

# New Approach to the Development of Gas Hydrate Accumulations Located at the Bottom of the Seas and Oceans

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## ABSTRACT

Nowadays fundamental scientific researches and practical works are carried out worldwide to identify and use alternative sources and resources of energy carriers in place of oil and gas. In the world practice, to date, there are no technologies and technology for the development of gas hydrate accumulations and gas hydrate deposits located at the bottom of the seas and oceans. In this article, some methods of possible drilling of conditional wells are being discussed, that is, the creation of gas-hydrodynamic channels for lifting gas through the water column and decomposition of gas hydrates inside gas-hydrate clusters-strata. The possibility of creating double-barrel horizontal wells for supplying the heat carrier and inhibitor to the bottom hole zone for fracturing the gas hydrate and producing gas by a single well is considered.

**Key words:** horizontal wells, gas-hydrate, temperature, pressure, packer

## PRELIMINARY

At present, fundamental scientific research and practical work is being carried out worldwide to identify and use alternative sources and resources of energy carriers in place of oil and gas. It is already known [1, 3, and 5] that one of such sources is hydrocarbons accumulated at the bottom of the seas and oceans in the gas hydrate state.

These accumulations exist as placers on the surface of the bottom, and in the form of a layer immersed to a certain depth of the interior, forming both a layer and a horizon like oil strata. The surface of such strata may be covered with mud or it represents elevations on the seabed. Basically, the roof of these clusters is the thickness of water, which creates pressure, and the temperature of the seabed corresponds to the conditions of formation and conservation of the gas hydrate state. It should be noted that gas hydrates by their origin and formation can be called organic, that is, formed during the decomposition of flora and fauna of benthic organisms and the migration of gas from the bowels of the earth in the direction from deposits deep from the bottom of the oceans.

Hydrates of organic origin are scattered on this surface, and the hydrates formed due to migration create gas hydrate-bearing strata at certain depths of the earth's interior from the ocean floor. Migration of gas from the depth of the earth occurs naturally due to the filtration of gas along the overlying permeable rocks and the created filtration channels along tectonic disturbances in the bowels of the earth. Here it is impossible not to mention the processes of



eruption of volcanoes, which also create conditions for the movement of gas from the depths of the earth to the surface of the seabed. It is pertinent to note that numerous exploration and exploration work has been carried out and carried out in many geographic areas to drill wells to discover oil and gas deposits.

## LITERATURE REVIEW

These wells also create channels for gas filtration from the underlying seams to the seafloor. It is known that the change in the aggregate state of substances is mainly due to a sudden change in conditions.

Considering the migration of gas from the depths of the interior and comparing the temperature change in the ground and sea water, a broken curve is obtained, that is, a jump in the temperature change. This phenomenon is described in [3, 5], the formation of hydrate at the contact water-air. It is also possible to explain the formation of the hydrate at the contact of the transition of the intermediate strata of the earth at the bottom of the ocean and water.

It should be noted that the kinetics of hydrate formation is based on the theory of the mechanism of nucleation of nuclei (nuclei) of crystallization and their growth in a porous medium filled with water, that is, in these soils is extremely small. Carried out experimental work in the Gubkin RSU of Oil and Gas in installations with imitation of a water-saturated porous medium helped to establish the positive effect of the porous medium on the hydrate formation process.

Therefore, it can be judged that when gas migrates from the depths of the earth, gas, when water-saturated bottom rocks of a water basin pass, hydrate formation already takes place and a roof is created for the accumulation of hydrates directly in rocks lying at a rather deep depth in the ground. In some cases, clusters - "deposits" -gas hydrates can form deposits of a gorgeous species that formed on the crater of mud volcanoes. Dimensions of such formations 2.5-4 km in diameter, 75-180 m in height and conical in appearance, are located on the Caspian Sea at a depth of 500-600 meters. Such clusters include "Buzdag", "Elm" and "Abykh" [2].

