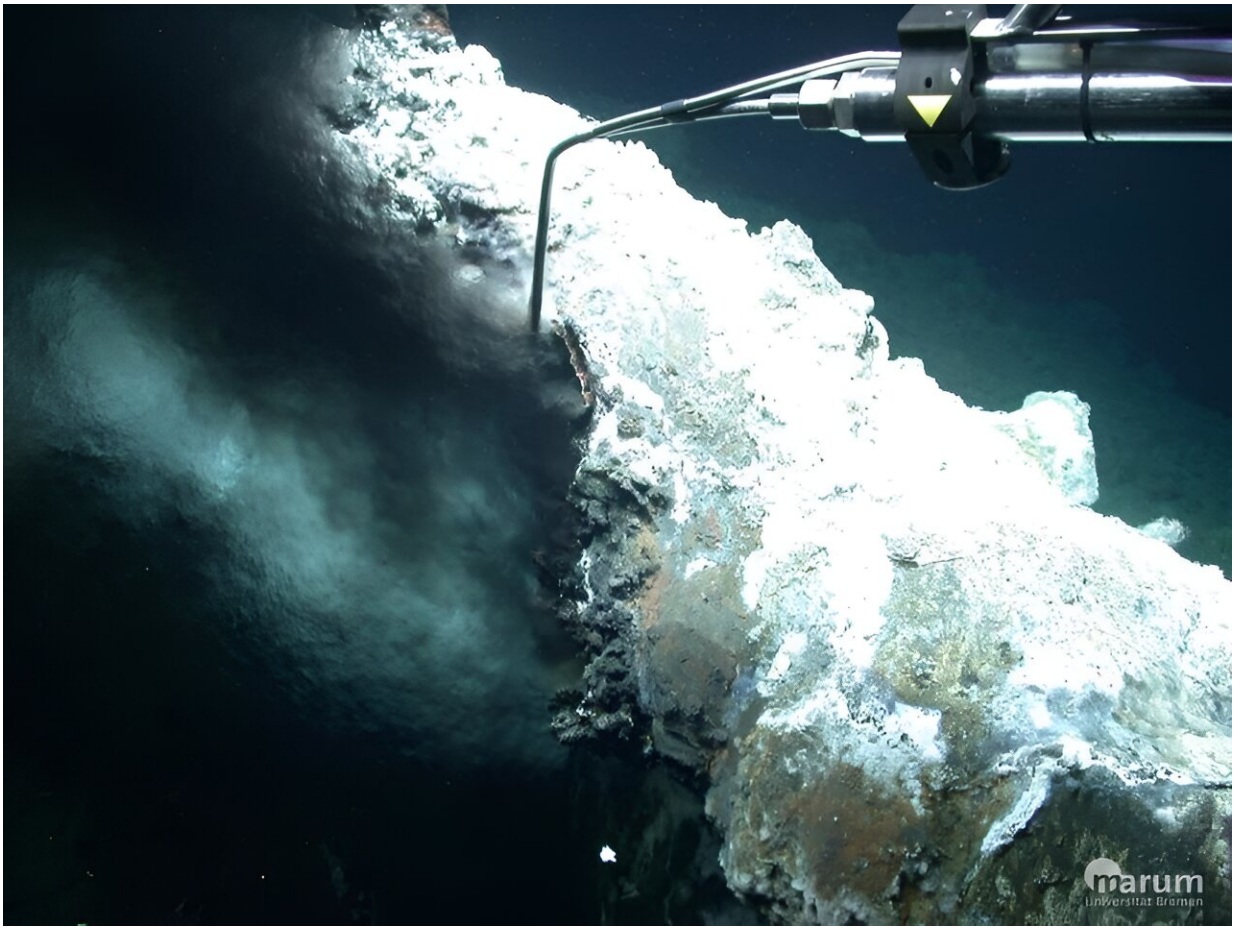
Investigating newly discovered hydrothermal vents at depths of 3,000 meters off Svalbard

June 28 2024, by Ulrike Prange



The temperature measurement at the outflow opening of the black smoker revealed fluid temperatures greater than 300°C. Credit: University of Bremen

Hydrothermal vents can be found around the world at the junctions of drifting tectonic plates. But there are many hydrothermal fields still to be discovered. During a 2022 expedition of the MARIA S. MERIAN, the first field of hydrothermal vents on the 500-kilometer-long Knipovich Ridge off the coast of Svalbard was discovered.

