Accepted Manuscript

The sensitivity of gas hydrate reservoirs to climate change: Perspectives from a new combined model for permafrost-related and marine settings

Thomas Mestdagh, Jeffrey Poort, Marc De Batist

PII: S0012-8252(16)30437-8
DOI: doi: 10.1016/j.earscirev.2017.04.013
Reference: EARTH 2412

To appear in: *Earth-Science Reviews*

Received date: 21 November 2016
Revised date: 24 April 2017
Accepted date: 27 April 2017

Please cite this article as: Thomas Mestdagh, Jeffrey Poort, Marc De Batist , The sensitivity of gas hydrate reservoirs to climate change: Perspectives from a new combined model for permafrost-related and marine settings, *Earth-Science Reviews* (2017), doi: 10.1016/j.earscirev.2017.04.013

The sensitivity of gas hydrate reservoirs to climate change: perspectives from a new combined model for permafrost-related and marine settings

Thomas Mestdagh [a,*], Jeffrey Poort [b], Marc De Batist [a]

[a] *Renard Centre of Marine Geology, Department of Geology, Ghent University, Krijgslaan 281 (S8), 9000 Ghent, Belgium*

[b] *Institut des Sciences de la Terre de Paris, Université Pierre et Marie Curie, Case courrier 129-4, place Jussieu, 75252 Paris, France*

[*] Corresponding author: Thomas.Mestdagh@UGent.be

Abstract

Gas hydrate reservoirs store large quantities of gas in sediments on continental margins, in deep lakes, and in continental and relic sub-shelf permafrost. The gas hydrate structure is only stable at sufficiently low temperature and high pressure, and may therefore collapse under changing climatic conditions. If a temperature rise or pressure drop (e.g. through falling sea level) is effective enough to dissociate hydrate deposits, methane (the most common gas component in hydrates and a potent greenhouse gas) is released from the hydrate structure and may eventually enter into the atmosphere. This may generate a positive feedback effect, as resulting enhanced greenhouse gas levels would additionally warm the atmosphere and hence maintain or reinforce hydrate dissociation. The significance of this mechanism has been debated over the past decades, often within the framework of geologically rapid Quaternary climatic oscillations and present-day climate warming. An extensive set of studies has addressed the climate-sensitivity of gas hydrate reservoirs in various study areas and geological settings, and by means of various approaches. No real consensus has yet been reached on the matter. In this study, we seek to evaluate the sensitivity of gas hydrate reservoirs to changes in global climate from a more general perspective, by firstly reviewing the available literature, and secondly developing a new numerical model to quantify gas hydrate destabilization under changing environmental conditions. Qualities of the model include the wide applicability to both marine and permafrost-related hydrate reservoirs and the integrative