## RESEARCH METHODS

In the world practice, to date, there are no technologies and technology for the development of gas hydrate accumulations and gas hydrate deposits located at the bottom of the seas and oceans. The only development and operation of the gas hydrate deposit is in Russia at the Messoyakh field, which lies at a depth of 800-900 meters with a 450-meter thick production layer, with a reservoir pressure of 78 kgf / cm<sup>2</sup> and a temperature of 10 ° C. The deposit is located in the perennial permafrost zone of the Earth's crust.

Similar deposits are also located in Canada. In these deposits, unlike the deposits located in the water area of the seas and oceans, the roof is a sealed earth crust. On the deposits located in the seas and oceans, the role of the roof is played by the water column, which cannot provide tightness both in the drilling processes and in the processes of their development and operation.

As noted above, the gas hydrates at the bottom of the seas can be in a state of placers along the surface of the bottom, deepened into the bowels of the earth and in a gorgeous shape. Surface placers of hydrates are attempted to be loaded into containers and ships where the hydrate is decomposed with the collection and use of gas. The development of hydrate deposits on land in



the bowels of the earth is not particularly difficult, since they are sealed by an impenetrable roof consisting of overlying rocks, for example the Messoyakh field.

In this article, some methods of possible drilling of conditional wells are being discussed, that is, the creation of gas-hydrodynamic channels for lifting gas through the water column and decomposition of gas hydrates inside gas-hydrate clusters-strata.

## RESEARCH RESULTS AND DISCUSSION

One of the main problems is that a slight increase in temperature, as well as a decrease in pressure, lead to the destruction of gas hydrates, that is, the gas is freed from the hydrate cell and, due to its smaller specific gravity; it tends to rise to the surface through the water column of the seas and oceans.

Therefore, when access to these accumulations - “drilling” and creating a gas-dynamic channel - wells, strict maintenance of design pressure and temperature is required, preventing the spontaneous decomposition of gas hydrates and the advance of gas through the water column to the surface (Fig. 1).

Consequently, under these conditions, firstly, by drilling a well, it is necessary to form a focus decomposition of the gas hydrate at a certain depth of the reservoir, without failing to observe the tightness between the well and the gas-hydrate layer. Here it is meant to preserve the contact surface of the clusters with water, so that this cluster surface functions as an impenetrable roof. Further, in the source - bottomhole zone - conditions are created for the destruction of hydrate by various methods.

These methods are mainly reduced pressure, increased temperature and the use of various inhibitors.

It should be noted that decomposition of gas hydrates produces gas and water. Consequently, in the selection of gas, it is also necessary to remove water from the source of the decomposition of hydrates, that is, from the bottomhole zone. In actual conditions, the products of the decomposition of gas hydrates in addition to gas and water are also mechanical impurities - granules of a porous medium. If possible, they should also be extracted from the source of decomposition of gas hydrates. It should be noted that the gas hydrate deposits of the Caspian Sea are at a depth of more than 300 meters below the water column, and here, usually, a semi-submersible installation is used for drilling wells.

Therefore, having extensive experience of drilling wells in the shelf part of the Caspian Sea, the use of such facilities will, to some extent, solve our problem associated with the development of gas hydrate deposits.

One of the main tasks, as mentioned above, is to keep the temperature in the drilling process, which should remain constant. To this end, we propose a method, as shown in (fig. 1,3,2) to drill a well using a screw, which allows you to raise sludge from the bottom of the sea without washing (fig. 1, 2). To remove this slurry, the method was used, which is shown in (fig. 3) which is “raise sludge from the well, which can be filled with sea water, accumulates in the SCM, and there, using the mud pump, the RMR rises to the surface”. at the bottom, where the drilling is supposed to go down the bottom plate, in the middle of which there is an opening for the passage of the column and bit (Figure1).



