

## **Effective studies of ice scouring in the Russian Arctic using parametric sub-bottom profiler SES-2000 standard**

**Dr. Oleg Levchenko**, et al.  
P.P. Shirshov Institute of Oceanology, Russia

### **Contact**

Address P.P. Shirshov Institute of Oceanology,  
Russian Academy of Science  
Moscow  
Russia

Website [www.ocean.ru](http://www.ocean.ru)

Email [olevs@rambler.ru](mailto:olevs@rambler.ru)

## Effective studies of ice scouring in the Russian Arctic using parametric sub-bottom profiler SES-2000 standard

O. Levchenko<sup>1</sup>, R. Ananyev<sup>1</sup>, V. Arkhipov<sup>2</sup>, N. Dmitrevskiy<sup>1</sup>

<sup>1</sup>P.P.Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow

<sup>2</sup>N.N. Zubov State Oceanographic Institute, Moscow

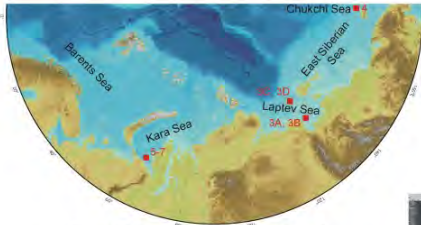
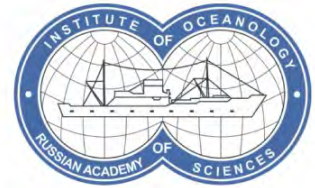


Fig. 1. The Russian Arctic. Location of pictures in Fig. 3-7 is shown by figures. (Bathymetric map from IBCAO)



Fig. 2. Installation of the "SES-2000 standard" and "Hydra" transducers on board of vessel.

In 2011-2012, P.P.Shirshov Institute of Oceanology has studied upper sediments' structure in the Russian Eastern Arctic (Laptev, East Siberian and Chukchi Seas) (Fig. 1) used echosounder & subbottom profiler "SES-2000 standard" and side-scan sonar "Hydra" (Fig. 2). Numerous furrows of various shapes and sizes were revealed in the sea floor at different water depths (Figs. 3 and 4). Their specific morphology with mounds on both sides, which is displayed distinctly in the SES pictures, evidences ice scouring origin.

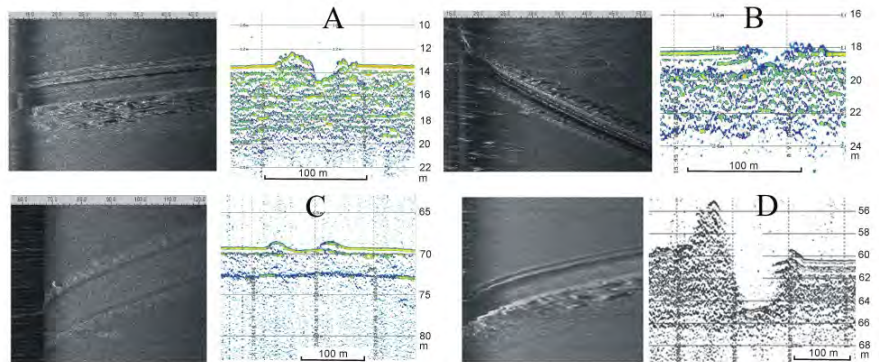


Fig. 3. Ice scouring furrows (ploughmarks) in the Laptev Sea: shallow-water and partly buried by recent sediments (A and B); deep-water with (C) and without (D) recent sediments filling (up to 4-5 m deep).

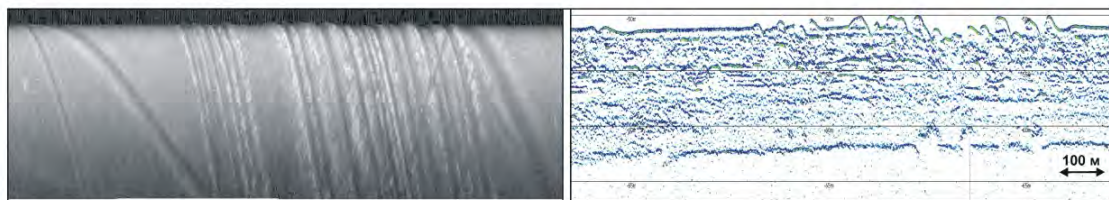


Fig. 4. Ice scouring furrows in the Chukchi Sea.

Recently in July-August 2015 were collected ~1500 miles of seismic profiles with "SES-2000 standard" in the Kara Sea, Western Russian Arctic (Fig. 1). Many overlapping different age ice-scours were identified here. Their vast majority has small size (up to tens meters) and depth (less 1 m) and is generating by drifting grounded ice hummocks (Fig. 5). Rare revealed scours up to total depth 6-7 m and 150 m wide were formed by floating icebergs (Figs. 6 and 7). They are expressed by about half in the bottom and half filled with sediments. The layered sedimentary filling of these large scours evidences their relatively ancient age. One of goals of the study is to determine how long ago the last episode of such icebergs scouring happened in this area.

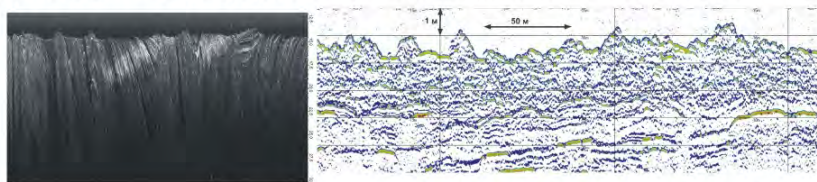


Fig. 5. The Kara Sea. Ice scouring furrows generated by drifting grounded ice hummocks.

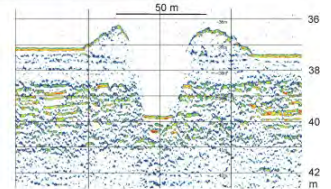


Fig. 6. The Kara Sea. Large ice scouring ploughmarks generated by floating iceberg.

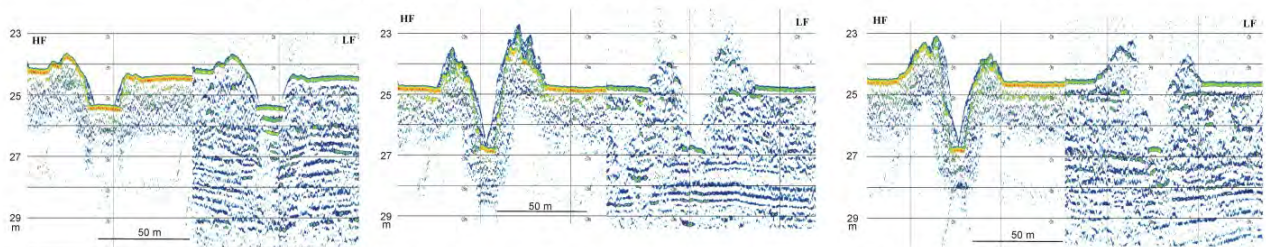


Fig. 7. Large ice scouring ploughmarks in the Kara sea: left HF- high frequency (100 kHz) and right LF- low frequency (8 kHz) channels.

Three-channel acoustic system "SES-2000 standard plus" (echosounder, profiler and side-scan sonar) would be very effective for the study of ice/iceberg scouring providing data on topography and acoustic image of the seabed as well structure of underlying sediments.