Astrophysicists investigate the possibility of life below the surface of Mars

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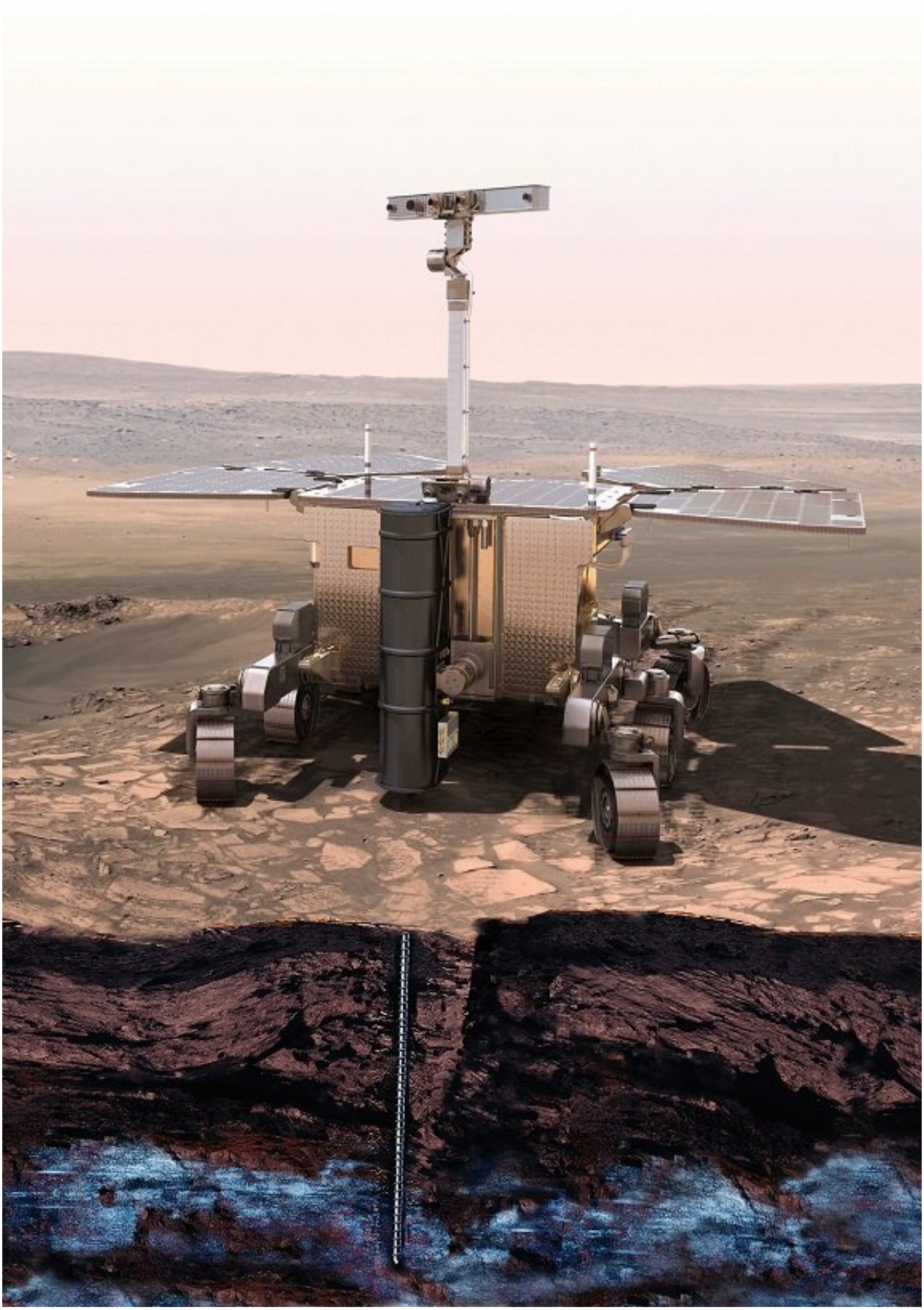


The Rosalind Franklin rover by European Space Agency and Roscosmos will drill 2 meters below the surface of Mars to search for signs of life. Credit: NYU Abu Dhabi

