

Accepted Manuscript

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PII: S0165-232X(17)30188-X
DOI: doi:[10.1016/j.coldregions.2018.02.007](https://doi.org/10.1016/j.coldregions.2018.02.007)
Reference: COLTEC 2535

To appear in: *Cold Regions Science and Technology*

Received date: 22 April 2017
Revised date: 17 January 2018
Accepted date: 18 February 2018

Please cite this article as: V.S. Yakushev, A.P. Semenov, V.I. Bogoyavlensky, V.I. Medvedev, I.V. Bogoyavlensky , Experimental modeling of methane release from intrapermafrost relic gas hydrates when sediment temperature change. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Coltec(2017), doi:[10.1016/j.coldregions.2018.02.007](https://doi.org/10.1016/j.coldregions.2018.02.007)

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Experimental modeling of methane release from intrapermafrost relic gas hydrates when sediment temperature change

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Highlights

- “Yamal ice crater” formation is caused by gas\water mix blowout from permafrost
- Relic, metastable hydrates can be the reason of gas\water blowouts
- Even small temperature changes in the permafrost clay-enriched sediments can cause relic hydrates decomposition and considerable volume of greenhouse gas emission
- “Permafrost pockmarks” in Arctic lakes can be caused by relic gas hydrates decomposition

Abstract

Special experiment on metastable relic methane hydrates behavior in clay-enriched sediment recovered from “Yamal ice crater” has been arranged to check sensitivity of relic gas hydrates to small temperature changes in permafrost section. The experiment was conducted in an experimental cell with P/T conditions registration and equipped by stirrer. Prepared sample was saturated by methane hydrates and chilled to temperature -7°C , and then cell was depressurized to form metastable hydrates. After few times of depressurization (extra pressure relief) and pressure stabilization for a relatively long time at temperature -6.79°C , the sample was slowly heated to temperature $+2.0^{\circ}\text{C}$. It was established, that even small temperature changes have a great impact to metastable intrapermafrost hydrates. The majority of remaining (after depressurization) metastable hydrates had decomposed in the temperature range $-6.75 - -6.57^{\circ}\text{C}$ practically immediately after the sample slow heating beginning, confirming the supposition, that permafrost can produce huge volumes of greenhouse gases even at small surface (climatic) changes without sediment ice complete thawing.

Keywords: permafrost; microbial gas; relic gas hydrates; gas liberations; climate change; “permafrost pockmarks”

Introduction

Intensive development of oil and gas fields in permafrost regions is accomplished by observations of gas liberations from the ground around production wells and in neighboring areas. From the first time the reason of these liberations was assumed as hydrocarbon gas

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