Geophysical Research Abstracts
Vol. 19, EGU2017-18133, 2017
EGU General Assembly 2017

Relict gas hydrates as possible reason of gas emission from shallow permafrost at the northern part of West Siberia

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Intra-permafrost gas (mostly methane) is represent a serious geological hazards during exploration and development of oil and gas fields. Special danger is posed by large methane accumulations which usually confined to sandy and silty sand horizons and overlying in the frozen strata on the depth up to 200 meters. Such methane accumulations are widely spread in a number of gas fields in the northern part of Western Siberia. According to indirect indicators this accumulations can be relic gas hydrates, that formed earlier during favorable conditions for hydrate accumulation (1, 2). Until now, they could be preserved in the frozen sediments due to geological manifestation of the self-preservation effect of gas hydrates at temperatures below zero. These gas hydrate formations, which are lying above the gas hydrate stability zone today, are in a metastable state and are very sensitive to various anthropogenic impacts. During drilling and operation of production wells in the areas where the relic of gas hydrates can occur, there are active gas emission and gas explosion, that can lead to various technical complications up to the accident. Mathematical and experimental simulations were were conducted to evaluate the possibility of existence of relic gas hydrates in the northern part of West Siberia. The results of math simulations revealed stages of geological history when the gas hydrate stability zone began virtually from the ground surface and saturated in shallow permafrost horizons. Later permafrost is not completely thaw. Experimental simulations of porous gas hydrate dissociation in frozen soils and evaluation of self-preservation manifestation of gas hydrates at negative temperatures were carried out for identification conditions for relic gas hydrates existence in permafrost of northern part of West Siberia. Sandy and silty sand sediments were used in experimental investigations. These sediments are typical of most gas-seeping (above the gas hydrate stability zone) permafrost horizons. The results show that all investigated frozen hydrate-bearing sandy and silty sand samples in the temperature range from -16 °C to -2 °C are characterized by not complete decomposition of pore hydrate at relieving pressure below the equilibrium. It was observed that at typical north Western Siberian permafrost temperature of -6 ° C the safety of pore hydrate in frozen samples can reach 60% at the pressure reducing below the equilibrium. In was found that with increasing temperature and particle size (dispersity) the efficiency of pore hydrate self-preservation is decreased, but even at the temperature of -2 °C there is residual pore methane hydrate content in non-saline sandy samples. All this suggests about high preservation of methane hydrates in frozen sediments at non-equilibrium thermobaric conditions, close to reservoir conditions.

Based on the results of mathematical and experimental simulations about the possibility of relic gas hydrates existence on permafrost depth up to 200 m in the northern part of Western Siberia on the less than 200 m due to geological manifestation of the self-preservation effect of gas hydrates.

References.

1.Chuvilin EM, Yakushev VS, Perlova EV. Gas and gas hydrates in the permafrost of Bovanenkovo gas field, Yamal Peninsula, West Siberia. // Polarforschung 68: 215-219, 1998. (erschienen 2000).

2.Yakushev V.S., Chuvilin E.M. 2000. Natural gas and hydrate accumulation within permafrost in Russia. Cold Regions Science and Technology. 31: 189-197.

These researches are supported by grant RSF №16-17-00051.