Changes in ice volume control seabed methane emissions

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The manipulator arm of the ROV Ægir 6000 samples seep carbonates from the seabed at 1200 m water depth, off western Svalbard. Credit: NORCRUST Using the manipulator arm of the ROV Ægir 6000 aboard R/V G.O. Sars in July 2016 for sampling seep carbonates from the seabed at 1200 m water depth, off western Svalbard. Credit: NORCRUST

Ice sheet dynamics of the past likely caused fault movements in the Earth's crust, resulting in seabed methane release in ~1200 m water depth offshore Svalbard, an archipelago in the Norwegian Arctic.

"Our results show similar patterns over the last two ice ages, from 160,000 years ago through today. The new data suggest a link between changing continental ice volumes and deep-sea methane emission in the Arctic," says Tobias Himmler, researcher at the Geological Survey of Norway (NGU) and principle author of the study.

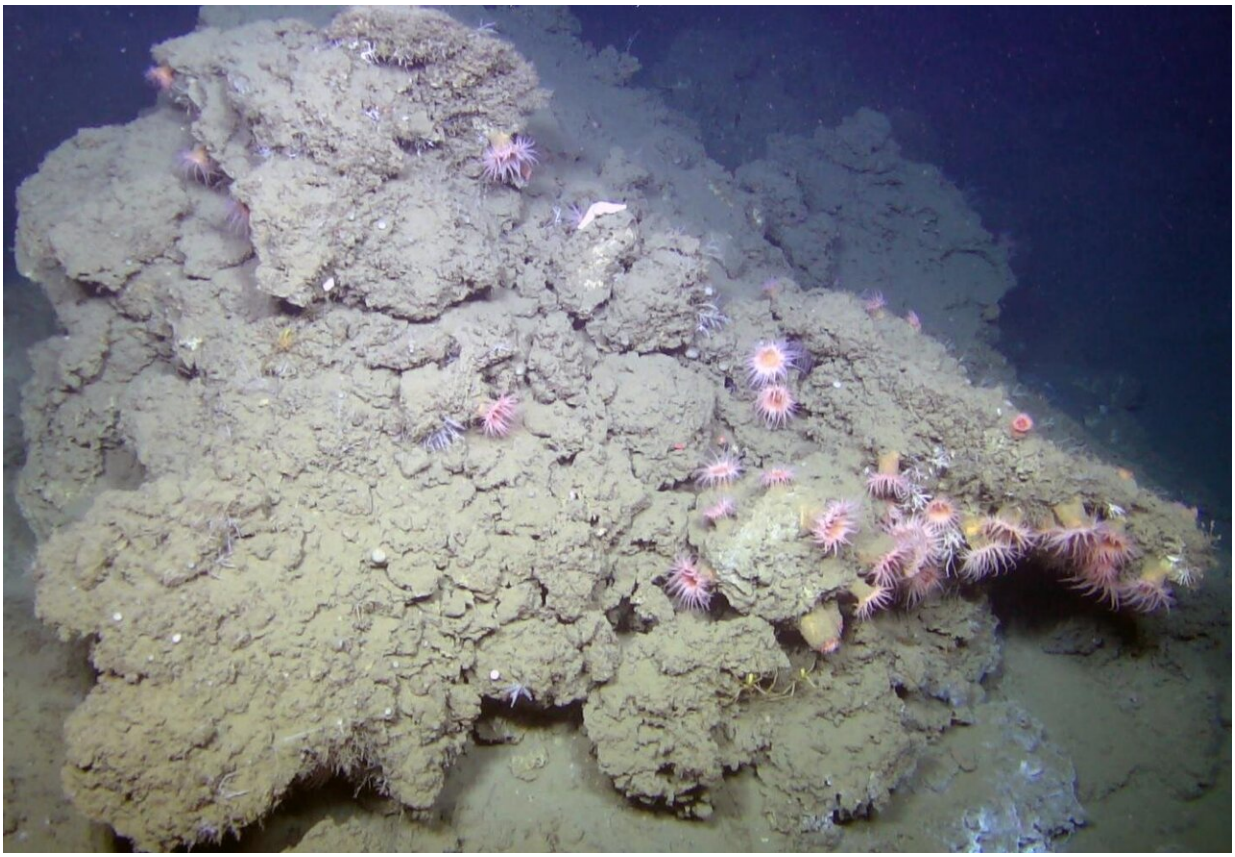
Seabed and sub-seabed samples reveal the past

Researchers from NGU and the Center for Arctic Gas Hydrate, Environment and Climate (CAGE) at UiT The Arctic University of Norway in Tromsø; participated in two research expeditions connected to this project in the summer of 2016.

During the first expedition aboard research vessel G.O. Sars, samples were collected from the seabed at the Vestnesa Ridge off western Svalbard at ~1200 meter water depth using the remotely operated vehicle (ROV) Ægir 6000.

A second expedition to the same location took place some weeks later aboard research vessel Maria S. Merian, bringing with it the MARUM-MeBo70 deep sea drilling rig. This time, researchers were able to obtain several 10+ m long sediment cores for further study.

Seep carbonates were collected from the seabed with the help of the ROV, while more were also found within the MeBo core samples drawn from below the seabed.



A seep carbonate mound on the Vestnesa Ridge seabed measuring approximately 1.5 meters wide and 1 meter high. Credit: NORCRUST

The seep carbonates resulted from the sediment cementation that occurred when methane migrated up from deep below and became oxidized by methane-consuming microbes near the seabed.

"Seep carbonates serve as geological archives of past seabed methane emissions," says Himmler.

Multiple episodes of methane emission revealed

After measuring the amounts of radioactive isotopes uranium and

thorium found in the seep carbonates, scientists at the British Geological Survey were able to calculate the ages of the carbonate pieces. This data reveals three separate 10,000- to 20,000-year long methane emission episodes over the last 160,000 years. Methane was released when thick ice sheets moved in to cover Svalbard and the Barents Sea area, and later after the ice diminished.

"During ice sheet growth, the extra weight of the ice presses the Earth's crust downward. Following the melting of the ice, the crust rises again. Our data indicate that methane off western Svalbard emanated from the seabed primarily when ice sheet movements activated faults. How much methane was emitted, however, we don't know," explains Himmler.

Previous research has shown that methane emissions have occurred consistently since the last ice age, beginning about 23,000 years ago. Scientists from NGU and CAGE have now managed to -literally- drill further back in time using the MARUM's MeBo70 sea floor drill rig. The drilled seep carbonate samples reveal that there have been at least two older methane emission episodes in the past, between about 160,000 to 133,000 years and 50,000 to 40,000 years ago.

"Ice sheet dynamics is a new factor when considering the natural drivers of deep-sea methane release in the Arctic," says Tobias Himmler.

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More information: Tobias Himmler et al, A 160,000-year-old history of tectonically controlled methane seepage in the Arctic, *Science Advances* (2019). DOI: 10.1126/sciadv.aaw1450

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