

ANNUAL REPORT ON GEOTRACES ACTIVITIES IN RUSSIA

June 1st, 2015 to April 30th, 2016

New results

- Distribution of atmospheric Black Carbon (BC) in the marine boundary layer was estimated in the North Atlantic, as well in the Baltic, North, Norwegian, Barents, White, Kara and Laptev Seas based on samples collected in the 62 and 63 research cruises of the RV “Akademik Mstislav Keldysh” since July 23 to October 6, 2015. During some parts of the cruises, air masses arrived from the background areas of high latitudes, and the measured BC concentrations were low. During other parts of the cruise, air masses arrived from industrially developed areas with strong BC sources, and this led to substantially enhanced measured BC concentrations. Model-supported analyses are currently performed to use the measurement data for constraining the emission strength in these areas (V.P. Shevchenko).
- The first data were obtained on the vertical chlorin flux in the water column and its accumulation in the upper layer of sediments of the Caspian Sea. Seasonal variability of the chlorine concentration in sedimentary matter was evaluated. During the last 60 years, the content of the phytoplankton-synthesized (autochthonous) organic matter, the marker of which is the chlorophyll a concentration, generally decreased. Incomplete organic matter mineralization in the water column promotes accumulation of the labile form of the autochthonous organic matter near the sea bottom and is an additional source of energy for biogeochemical processes in the interface water–bottom sediment layer. The results of study of the chlorine concentration may be applied in reconstructions of paleoproductivity of the Caspian Sea waters. Chlorophyll a and its derivatives are markers of the phytoplankton origin organic matter in the water column and bottom sediments and reliable quantitative indicators of the conditions and processes of biogenic sedimentation [Kravchishina et al., 2016].
- The trace metals (Al, Fe, Mn, Mo, Cu, Co, Cd, Pb, Ni, Cr, As) behavior in the processes of early diagenesis in high resolution (1-2 cm) core of the Barents Sea bottom sediments was examined on the base of the trace metal speciation. Along the core length (44 cm) Al is almost totally presented by lithogenous geochemically inert form, meanwhile portion of Fe, Cr and Ni in this form varies from 61 to 87% from total content. Mn and Mo were the most labile metals (till 90% from total content) in the upper 0-6 cm layer, while down the core they were progressively altered. The adsorbed, organically-bound and lithogenous forms of Co, Cd, Cu, Pb, and As contribute approximately equal portions in accumulation of these metals in the Barents Sea bottom sediments [Demina et al. 2016].
- The monitoring investigations to control the heavy metal concentrations in water and in suspended particulate matter (SPM) of small rivers on the Caucasus coast of the Russian Federation and in the coastal waters of the Black Sea have been carried out over 5 years (2009-2014) in frameworks of the program “ Small Rivers of the Black Sea”. Special attention was paid to areas nearby the capital of the recent Winter Olympic Games in Sochi (February-March 2014). The results have shown that no significant changes in the water due to large scale preparations and fulfillment of the Olympic Games were detected.
- Very interesting results were obtained in studying of several elements' behavior in the river/sea mixing zone of the Mzymta River. Due to small sizes and short residence time of

river water in this zone, the riverine sedimentary material crosses it without any changes of its chemical composition [Gordeev et al., 2015].

- Isotopic composition of S ($\delta^{34}\text{S-SO}_4$) in water was studied in the H_2S oxidation zone of central part of the Black Sea at the horizons 110 and 120 m, i.e. just below the border of disappearance of hydrogen sulfide. Samples of water prepared in different chemical ways were identical in term of $\delta^{34}\text{S(SO}_4)$ within the reproducibility of the method ($< 0.2\text{‰}$) and do not show the lightening of the isotopic composition of sulfur, unlike the earlier data [A.V. Dubinin, E.O. Dubinina]

Cruises

Shirshov Institute of Oceanology RAS has completed 3 cruises connected with the International GEOTRACES Program:

