Annual report on GEOTRACES activities in Russia

April 1st, 2019 to March 31st, 2020

New GEOTRACES or GEOTRACES relevant scientific results

Rusian Arctic seas

- Major and trace elements in suspended matter of 33 small and medium size western Siberian rivers of Ob River catchment area were studied by scientists from BIO-GEO-CLIM Laboratory, Tomsk State University (Tomsk, Russia), N. Laverov Federal Center for Integrated Arctic Research (Arkhangelsk, Russia), Shirshov Institute of Oceanology, Russian Academy of Science (Moscow, Russia) and Geosciences and Environment Toulouse, UMR 5563 CNRS (Toulouse, France) (*Krickov et al., 2020*). Major and trace elements in particulate (>0.45 µm) and dissolved (<0.45 µm) fraction were analyzed. Compared to the world river suspended matter (RSM) average, the West Siberian Lowland rivers exhibited lower concentrations of all elements except Mn and P and a low share of suspended elements relative to total (suspended + dissolved) forms of trace metals and of low-mobility (lithogenic) elements. Likely reasons for these features are: (i) low runoff and low RSM concentration as there is no rock and mineral substrate exposed to physical weathering in WSL peatland; (ii) organic, rather than mineral, nature of surrounding (*Krickov et al., 2020*).

- Two methane seep fields located on the outer shelf of the Laptev Sea at depths of 63–73 m were studied in 2017–2018. In total, 55 hydroacoustic anomalies (gas flares) were recorded in this area with an area of ~35 km^2. These fields are located inside the methane seep domain. The domain strikes in the SW–NE direction, and its dimensions are 180 × 60 km. These methane seep fields are linked to the fault system consisting of deep-seated and surface faults (**Fig.** 1). The deep-seated faults belonging to the Laptev Sea Rift System and the Khatanga–Lomonosov Fracture Zone serve as conduits for gas migration from the lower sediment strata to the gas reservoir in the upper sediment strata below the caprock formed by permafrost and gas hydrates. Shallow faults related to subsidence of the outer shelf cut this caprock and form conduits for bubble methane discharge (*Baranov et al., 2020*).

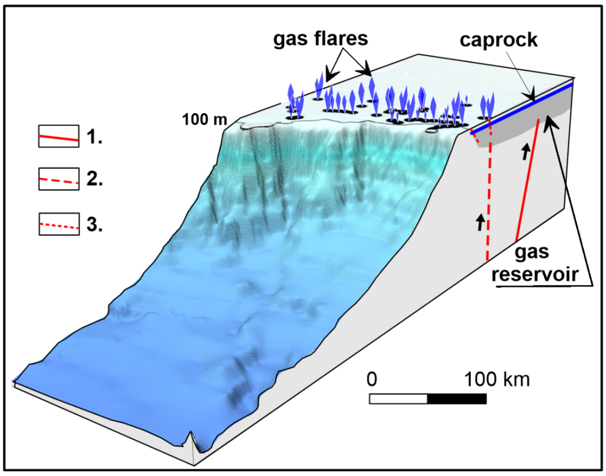

Figure 1. *3D model of the Laptev Sea slope and shelf (grid IBCAOV.3) with faults that may serve as conduits for methane migration and emission. Deep-seated faults: 1, Laptev Sea Rift System; 2, Khatanga−Lomonosov Fault Zone; 3, shallow faults of the outer shelf. Arrows show direction of free gas migration through conduits to and from suggested gas reservoir. Cross section is not to scale (Baranov et al., 2020).*

- New data on the heavy metal (Cd, Co, Cr, Cu, Mo, Ni, Pb) and As partition in the Calanus zooplankton collected in the Barents Sea in July–August, 2017 were presented. Spatial distribution of metals in zooplankton organisms is influenced by biotic and abiotic parameter of ecosystem (primary production, SPM concentration, etc.), as well as by hydrological characteristics of water masses. In the zooplankton of the Arctic Water mass (to S-E of Franz Josef Land), an increased content of essential heavy metals (Cu, Zn, and Cr) in comparison with the Coastal and Atlantic Water masses was detected. Zooplankton from the central part of the sea (Atlantic Water) is characterized by the increased concentrations of most elements (Ni, Cu, Zn, As, and Pb) (**Fig. 2**). Comparison of average concentration of each the metals for the Barents Sea entirely, let us to reveal the elevated concentrations not only for an essential heavy metals (Zn and Cu), but for the potential toxic metalloid As; that may indicates a non-selective bioaccumulation of trace elements by copepod zooplankton (*Demina et al., 2019*).

