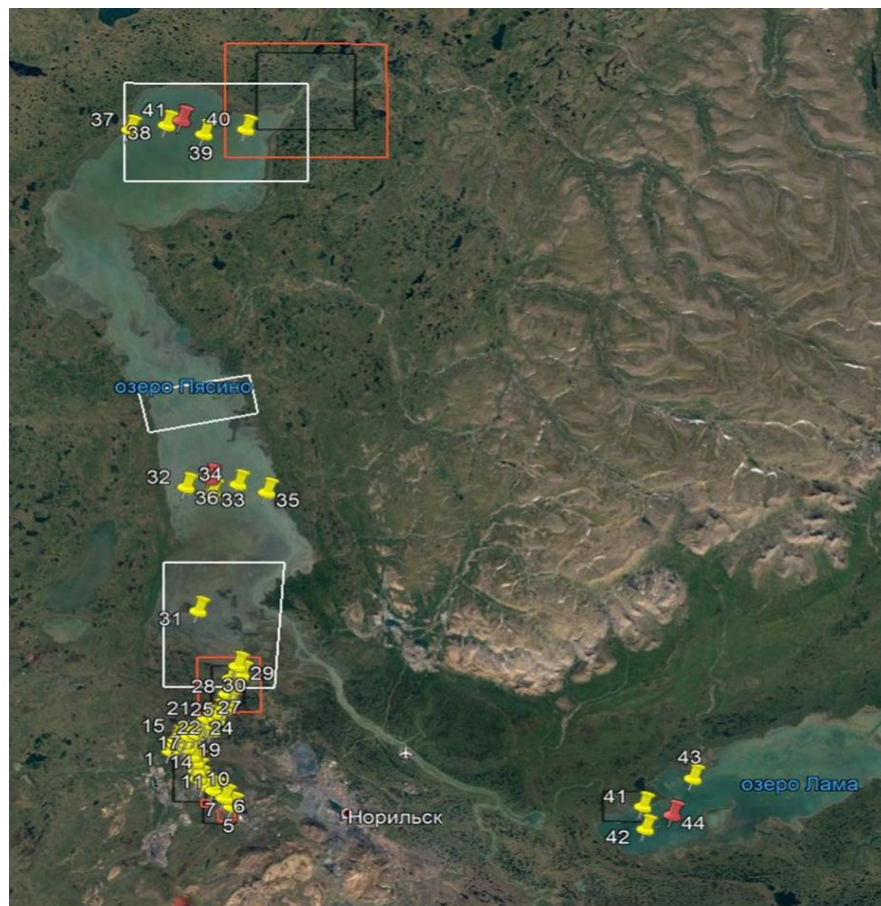
geophysical, geochemical, geocryological research



Biological and zoological diversity

botanical and zoological research

Sampling Map



- Hydrochemical and microbiological testing (yellow marks 1-54 - INGH, IPNG)
- Hydrobiological studies - (white rectangles - IBF)
- Geochemical and geochronological studies of bottom sediments and soils (yellow marks 31-44 and red marks - IGM, IPNG)
- Soil, vegetation cover and biodiversity studies - (red rectangular zones in Figures 1-3 - NIISHEA, CSBS, IL, IPNG)
- Geophysical and geocryological studies - (Blue rectangular zones - INGG, IMZ)