- Cruise of *R/V Akademik Ioffe* in the North Atlantic (22 June - 4 July 2015) was performed to research the modern sedimentation system, including employment of 3 deep-sea automatic observatories with sediment traps, samples of SPM and bottom sediments were collected to study the high-resolution reconstruction of the climate change over the Holocene.
- Cruise of *R/V Akademik Mstislav Keldysh* in the North Atlantic (21 July -20 August 2015) was carried out. Unique material was sampled to study the modern sedimentation processes and the high-resolution reconstruction of the climate change in boundary areas the North Atlantic - Arctic: straits between Greenland, Iceland, Faroe Islands and Shetland Islands, the Norway and Barents Seas. For these purposes, based on hydrophysical sounding SPM samples were collected, as well as 8 sediment cores (to 512 cm length), 3 sediments cores (to 40 cm length) by the Neimisto tube with undisturbed contact zone between near-bottom water and bottom sediments.
- Cruise of *R/V Akademik Mstislav Keldysh* in the Kara Sea and Sea of Laptev (24 August - 10 October 2015) was held. New data on the SPM concentrations, vertical fluxes of sinking particles and aerosols, as well as diagenetic processes in the bottom sediments of the Kara and Laptev Seas processes were obtained to better understanding of modern sedimentation in the Arctic Ocean. Joint study of the system "dispersed sedimentary matter (aerosols, SPM, sedimentary matter collected by sediment traps) - uppermost bottom sediment - underlying sedimentary cover" is a new stage in investigation of the sedimentation in the Arctic Ocean.

All the samples obtained are in the processes of chemical treatment and ICP-MS, AAS analysis, including trace metals, as well as under mineralogical investigations (SEM, X-Ray diffraction, optical microscopy).

New projects and/or funding

Russian Science Foundation - 2 projects till 2017:

- № 14-50-00095 "World Ocean in XXI Century: climate, ecosystems, mineral and biological resources and disasters", an issue "Geospheres' interaction and mineral resources in the World Ocean" under the direction of academician Alexander Lisitzyn.
- № 14-27-00114 "Sedimentology and biogeochemistry of the seas of Russian European part (dispersed sedimentary matter, bottom sediments, diagenesis)" under the direction of academician Alexander Lisitzyn.

Meetings

- Demina L.L. 26 IUGG General Assembly, Prague, June 27 – July 1, 2015: Co-conviner of Symposium P-02 "Physics and Biogeochemistry of Semi-Enclosed and Shelf Seas", Poster presentation: Demina L. L., Budko D. F., Novigatsky A.N., Filippov A.S. "Occurrence Forms of Some Heavy Metals in the Surface Sediments of the White Sea".
- Simposium P-11. Oral presentation: Elena Masferrer Dodas, Ed Boyle, Reiner Schlitzer, Catherine Jeandel, Ludmila L. Demina "GEOTRACES highlights in the Indian Ocean and plans for the future.
- Shevchenko V.P., Kopeikin V.M., Evangelidou N., Novigatsky A.N., Pankratova N.V., Starodymova D.P., Stohl A., Thompson R. The distribution of atmospheric black carbon in the marine boundary layer over the North Atlantic and the Russian Arctic Seas in July – October 2015 // European Geosciences Union (EGU) General Assembly, Vienna, April 17–22, 2016 / Poster.
- Kravchishina M.D. Workshop "Biogeochemical Studies in the Siberian Shelf Seas", GEOMAR, Kiel, Germany, 27–28 January 2016.

Outreach activities

- The research results of the GEOTRACES Program were many times cited in : "Trace Metal Biogeochemistry and Ecology of Deep-Sea Hydrothermal Vent Systems" (eds. Demina L.L. and Galkin S.V.). Handbook of Environmental Chemistry. SPRINGER-Nature. 2016 (in press).

Other activities (e.g., acquisition of new sampling systems)

- New samplers of bottom sediments (Multi-corers, Sediment traps, eco-soundings).
- Teflon - covered heating platform, Teflon sub-boiling system to obtain clean acids, Laminar Box to prepare filters and analytical solutions.

New publications

- L.L. Demina, A.Yu. Lein, S.V. Galkin, and A.P. Lisitzyn. Features of trace metal distribution in the components of the ecosystem of the Lost City hydrothermal vent field (Mid-Atlantic Ridge). Doklady Earth Sciences. 2015. Vol 465, part 2. pp. 1312-1316. DOI: 10.7868/S0869565215360189
- Gordeev V.V., Makkaveev E.P., Kochenkova A.I. Heavy metals in water and suspended matter in mouths of small rivers and in coastal zone of the Russian part of the Caucasus coast of the Black Sea.// Water: chemistry and ecology, 2015, V.19, N11, P.7 -21.
- Kravchishina M.D., Klyuvitkin A.A., Pautova L.A., Politova N.V., Lein A.Yu., Lisitzin A.P. Chlorophyll a in Suspended Particulate Matter of the Caspian Sea as an Indicator of Biogenic Sedimentation Conditions // Doklady Earth Sciences. 2015. T. 465. Part 1. C. 1200–1205.
- Kravchishina M.D., Lein A.Yu., Sukhanova I.N., Artem'ev V.A., Novigatsky A.N. Genesis and Spatial Distribution of Suspended Particulate Matter Concentrations in the Kara Sea during Maximum Reduction of the Arctic Ice Cap // Oceanology. 2015. T. 55. № 4. 623–643.