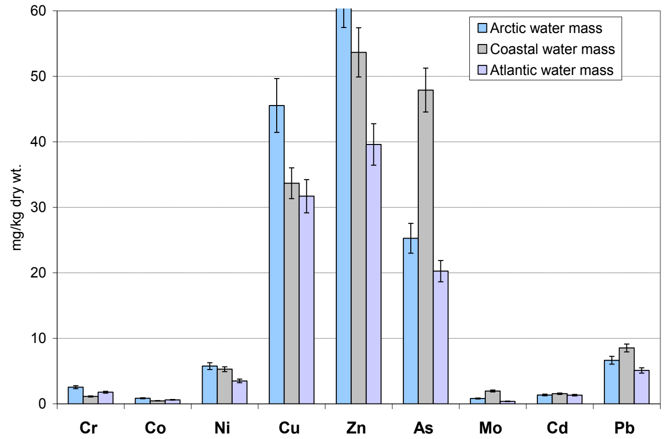

Figure 2*. Average concentrations heavy metals and As in copepod zooplankton, Calanus genus, in different water masses of the Barents Sea (Demina et al., 2019).*

• The elemental composition of suspended particulate matter (SPM) in the Barents Sea was studied using ICP-MS and AAS methods. The material was collected in August 2017. The SPM composition was shown to be determined by variety of factors including biological processes, terrigenous runoff, redox conditions etc. The deep water SPM is significantly different from the one in surface water mainly due to decay of organic and carbonate matter with depth. A maximum of strontium was found in the surface layer at the sites of coccolithophore bloom. A difference was found between the composition of the fluffy layer and the SPM in near bottom layer (**Fig. 3**) what indicates a significant transformation of sedimentary material during sedimentation and early diagenesis (*Starodymova et al., 2020, in press*).

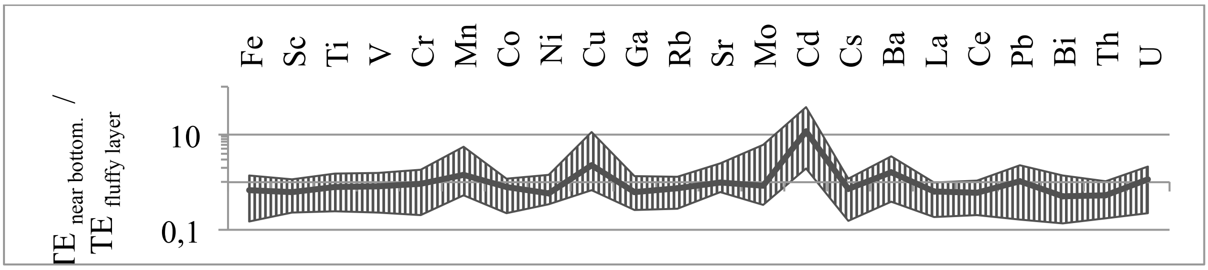

Figure 3*. The ratio of trace elements (TE) in the SPM of near bottom layer and fluffy layer.*

• We have observed for the first time that the main mechanism regulating the phytoplankton calcium carbonate pump in the Norwegian and Barents Seas is the nutrients concentrations, first of all mineral forms of nitrogen and phosphorous, and their ratio (N : P), which control the abundance of calcifying species (Coccolithophores). High mineral N and P concentrations and high N : P values (exceeding the Redfield ratio) are required for maximum *Coccolithus pelagicus* growth. A low mineral N concentration and a low N : P ratio promote intensive *Emiliania huxleyi* growth (*Pautova et al., 2020*).

• A brief lithological description of modern bottom sediments collected in the Barents Sea at test sites were carried out (**Fig. 4**). The distribution of Cr, Ni, Cu, Zn, Cd, and Pb in modern bottom sediments was compared with background concentrations and contents of these elements in the Post-Archean Australian Shale (PAAS). Sc, V, Cr, Ni, Y, Zr, Nb, Mo, Hf, Th, U, and REE are characterized by a moderate positive correlation with the fine pelitic (<0.001 mm) fraction. The correlation of these elements with the total organic carbon revealed three groups of studied elements: (i) with moderate positive correlation, (ii) with low positive correlation, and (iii) with virtual absence of correlation. Distribution of element indicators of the source rock composition (Sc, Th, Co, Cr, La, and Sm) and REE in modern bottom sediments of the Barents Sea demonstrates that the majority of them are geochemically mature, and they were sourced from the Kola Peninsula and Spitsbergen (?). Bottom sediments of the Cambridge Strait (FJL) are represented by geochemically less mature material, which, apparently, entered the sea as a result of erosion of rocks of the Franz Josef Land Archipelago (*Maslov et al., 2020*).

