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Climate of the Past Discussions

Interactive comment on "Modeling of stability of gas hydrates under permafrost in an environment of surface climatic change – terrestrial case, Beaufort-Mackenzie basin, Canada" *by* J. Majorowicz et al.

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General comments

The manuscript presents results from numerical simulations of the influence of paleoclimate change in the Beaufort-Mackenzie basin on the formation and preservation of ice bearing permafrost (IBP) and gas hydrate GH). These results may be useful for understanding how IBP and GH appeared and evolved. The investigation also allows to evaluate the stability of IBP and GH under future climate change. The authors had

considered 14 Myr of temperature history and 2 cases of gas hydrate formation: (1) initially separated from permafrost by impermeable beds, and (2) spatially coincided with permafrost. One of the most important conclusions of the study is that the gas hydrate zone under the permafrost is stable even during the interglacial warming periods. I have no doubts that the paper should be published in Climate of the Past with minor revisions.

Specific comments.

The weakest link in this simulation is the choice of a suitable ground surface temperature history. For this purpose authors used global reconstructions of air surface temperature change adapted for the investigated area. However, when modeling heat transfer the upper boundary condition is the ground surface temperature, which may differ significantly from the air temperature. Meanwhile, using such unreliable data (1 K, 6 – 5.5 Myr ago), the authors suggested several cycles of GH formation/degradation. Ground surface temperature changes over the last 2.5 Myr may be even more unreliable. During the glaciation periods the investigated area probably was covered by ice sheets. At least the north margin of the Laurentide Ice Sheet (95 – 20 kyr ago) extended to the shelf of the Beaufort Sea. It is known that temperature regime at the bed of ice sheet may be substantially different from that at its upper surface (Marshall and Clark, 2002). We also found that besides air temperature the geothermal heat flow and the rate of vertical ice advection determine temperature at the bed of ice sheet (Demezhko et al., 2007). I believe the authors need to expand the final part of the manuscript "Discussion and conclusions" and include here raised issues.

Page 2879, lines 24,25. Authors used the term "thermal inertia" in the everyday sense, as it has a definite physical meaning. The "thermal inertia" (or "thermal effusivity") is defined as the square root of the product of the bulk thermal conductivity and volumetric heat capacity. This parameter is displayed in problems where the heat exchange in a system of contacting bodies is considered. In the context of the paper is better to use the term "low thermal diffusivity".

Technical corrections

Page 2871, line 25 “ice are” instead “iceare”

Page 2874, line 2 “of the” instead “ofthe”

References

Demezhko, D.Yu, Ryvkin, D.G., Outkin, V.I, Duchkov, A.D., and V. T. Balobaev. 2007. Spatial distribution of Pleistocene/Holocene warming amplitudes in Northern Eurasia inferred from geothermal data. Clim. Past, 3, 559-568, 2007. www.clim-past.net/3/559/2007/doi:10.5194/cp-3-559-2007

Marshall, S.J., and P. U. Clark. Basal temperature evolution of North American ice sheets and implications for the 100-kyr cycle. GEOPHYSICAL RESEARCH LETTERS, VOL. 29, NO. 24, 2214, doi:10.1029/2002GL015192, 2002

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