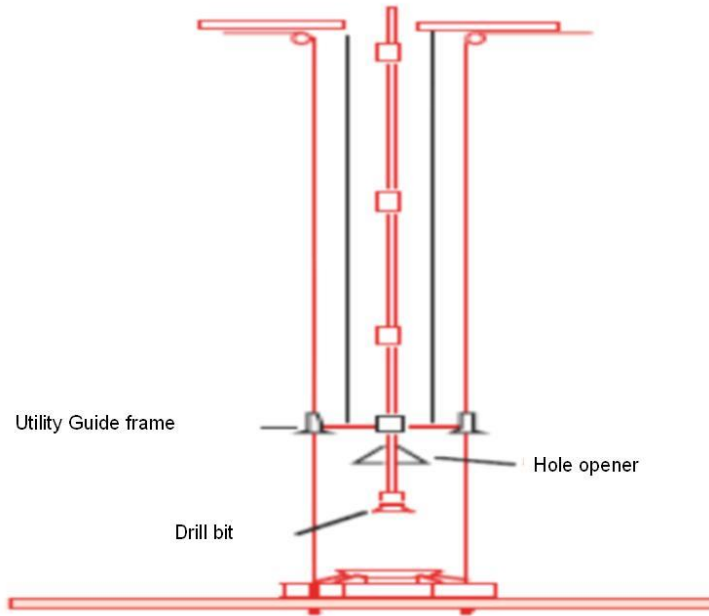


Figure 1. The scheme of drilling wells in the sea under the direction (conductor)

To open the channel, unlike conventional drilling, a screw is installed in the arrangement of the corresponding interval in the lower part after the bit (Fig. 2). The chisel drills a layer of gas hydrate - ground formation, and the auger helps to lift the sludge to the bottom of the sea. In this case, the temperature remains unchanged. Removal of the sludge is carried out by auger and here it is possible to use RMR Typical System View-Floater Well system successfully used in Azerbaijan during drilling on the Caspian Sea shelf for collection, removal from the wellhead and rising to the sea surface (Fig. 3).

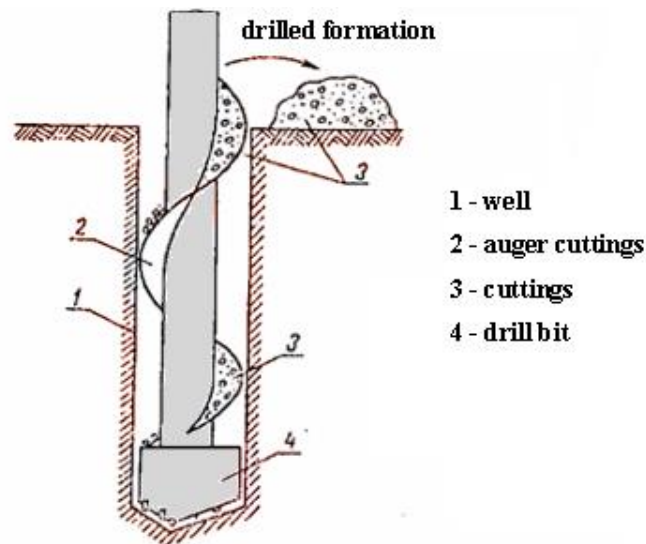


Figure 2. The proposed scheme of drilling wells under the direction (conductor)