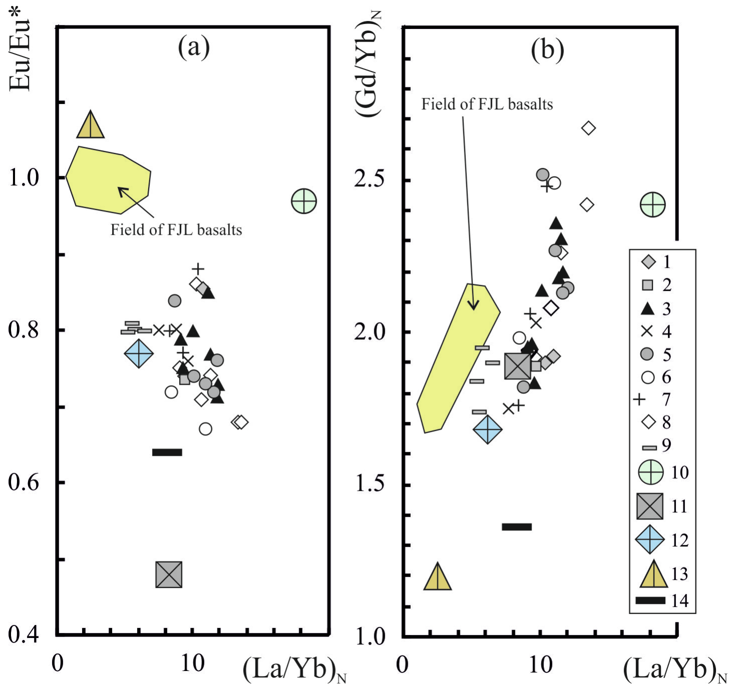

***Figure 4**. Position of data points of the modern bottom sediments from different test sites and some reference objects (after Condie, 1993) in the $(La/Yb)_N$–Eu/Eu* (a) and $(La/Yb)_N$–$(Gd/Yb)_N$ (b) diagrams. (1–9) Test sites: (1) "Pechora Sea", (2) "Western slope of the Kanin shoal", (3) "Shtokman", (4) "Russkaya Gavan" Fjord, (5) "Medvezhinsky (Bear Island) Trough", (6) area south of Spitsbergen, (7) "Kola Meridian", (8) "Spitsbergen–Franz Josef Land (FJL) Archipelago", (9) "Cambridge Strait"; (10–14) reference objects: (10) Archean tonalite–trondhjemite–granite associations, (11) Proterozoic granites, (12) Meso-Cenozoic andesites, (13) Meso-Cenozoic basalts, (14) PAAS.*

• The Co, Hf, Ce, Cr, Th, and REE data of modern bottom sediments from the Barents Sea bays and inlets indicated that the most sediments are composed of fine siliciclastic material enhanced with a particulate matter of the North Cape current, which erodes the western coast of Scandinavian Peninsula, and due to bottom erosion of some marine areas, as well as erosion of rock complexes of Kola Peninsula, Novaya Zemlya Archipelago, and Franz Josef Land (local provenances). Material from Spitsbergen also probably played a certain role. In the southern part of the Barents Sea, clastic material is carried out by Pechora River (*Maslov et al., 2019*).

• For the first time, the element speciation in the sediment core covering about 10,000 cal yr BP period was investigated in the White Sea (European Arctic) (*Budko et al., 2020*). The cooling periods (the early Holocene and the Subboreal stage) were characterized by a trend of increase in Si, Al, and Ti contents and Ti/Al ratios, which reflect lithogenous contribution, and decrease in geochemically labile forms of trace elements. A significant increase in the content of organic-bound trace elements and biogenic components (C_{org}, Si_{bio}, and chlorin) was observed during periods of Holocene climatic optimums. The evident relationship between the metal speciation and indicators of the sedimentation paleoenvironment is observed at the stage of the active phase of early diagenesis after the slowing down of the biogeochemical processes. Down-core decrease in the Mn oxyhydroxide content exhibited a weakening of diagenesis processes at the ~130–150 cm depth (*Budko et al., 2020*).

• The geochemical and microfossil data of a sediment corer from the northern part of the East Novaya Zemlya Trough (**Fig. 5**) demonstrated a low variability of sedimentation conditions over the last 250 years. Even low microfossils changes, as well as lithological and geochemical parameters, allow us to indicate some short periodical climate changes in this area that probably controlled by atmospheric circulation. A clear binomial structure was reflected changes in sedimentation at the end of the Little Ice Age (LIA) and later. Low sea surface temperatures and an increase in ice cover duration were revealed at the end of the LIA in the 1780−1810s. Since 1810th, the hydrodynamic activity of water masses intensified sharply due to the glacier melting. We assumed an increase in sea surface temperature with the exception of the cooling of the 1910s. Later, the circulation of water masses increased, contributing to the supply of terrigenous matter to the deep parts of the trough (*Novichkova et al., 2020*).

