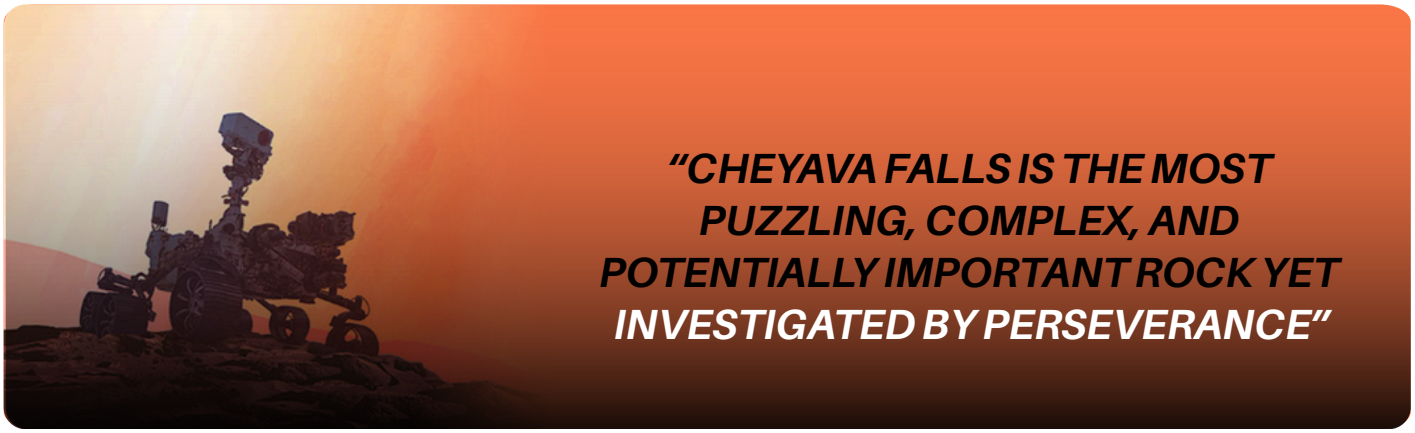
NASA's Rover Perseverance Spots a Possible Biosignature on Mars



NASA's Perseverance rover might be holding a tiny piece of Martian history, and possibly, evidence of ancient life. Last year, the rover collected a sample called "Sapphire Canyon" from a rock named "Cheyava Falls" in a rugged stretch of rocky outcrops lining the northern and southern edges of Neretva Vallis, an ancient river valley about a quarter-mile (400 meters) wide that was once sculpted by flowing water entering the Jezero Crater. Scientists believe that the sample could preserve potential biosignatures, indicating the presence of ancient microbial life on the red planet.

A potential biosignature is a substance or structure that might have a biological origin but needs further study before a conclusion can be reached about the absence or presence of life.

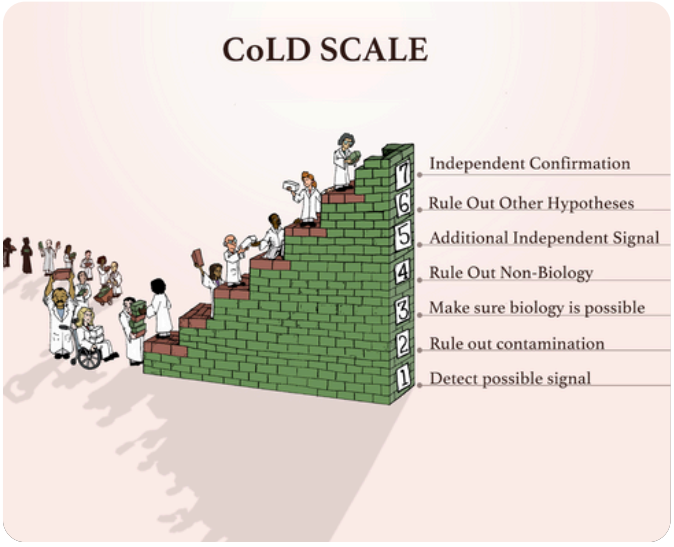
The rover made an intriguing discovery in July 2024 while exploring the "Bright Angel" formation. During this investigation the rover encountered the distinctive rock later named as Cheyava Falls from which it collected its 22nd core sample, called Sapphire Canyon. Analysis by the rover's onboard instruments revealed that this reddish, fine-grained rock had likely formed billions of years ago from sediment deposited on the bottom of an ancient Martian lake.

