Using a microscope it is possible to clearly observe hypidiomorphic dioritic composition in the analysed thin sections. Idiomorphism series is well expressed; one can detect wide tabular crystals of plagioclase, hornblende, which are interlayered with xenomorphic quartz grains filling irregular sections between older rock minerals.

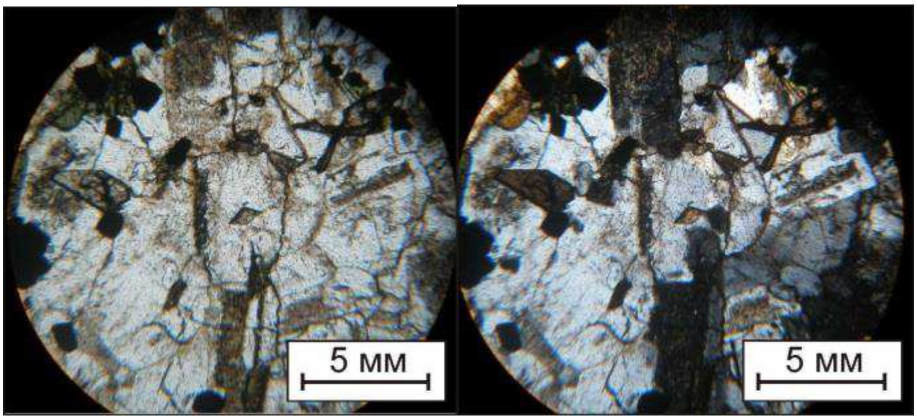

***Fig. 3 Thin section sample № 2. Wedge*-shaped sphene inclusion in plagioclase crystals observed using light (left) and dark-field microscopy (right)**

The rock consists of plagioclase - andesite (50%), in smaller quantities there is normal hornblende (30%), quartz (10%). The percentage (about 10%) of ore mineral (as may be supposed magnetite (10%)) and accessory minerals like sphene is noticeably high.

In the samples studied in the reflected light there are inclusions of ore mineral - magnetite which have regular isometric octahedral shape. The clusters of grains frequently form aggregates up to 1-2 mm. In particular cases, the decay structure represented by hematite plates can be observed in magnetite.

The analysis of ΔT isodynams plan of the survey area makes it possible to draw a number of conclusions. The most intense anomalous zone has a relatively small area of about 400 m2, sublatitudinal distribution and it is located in the western part of the study area. Based on the assumption that there is one anomalous body, one can conclude that it has a steep dip. This conclusion is based on the spatial proximity of the anomalous field extremum points. The closer they are, the steeper the dip angle of the body provided that there is on-dip magnetization.

Taking into consideration the spatial location, both positive and negative values may indicate that the zone of ore mineralization occurs at a certain angle to the surface. The dip angle of ore mineralization area depends on the extreme values of induction, particularly in-between angle and in this case it is approximately equal to 50^0 (maximum dip angle). Furthermore, the observation of isodynams can reveal that the zone of ore mineral intrusion is more likely to have a plate-like shape. This is indicated by the position of local extreme isodynam values on the plan. Punching of ore minerals resulted most probably from contact metasomatism, which confirms the fact that the analyzed diorite outcrop is close to a granitic intrusion.

Thus, the magnetic field anomaly is caused by magnetite mineralization. The investigation permitted to determine the approximate angle of dip of ore formation and peculiarities of ore mineralization occurrence.

The further research in the laboratory would be devoted to the analysis of physical parameters of samples that will give information about the exact angle of dip and uniformity of mineralization, as well as about the nature of the studied anomalies in general.

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COMPUTATION OF STRESSEDLY-DEFORMED SECTORS OF A PIPELINE IN THE PROCESS OF LAYING ON THE SEABED

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Nowadays the main promising exploitations of oil and gas fields in the Russian Federation are carried out in the northern seas. Due to the depletion of the known land deposits and a growing need in the oil and gas offshore exploitations are intensified and the amount of produced oil and gas is rising up. That point is proved by statistics data of 2012: almost 30 % of oil and gas in the world is extruded from the sea [1].

