Shirshov Institute of Oceanology
of Russian Academy of Sciences
(IO RAS)
Moscow, Russia

Annual report on GEOTRACES activities in RUSSIA

PhD Marina Kravchishina,
SSC member

Salvador, Brazil
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On the image is RV *Academic Mstislav Keldysh* in the Franz Josef Trough, Barents Sea (Arctic Ocean), August 2017

Particular Russian GEOTRACERS interests include the following issues:

•biogeochemical processes in the major rivers estuaries, Arctic seas and North Atlantic with special emphasize on SPM and bottom sediments (grain-size, chemical, isotopic, and mineral composition);

•sedimentary and chemical fluxes from atmosphere to the Arctic Seas.

I. Some new scientific results

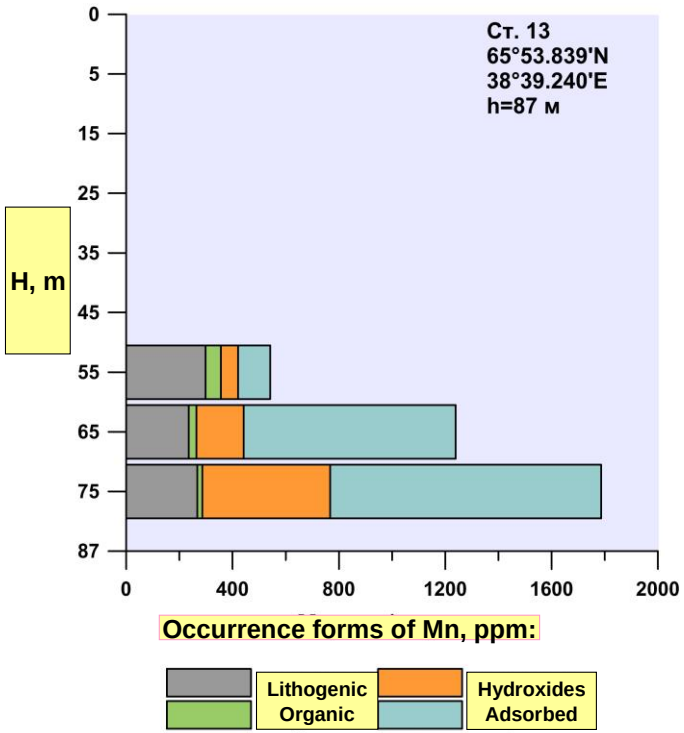
Trace element (Al, Fe, Mn, Cd, Cr, Co, Cu, Mo, Ni, Pb) speciation in trapped sedimentary material, the White Sea (Arctic Ocean).

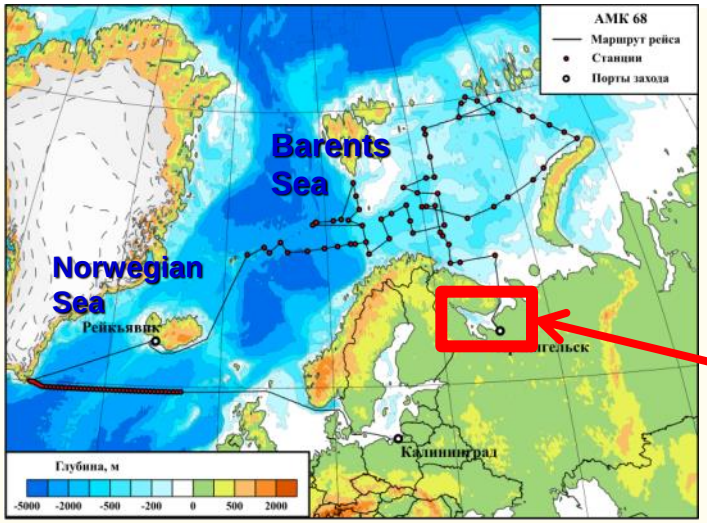
L.L. Demina et al., 2017 (past SSC member)

A mooring equipped with sediment traps, STD and ADCP after year-round deployed is on the images

Trapped sedimentary matter was collected using year-round deep automatic sedimentological moorings deployed in the White Sea at various depth and equipped with sedimentary traps of different designs: small cylindrical traps (SCT-110) of our own production with one collection cup, a Hydrobios cylindrical automatic trap (Germany), and a "Lotos" conical automatic trap (Russia) with 12 collection cups.

Trace element (Al, Fe, Mn, Cd, Cr, Co, Cu, Mo, Ni, Pb) speciation in trapped sedimentary material
L.L. Demina et al., 2017 (past SSC member)





- For the first time the trace element (Al, Fe, Mn, Cd, Cr, Co, Cu, Mo, Ni, Pb) speciation in sinking particles was examined using a modified method of selective chemical leaching [Tessier et al., 1979].

- Sinking particles were collected by use of 18 sediment traps deployed at different layers of the water column (deployment period varied from 1 month to 1 year).

- Based on contribution of the lithogenic fraction, the three groups of trace metals were distinguished:

1) Al and Cr as a typical lithogenic elements (till 90% of total content);
2) Fe, Mo, Ni, Co and Cd – with the intermediate contribution of lithogenic fraction (from 50 to 75% of total content);
3) Mn, Cu and Pb as the least lithogenic elements and in the same time the most geochemically labile elements.

