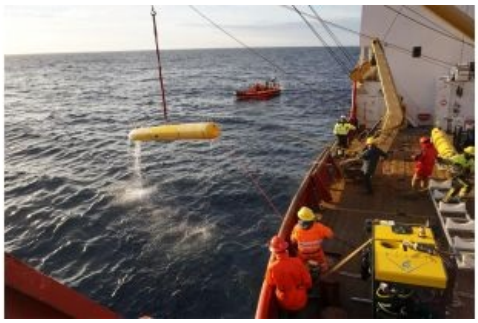
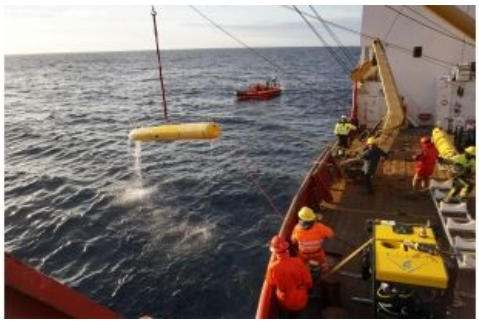
Advanced Mapping Reveals Rapid Changes to Arctic Seafloor





Numerous peer-reviewed studies show that thawing permafrost is creating unstable land across the Arctic that negatively impacts important infrastructure and Indigenous communities. Now, a new study from MBARI researchers and their collaborators published in the *Proceedings of the National Academy of Sciences* finds dramatic changes offshore and is the first to document how the thawing of permafrost underwater at the edge of the Arctic Ocean is affecting the seafloor.

About one quarter of the land in the northern hemisphere is permafrost or frozen ground. At the end of the last ice age (12,000 years ago), melting glaciers and sea-level rise submerged large swaths of permafrost. Until just recently, this submerged permafrost was largely inaccessible to researchers. But now, thanks to technological advancements, including MBARI's autonomous mapping robots, scientists are able to conduct detailed surveys and assess changes in the seafloor.

Autonomous Mapping Robots to Map Sinkhole-like Depressions

High-resolution bathymetric surveys in the Canadian Beaufort Sea have revealed changes in the seabed from 2010 to 2019. Using autonomous mapping robots, scientists have documented multiple large sinkhole-like depressions – the largest the size of an entire city block of six-story buildings – that have developed in less than a decade.

"We know that big changes are happening across the Arctic landscape, but this is the first time we've been able to deploy technology to see that changes are happening offshore too," said Charlie Paull, a geologist at MBARI who led the study with Scott Dallimore from the Geological Survey of Canada, Natural Resources Canada and an international team of researchers. "While the underwater sinkholes we have discovered are the result of longer-term, glacial-interglacial climate cycles, we know the Arctic is warming faster than any region on Earth. As climate change continues to reshape the Arctic, it's critical that we also understand changes in the submerged permafrost offshore."

Modern Marine Research Platforms

Since 2003, MBARI has been part of an international collaboration to study the seafloor of the Canadian Beaufort Sea with the Geological Survey of Canada, the Department of Fisheries and Oceans Canada and, since 2013, the Korean Polar Research Institute. Support for this work has been provided by the David and Lucile Packard Foundation, Geological Survey of Canada, Fisheries and Oceans Canada, and the Korean Ministry of Ocean and Fisheries (KIMST grant No. 1525011795).

"This research was made possible through international collaboration over the past decade that has provided access to modern marine research platforms such as MBARI's autonomous robotic technology and icebreakers operated by the Canadian Coast Guard and the Korean Polar Research Institute," said Dallimore. "The Government of Canada and the Inuvialuit people who live on the coast of the Beaufort Sea highly value this research as the complex processes described have implications for the assessment of geohazards, the creation of unique marine habitat, and our understanding of biogeochemical processes."

Repeated mapping of the seafloor with ship-based sonar and an autonomous underwater vehicle (AUV) were critical to this work. MBARI's mapping AUVs can resolve the bathymetry of the seafloor down to a resolution of a one-metre (about three-feet) square grid, or roughly the size of a dinner table. These self-guided robots have been instrumental in enabling detailed visualization of the seafloor and documenting changes over time.

Read the full story here

MBARI technology, including autonomous underwater vehicles (AUVs, left) and a portable remotely operated vehicle

(MiniROV, right), have revealed rapid changes to the seafloor in the Canadian Beaufort Sea. These changes are associated with degradation of submarine permafrost. (Courtesy: Charlie Paull)