LITHOLOGICAL FEATURES OF BED SEDIMENTS IN THE NOTHERN PART OF THE LAPTEV SEA

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Currently, the Arctic shelf is of great scientific and practical interest. However, mineral resource development of the Arctic water areas is associated with high risks, such as specific environmental conditions, absence of the ground organization, and lack of experience in eliminating the impact of oil spill on the arctic system, insufficient shelf knowledge. During the organization and performance of the offshore drilling works, one more serious risk to be noticed is the gas-hydrates, which are not elucidated enough in our arctic seas. The Laptev Sea shelf is of primary concern from the perspective of hydrate presence [3]. The Laptev Sea is a submarine cryolithic zone [2], where the highly-energetic and multiple methane breaching [3, 4] (concentration up to 700 nM) in a form of flowing bubbles (known as plumes) was discovered. They rise from the bottom of the sea (from the depth of 60-110 m) through the water layer, and sometimes go up to the atmosphere. It is this depth interval in which the most significant thawing of the submarine cryolithic zone has been anticipated. Such an interval provides developing gas outlet through paths [4].

The facts of temperature jumps as compared to the past century (about 5^{o}C) [1], the highest coastal erosion rate, annual methane discharge, enormously intense, in contrast with the other objects, revealed ocean anomalies of the dissolved methane, including big gas plumes (up to 500 m in diameter) [2-4], have induced to perform a more detailed research.

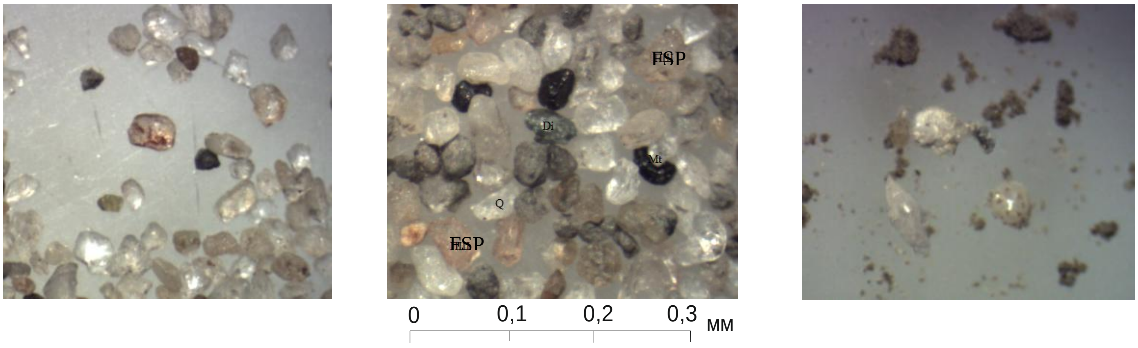
This study was carried out in TPU within the contract № 14.Z50.31.0012 dated as of May 19, 2014, named as “The global importance of the Siberian Arctic shelf as a source of greenhouse gases: quantitative flow assessment and identification of possible ecological and climatic consequences” supported by the Ministry of Education and Science of the Russian Federation.

24 bed-sediment (0-5 cm) samples were collected from the northern part of the Laptev Sea to assess particle-size distribution and mineralogical composition as well as to examine organic matter content. The study area was explored by the Russian and US scientists in September-October 2011 on the board of research vessel Academician Lavrentiev.

Particle size distribution was examined by laser diffraction method. Mineralogical analysis was carried out using a bimocular microscope to reveal the different mineral species within sandy and silt fraction. Organic matter content was determined in the sediments by the Rock Eval pyrolysis. The analysis was carried out at the Arctic Sea's Carbon Research International Laboratory, Tomsk Polytechnic University.

In terms of the granulometric composition, the fractions with dimensions from 0,01 mkm to 3,08 mm were obtained. The range of fractions consisted of predominant pellite fraction (<0,01 mm) with the content from 24 to 77%, aleurite (form 22 to 45%), and psammitic (from 0,3 to 47%) fractions are minor. Due to the classification of clastic sedimentary rocks, the samples were primarily represented in the form of aleuritic-clays, less frequently in the form of silty clays and sands. Using the granulometry data, the cumulative curves were built, the calculated sorting coefficient changed within the range of 1,18-3,65, which indicated the mean sorting ratio for aulerites' clastic material, and good sorting ratio for sands' clastic material.

Mineral analysis by physical method indicated the presence of quartz, feldspar, muscovite, biotite, garnet, and some of the other sediment minerals in sediment samples. Quartz and feldspars predominated in all samples. Quartz was the most common mineral which was found to be about 30-60% of total sediment, grains being colorless and transparent or translucent, ranging from rounded to angular. They were colorless and rarely included trace of hematite (fig.1, A).