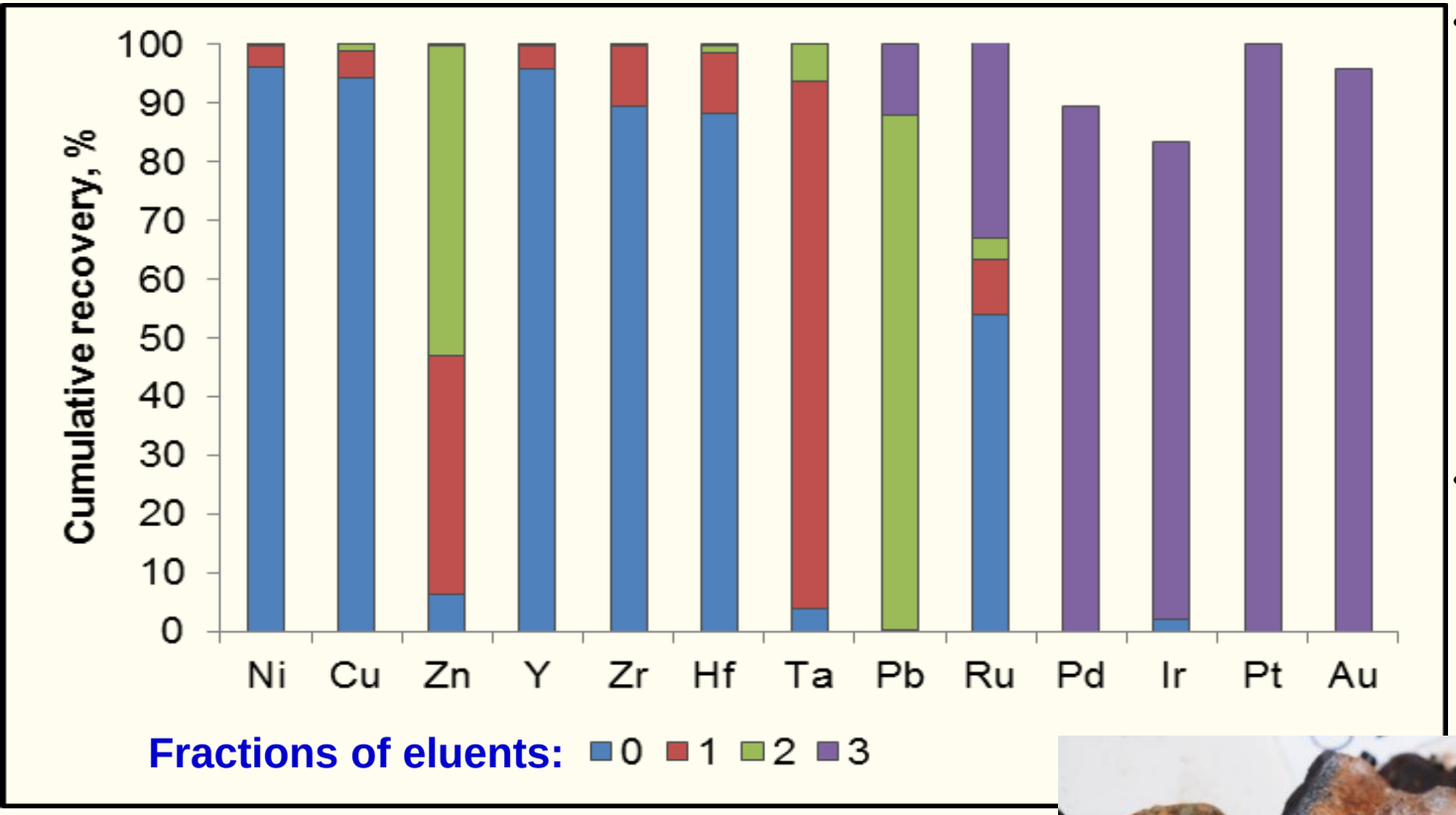
- For each of trace elements a contribution of adsorbed, organic and associated with amorphous hydroxides fractions in sum exceeds 50% (of total content), for Mn this value is the maximal one (to 90%). In direction to the sea bottom the Mn content in the form of hydroxides as well as in the adsorbed ones distinctly increased. Partitioning of the Mn occurrence forms in the sinking particles in the near-bottom layers is close to that in the uppermost (0–2 cm) sediment layer.

White Sea

Determining Ru, Pd, Ir, Pt and Au mass fractions in ferromanganese nodules

E.D. Berezhnaya, A.V. Dubinin, 2017

Typical elution curve for PGE, Au and some matrix elements for one of the NOD-A-1 subsamples



- A measurement procedure for determining of Ru, Pd, Ir, Pt and Au mass fractions in ferromanganese nodules by inductively coupled plasma-mass spectrometry after acid digestion and anion exchange preconcentration is presented.
- To eliminate incomplete recovery after sorption preconcentration of the platinum-group elements (PGE) and Au, a standard addition method was used.

0 – loaded,
1 – 0.4 mol·l^{-1} HCl + Cl_2,
2 – 1 mol·l^{-1} HNO_3 + Cl_2,
3 – 14 mol·l^{-1}HNO_3 (90°C)

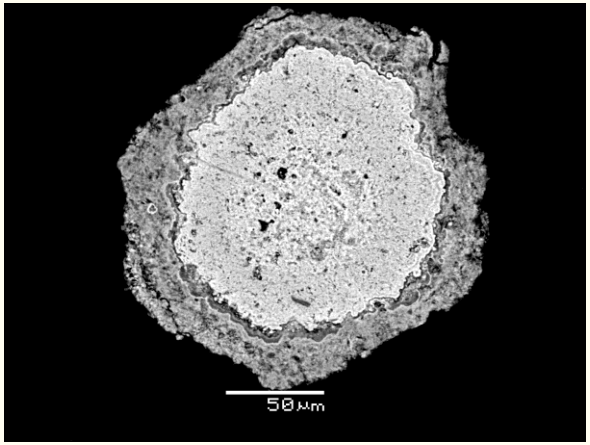
Berezhnaya E.D., Dubinin A.V. (2017) Determination of the Platinum-Group Elements and Gold in Ferromanganese Nodule Reference Material NOD-A-1. *Geochemistry International*. V. 55. No. 2. P. 218–224.