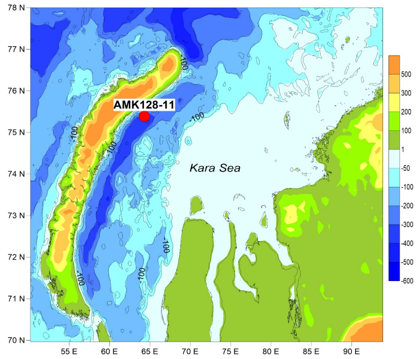

***Figure** 5. AMK128-11 core location at the East Novaya Zemlya Trough, the Kara Sea (Siberian Arctic).*

• Black carbon (BC) has a significant impact on climate change and the degree of pollution of the Arctic. BC was studied over the Baltic and North Seas, the North Atlantic, the Norwegian, the Barents, the Kara and the Laptev seas from June 30 to September 29, 2017 (*Shevchenko et al., 2019*). The conducted studies show low values of BC concentrations (<50 ng/m^3) along the expedition route when air masses came from the background areas of the North Atlantic and the Arctic. High concentrations of black carbon (100–200 ng/m^3 and higher) are characteristic for areas with active navigation (the South-Eastern Baltic, the North Sea) and near ports (eg. Reykjavik), as well as for incoming air masses from the industrialized regions of Europe to South-Eastern Baltic and from areas of oil and gas fields where associated gas is flared (the Northern, the Norwegian and the Kara seas).

• Aerosol and black carbon (BC) concentrations in the marine boundary layer, as well as of aerosol optical depth (AOD) over the North Atlantic and Arctic Ocean were measured in two expeditions in 2018 (*Sakerin et al., 2019*). The spatial distribution shows aerosol characteristics, decreasing with the growing latitude (from the Baltic to Barents Sea), and comparably low characteristics over Arctic seas, from the Barents to East Siberian Sea. The average aerosol characteristics over the Arctic Ocean were: 4.8 cm^{-3} for number concentrations of particles (with diameters of 0.4–10 μm), 40 ng/m^3 for BC mass concentration, and 0.048 for AOD (0.5 μm). The largest characteristics were obtained in the south of the Barents Sea (near Scandinavia), with values 11 cm^{-3} for particle concentration, 310 ng/m^3 for BC, and 0.164 for AOD (0.5 μm).

Baltic Sea

• For the first time, a detailed description of seasonal changes in phytoplankton primary production (PP) in the coastal zone of the S-E Baltic Sea is presented (*Kudryavtseva et al., 2019*). With high statistical significance, it can be asserted that the level of NO_3^- is a key factor in the determination of seasonal PP variations. During the first half of the spring bloom, a weak consumption of NO_3^- and SiO_4 by diatoms is observed. Further increases in NH_4^+ concentration due to the decomposition of organic matter and nitrogen fixation by cyanobacteria change the prevailing N-limitation for phytoplankton, growing into a P-limited phase at the beginning of summer. In July, concentration of both NO_3^- and PO_4^{3-} can fall to minimum values that approach detection limits. The annual level of PP (290 $gC \cdot m^{-2} \cdot yr^{-1}$) is eutrophic. The most significant primary producers during the spring period were dinoflagellates and during the summer dominated cyanobacteria and green algae. Changes in the phytoplankton composition may also account for some of the seasonality of assimilation numbers (AN_{max}). Diatoms were common at the highest AN_{max} in April 2009, July, August, and October 2008. This means that AN_{max} is uncoupled from the inorganic nutrient concentration, likely a reflection of physiological acclimation and changing of phytoplankton community (*Kudryavtseva et al., 2019*).

<u>*Subpolar North Atlantic*</u>

The Trollveggen hydrothermal vent field area located at the Mohn Ridge near the Jan Mayen hotspot at a depth of about 550 m (71°18′ N, Norwegian–Greenland Basin) was investigated in 2017. The hydrothermal vent field plume was characterized by a weak distribution; temperature, density, and salinity anomalies; a moderate methane concentration; and a low SPM concentration. The enrichment of bottom sediments in barium, strontium, and some sulfide-forming elements (zinc, lead, copper, and molybdenum) was shown. Two mineral assemblages of hydrothermally modified bottom sediments were revealed: pyrite and barite–marcasite. The temperature of hydrothermal fluids was established by thermal and cryometric studies of gas–liquid fluid inclusions in barite (128–260°C), **Fig. 6**; the FeS–ZnS equilibrium diagram of sulfide minerals was also used (130–290°C). Our data were close to direct fluid temperature data by *Pedersen et al., 2010*. The bottom sediments of the studied vent field are close in chemical and mineral composition to the sediments of the Lucky Strike and Menez Gwen vent fields (Azores hotspot). As a result, we confirmed the influence of ocean depth and PT conditions on the formation of hydrothermal deposits (*Kravchishina et al., 2019*).

