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DNA from the past

Limestone serves as a repository of microbial genetic information

Most of the earth's microbial biomass is hidden in the subsurface. According to estimates, microorganisms can be found at depth of up to five kilometres below the continental surface. Here they also colonize solid rock. Since this deep biosphere is difficult to access, researchers know little about the composition and role of these microorganisms in biogeochemical cycles. A research team from Friedrich Schiller University Jena and its Cluster of Excellence "Balance of the Microverse" as well as other research networks and institutes have now discovered that limestone serves as an archive for microbial colonisation of the subsurface. The first results of the study have been published in the scientific journal "Microbiome" (https://doi.org/10.1186/s40168-023-01647-2).

"We examined drill cores from a depth of up to 300 metres from the Thuringian Basin to gain insights into the biomass in solid rocks and the metabolic status of rock-dwelling microbiomes," says Dr. Carl-Eric Wegner, lead author of the study. "Based on previous research results, we assumed that the high calcium content in limestone could preserve the DNA of microorganisms, similar to dental calculus in mummies or skeletons. However, due to the low biomass in the rock, existing methods had to be adapted."

In order to extract the DNA contained in the rock samples for a so-called metagenomic analysis, the researchers adapted methods from microbial archaeology and palaeogenomics. "Our goal was to decipher the genetic information of microorganisms in the stones and to classify them both taxonomically and functionally," explains Prof. Dr Christina Warinner, Professor of Microbiome Sciences at the University of Jena.

"We have also been able to detect genetic information from past microbial communities - so-called paleomes - in three rock samples. These give us information about which metabolic performances played a role when these microorganisms were still alive," says Prof. Dr Kirsten Küsel, spokesperson of the Balance of the Microverse Cluster of Excellence, and initiator of the study.

The authors conclude that the study of limestone is particularly suitable because its properties favour the long-term preservation of genetic information. "Determining the age of endolithic DNA is the key to the geomicrobiological history of the subsurface," Küsel summarizes.

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About the Cluster of Excellence Balance of the Microverse:
Balance of the Microverse is funded by the German Research Foundation under Germany's Excellence Strategy, and brings together researchers from different disciplines to conduct joint research on the dynamics of microbial communities on Earth. Microorganisms are virtually everywhere and live in harmony with other large and small

organisms. If this coexistence is out of balance, this can have severe consequences such as weather extremes, crop failures, or the spread of diseases. The mission of the Cluster of Excellence is to gain a profound understanding of the interactions of microorganisms with each other and with other living organisms. With this knowledge, the researchers want to determine the causes of dysbalance and find out how such a system can be brought back into balance.

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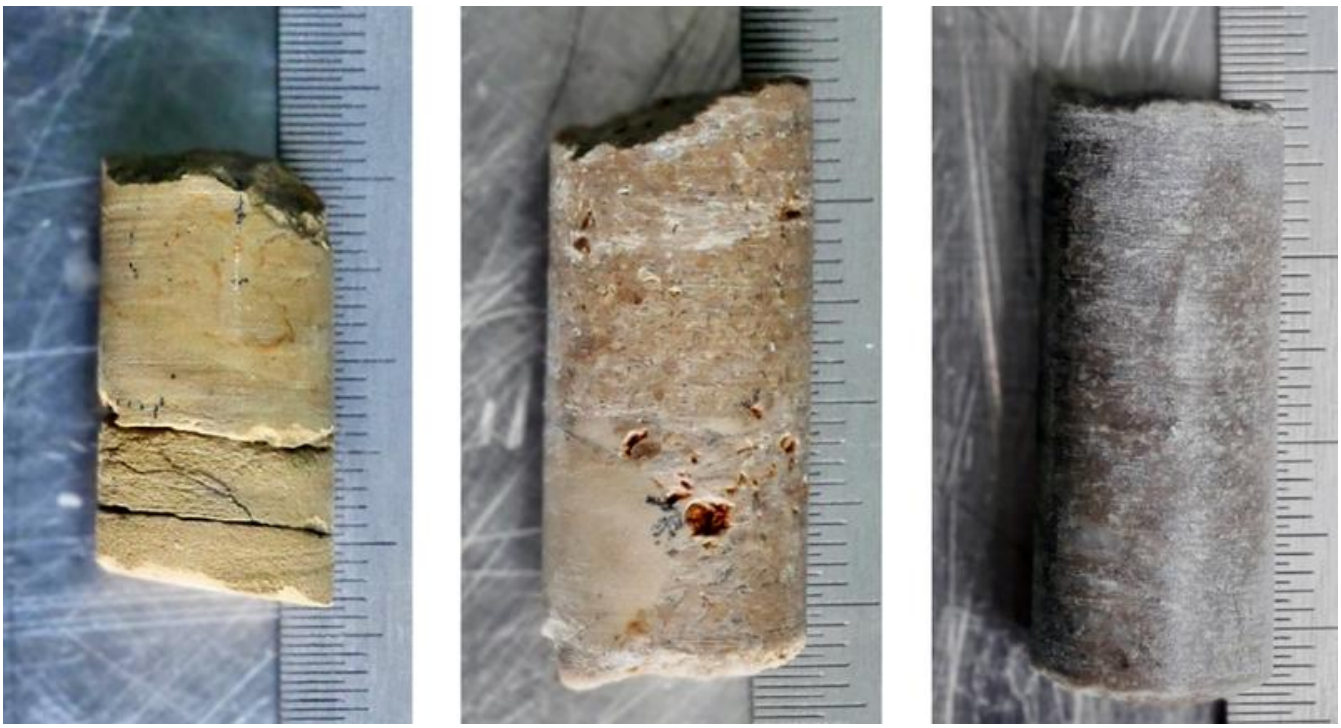

Rock cores used for the investigation.
Image: Robert Lehmann