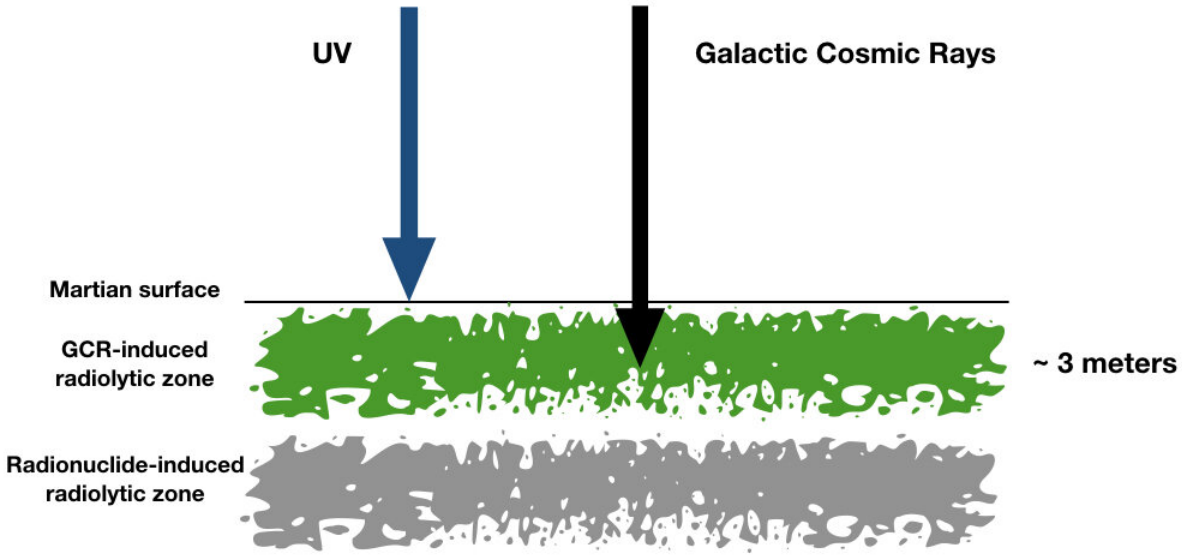
Although no life has been detected on the Martian surface, a new study from astrophysicist and research scientist Dimitra Atri at the Center for Space Science at NYU Abu Dhabi finds that conditions below the surface could potentially support it. The subsurface—which is less harsh and has traces of water—has never been explored. According to Atri, the steady bombardment of penetrating galactic cosmic rays (GCRs) might provide the energy needed to catalyze organic activity there.

Atri investigated the biological potential of galactic cosmic-ray-induced, radiation-driven chemical disequilibrium in the Martian subsurface environment; the results are published in the journal *Scientific Reports*.

There is growing evidence suggesting the presence of an aqueous environment on ancient Mars, raising the question of the possibility of a life-supporting environment. The erosion of the Martian atmosphere resulted in drastic changes in its climate: Surface water disappeared, shrinking habitable spaces on the planet, with only a limited amount of water remaining near the surface in form of brines and water ice deposits. Life, if it ever existed, would have had to adapt to harsh modern conditions, which include low temperatures and surface pressure, and high radiation.

The subsurface of Mars has traces of water in the form of water ice and brines, and undergoes radiation-driven redox chemistry. Using a combination of numerical models, space mission data and studies of

deep-cave ecosystems on Earth for his research, Atri proposes mechanisms through which life, if it ever existed on Mars, could survive and be detected with the upcoming ExoMars mission (2022) by the European Space Agency and Roscosmos. He hypothesizes that galactic cosmic radiation, which can penetrate several meters below the surface, will induce chemical reactions that can be used for metabolic energy by extant life, and host organisms using mechanisms seen in similar chemical and radiation environments on Earth.



Proposed radiation-induced habitable zone below the surface of Mars. Credit: NYU Abu Dhabi

"It is exciting to contemplate that life could survive in such a harsh environment, as few as two meters below the surface of Mars," said Atri. "When the Rosalind Franklin rover on board the ExoMars mission (ESA and Roscosmos), equipped with a subsurface drill, is launched in 2022, it will be well-suited to detect extant microbial life and hopefully provide some important insights."

More information: Dimitra Atri. Investigating the biological potential of galactic cosmic ray-induced radiation-driven chemical disequilibrium in the Martian subsurface environment, *Scientific Reports* (2020). DOI: 10.1038/s41598-020-68715-7

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