Early findings suggest that Sapphire Canyon contains chemical signatures and microscopic textures that may qualify as potential biosignatures. Such patterns and compositions have similarities to the structures seen in certain rocks on Earth that were shaped by biological activities. But it is still possible that many of the same features have emerged after nonbiological, chemical processes. To determine which explanation is correct will require further investigation and detailed examination of the sample once it's returned to Earth as part of NASA's planned Mars Sample Return campaign.

"The combination of chemical compounds we found in the Bright Angel formation could have been a rich source of energy for microbial metabolisms. But just because we saw all these compelling chemical signatures in the data didn't mean we had a potential biosignature. We needed to analyze what that data could mean."

~ Joel Hurowitz, Stony Brook University, New York.

DETECTING THE MARTIAN SIGNATURES



The Cheyava Falls sample currently falls at step one of the CoLD (Confidence of Life Detection) scale to assess potential signs of life.

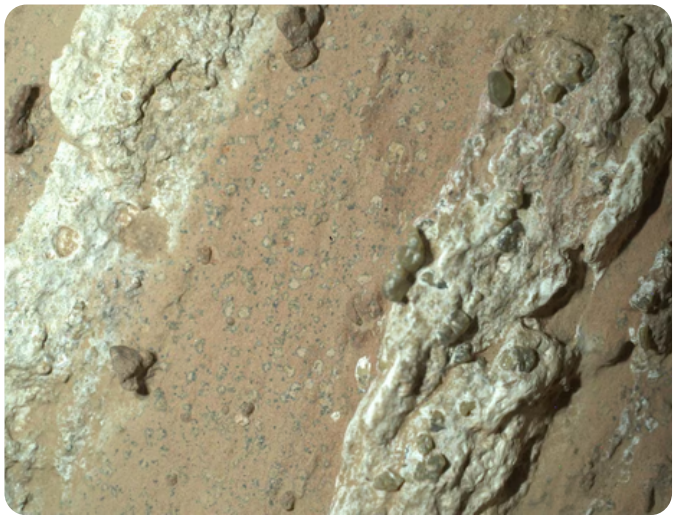
The first close-up look at the Cheyava Falls rock came from Perseverance's suite of high-precision instruments: PIXL (Planetary Instrument for X-ray Lithochemistry) and SHERLOC (Scanning Habitable Environments with Raman and Luminescence for Organics and Chemicals). These tools revealed that the sedimentary rocks are composed mainly of clay and silt, materials that on Earth are excellent at preserving signs of ancient microbial life. The analysis also showed that the rocks are rich in organic carbon, sulfur, oxidized iron (rust), and phosphorus. Again, all elements that play essential roles in biological and chemical processes associated with life.

"Getting such a significant finding as a potential biosignature on Mars into a peer-reviewed publication is a crucial step in the scientific process because it ensures the rigor, validity, and significance of our results. And while abiotic explanations for what we see at Bright Angel are less likely given the paper's findings, we cannot rule them out."

~ K.S. Morgan, Research Scientist, JPL

WHAT THE SAPPHIRE CANYON SAMPLE REVEALED

Two key minerals: vivianite (an iron phosphate) and greigite (an iron sulfide) were detected in the sample and appear to have likely formed through chemical reactions between the Martian mud and the organic matter once present within it. High-resolution imaging revealed that these minerals occur in distinctive "leopard spot" reaction fronts, where chemical and physical transformations took place. On Earth, vivianite commonly forms in water-rich environments like peat bogs and lakebeds, while certain microbes are known to produce greigite as part of their energy-generating processes.



"Leopard spots" on a Martian rock named Cheyava Falls, hinting that ancient chemical reactions there might once have supported life.

The coexistence of these two minerals could represent a potential fingerprint of microbial activity. However, scientists are aware that such reactions can also occur abiotically without life through sustained heat, acidity, or organic catalysis. Yet the Bright Angel rocks show no signs of such conditions, leaving open the question of whether life once influenced these processes. Even more intriguing, this finding comes from some of the youngest sedimentary rocks as opposed to previous expectations of being confined to oldest formations, suggesting Mars may have stayed habitable longer than once thought, or that traces of life are simply more subtle and widespread than expected.