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## **Why did gas hydrates melt at the end of the last ice age?**

**GEOMAR researchers find links between sedimentation and methane seeps on the seafloor off the coast of Norway**

**12 February 2018 / Kiel.** Large amounts of the greenhouse gas methane are locked up as solid gas hydrates in the continental slopes of ocean margins. Their stability depends on low temperatures and high pressure. However, other factors that influence gas hydrate stability are not as well understood. A German-Norwegian research team has found evidence off the coast of Norway that the amount of sediment deposited on the seafloor can play a crucial role. The study has been published today in the international journal *Nature Communications*.

Methane hydrates, also known as 'burning ice', occur at all ocean margins. The compound of gas and water occurs in the seafloor and it is only stable under relatively high pressures and low temperatures. If the pressure is too low or the temperature too high, the hydrates dissociate (break down), the methane is released and the gas can seep from the seafloor into the ocean. Thus, scientists fear that warming of global water temperatures could destabilize gas hydrates on a large scale. At the same time, it has not been fully understood which other factors influence the stability of gas hydrates.

A team of researchers from the GEOMAR Helmholtz Centre for Ocean Research Kiel together with colleagues from Bergen, Oslo and Tromsø (Norway), have now discovered that large-scale sedimentation caused by melting of glaciers in a region off Norway has played a greater role in gas hydrate dissociation than warming ocean waters.

For their study, the team had investigated the history of gas hydrates in the Nyegga area. "This region off middle Norway is quite interesting if you want to study the dynamics of gases and liquids in the seafloor. There are large gas hydrate deposits, and many crater-like structures, so-called 'pockmarks', on the seabed. They are generally associated with gas leaks from deeper gas reservoirs, but their exact origin in this area is still unclear."

Numerous bathymetric maps, sediment cores and seismic surveys already exist in the Nyegga area, which the researchers used as a basis for the new study. "So we knew that in the final period of the recent Ice Age, between 30,000 and 15,000 years ago, large amounts of sediment were deposited in the region in a relatively short period of time," explains Dr. Karstens. In a computer model, the team used the available data to simulate the evolution of the seabed and the response of the gas hydrates during this period.

Despite the rising sea level and therefore increasing pressure, the simulation showed that towards the end of the ice age large amounts of gas hydrate became unstable and the released gas escaped through the sediment to the seawater. "Gas hydrates are only stable at a certain depth below the actual seafloor. When dozens of meters of new sediment settle on the seafloor, the solid compounds dissociate at the base of the hydrate stability zone, while new hydrates can form at the upper end of the stability zone. However, if the seafloor is already saturated with gas and the process takes place very quickly, the released gases make their way to the seafloor, without forming new hydrates," says Dr. Karstens.

The numerical simulations of the seafloor also showed that the pockmarks in Nyegga are likely associated with this phenomenon because they are located right in the area of the largest gas hydrate dissociation event at the end of the Ice Age. Samples from the seafloor confirm this assumption. Mussel shells of the species *Isorropodon nyeggaensis* were found in the pockmarks. The species is known from its symbiosis with bacteria that feed on methane. The researchers were able to date the shells precisely to the time when, according to the model calculations, the largest gas hydrate dissociation event occurred.

"We show that rapid changes in sedimentation can have a pronounced impact on the gas hydrate system and thus the entire carbon cycle", Dr. Karstens concludes. To date, this aspect has hardly been considered. However, further studies on other ocean margins are needed to obtain a more global picture, emphasizes the Kiel geophysicist.

**Original work:**

Karstens, J., H. Hafliðason, L. W. M. Becker, C. Berndt, L. Rüpke, S. Planke, V. Liebetrau, M. Schmidt, J. Mienert (2017): Glacigenic sedimentation pulses triggered post-glacial gas hydrate dissociation. *Nature Communications*, <http://dx.doi.org/10.1038/s41467-018-03043-z>

**Links:**

[www.geomar.de](http://www.geomar.de) GEOMAR Helmholtz Centre for Ocean Research Kiel

**Images:**

At [www.geomar.de/n5732-e](http://www.geomar.de/n5732-e) images are available for download.

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