- Kravchishina M.D., Lisitzin A.P., Lein A.Yu., Lukashin V.N., Novigatsky A.N., Klyuvitkin A.A. First Results on Determination of Chlorophyll A and Its Derivatives in the System of Trapped Sedimentary Material–Fluffy Layer–Bottom Sediment of the Caspian Sea // *Doklady Earth Sciences*. 2016. T. 467. Part 1. C. 284–288.
- Kravchishina M.D., Lein A.Yu., Pautova L.A., Klyuvitkin A.A., Politova N.V., Novigatsky A.N., Silkin V.A. Vertical distribution of suspended particulate matter in the Caspian Sea in the beginning of summer // *Oceanology*. 2016. In press.
- Shevchenko V.P., Starodymova D.P., Vinogradova A.A. et al. Elemental and organic carbon in atmospheric aerosols over the northwestern coast of Kandalaksha Bay of the White Sea // *Doklady Earth Sciences*. 2015b. V. 461. Part 1. P. 242–246.
- Guieu C., Shevchenko V.P. Dust in the Ocean // *Encyclopedia of Marine Geosciences*. Dordrecht: Springer Science+Business Media, 2015. DOI 10.1007/978-94-007-6644-0_56-3.
- Manasypov R.M., Vorobyev S.N., Loiko S.V., Kritzkov I.V., Shirokova L.S., Shevchenko V.P., Kirpotin S.N., Kulizhsky S.P., Kolesnichenko L.G., Zemtzov V.A., Sinkinov V.V., Pokrovsky O.S. Seasonal dynamics of organic carbon and metals in thermokarst lakes from the discontinuous permafrost zone of western Siberia // *Biogeosciences*. 2015. V. 12. P. 3009–3028.
- Shevchenko V.P., Vorob'ev S.N., Kirpotin S.N., Kritskov I.V., Manasypov R.M., Pokrovsky O.S. and Politova N.V. Investigations of insoluble particles in the snow cover of Western Siberia from Tomsk to the Ob estuary. *Optika Atmosfery i Okeana*. 2015. V. 28(6), 499–504 (in Russian).

Some publications (in press)

- Demina L.L. Trace metals in water of deep-sea hydrothermal biotopes. Chapter 3. In: "Trace Metal Biogeochemistry and Ecology of Deep-Sea Hydrothermal Vent Systems" (eds. Demina L.L. and Galkin S.V.). *Handbook of Environmental Chemistry*. SPRINGER-Nature. 2016 (in press).
- Demina L.L., Galkin S.V. Factors controlling the trace metal distribution in hydrothermal vent organisms. Chapter 6. In: "Trace Metal Biogeochemistry and Ecology of Deep-Sea Hydrothermal Vent Systems" (eds. Demina L.L. and Galkin S.V.). *Handbook of Environmental Chemistry*. SPRINGER- Nature. 2016 (in press).
- Demina L.L., Bud'ko D.F., Lisitzyn A.P. Geochemical fractionation of some trace metals in the high-resolution sedimentary core of the Barents Sea (*Doklady Earth Science*, 2016, submitted)
- Dubinin A.V., Dubinina E.O., Kossova S.A., Berezhnaya E.D. Ventilation of anaerobic zone in the Black Sea from $\delta^{34}\text{S}$ - SO_4 isotopic data (*Doklady Earth Science*, 2105, accepted)
- Berezhnaya E.D., Dubinin A.V. Elements of Platinum group and gold in the Fe-Mn nodules reference material NOD-A-1. *Geochemistry International* (accepted).
- Rimskaya-Korsakova M.N., Berezhnaya E.D., Dubinin A.V. Determination of Mo, W and V in the Atlantic Ocean by concentration method with 8-oxychinolin extraction followed by ICP-MS analysis (*Oceanology*, 2016, in press).

- Dubinin A.V., Uspenskaya T.Yu., Rimskaya-Korsakova M.N., Demidova T.P. Rare elements and isotopic composition of Nd and Sr в manganese micro-nodules of the Brazil depression of the south Atlantic Ocean. Lithology and mineral resources. 2015(in press).

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