

Estimations of hydrate stability in Baikal

S.N. Denisov

A.M. Obukhov Institute of Atmospheric Physics RAS, 3 Pyzhevsky, 119017 Moscow, Russia
denisov@ifaran.ru

Large volumes of methane are stored in subaqueous hydrate deposits. Because of projected warming, there is considerable concern that a water temperature increase will lead to dissociation of subaqueous hydrate deposits with release of potentially large amounts of methane [1]. Such a release could amplify atmospheric warming and possibly accelerate dissociation of remaining hydrates. This study assesses the stability of hydrates in Baikal.

Methane hydrates are stable at low temperature and high pressure. Water temperature in Baikal is about 3.5 °C on the depths higher than 200 m. Using the pressure-temperature equilibrium equation for hydrates [2], hydrate stability zone in Baikal sediments found to exist on the floor depths higher than 380 m. Total area extent of hydrate accumulations is about 23300 km². Assuming the geothermal gradient of 35 °C/km the thickness of hydrate stability zone in Baikal varies from 120 m on the 400 m floor depth to 520 m on 1600 m floor depth. It results in total of $1.68 \cdot 10^{11}$ m³ of hydrates or about $2.3 \cdot 10^{13}$ m³ of methane (~14 GtC) in assumption that hydrates occupy 5% of pore space in sediments [3].

Changes in hydrate stability zone for the Baikal floor depths of 400 m and 700 m are shown on fig.1. Current temperature profile in water and sediments (1) is shifted to new equilibrium state (2) after an 1 K increase in water temperature. Hydrate stability zone on the Baikal floor depths shallower than 400 m completely disappears. Its thickness reduces by 50 m on average and the area extent reduces by about 5%. It leads to release of about 1.2 GtC of methane which is comparable with about 0.5 GtC of total yearly methane emissions to atmosphere on Earth. But only small part of methane from subaqueous hydrates can reach the atmosphere and it may take thousands of years to achieve the equilibrium temperature in deep sediments.

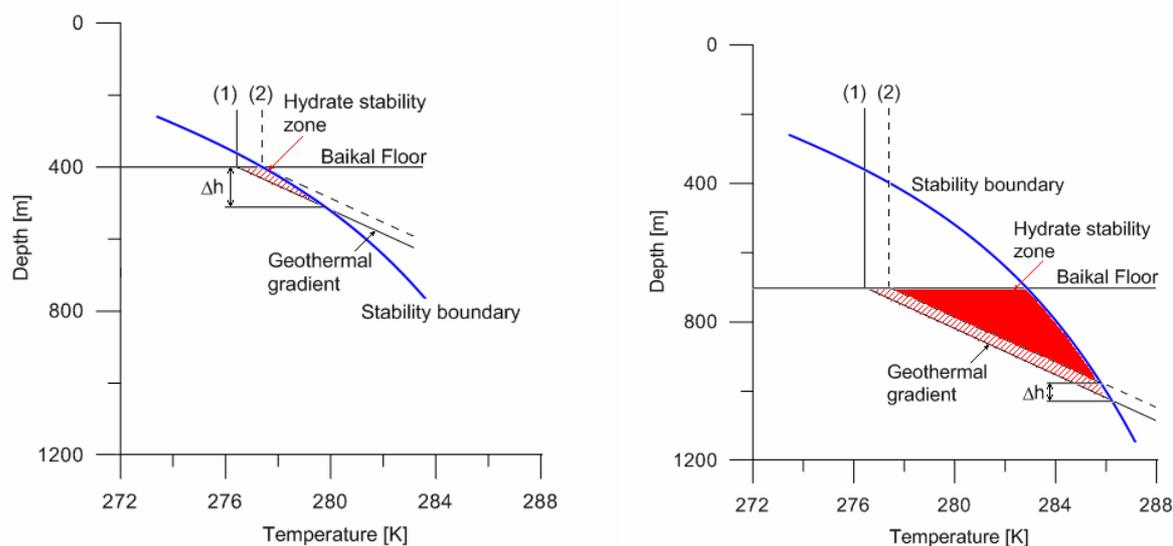


Fig.1 Changes of hydrate stability zone in Baikal due to 1K temperature increase for 400 m and 700 m floor depth.

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