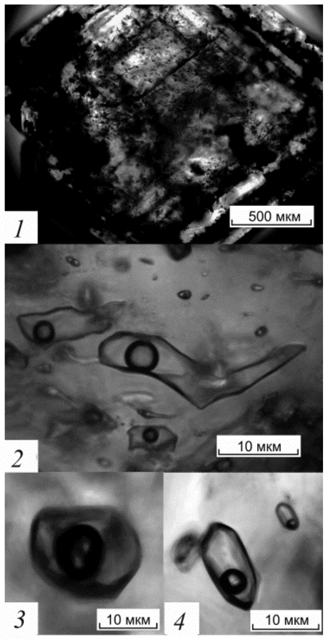

Figure 6*. Zoned barite crystal (1) and biphase fluid inclusions in barite (2–4).*

<u>*South Atlantic*</u>

• The content of Platinum Group Elements (Pt, Ir, Pd, Ru) and Au in Fe-Mn nodules of different morphology and in their separate layers (**Fig. 7**) from the Cape Basin, Atlantic Ocean was studied from two sites: 36º27.14´ S, 08º0.50´ E, depth 4764 m and 36º35.48´ S, 08º10.91´ E, depth 4708 m. Layer-by-layer analysis of Fe-Mn nodules showed that Platinum Group Elements (PGE) are accumulated in the ferromanganese oxyhydroxide layers relative to clayey nuclei. Among oxyhydroxide layers, PGE are more concentrated in the hydrogenous (sedimentation) layers of nodules to a greater extent than in the layers with predominant oxic and suboxic diagenetic material. PGE accumulation decreases in this sequence of processes. It was shown that Au does not accumulate in Fe-Mn nodules (*Dubinin, Berezhnaya, 2020*).

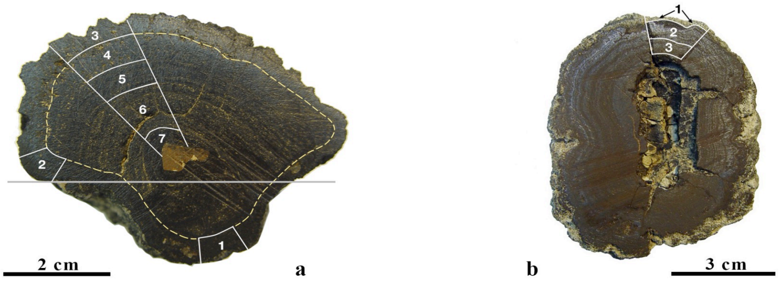

Figure *7. Sectional view of nodules from stations 2194 (a) and 2195 (b). Sampling layers with number of sample are shown. The gray line is the sediment – bottom water interface.*

The reason for the predominant accumulation of platinum relative to palladium in nodules is the oxidative sorption on manganese oxyhydroxides suspended in seawater. An increase in the growth rate of nodules due to diagenetic matter input from sediments is accompanied by an increase in the Mn/Fe value in the composition of nodules. It was shown that the increase of Mn/Fe value in nodules leads to a decrease in Pt/Pd (**Fig. 8**), which indicates the dominant role of the hydrogenous input of Platinum Group Elements to nodule. The contents of iridium and ruthenium correlate with the contents of platinum and cerium (*Dubinin, Berezhnaya, 2020*).

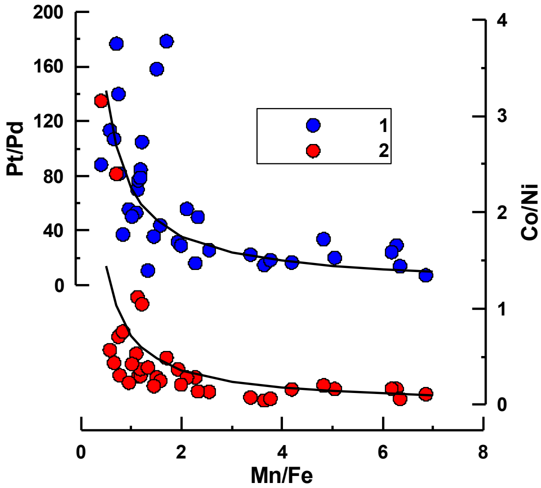

Figure 8. *The dependence of Pt/Pd (1) and Co/Ni (2) on Mn/Fe in Fe-Mn nodules of the World Ocean. Our and literature data are used.*

GEOTRACES or GEOTRACES relevant cruises

- The 75th cruise of the RV *Akademik Mstislav Keldysh* was carried out from May, 27, to June, 30, 2019 in the European Arctic (PhD Alexey Klyuvitkin and PhD Marina Kravchishina are cruise leaders). The study area covered the active mid-oceanic Mohns and Knipovich Ridges the dead Aegir Ridge, the deep-sea basins of the Norwegian and Greenland Seas, the continental slope of the Svalbard archipelago, troughs of the western continental margin of the Barents Sea and its southern shelf (**Fig. 9**).

