Two Miles Below
by Stephen Whitt

What is the most isolated place on Earth? One good answer is a mountain chain at the bottom of the Arctic Ocean.

Two miles below the frozen surface of the Arctic Ocean lies the Gakkel Ridge. It is one of the most difficult places on Earth to explore. Think about the obstacles.

First, there are two miles of very cold water on top of it. The pressure of all this water is enormous. An ordinary submarine would be crushed like an eggshell. Second, the water at this depth is pitch-black. If you want to see here, you’ll need to bring your own light. Third, there’s a thick block of ice between the water and the sky. If you need to come to the surface quickly, you’ll likely find a wall of ice between you and the nearest oxygen.

And yet scientists are now exploring this new frontier. The scientists can’t visit the Gakkel Ridge themselves. Instead, they send robots.

The names of these robots don’t make one think of cold water or deep oceans. PUMA stands for “plume mapper.” This robot uses sound, lasers, and chemical sensors to spot underwater volcanic plumes (the black smoke that rises from volcanoes). JAGUAR is PUMA’s partner. Once PUMA spots a plume, JAGUAR travels to the spot. JAGUAR hovers over the plume, gathering images and information.

The robots work with little direction from the scientists on the surface. PUMA and JAGUAR are dropped into the water through a hole in the ice. Hours later, the robots must, on their own, find that hole once again. If the hole would only stay in the same place, the job would be easier. But ice moves. The hole might have drifted several miles, might have changed shape, might even have closed up since the robots went into the water.

Even worse, it is difficult to communicate through water. The scientists say it is easier to operate a robot on Mars than to keep track of their robots below the ocean. Radio waves easily travel through empty space. Water absorbs radio waves.

Copyright February 2010 – Ohio State University. This material is based upon work supported by the National Science Foundation under Grant No. 0733024. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. This work is licensed under a Creative Commons Attribution-Share Alike 3.0 Unported License: http://creativecommons.org/licenses/by-sa/3.0/.
In warm water, that problem can be solved with a **tether**. But in an ice-covered region, shifting ice sheets can snap tethers. If that happens, the robot is lost.

Without tethers or radio waves, PUMA and JAGUAR have to be smart. They must make good choices. They must decide where to go and what to study. They must know how to get back home. So far, they’ve performed beautifully.

And what have the scientists and their amazing robots found? Wonder! The animals of the Gakkel Ridge have been isolated for millions of years. In that time they’ve changed in unexpected ways. Perhaps the most exciting animal sighting was a new kind of Dumbo octopus. Flaps that look like elephant ears project from the creature’s head. The octopus gently moves its flaps to swim.

One day another animal swam into the view of the robotic camera. This animal looked like a sea cucumber with a fish’s tail. Scientists still have no idea what this creature might be.

Gakkel Ridge’s volcanoes are still active. Since 1999 three of them – named Odin, Thor, and Loki – have erupted. The robots discovered glass scattered about the ocean floor. The glass isn’t human-made pollution. Instead, it is left over from the eruptions of these hot, active, underwater volcanoes.

Today we send robots to faraway planets and moons. Yet there are still places to discover right here on Earth. The Gakkel Ridge is one of those amazing places.

**Glossary**

- **hovers** - floats in the air over one spot
- **isolated** - alone and far away from other things and places
- **obstacles** - something that stands in the way
- **tether** - a rope or chain to hold an object or animal in place yet allowing it to move in short circles

---

Copyright February 2010 – Ohio State University. This material is based upon work supported by the National Science Foundation under Grant No. 0733024. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. This work is licensed under a Creative Commons Attribution-Share Alike 3.0 Unported License: [http://creativecommons.org/licenses/by-sa/3.0/](http://creativecommons.org/licenses/by-sa/3.0/)