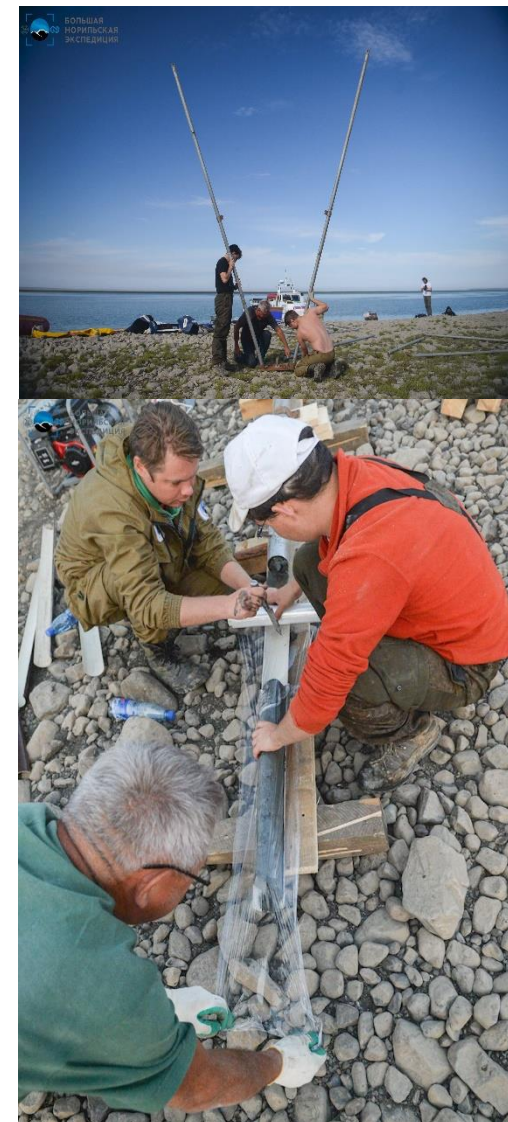
Permafrost Study

Geophysical Research Focus:

- Study of the structure and conditions of the cryolithic zone as a basis for recommendations on reduction of current environmental impact and remediation of previous industrial activities
- An assessment of the depth of permafrost roofing in undisturbed conditions and within infrastructure facilities
- Delineation of anthropogenic rims within across production facilities
- Identification of technological options for filtering of polluted waters and petroleum products from the facilities
- Assessment of the capacity of loose sediments within the infrastructure

Geocryological Research Focus:

- Assessment of the current cryolithosone status and historical trends in the Norilsk region
- Analysis of the distribution and peculiarities of occurrence of permafrost sequences
- Assessment of the boundaries of distribution, the degree of intensity of development of cryogenic processes and formations
- Description of the degree of surface contamination by these processes and formations
- Estimation of depth and dynamics of seasonal ground thawing and freezing depending on surface conditions
- Calculation of normative depth of seasonal thawing and freezing
- Assessment of the distribution, character of manifestation, genesis of taliks (if any) (based on materials of engineering surveys and drilling data)
- Forecast of changes in geocryological conditions



Water Surface and Soil Study

Hydrobiological and Hydrochemical Research (oil products)

- Collection of hydrobiological data, study of fish food base
- Assessment of the volume and biomass of plankton and benthos
- Assessment of the impact on aquatic bioresources
- Assessment of the actual chemical composition of the inspected rivers, including acidity, mineralization, concentration of basic cations, anions, trace elements and dissolved organic substances
- Comparison of normalized indicators against maximum allowable concentration levels, assessment of ecological hazard of effluents.

Soil and plants

- Definition of the nature of the vegetation cover
- Compilation of geobotanical descriptions of prevailing plant communities and lists of vascular plant species
- Territory mapping, preparation of description and diagnostics of soils at permanent test sites
- Assessment of the current geochemical status of coastal soils and bottom sediments
- Taking samples of soil, soil and swamp sediments