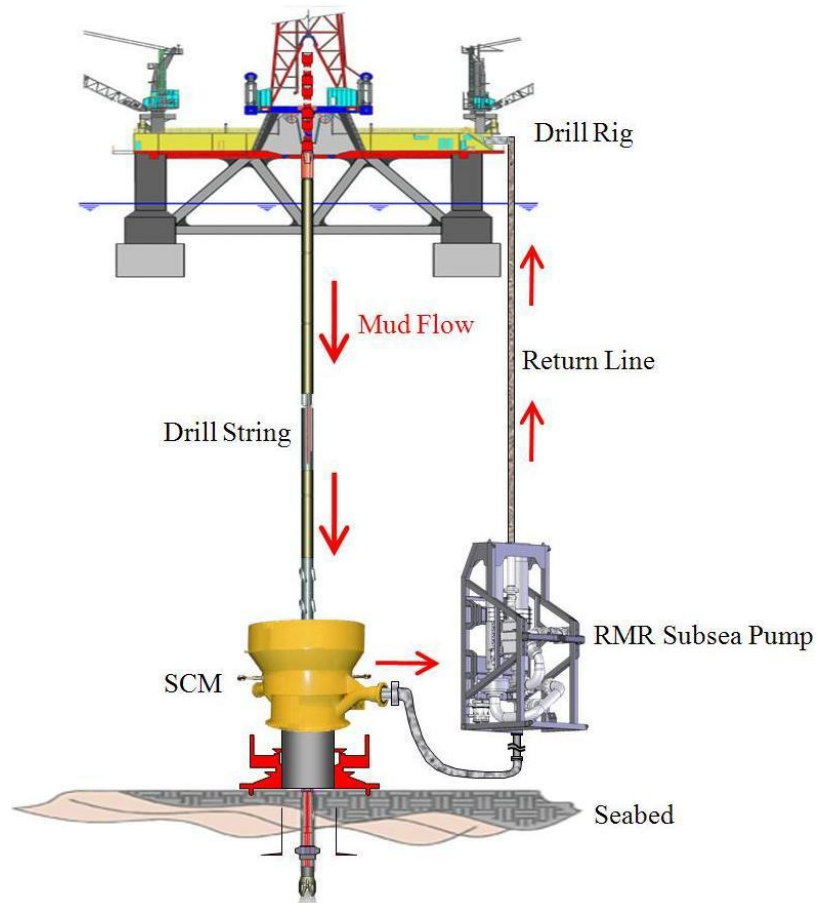
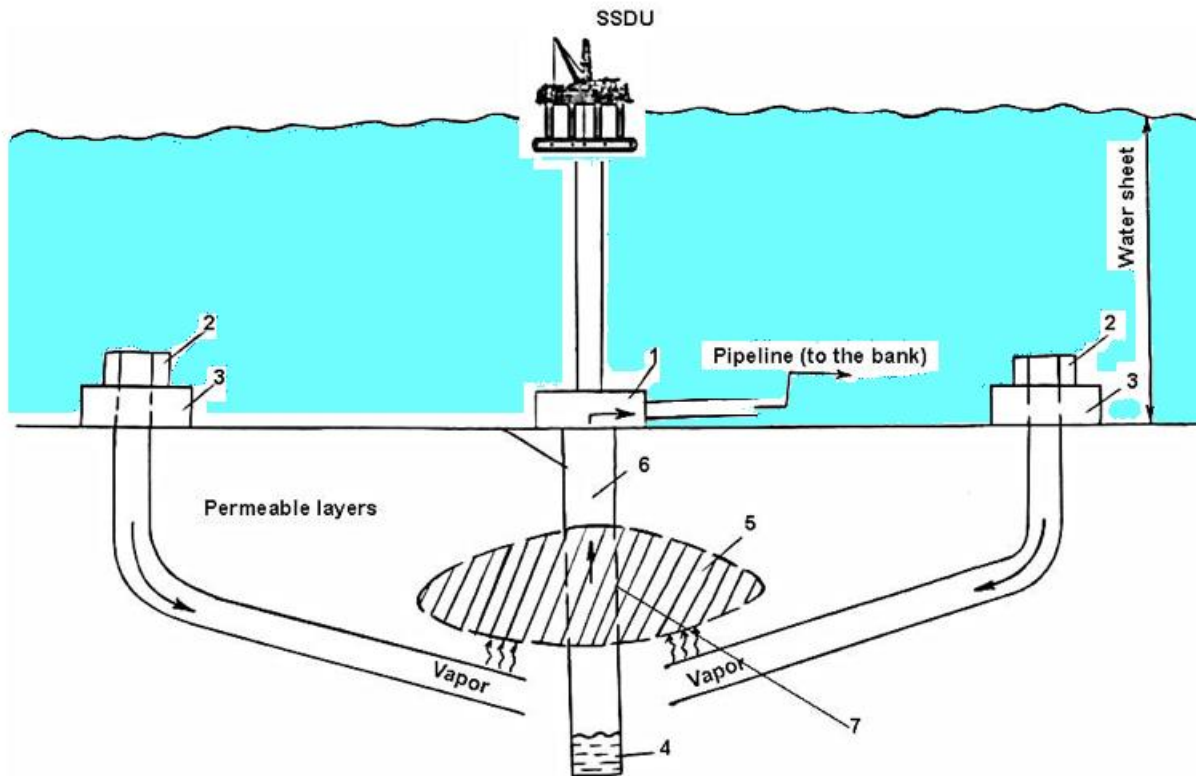