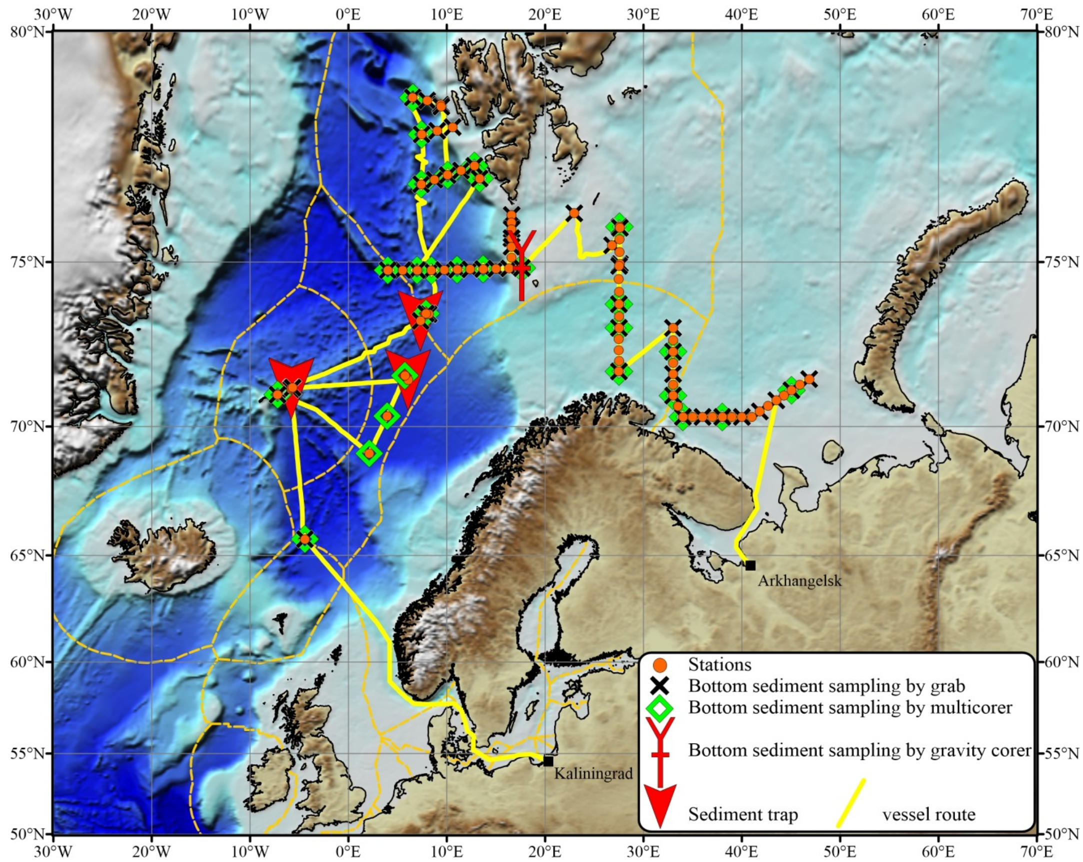

Figure 9. *Sampling stations in the Barents Sea and Norwegian-Greenland Basin, the 75th cruise of the RV Akademik Mstislav Keldysh, May–June 2019.*

The main goal of the cruise was a combined study both of sedimentary matter (aerosols and SPM) and bottom sediments with an emphasis on the processes of sedimentogenesis and early diagenesis in combination with paleooceanological reconstructions. Vertical particle fluxes were obtained used sediment traps moored in the Lofoten Basin (Norwegian Sea) and at the hydrothermal vent fields of the Ultraslow-Spreading *Mohns Ridge* (Trollveggen and Soria Moria near Jan Mayen and Loki's Castle in the N-E part of the ridge) (*Klyuvitkin et al., 2020*).

• Insoluble particles in the snowpack of Western Siberia in the catchment area of Ob River flowing to the Kara Sea were studied at 36 sites on a 2800-km submeridional profile from the city of Barnaul to Salekhard in February 2020 in the expedition in the frame of Russian Foundation for Basic Research, project No. 19-05-50096 "Investigation of the role of microparticles in the influx of heavy metals from the atmosphere into the Ob River drainage basin" (Dr. Vladimir Shevchenko is a project leader). Snow samples were taken from the surface of the snow cover to the boundary with soil except the lower 1–2 cm in clean plastic bags and transported to the laboratory in Tomsk. Now the composition of particles is studies.

