Study finds highly effective communities of bacteria in Mariana Trench

March 17 2013

An international research team announces the first scientific results from one of the most inaccessible places on Earth: the bottom of the Mariana Trench located nearly 11 kilometers below sea level in the western Pacific, which makes it the deepest site on Earth.

Their analyses document that a highly active bacteria community exists in the sediment of the trench - even though the environment is under extreme pressure almost 1,100 times higher than at sea level.

In fact, the trench sediments house almost 10 times more bacteria than in the sediments of the surrounding abyssal plain at much shallower water depth of 5-6 km water.

Deep sea trenches are hot spots

Deep sea trenches act as hot spots for microbial activity because they receive an unusually high flux of organic matter, made up of dead animals, algae and other microbes, sourced from the surrounding much shallower sea-bottom. It is likely that some of this material becomes dislodged from the shallower depths during earthquakes, which are common in the area. So, even though deep sea trenches like the Mariana Trench only amount to about two percent of the World Ocean area, they have a relatively larger impact on marine carbon balance - and thus on the global carbon cycle, says Professor Ronnie Glud from Nordic Center for Earth Evolution at the University of Southern Denmark.

Ronnie Glud and researchers from Germany (HGF-MPG Research Group on Deep-Sea Ecology and Technology of the Max Planck Institute in Bremen and Alfred Wegener Institute in Bremerhaven), Japan (Japan Agency for Marine-Earth Science and Technology), Scotland (Scottish Association for Marine Science) and Denmark (University of Copenhagen), explore the deepest parts of the oceans, and the team's first results from these extreme environments are today published in the widely recognized international journal *Nature Geoscience*.

Diving robot

One of the team's methods was to measure the distribution of oxygen into these trench sediments as this can be related to the activity of microbes in the sediments. It is technically and logistically challenging to perform such measurements at great depths, but it is necessary in order to get accurate data on rates of bacterial activity. "If we retrieve samples from the seabed to investigate them in the laboratory, many of the microorganisms that have adapted to life at these extreme conditions will die, due to the changes in temperature and pressure. Therefore, we have developed instruments that can autonomously perform preprogrammed measuring routines directly on the seabed at the extreme pressure of the Marianas Trench", says Ronnie Glud. The research team has, together with different companies, designed the underwater robot which stands almost 4 m tall and weighs 600 kg. Among other things, the robot is equipped with ultrathin sensors that are gently inserted into the seabed to measure the distribution of oxygen at a high spatial resolution.

"We have also made videos from the bottom of the Mariana Trench, and they confirm that there are very few large animals at these depths. Rather, we find a world dominated by microbes that are adapted to function effectively at conditions highly inhospitable to most higher organisms", says Ronnie Glud.

The remaining "white spots"

The expedition of the Mariana Trench took place in 2010. Since then, the research team has sent their underwater robot to the bottom of the Japan Trench which is approximately 9 km deep, and later this year they are planning a dive in the world's second deepest trench, the 10.8 kilometers deep Kermadec-Tonga Trench near Fiji in the Pacific.

"The deep sea trenches are some of the last remaining "white spots" on the world map. We know very little about what is going on down there or which impact the deep sea trenches have on the global carbon cycle as well as climate regulation. Furthermore, we are very interested in describing and understanding the unique bacterial communities that thrive in these exceptional environments. Data from multiple deep sea trenches will allow us to find out how the general conditions are at extreme depths, but also the specific conditions for each particular trench – that may experience very different deposition regimes. This will contribute to our general understanding of Earth and its development, says Ronnie Glud.

More information: "High rate of microbial carbon turnover in sediments in the deepest oceanic trench on Earth" *Nature Geoscience*, 2013. dx.doi.org/10.1038/ngeo1773

Provided by University of Southern Denmark