Figure 3. Schematic drawing of cuttings circulation on the surface

Drilling a well with this method to a certain depth, a column with a minimum thermal conductivity descends; further drilling of the well is carried out in the usual way, that is, with washing. After the completion of the construction of the gas-hydrodynamic channel - wells, it is possible to start drilling horizontal and horizontal trunks along the structure of the reservoir. Drilling of directional wells is desirable, if possible, carried out in the lower part of the deposit in order to maintain an impenetrable roof in the decomposition zone of the gas hydrate, as shown in Fig. 4.



1-Wellhead equipment; 2-heat carrier; 3-wellhead equipment; 4-water; 5—gas hydrate; 6-gas; 7-slotted casing (screen)

Figure 4. Proposed scheme for gas production from gas hydrate deposits at the bottom of the sea and oceans

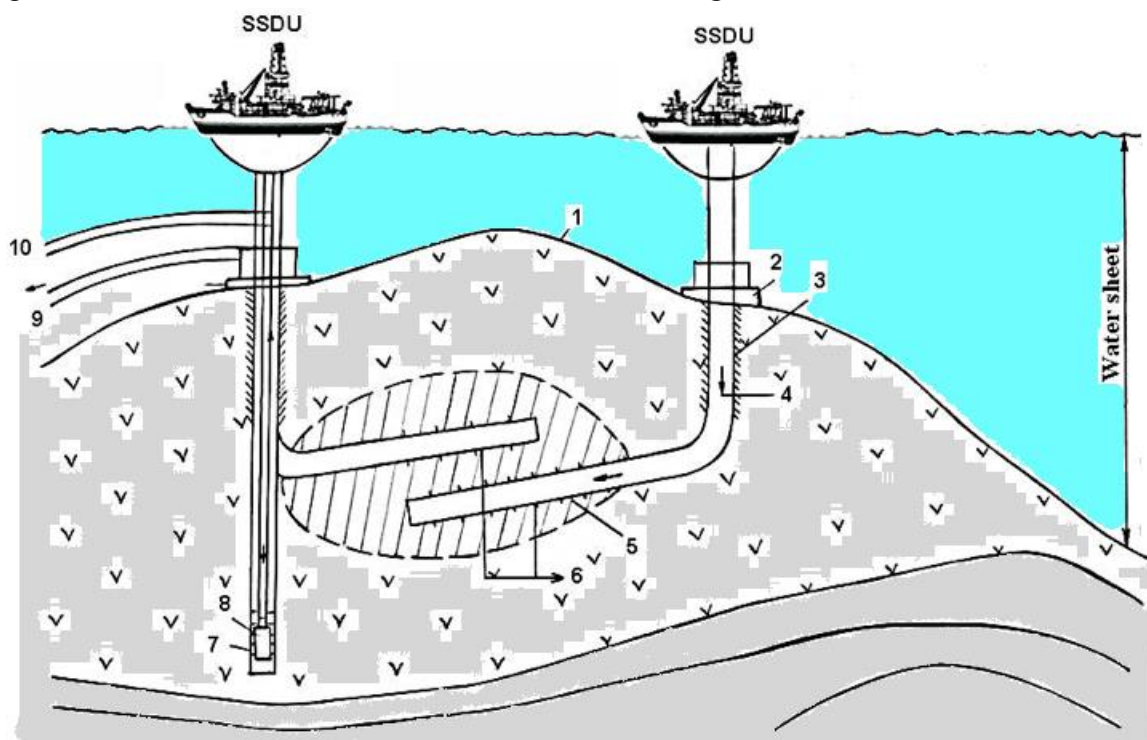
In view of the fact that in the first part of the article we considered the case of gas production from gas hydrate deposits located at a shallow depth from the seabed (fig. 1, 2, 3, 4), the need for the column at the time of drilling under the direction (as they usually do) there is no need.