New projects and/or funding

• "The participation of heterogeneous microparticles in biogeochemical processes in the Russian seas", project No. 19-05-50090, 2019–2021. PhD. Marina Kravchishina is project leader. *Russian Foundation for Basic Research*. URL: https://www.rfbr.ru/rffi/eng. The main goal of our project is to identify the genesis of microparticles in the system of suspended particulate matter – fluffy layer – bottom sediments, to assess their fluxes and the degree of participation in the biogeochemical processes of marine geosystems under the influence of climate change and increased anthropogenic impact.

• "The role of hydrothermal and thermogenic processes in recent sedimentation in the subpolar North Atlantic and Arctic Oceans", project No. 20-17-00157, 2020–2022. PhD. Marina Kravchishina is project leader. *Russian Science Foundation*. URL: https://www.rscf.ru/en/. The main goal of the project is to understand the combined role of hot (hydrothermal) and cold (seep) fluids in modern sedimentation processes in the Norwegian-Greenland Basin and Eurasian Arctic shelf seas.

• "Investigation of the role of microparticles in the influx of heavy metals from the atmosphere into the Ob River drainage basin", project No. 19-05-50096, 2019–2021. Dr. Vladimir Shevchenko is a project leader. *Russian Foundation for Basic Research*. URL: https://www.rfbr.ru/rffi/eng. The project aims to study the role of microparticles in the influx of heavy metals from the atmosphere into the catchment basin of Ob River, which carries its own water and various chemical elements to the Kara Sea.

GEOTRACES workshops and meetings organised

• *2nd Russian GEOTRACES Seminar*, Shirshov Institute of Oceanology, Russian Academy of Sciences (IO RAS), Moscow, 7th February, 2020: "International GEOTRACES Programme: Observations across ocean gradients provide insights into biogeochemical cycles". Spiker: Prof. Dr. Eric Achterberg, Chemical Oceanography GEOMAR, Helmholtz Centre for Ocean Research Kiel and Christian-Albrechts University Kiel, SSC member.
Round Table: "TEIs clean sampling systems and analyses".
Organizers: Prof. Dr. Eric Achterberg (SSC member), PhD Marina Kravchishina (SSC member) and Prof. Dr. Piotr Zavyalov (Corresponding Member of RAS, Chairman).
https://www.geotraces.org/2nd-russian-geotraces/
https://ocean.ru/index.php/component/k2/item/1520-russian-geotraces (in Russian)

Other GEOTRACES activities

• An Internet page was created with the information on the GEOTRACES program and its activities in Russia on the website of the Shirshov Institute of Oceanology, Russian Academy of Sciences (in Russian) with links to the GEOTRACES website and video: https://ocean.ru/index.php/component/k2/item/1520-russian-geotraces

• Dina Starodymova, Researcher, PhD, IO RAS, participant of the International Summer School GEOTRACES–Spain, University of Cádiz (UCA), Spain, 23rd–28th September 2019.

New GEOTRACES or GEOTRACES-relevant publications (published or in press)

- Baranov B., Galkin S., Vedenin A., Dozorova K., Gebruk A. & Flint M., 2020. Methane seeps on the outer shelf of the Laptev Sea: characteristic features, structural control, and benthic fauna // *Geo-Marine Letters*. https://doi.org/10.1007/s00367-020-00655-7
- Budko D.F., Demina L.L., Novichkova E.A., Polyakova Ye.I., Kravchishina M.D., Melenevsky V.N., 2020. Postglacial sedimentation in the White Sea (northwestern Russia) reconstructed by integrated microfossil and geochemical data // *Quaternary Research*. Doi:10.1017/qua.2019.49
- Demina L.L., Novichkova E.A., Kozina N.V., 2019. Chemostratigraphy of the Snorri Drift in the North Atlantic // *Oceanology*. V. 59. No. 3. P. 425–431.
- Demina L.L., Novichkova E.A., Lisitzin A.P., Kozina N.V., 2019. Geochemical signatures of paleoclimate changes in the sediment cores from the Gloria and Snorri Drifts (Northwest Atlantic) over the Holocene-Mid Pleistocene // *Geosciences*. 9. 432. Doi: 10.3390/geosciences9100432
- Demina L.L., Solomatina A.S., Abyzova G.A., 2019. Heavy metals in zooplankton organisms of the Barents Sea // *Oceanological Researches*. No. 4. P. 62–75.
- Drits A.V., Pasternak A.F., Kravchishina M.D., Arashkevich E.G., Sukhanova I.N., Flint M.V., 2019. Role of plankton in the vertical flux in the East Siberian sea shelf // *Oceanology*. V. 59. No. 5. P. 746–754. https://doi.org/10.31857/S0030-1574595746-754
- Dubinin A.V., Berezhnaya E.D., 2020. Layered Distribution of Platinum Group Elements in Ferromanganese Nodules from the Cape Basin, Atlantic Ocean // Geochemistry International. Accepted for publication.
- Gladyshev S.V., Gladyshev V.S., Klyuvitkin A.A., Gulev S.K., 2019. New Look at the Water Exchange between the Arctic and the North Atlantic in Iceland Basin // *Doklady Earth Sciences*. 2019. V. 485. Part 2. P. 401–404.
- Klyuvitkin A.A., Garmashov A.V., Latushkin A.A., Orekhova N.A., Kochenkova A.I., Malafeev G.V., 2019. Comprehensive Studies of the Black Sea during the Cruise 101 of the *R/V Professor Vodyanitskiy* // *Oceanology*. V. 59. No. 2. P. 287–289.
- Klyuvitkin A.A., Gladyshev S.V., Kravchishina M.D., Novigatsky A.N., Eroshenko D.V., Lokhov A.S., Kochenkova A.I., 2019. Geological and hydrological studies in the North Atlantic in 2017 on a transect along 59°30′ N (cruise 68 of the *R/V Akademik Mstislav Keldysh)* // *Oceanology*. V. 59. No. 1. P. 161–163.
- Klyuvitkin A.A., Kravchishina M.D., Nemirovskaya I.A., Baranov B.V., Kochenkova A.I., Lisitzin A.P., 2020. Studies of sediment systems of the European Arctic during the 75th cruise of *the R/V Akademik Mstislav Keldysh* // *Oceanology*. V. 60. No. 3. In press.