Elemental and $^{143}Nd/^{144}Nd$ composition of ferromanganese nodules in pelagic sediments of the Brazil Basin

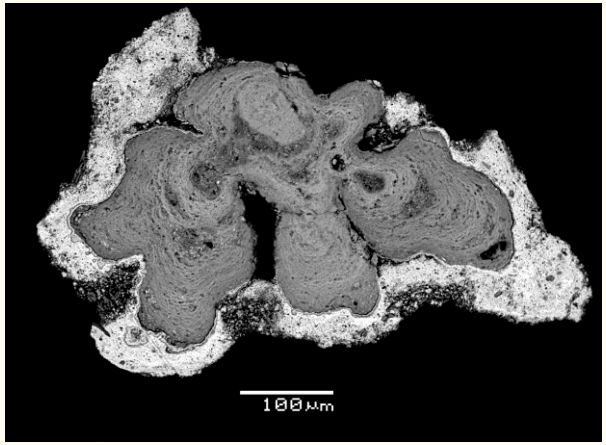
A.V. Dubinin et al., 2017

The examples of SEM micro images of ferromanganese nodules:

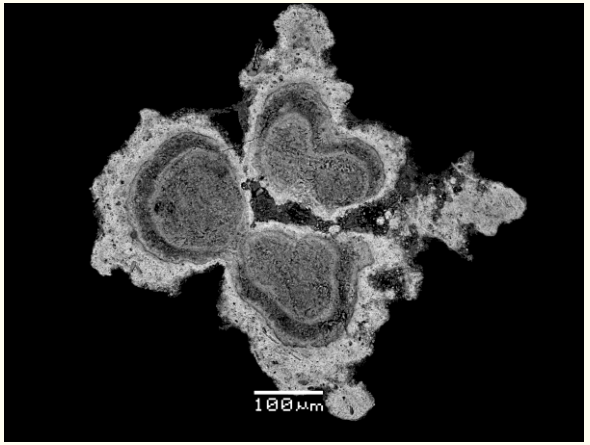
Rounded: the inner part is enriched in Mn; the outer part, in Al, Mg, and Fe (sediment layer 0–5 cm)



Multi nucleus: the outer part is enriched in Mn, Al, and Mg; the inner part, in Fe, (sediment layer 86–90 cm)



Multinucleus: the inner part is depleted in Mn relative to the outer part (sediment layer 0–5 cm)



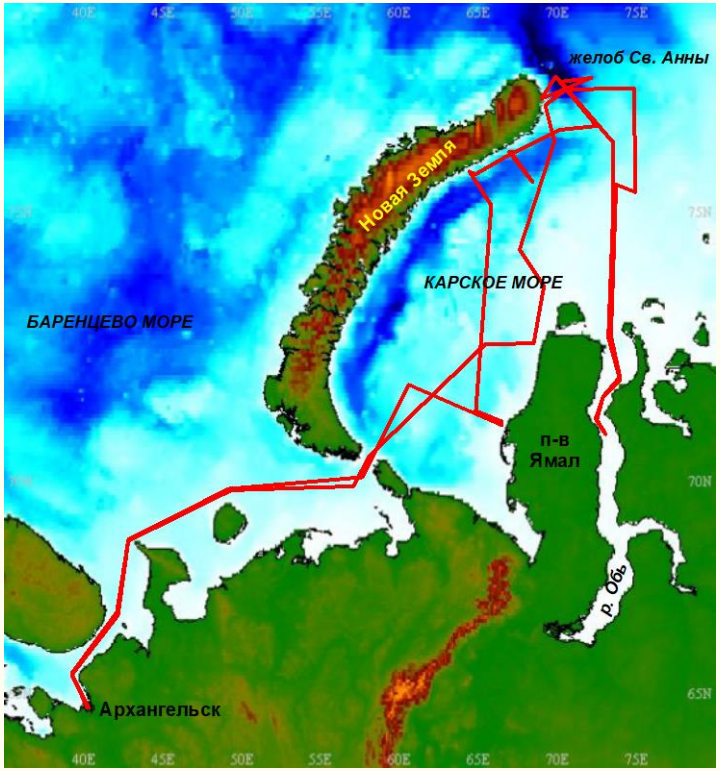
- **During diagenesis, the buried nodules (sediment layer 86–90 cm) lost the part of elements (Mn, Ni, Li, Tl) but it kept the elements associated with iron oxyhydroxide (Ce, Th, Be, As, V).**
- **The $^{143}Nd/^{144}Nd$ value in manganese micronodules differs between sediment layers, reflecting the isotopic composition of Nd in paleoocean at the time of micronodule formation, and did not differ between the it size fractions.**
- **The age of the pelagic sediments from Brazil Basin was determined using Sr isotope stratigraphy data for biogenic apatite. For layer 0–5 cm the age of sediments was 24.1±0.2 million years, and for layer 86–90 cm it was 24.8±0.2 million years.**

Chemical composition of zooplankton of the Kara Sea (Arctic Ocean)

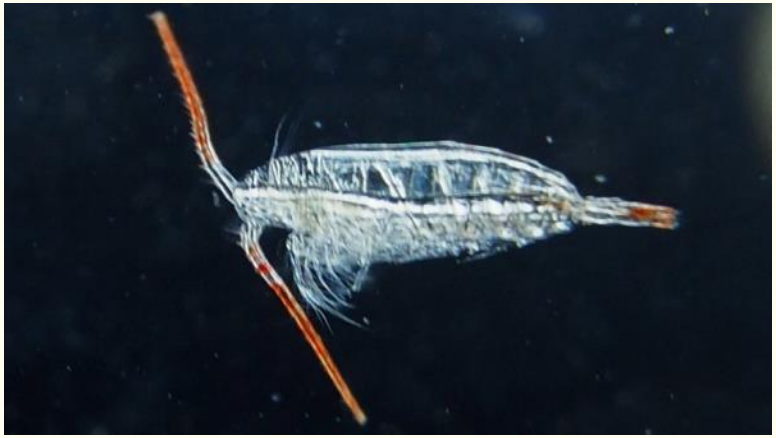
N.V. Lobus, 2017

For the dominant species of mesozooplankton were determined in the Ob River-estuarine system and the adjacent shelf of the Kara Sea:

- **content of C_{org} and lipids,**
- **major elements (Na, Mg, P, S, K and Ca),**
- **trace elements (Li, Be, B, Al, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, Y, Mo, Ag, Cd, Sb, Cs, Ba, Hg, Tl, Pb, Bi, Th and U),**
- **rare-earth elements (La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu).**



