

QUANTITATIVE MINERALOGY AND PARTICLE-SIZE DISTRIBUTION OF BED SEDIMENTS IN
THE NORTHERN PART OF THE LAPTEV SEA

M.Z. Kazhumukhanova

Scientific advisors associate professor T.G. Perevertaylo, associate professor I.A. Matveenko
National Research Tomsk Polytechnic University, Tomsk, Russia

The Arctic seabed is believed to contain a significant pool of organic carbon and methane (CH₄) preserved within and beneath the subsea permafrost, including permafrost-related and continental slope CH₄ hydrates [1 – 3]. Sustained CH₄ release to the atmosphere from thawing Arctic permafrost and dissociating hydrates are suggested to be positive and likely to be significant feedbacks to climate warming [4].

The former area is chosen as representative of the outer shelf, where permafrost thawing is suggested to be largely complete based on modelling results [1, 2].

24 bed-sediment (0-5 cm) samples were collected from the northern part of the Laptev Sea to assess particle-size distribution, 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 performed by laser diffraction method. Mineralogical analysis was carried out using a binocular 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.

According to the classification of sedimentary rocks, samples were mainly silty clays and sands well sorted in terms of detritus.

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 is 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 are colorless and rarely include trace of hematite. Feldspar (25-35%) is elongated, translucent, colorless, gray, pink and pale yellow angular-rounded and angular fragments. Micas (biotite and muscovite) is 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. Accessory minerals (to 5%) are presented by epidoty, diopside, apatite, chlorite, and grenades. Also there is a presence of carbonized vegetable fragments and the remains of clamshell of various forms.

According to information received by the study, the relation between water depth and grain size distribution has been established: clay sediments tend to the most low-lying areas, whereas sands, on the contrary, are confined by the shallow part (Fig.).

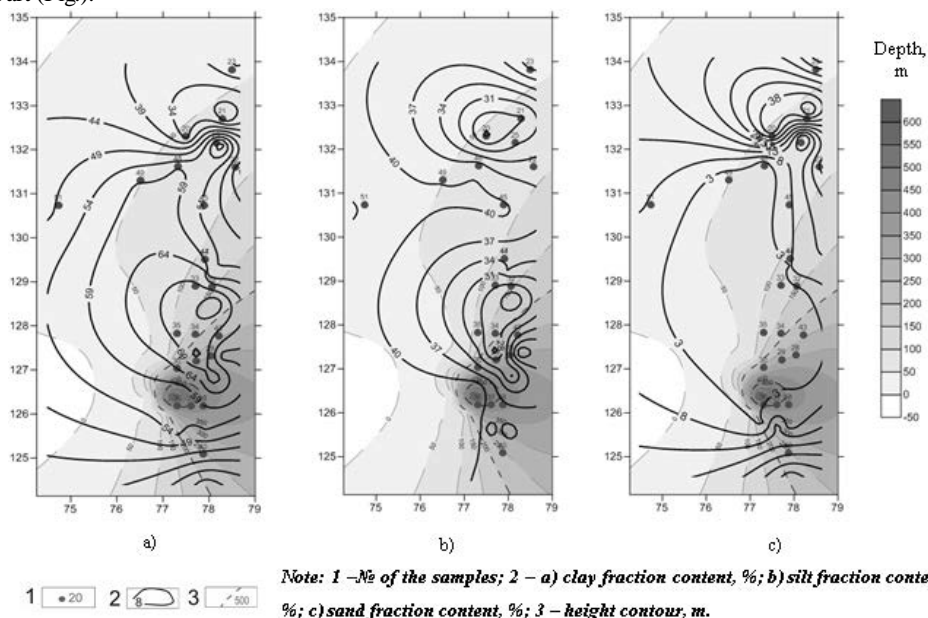


Fig. Organic carbon distribution map

To identify organic carbon content and distribution pattern of organic carbon, the distribution map was constructed which allowed us to estimate a relative enrichment with C_{org} in clay sediments of the northern part of the Laptev Sea. The correlation between organic carbon and sediment granulometry can be partly explained by the sorption of organic carbon by the thin clay fraction.

References

1. Большианов Д.Ю., Григорьев М.Н., Шнайдер А.С. и др. Колебания уровня моря и формирование ледового комплекса пород на побережье моря Лаптевых в позднем плейстоцене // Система моря Лаптевых и прилегающих морей Арктики: современное состояние и история развития. М.: Изд-во Моск. ун-та, 2009. С. 349–356.
2. Романовский Н.Н., Хуббертен Х.В. Формирование и эволюция криолитозоны шельфа и приморских низменностей (на примере региона моря Лаптевых) // Изв. РАН. Сер.геогр., 2001, № 3, с. 15–28.
3. Шахова Н.Е., Сергиенко В.И., Семилетов И.П. Вклад Восточно-Сибирского шельфа в современный цикл метана // Вестник РАН. - 2009. Т. 79, № 6. - С.507-518.
4. Rachold V. Near-shore arctic subsea permafrost in transition/ D.Y. Bolshiyarov [et al.] // Eos. - 2007. - V. 88, No. 13. - P.149-156.