- Klyuvitkin A.A., Novigatsky A.N., Politova N.V., Koltovskaya E.V., 2019. Studies of sedimentary matter fluxes along a long-term transoceanic transect in the North Atlantic and Arctic interaction area // *Oceanology*. 2019. V. 59. No. 3. P. 411–421.
- Klyuvitkin A.A., Ostrovskii A.G., Lisitzin A.P., Konovalov S.K., 2019. The energy spectrum of the current velocity in the deep part of the Black Sea // *Doklady Earth Sciences*. V. 488. Part 2. P. 1222–1226.
- Kravchishina M.D., Lein A.Yu., Boev A.G., Prokofiev V.Yu., Starodymova D.P., Dara O.M., Novigatsky A.N., Lisitzin A.P., 2019. Hydrothermal Mineral Assemblages at 71° N of the Mid-Atlantic Ridge (First Results) // *Oceanology*. V. 59. No. 6. P. 941–959. Doi: 10.1134/S0001437019060109
- Kravchishina M.D., Novigatskii A.N., Savvichev A.S., Pautova L.A., Lisitsyn A.P. , 2019. Studies on Sedimentary Systems in the Barents Sea and Norwegian–Greenland Basin during Cruise 68 of the *R/V Akademik Mstislav Keldysh* // *Oceanology*. V. 59. P. 158–160.
- Krickov I.V., Lim A.G., Manasypov R.M., Loiko S.V., Vorobyev S.N., Shevchenko V.P., Dara O.M., Gordeev V.V., Pokrovsky O.S., 2020. Major and trace elements in suspended matter of western Siberian rivers: first assessment across permafrost zones and landscape parameters of watersheds // *Geochimica et Cosmochimica Acta*. V. 269. P. 429–450. https://doi.org/10.1016/j.gca.2019.11.005.
- Kudryavtseva Elena, Aleksandrov Sergey, Bukanova Tatiana, Dmitrieva Olga, Rusanov Igor, 2019. Relationship between seasonal variations of primary production, abiotic factors and phytoplankton composition in the coastal zone of the south-eastern part of the Baltic Sea // *Regional Studies in Marine Science*. V. 32. 100862, https://doi.org/10.1016/j.rsma.2019.100862
- Lukashin V.N., Kravchishina M.D., Klyuvitkin A.A., Novigatsky A.N., Politova N.V., 2019. Geochemistry of Suspended Particulate Matter in the Volga River Marginal Filter // *Oceanology*. V. 59. No. 3. P. 381–391.
- Maslov A.V., Politova N.V., Kozina N.V., Shevchenko V.P., Alekseeva T.N., 2020. Rare and Trace Elements in the Modern Bottom Sediments of the Barents Sea // *Lithology and Mineral Resources.* 2020. V. 55. No. 1. P. 1–23.
- Maslov A.V., Politova N.V., Shevchenko V.P., Kozina N.V., Novigatsky A.N., Kravchishina M.D., 2019. Co, Hf, Ce, Cr, Th, and REE Charateristics of Modern Bottom Sediments of the Barents Sea // *Doklady Earth Sciences.* V. 485. Part 1. P. 298–302.
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- Demina L.L. (Past SSC member), Novichkova E.A., Kozina N.V. (IO RAS), “Geochemical proxies of the Late-Quaternary sedimentation during glacial-interglacial cycles in the North Atlantic”. Invited presentation at the *XXIII International Conference (School) on Marine Geology*, Moscow, Russia, 18–22 November, 2019.
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