- **Total accumulation of chemical elements per unit of volume (1 m^3) is higher in *Limnocalanus macrurus* than in *Senecella siberica* and *Calanus* spp., 6.63, 0.69, 0.41 mg, respectively.**
- **The authors revealed postmortem change of chemical composition in dead zooplankton.**
- **The authors revealed high accumulation of Li in *Calanus* spp., which concentration is approximately 350 times more than ones in *S. siberica* and *L. macrurus*.**

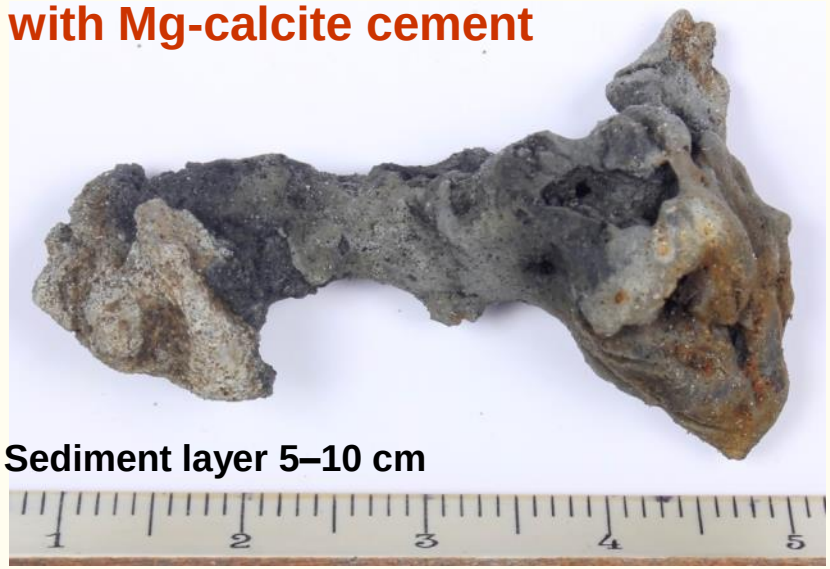


Lobus N.V., Drits A.V., Flint M.V. (*In press*) Accumulation of Chemical Elements in the Dominant Species of Copepods in the Ob Estuary and the Adjacent Kara Sea Shelf. *Oceanology*.

Stable isotopic composition of authigenic Mg-calcite at a cold methane seep site in the Laptev Sea (Arctic Ocean)

Kravchishina et al., 2017

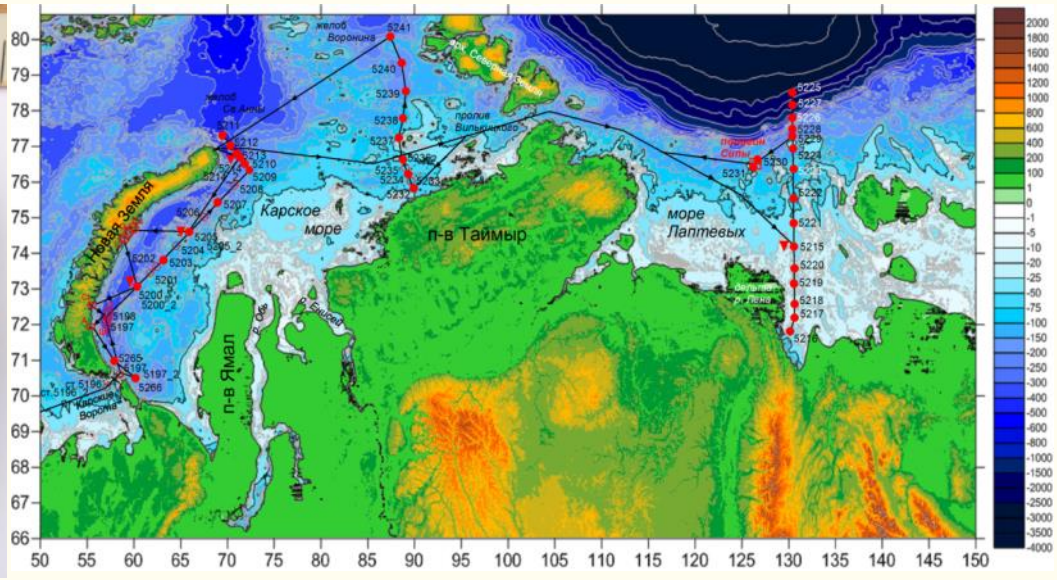
Large hard carbonate concretions with Mg-calcite cement



Sediment layer 5–10 cm

Sediment layer 10–14 cm

- Mg-calcite has $\delta^{13}C\text{-}C_{carb}$ values between –24 and –23‰ and $\delta^{13}C\text{-}C_{org}$ values between –44.5 and –88.5‰.
- It was found that methane-derived Mg-calcite accounts for 17–35% of concretion materials.
- Authigenic carbonate formation in the Arctic shelf seas can act as a biogeochemical filter mechanism limiting methane emissions from bottom sediments to the water column and atmosphere.