It is known that the Russian Federation has a long northern seas boundary and a huge amount of Arctic lands, so it gives a reason for the northern seas oil and gas fields development. But the question that should be raised is concerned with the transportation of crude oil to the downstream companies. It goes without saying that pipeline transportation is one of the most efficient methods to deliver oil and gas, but construction and exploitation of marine oil and gas pipelines are a challenging engineering task, which involves computation of a local contortion of pipelines. It could be stated, that the contortion is the main criteria of the pipeline productivity. This statement stipulates the relevance of the article.

The objective of the article is to perform a precise and comprehensive computation of a stressedly-deformed marine pipeline. In order to fulfill this objective the following tasks are set: to study building standards and development requirements; to perform a test computation of pipeline contortion and whipping during its laying on the seabed by S-formed trajectory using software package Ansys 14; to analyze obtained data; to compare data obtained with standard figures.

It is a fact, that the local contortion is irreversible waste of pipeline carrying capacity as a result of a combination of external factors, which include torsional moment, tensile longitudinal load and ambient pressure (hydrostatic pressure of the sea water). In this case, empirical evaluation of the pipeline stability is expressed by the following criterion equation [3]:

$$f\left(\frac{p}{p_0},\frac{M}{M_0},\frac{N}{N_0}\right)=1 \qquad (1)$$

where p (M, N) stands for ambient pressure (torsional moment, tensile longitudinal load);

p_c(M_c, N_c) – maximum allowed ambient pressure (torsional moment, tensile longitudinal load);

f – a functional dependence.

Russian standards ВН 39-1.9-005-98 (construction of marine pipelines) and Gazprom Company Standard 2-3.7-050-2006 (DNV-OS-F101 Submarine Pipeline Systems) are examined in the given article. Besides, there are such documents as British standard BS 8010 (part 3) and Norwegian Det Norske Veritas (DNV) OS-F101 in other countries. The main differences are discussed in the articles of Burkov, Protsenko and Gorochov [3].

According to the documents of the Russian Federation [2, 4] the following criteria are essential and sufficient conditions for blocking of the process of local contortion of pipelines:

$$\frac{p_0}{p_c}+\frac{\varepsilon_0}{\varepsilon_c}\le 1; \qquad (2)$$

where ε_0 - flexural strain, appearing during placing of pipelines on the sea floor, according to Russian standards [3], on the depth above 1000 meters flexural strain should be less than 0.015% (0.0015); on the depth bellow 1000 meters this strain is reckoned to be 0.4%;

$\varepsilon_c=\dfrac{\delta}{2D_e}$ – critical flexural strain, casing contortion in the result of “clear’ pipeline bending;

D_e – exterior pipeline diameter;

$p_c=\dfrac{p_e\times p_y}{\sqrt{{p_e}^2+{p_y}^2}}$ – average pressure.

The pipeline system Blue Flow was taken as an example for the computation and its characteristics are as follows: diameter is 610 mm, the thickness of the pipeline – 31.8 mm, maximum hydrostatic pressure – 21.17 MPa (because of the Black sea depth – 2150 meter), material liquid limit – 580 N/mm^2, temporary fracture strength – 590 N/mm^2.

The calculation situation is the location of the pipeline by means of pipe-laying vessel. The trajectory of the pipeline is S-formed. There is no axis translocating, active powers are gravitation, underwater pressure and the power of the basin conterpressure at the bottom of the Black sea.

The method used for computing is a finite difference method, which is used for the calculation and determination of the dangerous zones.

Figure 1,2 show zones with the biggest stress: joint weld and small area, that is located near it; “movement limiter” – usually holdfast anchors are used as “movement limiter” in order to stop the transporting of the pipeline system and to fix pipeline to the ocean or seabed.