Later, after drilling, the column is lowered to the appropriate depth; the filter is in the lower part of it (column with holes - Fig. 4). Subsequently, the gas hydrate accumulations are heated by hot steam through the drilled horizontal inclined wells (Fig. 4), gas is separated from the water (In order to separate methane from water, open well completion will be applied). At the same time, gas rushes towards the wells and, passing through the filter, rises to the top of the well, and from there it enters the pipeline that goes ashore, and water is collected at the bottom of the well.

The water accumulating due to the decomposition of the gas hydrate and the heat carrier (steam condensate) is discharged into the sea by means of the same well, or it is injected into the underlying water-absorbing layers. Wellhead equipment of wells is controlled by an automated system and the technology of decomposition of gas hydrate, gas production, water discharge from the zone is strictly maintained, and most importantly pressure and temperature in the bottomhole zone. This method can be applied also in the case when the accumulation of the gas hydrate is a mountainous form.



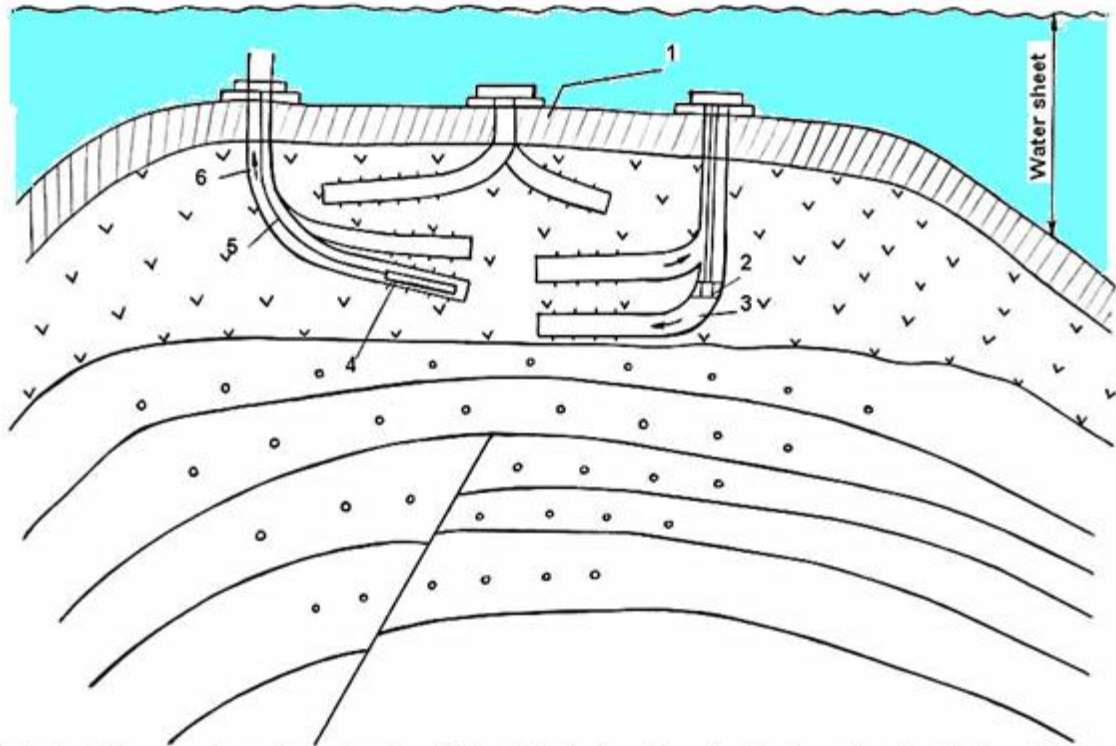
It should be noted that in contrast to the development of gas and gas condensate fields, where reservoir pressure is lowered in the process of production, in our case, the pressure in the zone will be increased or the temperature in the reservoir will be regulated. The extraction of water from the decomposition zone of the gas hydrate can also be carried out by choosing a well design, i.e. by lowering the tubing of smaller diameter into the lower part of the zone, creating conditions for rising water at the wellhead, and taking gas through the annular space of the well. If the gas hydrate accumulations are located at a certain depth in the bowels of the earth from the bottom of the reservoir, that is, the gas hydrates formed in aquifers communicating with the reservoir, then from the point of view of drilling, the tasks of their development are facilitated, and their operation is carried out by creating underwater mining industries, collection and transportation of gas. Here it is possible to single out various methods of destruction of gas hydrates by a coolant or heat exchangers, the creation of wells of various designs. It is pertinent to note that drilling double-barrel horizontal wells allows injection of the heat carrier and inhibitor, as well as production of one double-hole well, as illustrated in Figure 5.