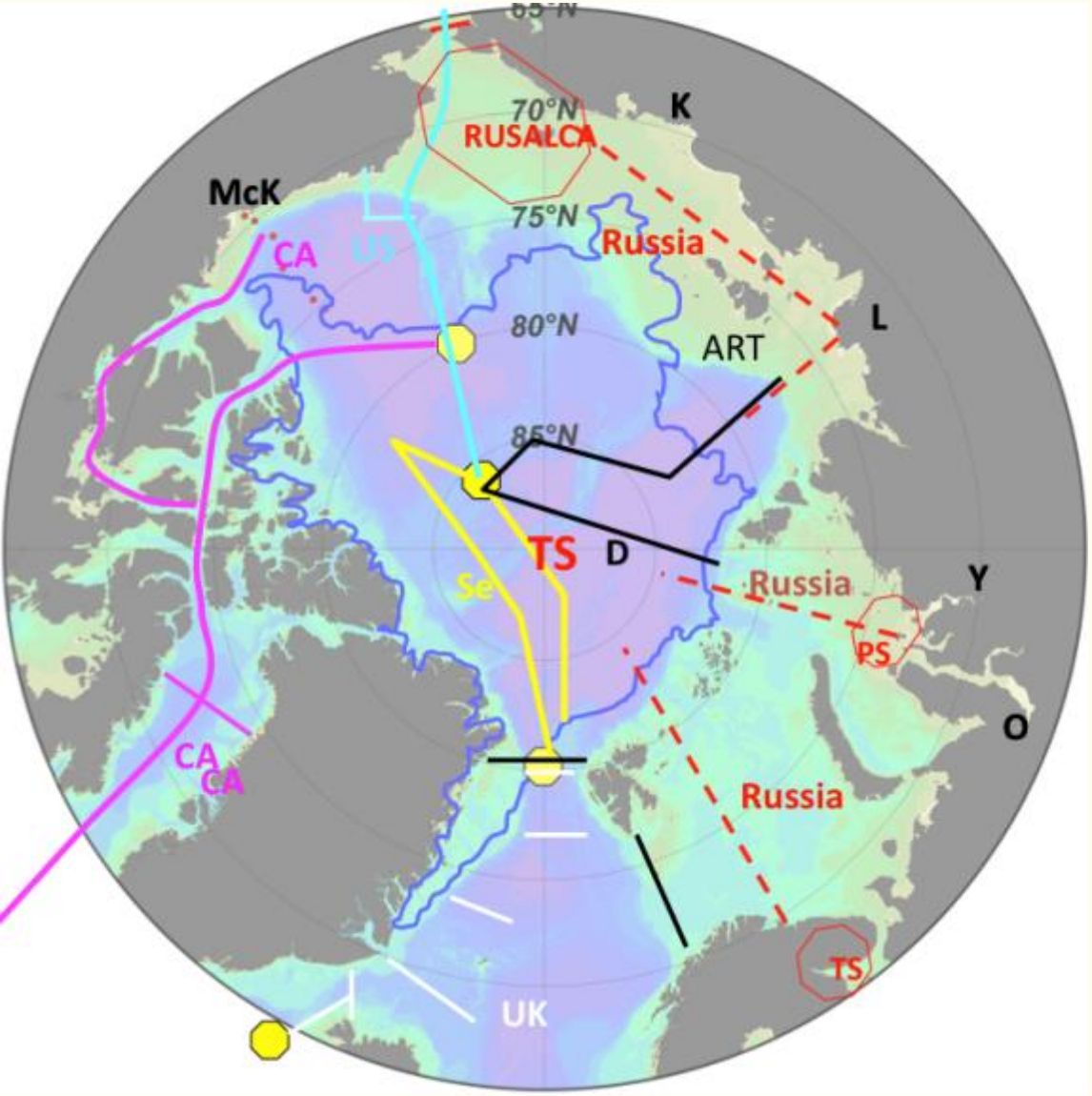


II. Cruises GEOTRACES-related

Approximate position of potential Russian GEOTRACES transects in the Arctic Ocean

From 1ST **RUSSIAN GEOTRACES WORKSHOP**: FINAL STATEMENT

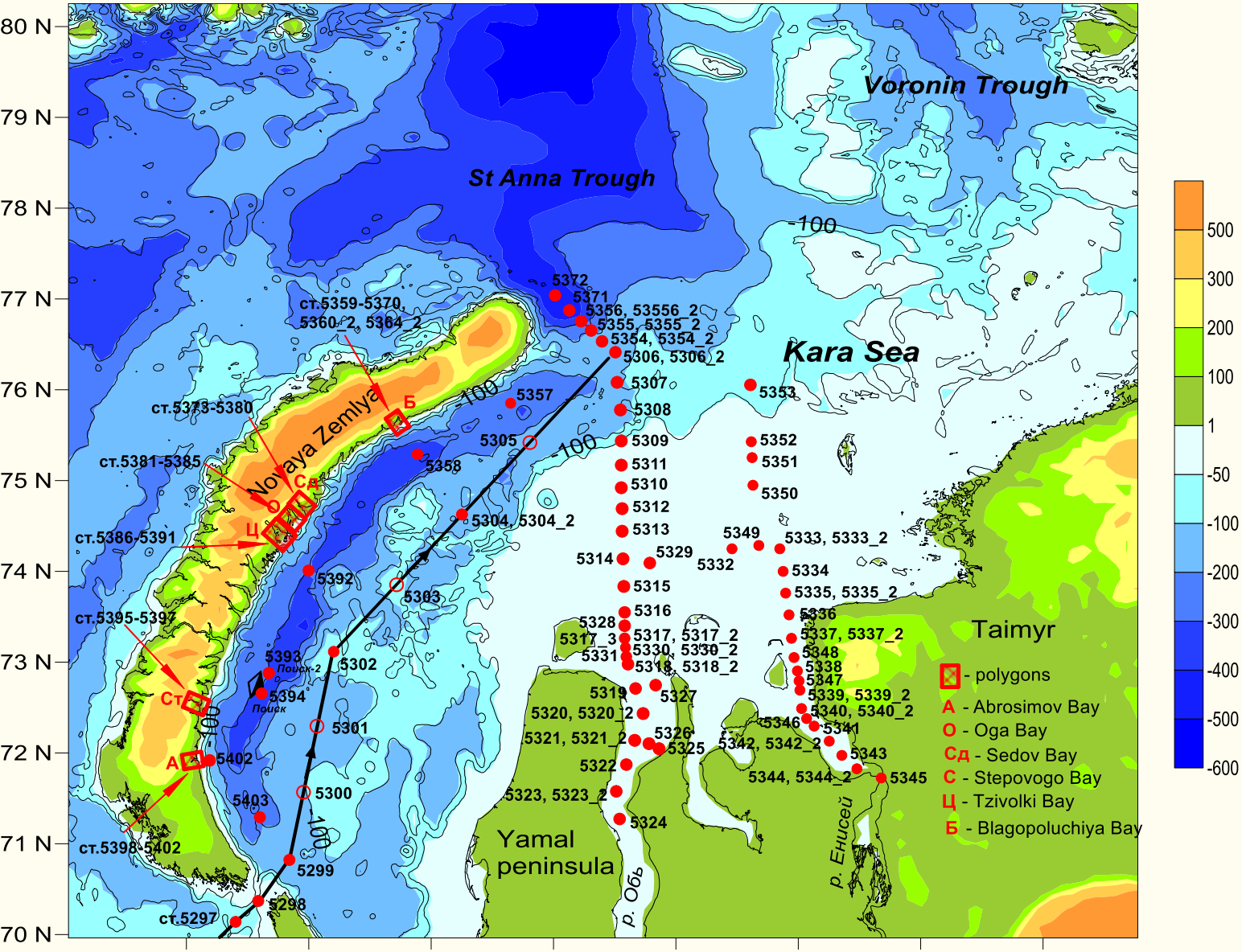
(DECEMBER 2012, Demina L., 2012)