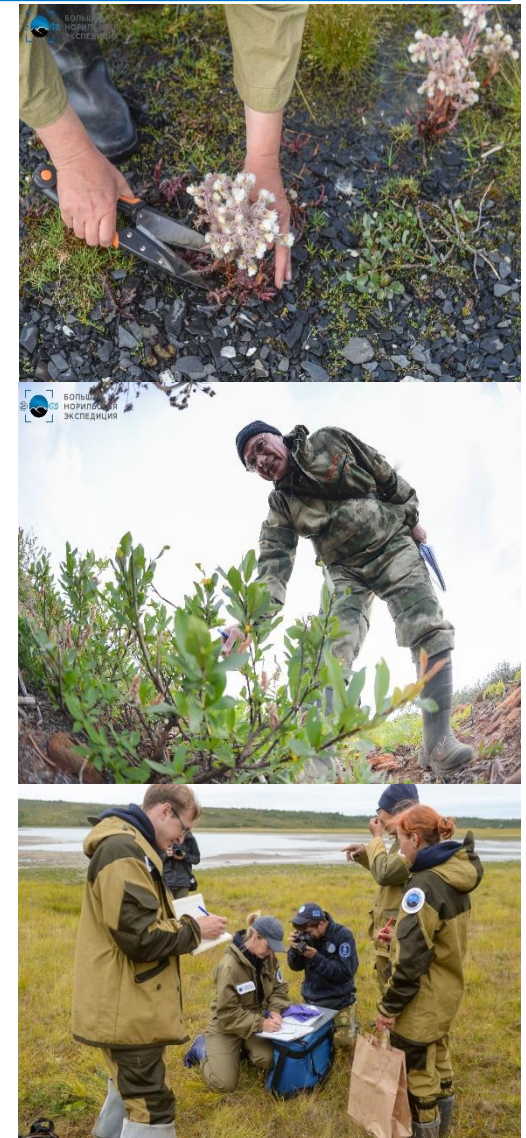
Biodiversity Study

Biological Research

- Assessment of external conditions for the development of hydrobionts based on hydrophysical indicators
- Study of hydrobiological indicators: quantitative and qualitative characteristics of bacterioplankton, phytoplankton, zooplankton, phytoperiphyton, zoobenthos

Biological and Zoological Diversity

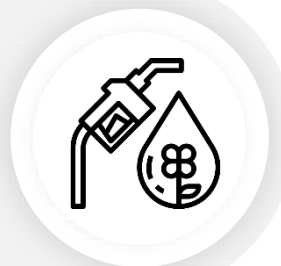
- Study of phytocoenotic diversity in the landscapes contaminated with oil products
- Assessment of phytocoenotic diversity of similar (background) non-polluted landscapes
- Assessment of fuel spill impact on flora
- Study of zoological diversity in landscapes contaminated with oil products, including fuel spill in the Ambarnaya River basin
- Study of zoological diversity (habitats, species, population, pathological) of similar (background) landscapes before and after pollution



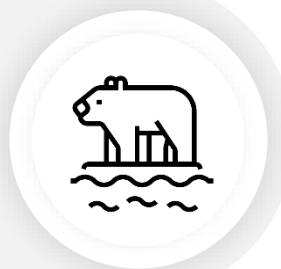
Cooperation Agreement with the Siberian Branch of the Russian Academy of Sciences

On September 15th, Nornickel signed a cooperation agreement with the Siberian Branch of the Russian Academy of Sciences:

Joint development of a long-term programme aiming at the elimination of the environmental impact of the fuel spill in Norilsk and preparation of recommendations for sustainable operations in the Arctic adhering to the highest ESG standards



This vast cooperation programme with the Academy of Sciences is the first precedent in the Russian metals & mining industry posing a major challenge for scientists who will have to assess the effects of human activities in the Arctic



The Big Norilsk Expedition happened for a reason: it is an important step on the company's path of building a completely new relationship between the Arctic and humans

Nikolay Yurkevich,

The Trofimuk Institute of Petroleum Geology and Geophysics of the Siberian Branch of the RAS (Novosibirsk)

I fully support the interaction of science and business for the benefit of the country and its citizens. Joint efforts can and must solve global challenges in the Arctic

Sergey Menyailo,

Presidential Envoy of the Siberian Federal District

Source: Company data

Read more: https://www.nornickel.com/news-and-media/press-releases-and-news/nornickel-and-siberian-branch-of-russian-academy-of-sciences-sign-agreement-on-comprehensive-arctic-study/?redirect_url=/news-and-media/press-releases-and-news/&type=news

Great Norilsk Expedition Photos



Source: Company data

Signing a Cooperation Agreement Between Nornickel and the Siberian Branch of Russian Academy of Sciences to Study Arctic



Source: Company data