FORMATION CONDITIONS AND COMPOSITION OF MAGMATIC ROCKS**D.A. Khramov**

Scientific advisor senior teacher R.S. Fediuk

Far Eastern Federal University, Vladivostok, Russia

Magmatic rocks are widely used in building material industry now [1-2].

Currently, geological processes associated with magma activity and its products are referred to as magmatism [3]. Magma is a substantially ion silicate and aluminosilicate melt occurring in the upper mantle and the crust with a quasicrystalline structure and complex subtaxic (or swarm) structure. Due to the substantially oxygen base, structural position, shape, motility and acid-base properties of the components in silicate melts are mainly determined by nature and binding energy with oxygen, which can be characterized qualitatively - the value of ionic potential and quantitatively - the value of the binding energy [4]. Acidic melts have elements having a large ionic potential (6 or more) and oxygen binding energy (60 kcal / g atom on one bond). These elements adjoin oxygen to form a melt with various complex anions significant shares covalent bond and have high polarization due to the ability to form polymeric anionic groups. Typical representatives of such elements are silicon, phosphorus, boron and others.

The main properties of melt are characterized by elements with low ionic potential (at least 3) and low binding energy with oxygen (5-30 kcal / g atom per bond). They form in the melt free (or complex) cations; for example, potassium, sodium, calcium, magnesium and others.

Amphoteric properties are elements having an intermediate value of ionic potentials and binding energy with oxygen 40-60 kcal / g · atom on one bond. Depending on the overall melt acidity they manifest themselves as acidic or basic components. These include aluminum, ferric iron, chrome, etc. Oxygen, sulfur, chlorine, fluorine, hydroxyl group and those close to them melt components are characterized by high polarizability. It increases with the radius and ionic charge. These components are present in the melt in the form of complex and simple anions.

The energy relations of the various cations nonequivalence with oxygen lead to the fact that the structure of quasi-crystal skeleton melt is stronger ordered silicon-oxygen groups polarized depending on the acidity of the melt (proximal structure). Long-range order in relation to the core melt structure exhibits the major components. Moreover, the degree of order in the "long-structure" increases with the binding energy in the cations with the oxygen core.

Based on the foregoing, we can say that the magma is a complex heterogeneous melt, occurring in geologically active parts of the Earth's crust and upper mantle, consisting of refractory and volatile components. This is ion-electron microheterogeneous fluid, sometimes with an ordered (clustered) structure, which is characterized by complex silicate and aluminosilicate anions such as $[\text{SiO}_4]^{4-}$, $[\text{AlO}_4]^{5-}$, $[\text{AlSi}_2\text{O}_6]$ - and other groups consisting of Mg^{2+} , Ca^{2+} , Na^+ , K^+ and other cations oxygen forming octahedra. That is, the magma is composed mainly of fragments of the polymer chains of silicate and aluminosilicate anions, whose number and relative molecular mass depend on the temperature. Water and gaseous components have great influence on the polymerization.

There is no consensus about the sources of magma. It is believed that the ultrabasic magma and the basic structure is formed in the upper mantle and basalt layer of the Earth, and acidic one- in the granite-metamorphic layer of the Earth's crust. It is believed that the granitoid magma is the product of differentiation of mantle material.

Temperature streamed magma (lava) forms at 900-1200 ° C, at least up to 1350 ° C; intrusive - 700-1100 ° C.

The composition and properties of igneous rocks depends on the composition and the degree of melting of source rocks, participation and composition of the fluid, the thermodynamic conditions in the melting and cooling, as well as the processes of differentiation and assimilation.

Differentiation, i.e. the division of the original magma melts of different composition, is due to the different physical and chemical phenomena.

Segregation is separation of the parent melt into two immiscible liquids. One of them, rich in silica, alkali, volatile components, respectively, lighter - occupies the top position. The other - more serious - accumulates at the bottom.

Crystallization, gravitational differentiation presents legitimate sequence of rock-forming minerals crystallizing from the melt: first refractory and fusible then.

As magma moves, it often melts and absorbs the surrounding rocks, thereby altering its composition. Rarely, but still there are cases of mixing of two magmas with different properties; which results in the formation of a hybrid composition of rocks.