Russian cruises were suggested:

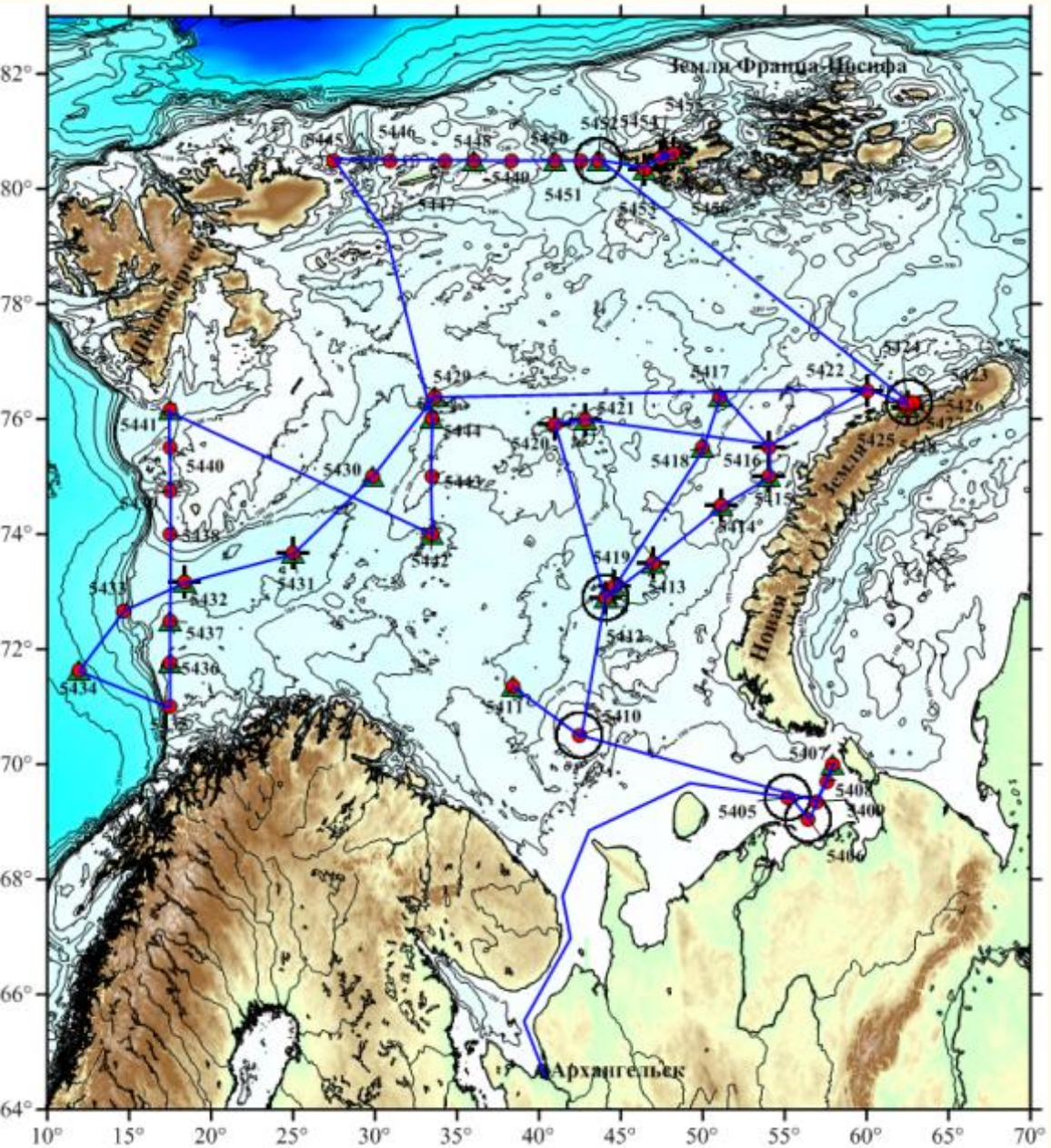
- **in the Kara Sea (to assess the near and far-field effects of major river inputs and the removal of metals at the shelf-margin);**
- **in the Barents Sea on an existing Russian repeat section (to assess shelf processes and the modification of inflowing Atlantic waters);**
- **on the Eastern Siberian Shelf (to assess the impact of methane release from permafrost and the mixing between Lena River waters with Pacific and Arctic waters).**
- And process studies (PS) were suggested for the major river estuaries of the Ob and Yenisei and for the Bering Strait.

IO RAS cruise to the Kara Sea from July to August 2016.
The 66th cruise of RV *Academik Mstislav Keldysh*



One of the main objects was to evaluate the specificity of the physical, hydrochemical, biological and geochemical processes of the ecosystems of the Kara Sea in the areas of large-scale impact desalinating runoff of the Ob and Yenisei rivers.

