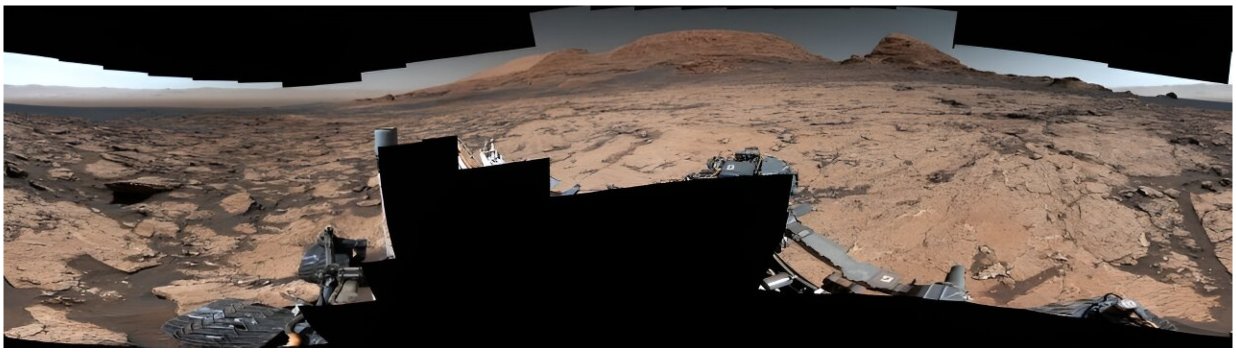
Ancient cracked mud found on Mars

August 29 2023, by Laurence Tognetti



A panorama image taken by NASA's Curiosity Mars rover shows a rock target nicknamed "Pontours" where researchers identified preserved, ancient mud cracks hypothesized to have shaped throughout lengthy cycles of wet and dry environments over many years. These cycles are hypothesized to support conditions where life could form. Credit: NASA/JPL-Caltech/MSSS/IRAP

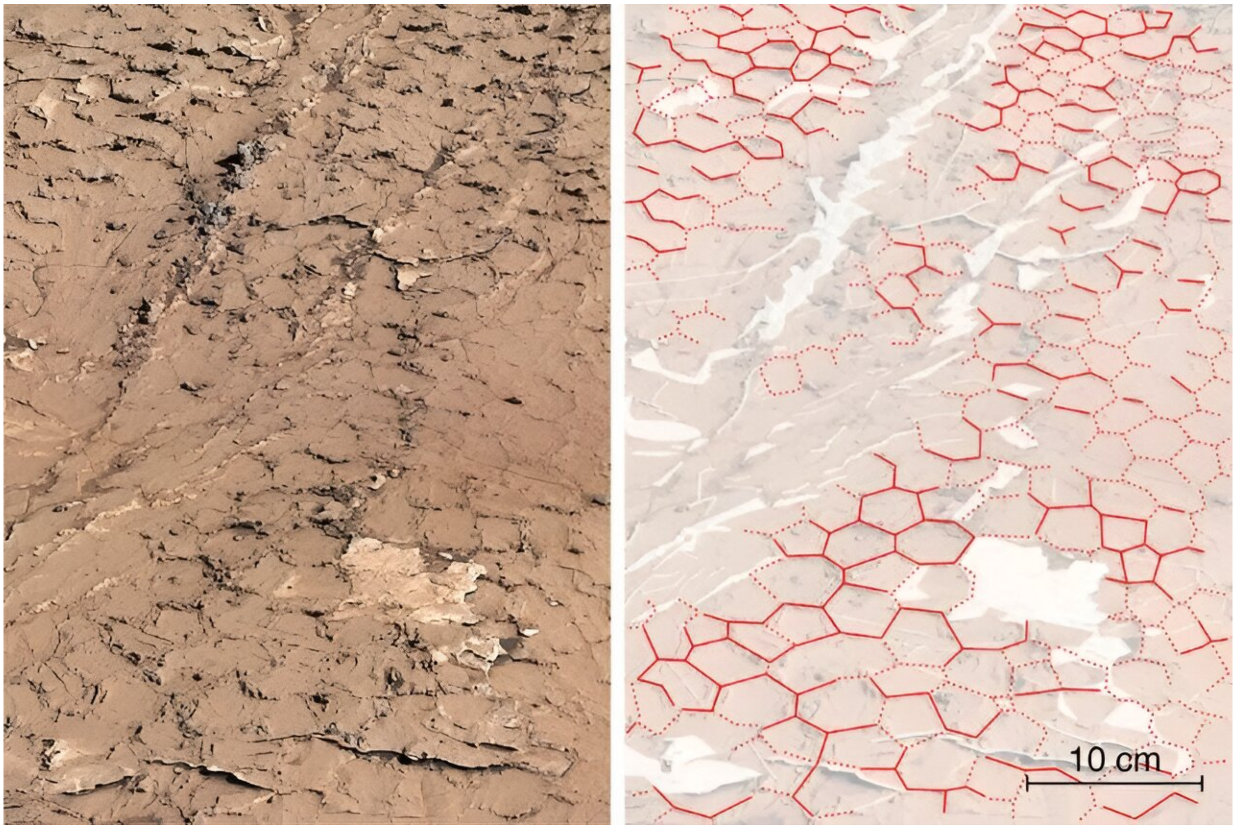
A recent study published in *Nature* examines how mud cracks observed on Mars by NASA's Curiosity rover could provide insight into how life on the red planet could have formed in its ancient past.