*1-sea bed, upper boundary of gas hydrates accumulations; plate, wellhead of production well; 3-gas-hydrodynamic channel; 4-heat carrier and inhibitor (heating of hydrate formation and destruction of gas hydrate); 5-heart of gas hydrate decomposition; 6- horizontal injector well; 7-packer; 8-pump; 9-gas pipeline; 10-water evacuation*

Figure 5. Proposed scheme for gas production from gas hydrate deposits at the bottom of the sea and oceans

It is noteworthy that in this case an acceleration of gas migration from the depths of the interior is created, which is slow because of the porous medium filled with gas hydrates, which impair its permeability. Of great importance is the fact that with the destruction of gas hydrate and gas production in the bottomhole zone, a secondary hydrate formation process is possible due to changes in pressure and temperature characteristic of the hydrate formation process. Therefore, it is necessary to strictly maintain the pressure and temperature in the bottomhole zone, which differ from their values, creating the conditions for hydrate formation. In this case, it is possible to introduce inhibitors into the well, which impede this process. (Fig.6)



1-indestructible upper boundary; 2-packer; 3-two-hole horizontal well; 4-heat carrier; 5-cable line; 6- gas

Figure 6. Proposed scheme for gas production from gas hydrate deposits at the bottom of the sea and oceans

Certain possibilities and expedient use of jet devices, such as ejectors and vortex tubes, in the technology of gas production from gas hydrate deposits are presented. For example, the creation of a borehole vortex tube will allow obtaining a cold flow of gas for its drying, and a hot stream to destroy the gas hydrate. Ejectors also allow regulating gas flows with different pressures in the near-wellbore zone, as well as when collecting gas.

## CONCLUSION

1. Some issues of development of gas-hydrate accumulations located on the bottom of the seas and oceans are being discussed.
2. Different types of formation of gas hydrates at the bottom of reservoirs are considered.
3. Some options for drilling gas hydrate deposits and ways to create gas-hydrodynamic channels for gas production are proposed.

By creating double-barrel horizontal wells, it is possible to supply the heat carrier and inhibitor to the bottomhole zone to destroy the gas hydrate and extract gas from one well.





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