Titan’s icy methane ocean re-created in lab

Picture taken by Cassini shows Titan, Saturn's largest moon, as a white dot at upper left. | Photo Credit: AP Photo/NASA/JPL/Southwest Research Institute

Scientists have recreated the ocean of Saturn’s moon Titan in the laboratory in an attempt to determine how an autonomous submarine would work on the icy cosmic body.

Engineers know how to design submarines on Earth, but building one gets a lot trickier when the temperature drops to minus 180 degrees Celsius and the ocean is made of methane and ethane. Titan is of particular interest to researchers because it is similar to Earth in one important way, it holds liquid. Unlike almost anywhere else in the solar system, Titan’s surface includes oceans, rivers and clouds, and like on earth, it can rain. However, instead of water, the hydrological cycle is based on methane.

NASA has been studying Saturn and its moons for more than a decade with data collected from the Cassini spacecraft. The submarine that the agency is designing will have to operate autonomously. It will need to study atmospheric and ocean conditions, move around sea beds, and hover at or below the surface.

The engineering is even trickier because, unlike the nearly homogeneous water in earth-based oceans, the concentration of ethane and methane can vary dramatically in the Titan oceans and change the liquid’s density properties. Researchers at Washington State University re- created the atmosphere of Titan and tested how a small heated machine might work under such conditions.

The team built a test chamber that housed the liquid mixture at very cold temperatures to simulate the seas of Titan. They added a two-inch, cylinder-shaped cartridge heater that would approximate the heat that a submarine would create.

One of the biggest challenges for researchers was understanding bubbles in the Titan seas. Add a submarine powered by a heat-producing machine into the very cold Titan liquid, and nitrogen bubbles will form. Too many bubbles would make it hard to manoeuvre the ship, see, take data and manage ballast systems.

The next big problem was getting a video in difficult conditions. Researchers engineered a solution using an optical device called a borescope and video camera that could withstand the low temperatures and high pressures to visualise what was going on within the test chamber. The researchers succeeded and took video footage of ethane-methane rain and snow.

The group also studied the freezing temperatures for methane and ethane lakes and determined that, because of a small amount of nitrogen in the liquid, the lakes freeze at lower temperatures than would be expected. The researchers are looking to continue the work with NASA to update the Titan Submarine design.

The study was carried out by scientists from Washington State University and NASA Glenn Research Center. The results were published in *Fluid Phase Equilibria.*

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