Figure 3 gives a clear view of the hardly stressed zone, where double margin of safety is provided.

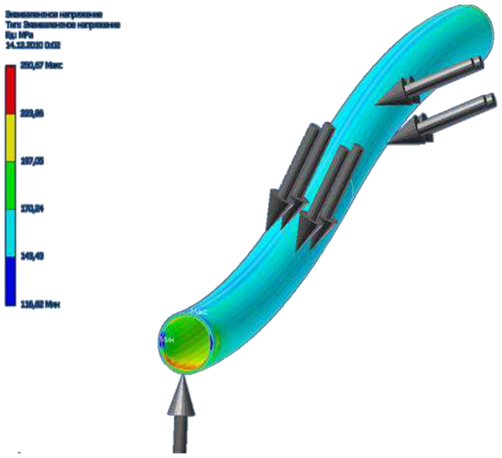

Fig. 1 Pipeline stresses

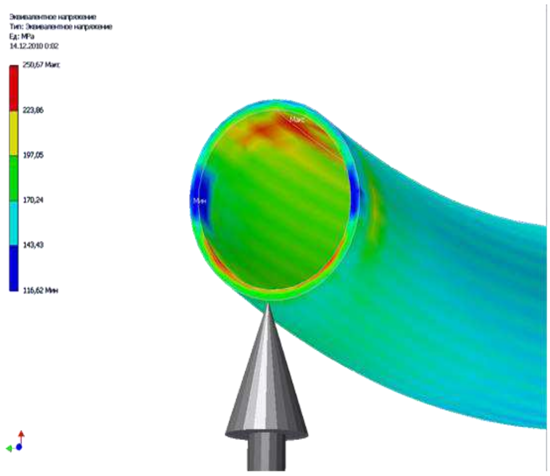

Fig. 2 Welded seam stress

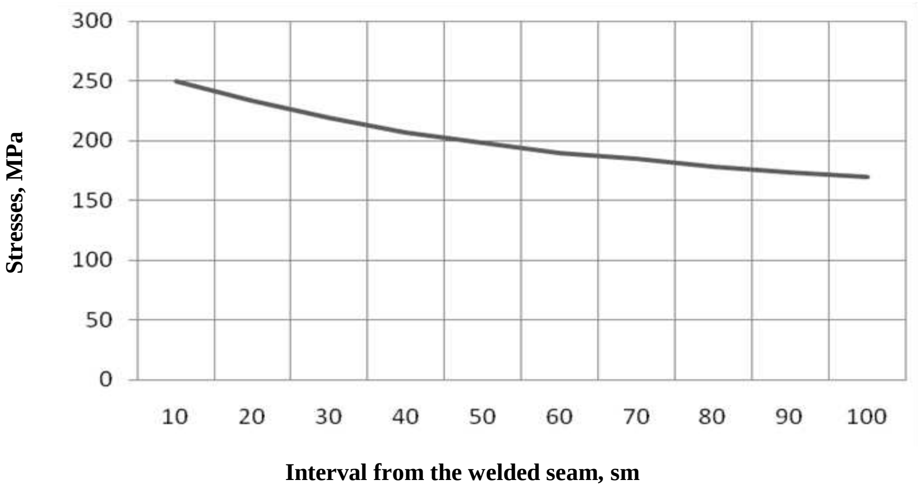

Fig. 3 Stress spreading in the welded seam zone

To sum it up, aforementioned tasks were carried out: functioning building and exploitation standards are studied; the test computation of pipeline contortion and whipping during its laying on the seabed with S-formed trajectory using software package Ansys 14 Workbench were performed; the analysis of the data obtained was carried out. It should be mentioned that Ansys 14 Workbench did not make it possible to compare the obtained data with a standard figures due to the absence of the needed option. It means that the situation, when the pipeline system is accessed by the software, is not authorized according to the Russian Federation standards. That is why a false sense of safety could be developed. Thus, the question about further scientific research results arises.

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