On Earth, mud cracks have traditionally been linked to cycles of wet and dry environments that assisted in developing the complex processes responsible for microbial life to take hold. This study was conducted by an international team of researchers and holds the potential to help scientists better understand the geological and chemical processes that might have existed in Mars' ancient past, up to billions of years ago.

"This is the first tangible evidence we've seen that the ancient climate of Mars had such regular, Earth-like wet-dry cycles," said Dr. William Rapin, who is a CNRS Research Scientist at IRAP (Institut de Recherche en Astrophysique et Planétologie), and lead author of the study. "But even more important is that wet–dry cycles are helpful—maybe even required—for the molecular evolution that could lead to life."

For the study, the team analyzed images of mud cracks obtained from NASA's Mars Curiosity rover, currently traversing Gale Crater on Mars, between sols 3154 to 3156 (June 20–22, 2021) when it was drilling in a rock nicknamed Pontours. The images reveal distinct T- and hexagonal-shaped cracks within the surface, which is indicative of many cycles of wet and dry conditions that once existed in this region.

Wet conditions, such as flowing rivers or lakes, are responsible for producing the mud, but when that same mud dries out, it compresses and cracks, resulting in the broken surface we see today. For context on sols, one Martian sol equals one day on Mars, which is just under 40 minutes longer than one day on Earth.