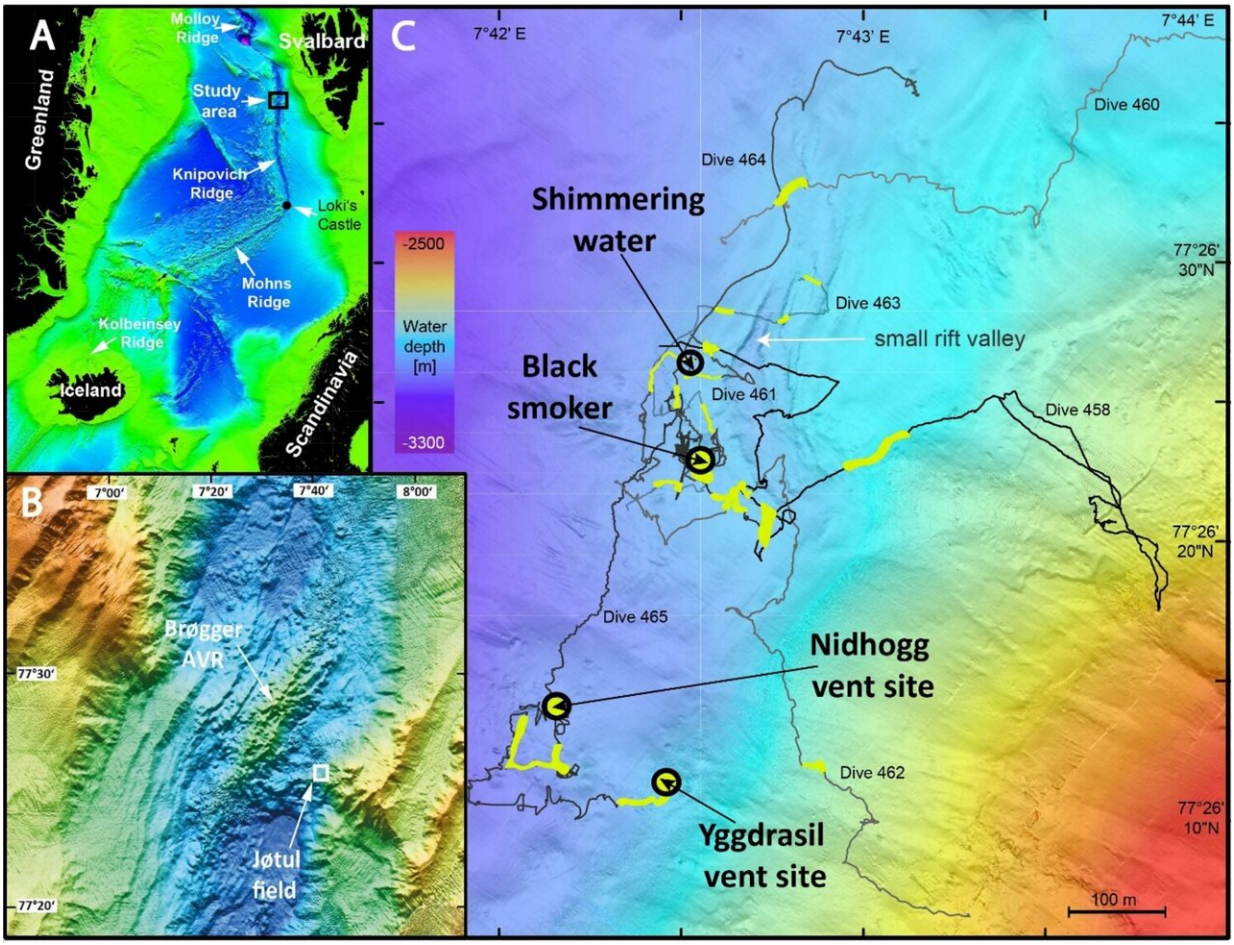
An international team of researchers from Bremen and Norway, led by Prof. Dr. Gerhard Bohrmann of MARUM—Center for Marine Environmental Sciences and the Geosciences department at the University of Bremen, now reports on the discovery in the journal *Scientific Reports*.