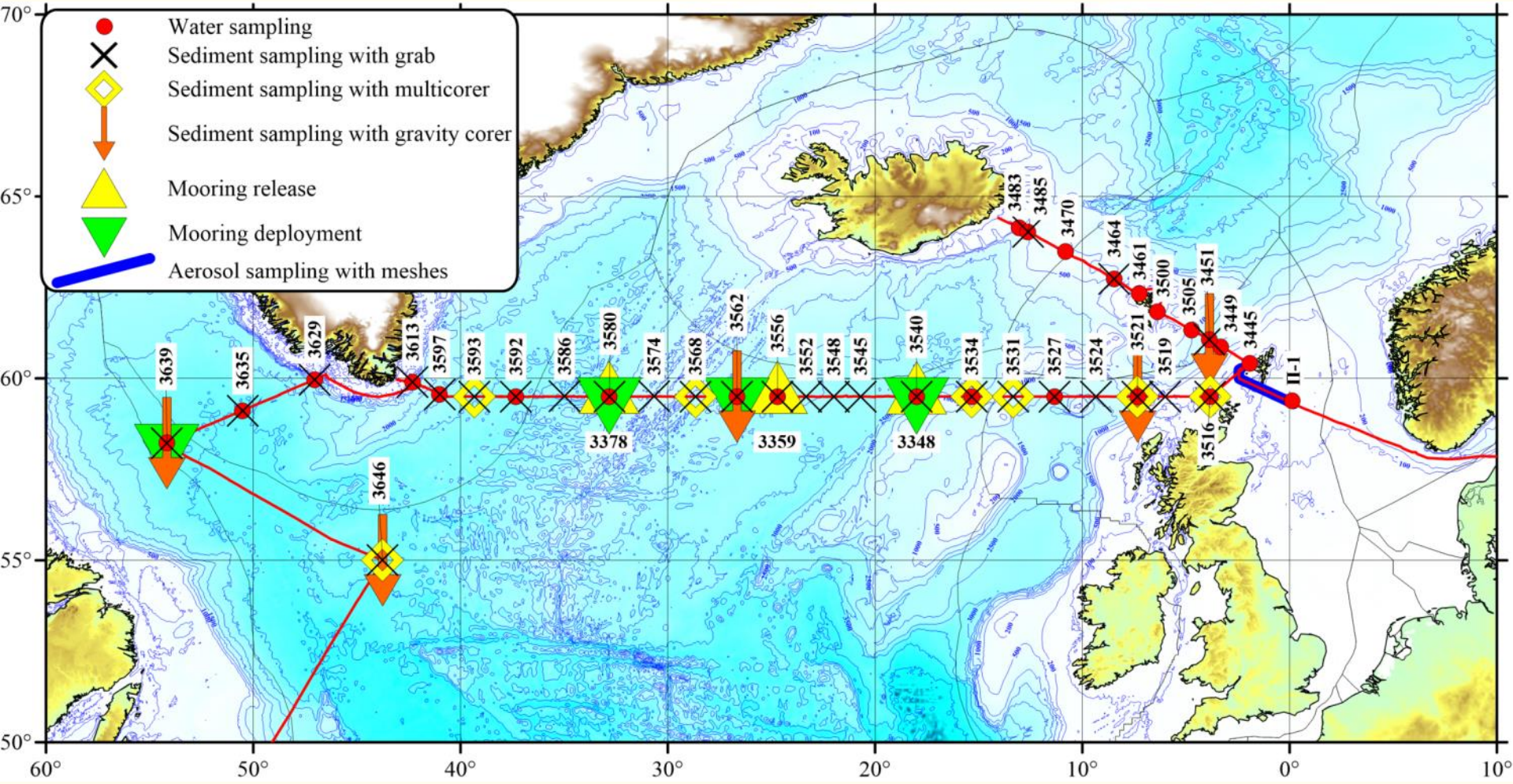
IO RAS cruise to the Barents Seaf rom August 25 to October 10, 2016: the 67th cruise RV *Academik Mstislav Keldysh*



- **The main objectives were modern sedimentation processes researches including biogeochemical studies of suspended particulate matter and bottom sediments**

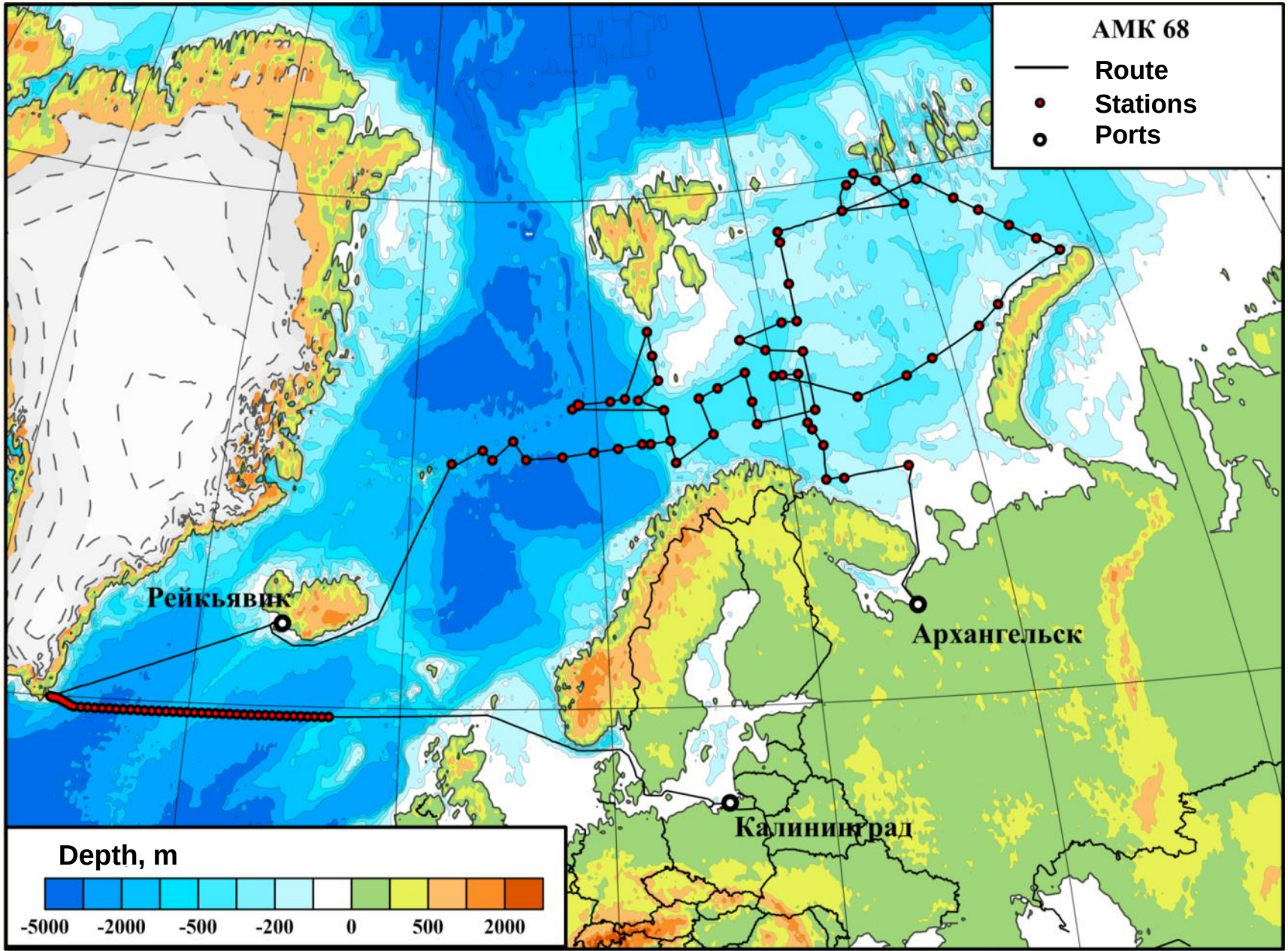
IO RAS cruise to the North Atlantic along 59°30'N: the 51th cruise of RV *Academik Ioffe*, June – July, 2016

