Microbes in the seafloor: Little nutrients, lots of oxygen

March 16 2015

About one quarter of the global seafloor is extremely nutrient poor. Contrary to previous assumptions, it contains oxygen not just in the thin surface layer, but also throughout its entire thickness. The underlying basement rocks contain oxygen as well. An international research team made these new discoveries through analysis of drill cores from the South Pacific Gyre.

In the latest issue of *Nature Geoscience* the scientists also point out the potential effects on the composition of Earth's interior because oxygen-containing deep-sea sediment has a different mineral composition than an oxygen-free one. Previously it was assumed that, except for a thin surface layer, the seafloor is oxygen free, because microbes consume all available oxygen.

The sediment that is constantly transported from the continents into the oceans and subsequently settles on the seafloor is rich in nutrients and acts a food source for the microbial community, which in turn consumes the oxygen. Below the thin oxygen-containing layer only those microbes can survive that are adapted to oxygen-free conditions.

During an expedition with the scientific drill ship "JOIDES Resolution", an international research team that included a participant from the GFZ German Centre for Geosciences was able to collect cores from the South Pacific Gyre, an area between Australia, South America and Antarctica. No other area on Earth is further away from the continents and their nutrient input, leading to strong nutrient depletion to which the microbes in the seafloor have to adjust.

As a result of these extreme conditions, the number of microbes is greatly reduced: "The microbial population density is ten to one hundred million times lower than in other places in the world's oceans," explains GFZ researcher Jens Kallmeyer, one of the authors of the study. "Those few microbes that survive find so few nutrients that they are not able to consume all the oxygen, therefore the seafloor contains oxygen not just in the uppermost layer but throughout its entire thickness. It also harbours only microbes that need oxygen to survive." Not just the sediment contains oxygen, it was also found in the basalt below.

One of the questions arising from this discovery was whether such conditions can only be found in the South Pacific Gyre or somewhere else as well. By using a combination of drill core analyses and satellite data it was shown that about one quarter of the world's oceans have nutrient concentrations that are as low as in the South Pacific Gyre. This lead the scientists to conclude that oxygen penetrates the entire depth of the seafloor in those regions as well. The consequences of these results reach as far as to plate tectonics. Jens Kallmeyer: "If a geologic slab with such oxygen-containing material descends into Earth and melts, oxygen

will be transported into Earth's interior." The effects of this process on geochemical processes in Earth's mantle will be the subject of future research.

More information: Steven D'Hondt et al., Presence of Oxygen an Aerobic Communities from Seafloor to Basement in Deep-Sea Sediments, *Nature Geoscience*, 16.03.2015, DOI: 10.1038/NGEO2387

Provided by Helmholtz Association of German Research Centres