



Press Release

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Earth's first bacteria made their own sunscreen

Tübingen scientists show iron minerals shield against harmful UV

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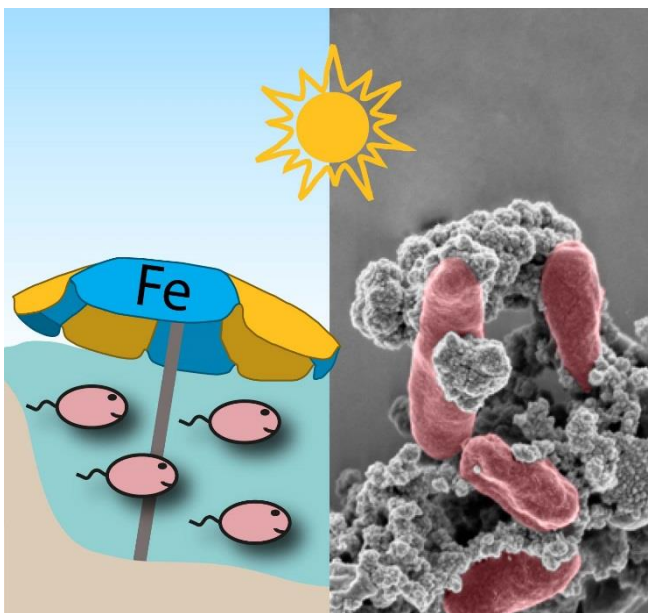
Earth in the days when life was just beginning had no protective ozone layer, so light-dependent, iron-oxidizing bacteria formed iron minerals around themselves to protect them from damaging ultraviolet rays. In this way, living beings were able to survive in the rough environment of 3-4 billion years ago. This is the conclusion reached by Tübingen geomicrobiologists Tina Gauger and Professor Andreas Kappler following a series of laboratory experiments in collaboration with Professor Kurt Konhauser of the University of Alberta in Edmonton, Canada. The results of this research have been published in the latest issue of *Geology*.

The atmosphere we breathe today is composed of about 20 percent oxygen, which is not just essential to many organisms – it also provides protection from the sun's more dangerous rays. In the presence of sunlight, oxygen molecules in the atmosphere react to form ozone. Up in the stratosphere, the ozone layer absorbs harmful UV radiation coming from space – protecting humans, animals and plants from the damage UV does. Three to four billion years ago, the atmosphere contained little oxygen and there was no ozone layer. "The earth's surface – and areas of shallow water – were subject to high levels of ultra-violet radiation," Andreas Kappler explains. "And yet, microbial life came to be. We wondered how that was possible."

Certain bacteria which need light are able to eat dissolved iron (Fe^{2+}) and to carry out photosynthesis in the presence of sunlight. But unlike today's green plants, they did not release oxygen in the process. The process produces rust and other iron minerals as waste products. The iron minerals have special qualities – They absorb harmful ultraviolet radiation, but the part of the sunlight needed for photosynthesis can still be used by organisms. "The iron needed to form the minerals was available in much greater amounts in the oceans than it is today," says Kappler. There are many indications that the photosynthesizing bacteria lived in these early oceans and oxidized iron. "We can still see the results

of this today in the form of enormous iron-bearing rocks known as banded iron formations. They are the biggest deposits of iron we have.”

In their experiments, the geomicrobiologists subjected the bacteria to high doses of ultraviolet radiation – either in the presence or the absence of the iron minerals the bacteria themselves produce. “In the presence of their own rust, considerably more bacteria survived and were active,” says Tina Gauger. “We also saw that the bacterial cells’ DNA suffered less damage. In our experiments, more bacteria survived with mineral sunscreen than without.” The new findings are helping the researchers to understand how very early organisms survived despite the high level of radiation, and how life was even able to develop in shallow seas with sufficient sunlight.



A sunshield for iron-oxidizing bacteria: These tiny organisms build their own sun umbrella by forming iron minerals or rust around their cells; this protects them from harmful UV rays.

Image: Kappler/Gauger/University of Tübingen

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