

A recent study led by the CAB shows that DNA could preserve biological information under the extreme conditions of the Martian surface.

DNA fragments could survive in Martian rocks for more than 100 million years



Sedimentary rocks from Yellowknife Bay in Gale Crater, studied by the *Curiosity* rover on Mars. These rocks have been exposed to surface radiation for about 78 million years and contain organic carbon and organic molecules (Credit: NASA/JPL-Caltech/MSSS).

08'oct.'25.- The Centro de Astrobiología (CAB), CSIC-INTA, has led a study published in *Communications Earth and Environment*, showing that if life had ever emerged on Mars, DNA fragments could be preserved within its rocks for more than 100 million years, acting as biomarkers of past life.

The research, led by Dr. María-Paz Zorzano, was inspired by a key finding from the *Curiosity* rover, which detected organic carbon and simple organic molecules in 3.5-billion-year-old sedimentary rocks in Gale Crater, Mars. Analyses indicated that these rocks had remained buried for most of their history and were only exposed to cosmic radiation during the last 78 million years. Based on this observation, the team asked a fundamental question: Could DNA—a complex

polymer containing life's essential information and considered an unquestionable biomarker—survive the harsh Martian conditions?

To answer it, the researchers worked with a collection of terrestrial sedimentary rocks analogous to those on Mars, with organic carbon contents similar to those detected by *Curiosity*. These samples, from different geological environments, host unique microbiomes adapted to recycling the rock's organic carbon and performing metabolic reactions based on the redox chemistry of minerals.

Using just half a gram of each sample, the team managed to extract and sequence hundreds of thousands of nucleobases through nanopore sequencing technology. The entire process was carried out in an ultra-clean room to avoid contamination. The rocks were also exposed to extreme doses of gamma radiation, equivalent to more than 100 million years of surface radiation on Mars.

The results were surprising: while small organic molecules such as amino acids or lipids degrade quickly under radiation, DNA—being a longer and more structured polymer—can retain recognizable fragments. Even after suffering breaks and irreversible radiological damage, between 1.5% and 8% of the DNA remained sequencable, and the analysis of these sequences enabled phylogenetic assignments. This demonstrates that such a molecule, essential for life, could preserve biological information even after millions of years of exposure to extreme Martian conditions.

The analysis also revealed that each type of rock hosted a characteristic microbiome: in some cases adapted to extremely arid environments, and in others characteristic of microorganisms that use iron.

This discovery comes at a key moment for Martian exploration. The *Perseverance* rover's investigations in Jezero Crater have already identified rocks containing promising biomarkers. However, to definitively determine whether life ever existed on Mars, it will be necessary to bring these samples back to Earth—one of the main goals of NASA/ESA's Mars Sample Return (MSR) missions and China's Tianwen-3 mission.

"Our results reinforce the idea that DNA is one of the best candidates for detecting signs of life in extreme and planetary environments" says Dr. Zorzano. This work shows that, with current technologies, just half a gram of Martian rock would be

sufficient to bring us one step closer to answering one of science's most profound questions: **Are we alone in the universe?**

MORE INFORMATION

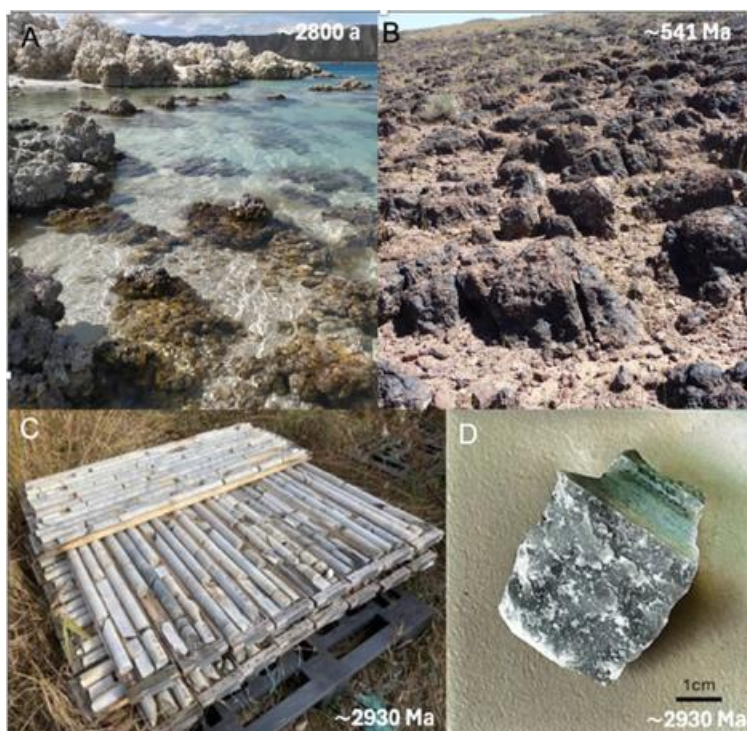


Figure: Examples of analogous rocks used in the study: (A) microbialite (~2,800 years) from Lake Alchichica (Mexico); (B) stromatolite (~541 Ma) from Morocco; (C) carbonates (~2,930 Ma) from Bridget Lake (Canada); and (D) detail of sedimentary carbonate.

<https://communities.springernature.com/posts/can-dna-survive-on-mars>

Scientific article in *Communications Earth and Environment*.

Zorzano, MP., Basapathi Raghavendra, J., Carrizo, D. et al. Fragmented deoxyribonucleic acid could be extractable from Mars's surface rocks. *Commun. Earth & Environ.* 6, 838 (2025). Doi: 10.1038/s43247-025-02809-w

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About CAB

The [Centro de Astrobiología](#) (CAB) is a joint research center of INTA and CSIC. Created in 1999, it was the first center in the world dedicated specifically to astrobiological research and the first non-US center associated with the NASA Astrobiology Institute (NAI), currently the NASA Astrobiology Program. It is a multidisciplinary center whose main objective is to study the origin, presence, and influence of life in the universe through a transdisciplinary approach. In 2017, the CAB was awarded by the Ministry of Science and Innovation as a “María de Maeztu” Unit of Excellence.

The CAB has led the development of the [REMS](#), [TWINS](#) y [MEDA](#) instruments, operational on Mars since August 2012, November 2018, and February 2021, respectively; as well as the science of the [RLS](#) and [RAX](#) Raman instruments, which will be sent to Mars at the end of this decade as part of the ExoMars mission and to one of its moons in the MMX mission, respectively. In addition, it is developing the [SOLID](#) instrument for the search for life in planetary exploration. The CAB also co-leads, together with three other European institutions, the development of the [PLATO](#) space telescope, and participates in various missions and instruments of great astrobiological relevance, such as [MMX](#), [CARMENES](#), [CHEOPS](#), [BepiColombo](#), [DART](#), [Hera](#), the [MIRI](#) and [NIRSpec](#) in [JWST](#), and the [HARMONI](#) in [ESO's ELT](#) (Extremely Large Telescope).

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