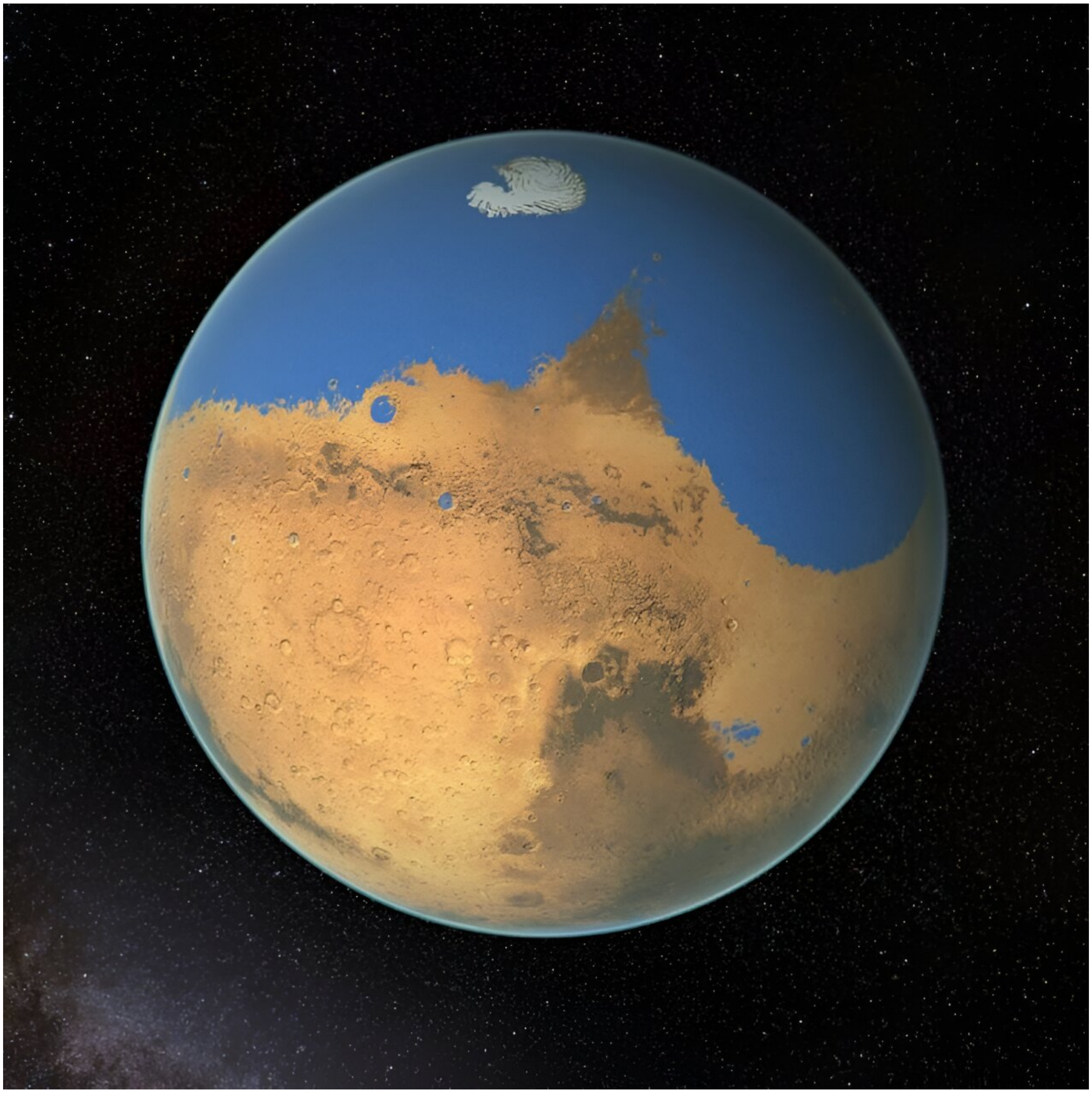


Zoomed-in portion of the panorama image obtained by the Curiosity rover's Mastcam at the rock target "Pontours" which unveils hexagonal patterns (red outlines in the same image, right) that propose these mud cracks were produced over a multitude of wet-dry cycles occurring over many years. Credit: NASA/JPL-Caltech/MSSS/IRAP

"These exciting observations of mature mud cracks are allowing us to fill in some of the missing history of water on Mars," said Dr. Nina Lanza, who is principal investigator of the ChemCam instrument onboard NASA's Curiosity rover, and a co-author on the study. "How did Mars go from a warm, wet planet to the cold, dry place we know today? These mud cracks show us that transitional time, when liquid water was less abundant but still active on the Martian surface."

The study's findings indicate that these cracks are indicative of a transition of minerals, notably smectite clays to sulfate-bearing strata, which potentially indicates that Mars experienced an Earth-like environment during the Noachian-Hesperian transition, or 3.8 to 3.6 billion years ago.

On Earth, smectite clays and sulfate-bearing strata are typically associated with aqueous environments. Also, like Earth, the red planet's geologic history is divided into time periods from oldest to youngest, with those time periods being the Pre-Noachian, Noachian, Hesperian, and Amazonian and each lasting approximately from 4.5 to 4.1 billion years ago, 4.1 to 3.7 billion years ago, 3.7 to 2.9 billion years ago, and 2.9 billion years ago to the present, respectively.



Artist illustration of an ancient ocean on Mars, which researchers have hypothesized contained more water than Earth's Arctic Ocean and that the Red Planet has lost almost 90% of that water to space. Credit: NASA/GSFC

While Mars is presently an extremely cold and dry planet that's inhospitable for life as we know it, scientific evidence suggests things were much different billions of years ago when it first formed. This was when liquid water flowed into lakes, rivers, and oceans while volcanoes spewed gases to keep the atmosphere thick enough for this liquid water to keep cascading across the surface. Auroras danced across the sky from the solar wind interacting with the red planet's magnetic field, much like we see on Earth today. But while these Earth-like conditions might have led to microbial life forming on Mars, these conditions weren't meant to last.

Over millions of years, the interior of Mars began to cool due to its small size—half of Earth—resulting in the decreasing temperature of its molten liquid outer core which gradually reduced its geological and magnetic influence on the red planet. The volcanoes stopped spewing gases and the magnetic field dissipated, taking the auroras with it. Along with this, protection from the solar wind was also lost, resulting in the latter slowly stripping the planet's atmosphere, leading to evaporation of all liquid water. In the end, Mars is the barren world we see today, without a drop of liquid water on its surface.

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