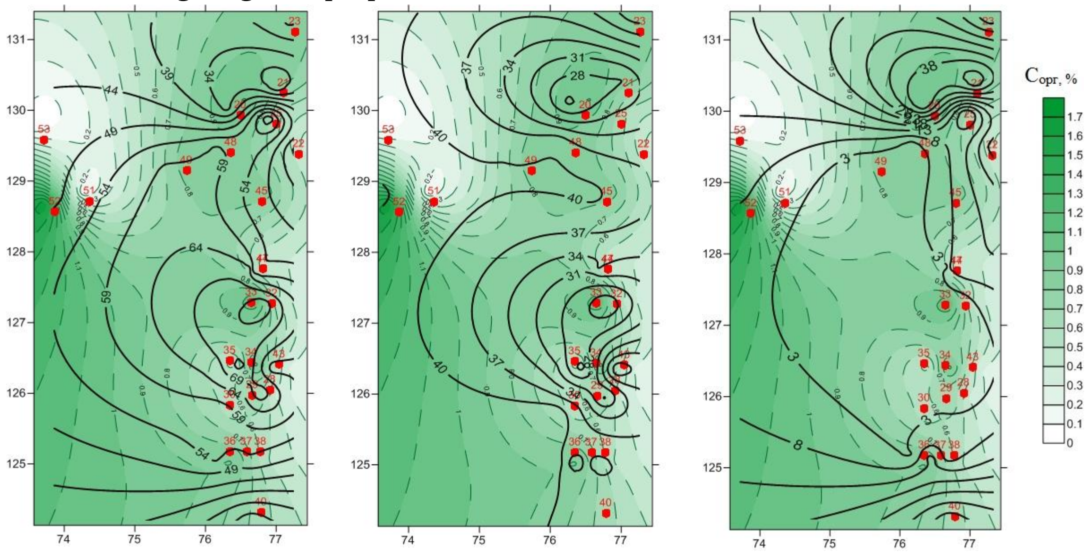
A) – The trace of hematite in quartz

B) – The grains of quartz (Q), feldspar (FSP), diopside (Di) and magnetite (Mt)

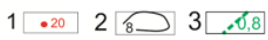
C) – The remains of clamshell of various forms

Fig.1 Features of the mineralogical composition of sands

Feldspar (25-35%) is elongated, translucent, colorless, gray, pink and pale yellow angular-rounded and angular fragments. Micas (biotite and muscovite) are found in small amounts (5-15%) in all samples. Carbonate minerals are presented by calcite brown siderite and are observed in samples No. 21, 22, 28, 30 in the amount of 10-15%. The magnetite (to 10%) is widespread among the ore minerals which has specific iron-black color and strong magnetic properties.



A) B) C)



Note: 1 – № of the samples; 2 – a) clay fraction content, %; b) silt fraction content, %; c) sand fraction content, %; 3 – organic carbon content (C_{org}), %.

Fig.2 Organic carbon distribution map

Accessory minerals (to 5%) are presented by epidoty, diopside, apatite, chlorite, and grenades. Also, there are carbonized vegetable fragments and the remains of clamshell of various forms (fig.1, B).

Organic substance study is the most important aspect of hydrochemical, hydrobiological and geological research, and organic carbon is its most presentable characteristic. In the studied sampling material the C_{org} content varies from 0,03 to 1,61%. The organic carbon distribution map is built to reveal the trends of C_{org} content and distribution in the surface of the north Laptev Sea's bottom sediments (fig.2).

Based on the obtained data, it has been found that depositions of pelitic sediments are inclined to the lower areas, whereas in contrast, the psammit depositions are limited to the shallow areas.

The concentration of north Laptev Sea's pelitic sediments with organic carbon is revealed. The probable reason of this process is the increased occlusion of C_{org} by fine pelitic fraction.

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NUMERICAL MODEL OF ATMOSPHERE MEDIUM WITH BLACK CARBON PARTICLES IN ARCTIC FOR DETERMINING OPTICAL RADIATION EXTINCTION

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Introduction

Nowadays, the problem of global warming and the melting of Arctic ice is given a large amount of attention. According to the estimations for year 2012, the volume of ice in Arctic has decreased by approximately 40% compared to the mean value for years 2007-2011 [5]. It is believed that black carbon is one of the highest contributors to the global warming effect. The black carbon is a component of the aerosol in atmospheric Arctic environment. Its particles can be transported by air masses for significant distances and often deposit within Arctic. Black carbon reduces the transmission of solar radiation and cause heating of the atmosphere. However, the behavior of the atmospheric black carbon particles have not been thoroughly researched yet.