- **We planed to collect sediment and pore water samples for joint trace element researches with Macquarie University (Australia) in the same expedition in June 2017. But the expedition was canceled.**

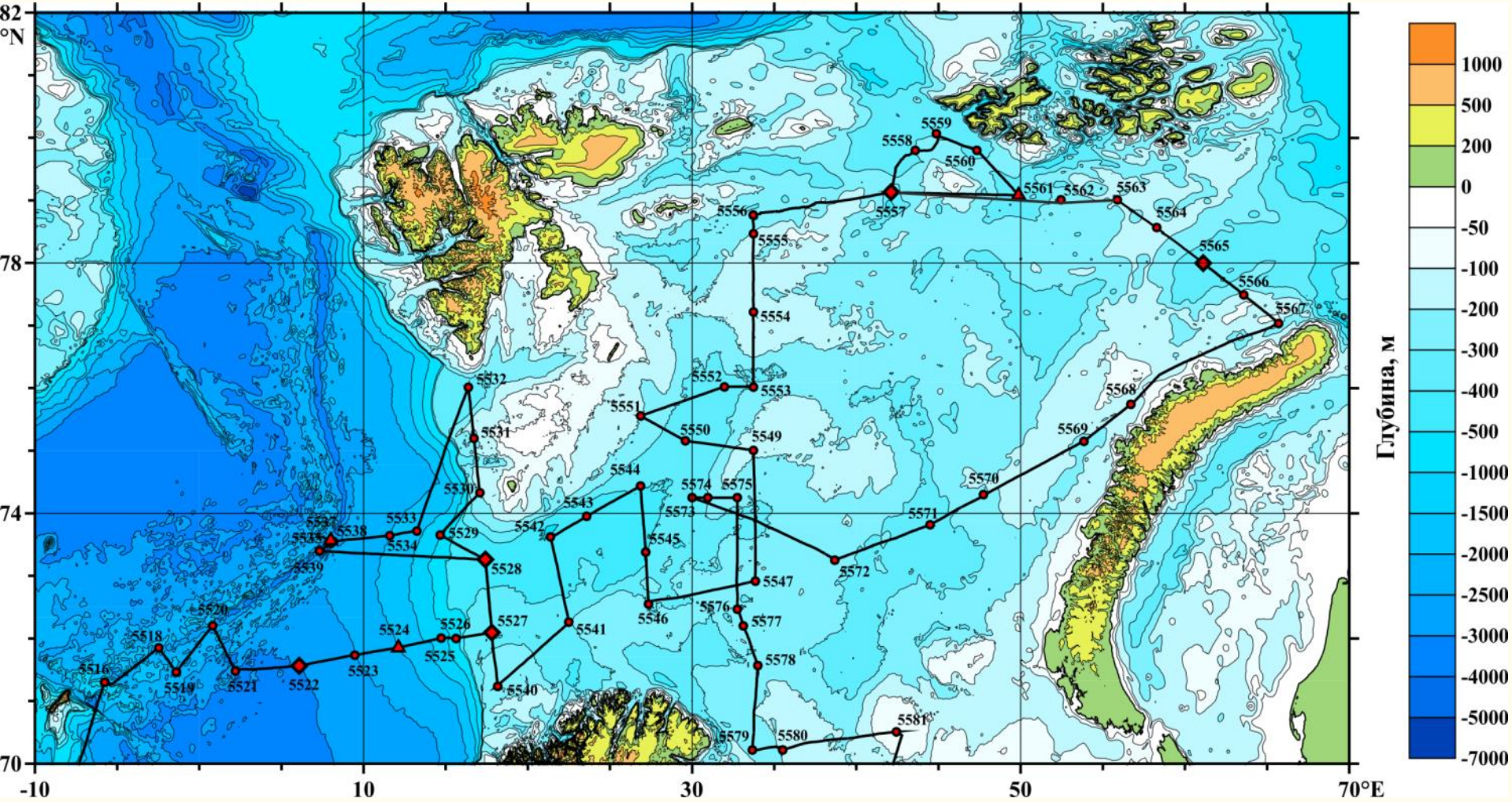


IO RAS cruise to the North Atlantic (along 59°30'N), Norwegian and Barents Seas

Route of the 68th cruise of RV *Academic Mstislav Keldysh,* June – August 2017



- **In the Barents Sea (the 68th cruise, 2017) we collected sea water and bottom sediments samples for joint trace element researches with our colleagues from the University of Southern Mississippi (USA).**



Thank you very much!

On the image is RV *Academic Mstislav Keldysh*
in the Kara Sea (Arctic Ocean), August 2016