Hydrothermal vents are seeps on the sea floor from which hot liquids escape. "Water penetrates into the ocean floor where it is heated by magma. The overheated water then rises back to the sea floor through cracks and fissures. On its way up the fluid become enriched in minerals and materials dissolved out of the oceanic crustal rocks. These fluids often seep out again at the sea floor through tube-like chimneys called black smokers, where metal-rich minerals are then precipitated," explains Prof. Gerhard Bohrmann of MARUM and chief scientist of the MARIA S. MERIAN (MSM 109) expedition.

At water depths greater than 3,000 meters, the remote-controlled submersible vehicle MARUM-QUEST took samples from the newly discovered hydrothermal field. Named after Jøtul, a giant in Nordic mythology, the field is located on the 500-kilometer-long Knipovich Ridge.

The ridge lies within the triangle formed by Greenland, Norway and Svalbard on the boundary of the North American and European tectonic plates. This kind of plate boundary, where two plates move apart, is called a spreading ridge.

The Jøtul Field is located on an extremely slow spreading ridge with a growth rate of the plates of less than two centimeters per year. Because very little is known about hydrothermal activity on slow spreading ridges, the expedition focused on obtaining an overview of the escaping fluids, as well as the size and composition of active and inactive smokers in the field.



(A) Map of the Norwegian-Greenland Sea (GEBCO data) with locations of active seafloor spreading centers and the study area. (B) Detailed map of the study area (ship-based multibeam data acquired during cruise MSM109) including the Brøgger Axial Volcanic Ridge (AVR) and the newly discovered hydrothermal active area called Jøtul hydrothermal field. (C) AUV-based bathymetry of the Jøtul hydrothermal field (data acquired during cruise

MSM109 and provided by the Norwegian Offshore Directorate). Track lines of ROV dives are shown and track portions, where hydrothermal activity was visually observed, are marked in yellow. Four sites were sampled for fluids during MSM109 and are indicated by circles. Credit: *Scientific Reports* (2024). DOI: 10.1038/s41598-024-60802-3

"The Jøtul Field is a discovery of scientific interest not only because of its location in the ocean but also due to its climate significance, which was revealed by our detection of very high concentrations of methane in the fluid samples, among other things," reports Gerhard Bohrmann.

Methane emissions from hydrothermal vents indicate a vigorous interaction of magma with sediments. On its journey through the water column, a large proportion of the methane is converted into carbon dioxide, which increases the concentration of CO_2 in the ocean and contributes to acidification, but it also has an impact on climate when it interacts with the atmosphere.

The amount of methane from the Jøtul Field that eventually escapes directly into the atmosphere, where it then acts as a greenhouse gas, still needs to be studied in more detail. There is also little known about the organisms living chemosynthetically in the Jøtul Field. In the darkness of the deep ocean, where photosynthesis cannot occur, hydrothermal fluids form the basis for chemosynthesis, which is employed by very specific organisms in symbiosis with bacteria.

In order to significantly expand on the somewhat sparse information available on the Jøtul Field, a new expedition of the MARIA S. MERIAN will start in late summer of this year under the leadership of Gerhard Bohrmann. The focus of the expedition is the exploration and sampling of as yet unknown areas of the Jøtul Field. With extensive data

from the Jøtul Field it will be possible to make comparisons with the few already known hydrothermal fields in the Arctic province, such as the Aurora Field and Loki's Castle.

The published study is a part of the Bremen Cluster of Excellence "The Ocean Floor—Earth's Uncharted Interface," which explores complex processes on the sea floor and their impacts on global climate. The Jøtul Field will also play an important role as an object of future research in the Cluster.

More information: Gerhard Bohrmann et al, Discovery of the first hydrothermal field along the 500-km-long Knipovich Ridge offshore Svalbard (the Jøtul field), *Scientific Reports* (2024). DOI: 10.1038/s41598-024-60802-3

Provided by University of Bremen